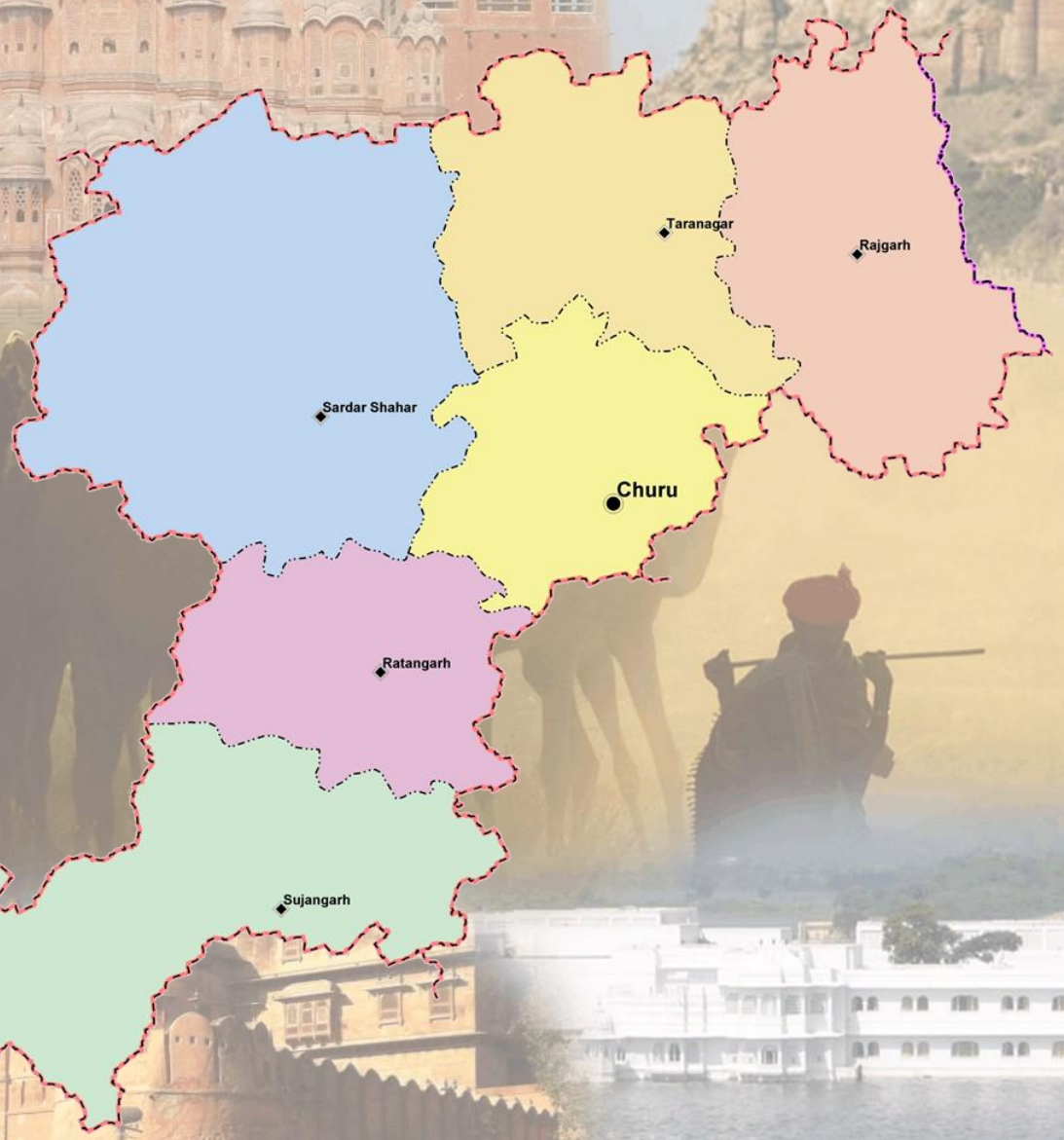
Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan

Churu District

European Union
State Partnership Programme

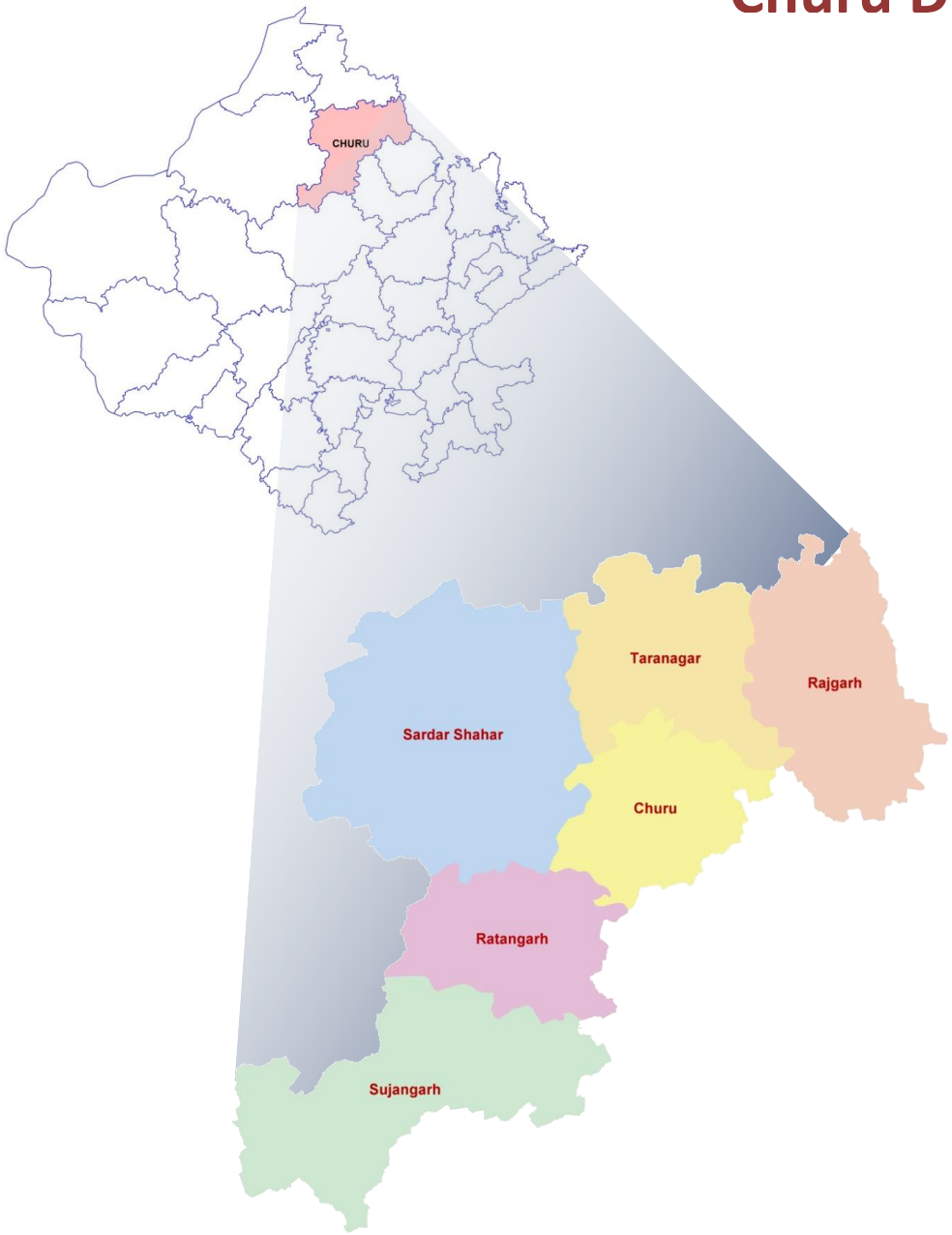


2013

ROLTA
Rolta India Limited

Hydrogeological Atlas of Rajasthan

Churu District



Contents:

2013

ADMINISTRATIVE SETUP

DISTRICT – CHURU

Location:

Churu district is located in the northern part of Rajasthan. It is bounded in the north by Hanumangarh district, in the east by state of Haryana and Jhunjhunun district, south by Sikar and Nagaur districts and by Bikaner district in the west. It stretches between 27^{o} 24' 31.50" to 29^{o} 00' 01.74" north latitudes and 73^{o} 50' 39.45'' to 75^{o} 40' 31.85'' east longitudes covering area of 13,844 sq km. The district does not have a properly evolved drainage system, except for a negligible part in the east which is part of Shekhawati River Basin, almost whole of the district is part of an 'Outside' Basin.

Administrative Set-up:

Churu district is administratively divided into six blocks. The following table summarizes the basic statistics of the district at block level.

S. No.	Block Name	Population (Based on 2001 census)	Area (sq km)	% of District Area	Total Number of Towns and Villages
1	Churu	2,60,844	1,573.5	11.0	108
2	Rajgarh	3,15,496	2,199.3	16.0	216
3	Ratangarh	2,44,412	1,601.9	12.0	103
4	SardarShahar	3,04,373	3,864.9	28.0	185
5	Sujangarh	3,85,069	2,736.3	20.0	158
6	Taranagar	1,78,072	1,868.1	13.0	122
Total		**16,88,266**	**13,844.0**	**100.0**	**892**

Churu district has 892 towns and villages, of which six are block headquarters as well.

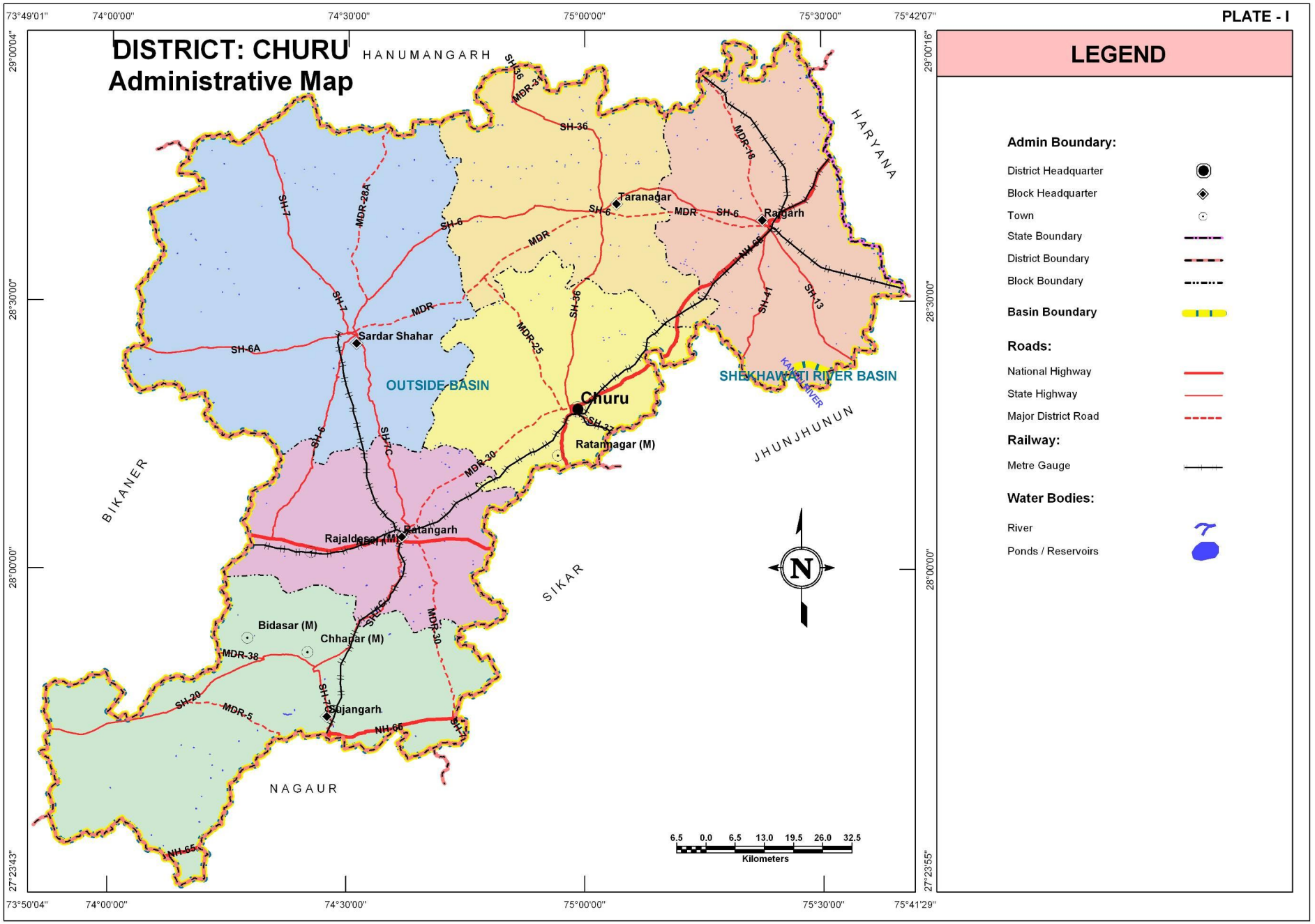
Climate:

Churu district is part of arid region. The district has dry climate and the area is well known for both highest in the country and lowest in the peninsular India recording below freezing point temperature in the winters to over 50 ^{o}C in the summer afternoons. There is a great variation in minimum and the maximum temperature of Churu. Average rainfall in the district is 353.9mm spread over three monsoon months of July to September.

Ground Water Department,
Rajasthan

European Union
State Partnership Programme

PLATE - I



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Roads:

- National Highway
- State Highway
- Major District Road

Railway:

- Metre Gauge

Water Bodies:

- River
- Ponds / Reservoirs

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TOPOGRAPHY

DISTRICT – CHURU

District Churu is a part of Great Indian Thar Desert. Surface is covered with sand and characterized by dunes. The general topography is almost an undulating plain area except some hillocks in south. District is part of Outside Basin and its small part is coming under Shekhawati River basin. The general topographic elevation in the district is between 250 m to 300 m above mean sea level. Elevation ranges from a minimum of 199.2 m above mean sea level in Rajgarh block in the northeastern part of the district and maximum of 470.7 m above mean sea level In Sujangarh block in southern part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
1	Churu	233.6	322.4
2	Rajgarh	199.2	301.1
3	Ratangarh	274.7	366.9
4	SardarShahar	200.0	311.1
5	Sujangarh	287.0	470.7
6	Taranagar	200.0	281.8

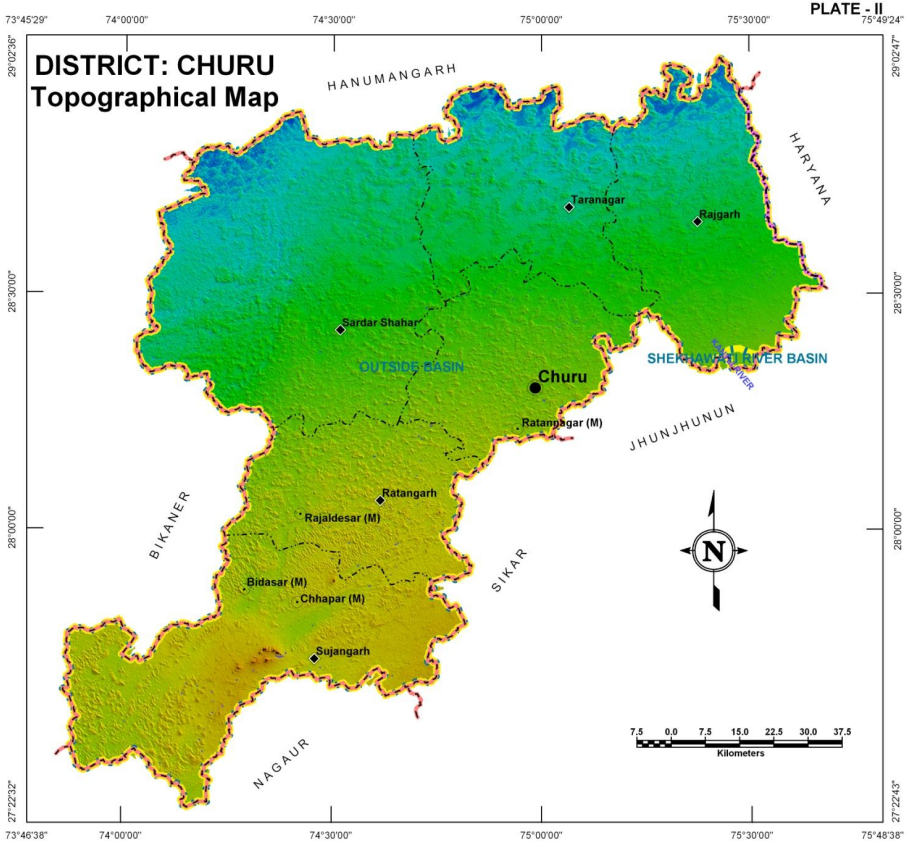
RAINFALL

The district received good rainfall in the year 2010. The general distribution of rainfall across can be visualized from isohyets presented in the Plate III. Rainfall is gradually increasing from Southwest to Northeast. The general distribution of rainfall range is 600 mm to 700 mm in which, it is covering maximum parts of the district. The annual average rainfall was 675.1 mm based on the data of available blocks while highest average annual rainfall was 777.7 mm in Rajgarh block. Lowest annual rainfall was lowest in Sujangarh block (456.9 mm). Rajgarh block has received highest maximum annual rainfall of about 947.2 mm.

Table: Block wise annual rainfall statistics (derived from year 2010 meteorological station data)

Block Name	Minimum Annual Rainfall (mm)	Maximum Annual Rainfall (mm)	Average Annual Rainfall (mm)
Churu	620.7	920.2	700.3
Rajgarh	669.8	947.2	777.7
Ratangarh	604.9	712.3	668.8
Sardar Shahar	556.7	677.9	611.3
Sujangarh	456.9	706.1	563.4
Taranagar	619.0	898.8	729.2

PLATE - II



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

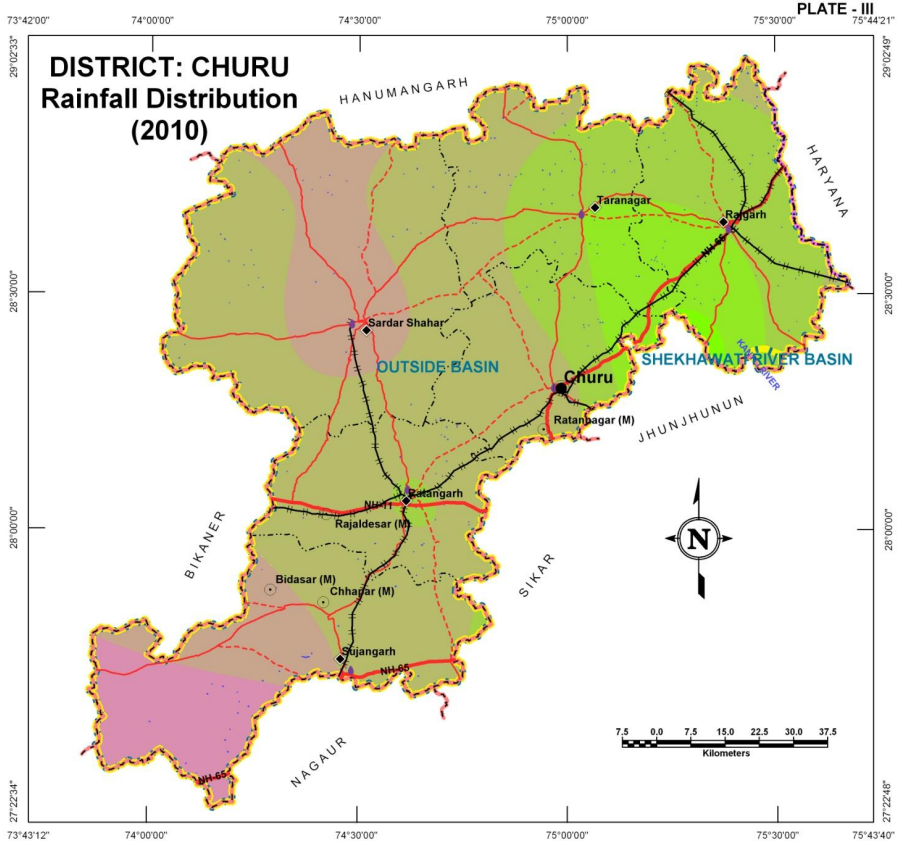
- River / Streams
- Ponds / Reservoirs

Elevation (m amsl):

471m – 450m – 400m – 350m – 300m – 250m – 200m

Source : SRTM DEM

PLATE - III



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- Raingauge Stations
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Roads:

- National Highway
- State Highway
- Major District Road

Railway:

- Metre Gauge

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Isohyets (mm):

- 400-500
- 500-600
- 600-700
- 700-800
- 800-900
- 900-1000

GEOLOGY

DISTRICT – CHURU

The whole of central and northern part of the district is occupied with primarily eolian sand and partly by fluvial deposits. The southern part of the district has some exposures of hardrock covered by Marwar Super Group which includes the rock formation of sandstone, shales and limestone. The small southwestern part of the district, in Sujangarh block occupies Erinpura granite & gneiss.

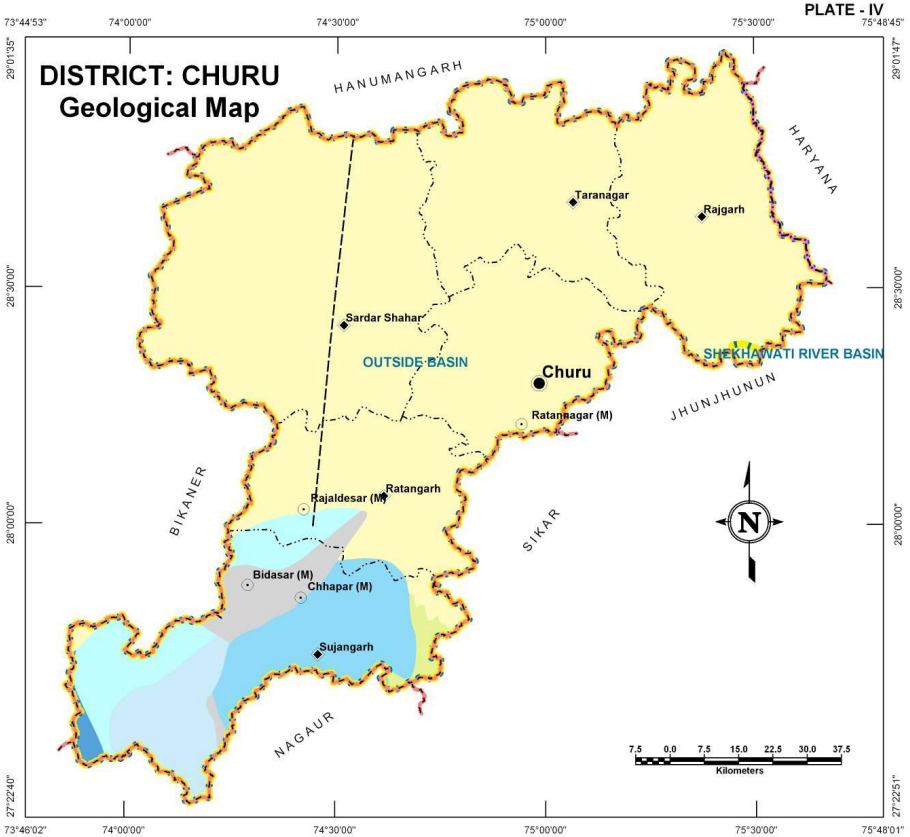
Super Group	Group	Formation
	Recent to Sub-recent	Wind-blown sand and older alluvium
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
	Paleocene	Gravel Beds, Claystone, Shale and Sandstone
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Marwar	Nagaur, Bilara and Jodhpur	Nagaur Series (Sandstone, Shales, Evaporite sequence), Bilara formation (Limestone & Shales), Jodhpur formation (Sandstone & Shales)
	Post Delhi Intrusives	Rhyolites and Granites, Phyllites
Delhi		Schists and Quartzites.

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
Aeolian	Dune Valley Complex	Cluster of dunes and interdunal spaces with undulating topography formed due to wind-blown activity, comprising of unconsolidated sand and silt.
	Eolian Plain	Formed by aeolian activity, with sand dunes of varying height, size and slope. Long stretches of sand sheet. Gently sloping flat to undulating plain, comprised of fine to medium grained sand and silt. Also scattered xerophytic vegetation.
	Eolian Plain (Reclaimed)	Gently sloping with sheet of sand or sand dunes, scattered xerophytic vegetation.
	Interdunal Depression	Slightly depressed area in between the dunal complex showing moisture and fine sediments.
	Sandy Plain	Formed of aeolian activity, wind-blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt and clay.
Denudational	Buried Pediment	Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.
Fluvial	Alluvial Plain (Sandy)	Flat to gentle undulating plain formed due to fluvial activity, mainly consists of gravels, sand, silt and clay with unconsolidated material of varying lithology, predominantly sand along river.

PLATE - IV



LEGEND

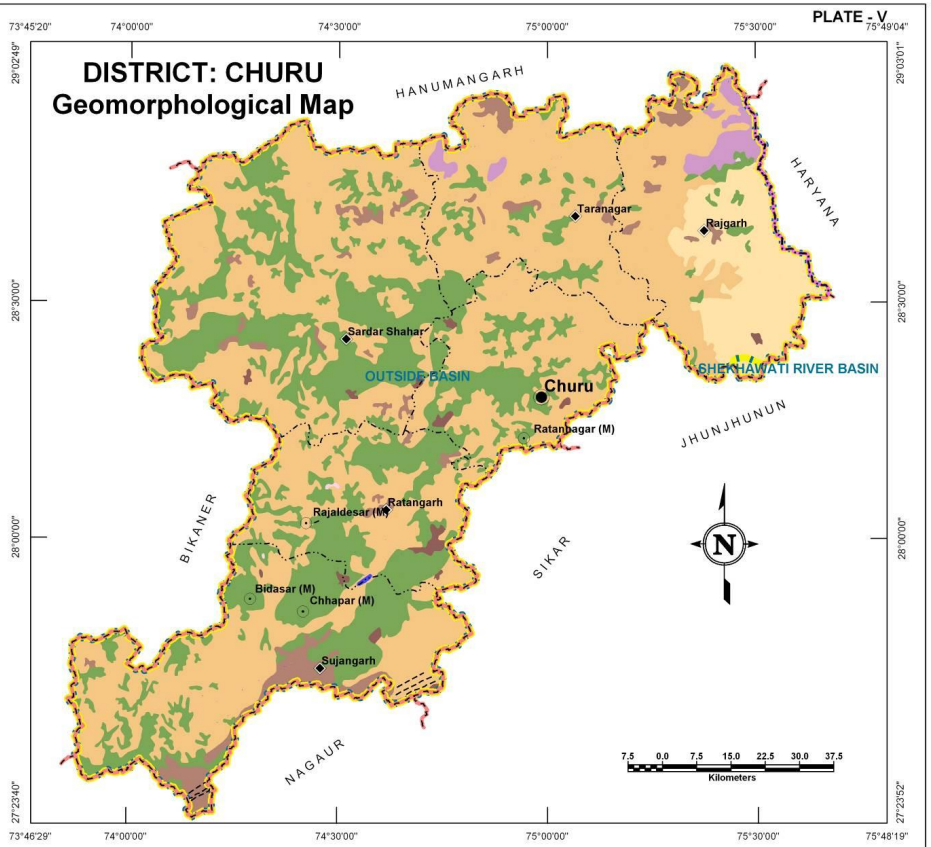
Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Structural Features:
- Fault

Geology:
- Alluvium and Wind blown sand
- Palana Formation
- Nagaur Group
- Bilara Group
- Jodhpur Group
- Punagarh Group
- Erinpura Granite & Gneiss

Source: District Resource Map of Rajasthan - GSI

PLATE - V



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Water Bodies:
- River/Ponds/Reservoirs

Structural Features:
- Fault/Fractures/Lineament

Landform Units:

Fluvial Origin:
- Alluvial Plain (Sandy)

Aeolian Origin:
- Eolian Plain
- Eolian Plain (Reclaimed)
- Sandy Plain
- Dune Valley Complex
- Interdunal Depression

Denudational Origin:
- Burried Pediment

Source: Ground Water Atlas of Rajasthan - SRSAC & GWD, Rajasthan

AQUIFERS

DISTRICT – CHURU

Water bearing formations in Churu district range from unconsolidated alluvium to semi consolidated sandstones and consolidated schistose rocks. The older and younger alluvium constituted of primarily sand of windblown and fluvial origin forms aquifers covering 71% of the district area. Next most prominent aquifers in the district are sandstones (17.5%) followed by schist (6.8%) and limestone (4.7%) aquifers. The hardrock aquifers are prominent in southern and partly in western part of the district.

Table: aquifer potential zones their area and their description

Aquifer in Potential Zone	Area (sq km)	% age of district	Description of the unit/Occurrence
Younger Alluvium	1,976.7	14.3	It is largely constituted of Aeolian and Fluvial sand, silt, clay, gravel and pebbles in varying proportions.
Older Alluvium	7,854.0	56.7	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Bilara Limestone	655.0	4.7	It is grey to buff coloured hard and compact.
Nagaur& Jodhpur Sandstone	2,415.1	17.5	Buff to reddish brown in colour, fine to medium grained hard and compact sandstone.
Schist	943.2	6.8	Medium to fine grained compact rock. The litho units are soft, friable and have closely spaced cleavage.
Total	**13,844.0**	**100.0**	

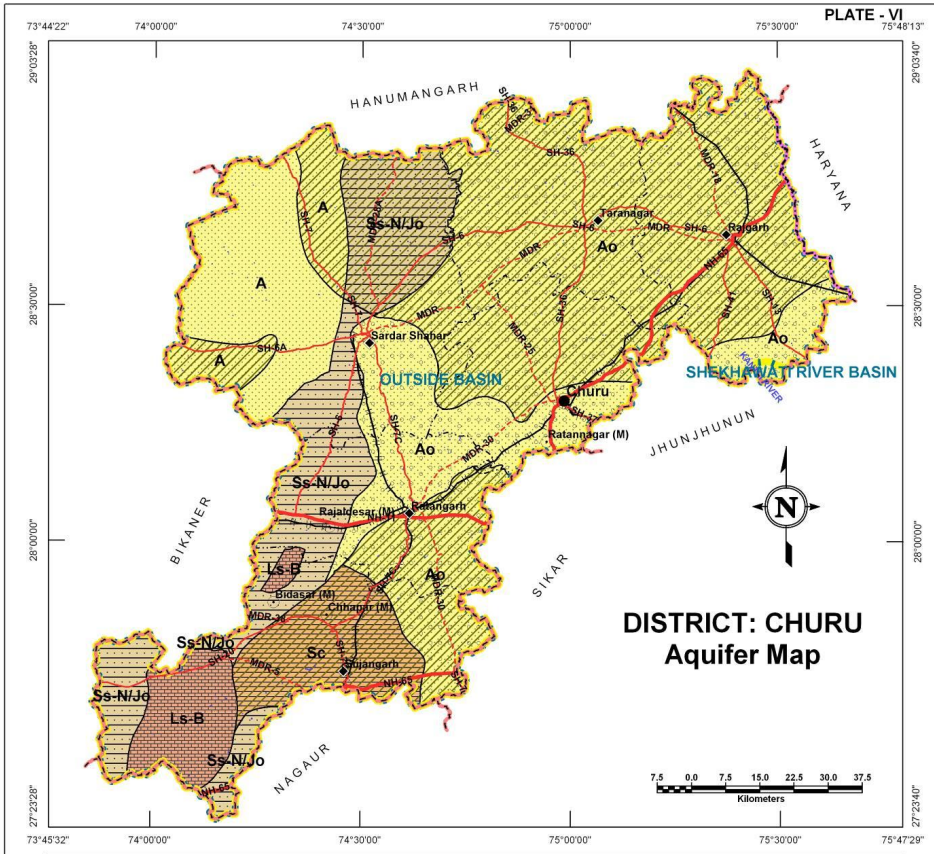
STAGE OF GROUND WATER DEVELOPMENT

Apart from Taranagar block which is completely saline, the rest of the five blocks fall into different categories of stage of ground water development. While Sardar Shahar is within 'Safe' category the Sujangarh and Rajgarh blocks are in 'Over Exploited' category warranting need for conservation measures.

Categorization on the basis of stage of development of ground water	Block Name
Safe	Sardar Shahar
Semi-Critical	Ratangarh, Churu
Over Exploited	Sujangarh, Rajgarh
Saline	Taranagar

Basis for categorization: Ground water development <= 70% - Safe; <= 70 – 90% Semi critical and >100% - Over-Exploited. In Notified blocks development of GW is not permitted any more.

PLATE - VI



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Roads:
- National Highway
- State Highway
- Major District Road

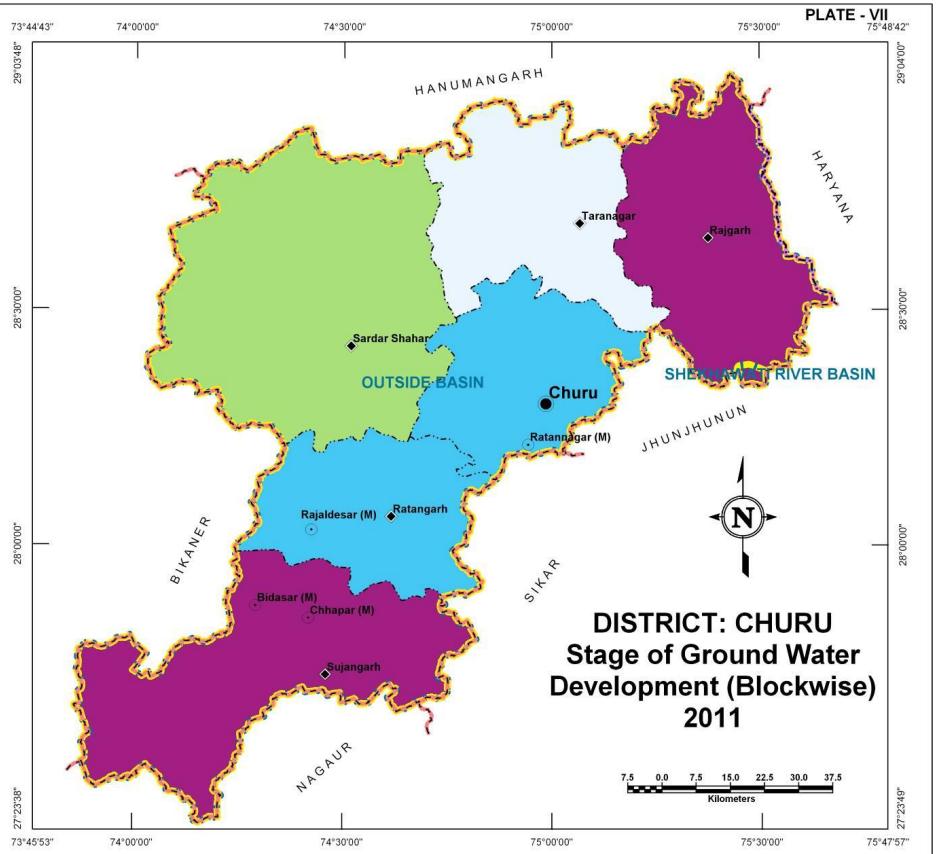
Railway:
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- **Saline Area**

Aquifer:
- Younger Alluvium
- Older Alluvium
- Bilara Limestone
- Nagaur & Jodhpur Sandstone
- Schist

Source: Ground Water Potential Zone Map - GWD, Rajasthan

PLATE - VII



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Stage of Ground Water Development:
- Safe
- Semi-Critical
- Over-Exploited
- Saline

Source: Ground Water Department, Rajasthan

LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS DISTRICT – CHURU

Churu district has a well distributed network of exploratory wells (216) and ground water monitoring stations (242) in the district owned by RGWD (155 and 165 respectively) and CGWB (61 and 77 respectively). The exploratory wells have formed the basis for delineation of subsurface aquifer distribution scenario in three dimensions. Benchmarking and optimization studies suggest that ground water level monitoring network is sufficiently distributed for appropriate monitoring and for water quality 59 additional wells in different blocks are recommended to be added to existing network for optimum monitoring of the aquifers.

Table: Block wise count of wells (existing and recommended)

Block Name	Exploratory Wells			Ground Water Monitoring Stations			Recommended additional wells for optimization of monitoring network	
	CGWB	RGWD	Total	CGWB	RGWD	Total	Water Level	Water Quality
Churu	11	40	**51**	9	24	**33**	-	-
Rajgarh	20	29	**49**	9	30	**39**	-	15
Ratangarh	20	21	**41**	16	20	**36**	-	9
SardarShahar	10	44	**54**	18	48	**66**	-	4
Sujangarh	-	17	**17**	19	32	**51**	-	4
Taranagar	-	4	**4**	6	11	**17**	-	27
Total	**61**	**155**	**216**	**77**	**165**	**242**	**-**	**59**

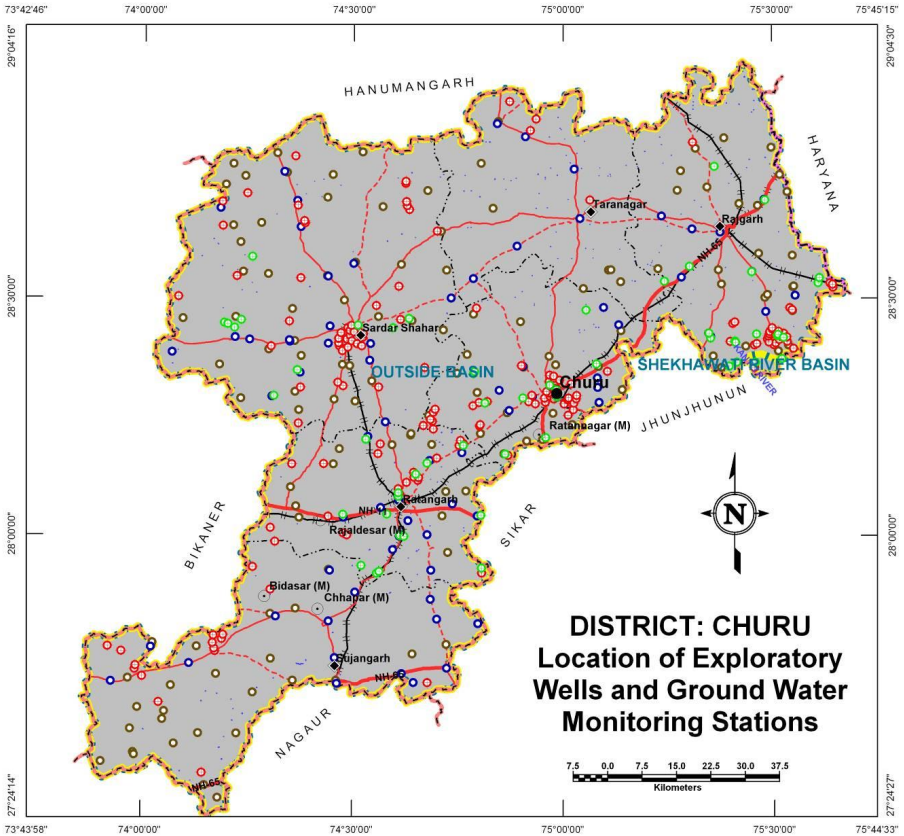
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

10m interval has been adopted to depict the depth to ground water levels in Churu district as shown in Plate – IX. Depth to water level varies significantly from less than 10m below ground level to more than 100mbgl. Rajaldesar and Bidasar towns show deeper water levels of more than 100m bgl. In northern, southwestern and central parts of the district, the water level is moderately deep (around 30-90m bgl) but in the northern parts and some patches in the southern fringe, the water level is quite shallow occurring at depths of 10m-20m bgl, occasionally even less than 10m bgl. In some areas water logging has also been noticed which are in the proximity of Indira Gandhi Canal flowing through those parts of the district.

Depth to water level (m bgl)	Block wise area coverage (sq km)						Total Area (sq km)
	Churu	Rajgarh	Ratangarh	SardarShahar	Sujangarh	Taranagar	
<10	-	-	-	-	0.1	4.6	**4.7**
10-20	0.5	385.2	-	-	199.7	723.4	**1,308.8**
20-30	562.3	827.2	67.2	82.0	757.8	1,064.9	**3,361.4**
30-40	748.6	447.2	399.2	371.8	613.6	-	**2,580.4**
40-50	262.2	267.0	668.2	2,082.7	527.1	75.2	**3,882.4**
50-60	-	228.6	89.4	1,023.3	232.6	-	**1,573.9**
60-70	-	43.7	86.2	191.0	102.2	-	**423.1**
70-80	-	0.5	105.3	90.4	116.0	-	**312.2**
80-90	-	-	178.2	23.6	164.7	-	**366.5**
90-100	-	-	8.3	-	20.7	-	**29.0**
>100	-	-	-	-	1.8	-	**1.8**
Total	**1,573.6**	**2,199.4**	**1,602.0**	**3,864.8**	**2,736.3**	**1,868.1**	**13,844.2**

* The area covered in the derived maps is less than the total district area since the hills have been excluded from interpolation/contouring.

PLATE - VIII



DISTRICT: CHURU
Location of Exploratory Wells and Ground Water Monitoring Stations

LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Roads:
- National Highway
- State Highway
- Major District Road

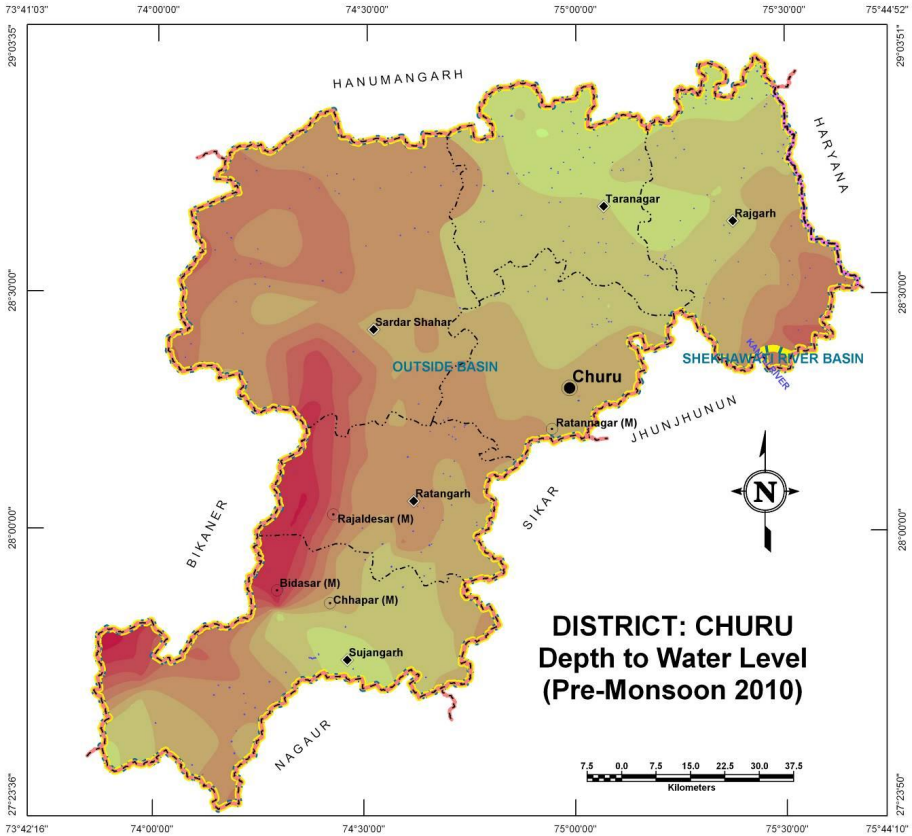
Railway:
- Metre Gauge

Water Bodies:
- Ponds / Reservoirs

Exploratory Wells:
- CGWB
- RGWD

Ground Water Monitoring Stations:
- CGWB
- RGWD

PLATE - IX



DISTRICT: CHURU
Depth to Water Level (Pre-Monsoon 2010)

LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Depth to Water Level(m bgl):
- <10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- >100

WATER TABLE ELEVATION (PRE MONSOON – 2010) DISTRICT – CHURU

Water table contour map is presented in Plate – X. General flow direction of ground water is from southeast to northwest and north within the district. Water table elevation varies between about 160m amsl to more than 300m amsl. The highest water table elevation is seen in southeastern part (Sujangarh Block) of the district and it gradually lowers towards northwest reaching a minimum elevation (<160m amsl) in the SardarShahar block. Flow gradient is steeper in the southwestern part and flattens towards north and northwest.

Table: Block wise area covered in each water table elevation range

Water table elevation range (m amsl)	Block wise area coverage (sq km)						Total Area (sq km)
	Churu	Rajgarh	Ratangarh	SardarShahar	Sujangarh	Taranagar	
< 160	-	-	-	645.3	-	-	**645.3**
160 - 180	-	-	-	1,244.7	-	23.3	**1,268.0**
180 - 200	-	731.9	-	908.5	-	415.6	**2,056.0**
200 - 220	1.0	905.6	114.9	493.9	1.7	1,082.9	**2,600.0**
220 - 240	245.6	542.3	187.0	342.3	224.8	337.6	**1,879.6**
240 - 260	802.7	19.6	156.7	223.5	338.2	8.7	**1,549.4**
260 - 280	524.3	-	646.1	6.6	912.5	-	**2,089.5**
280 - 300	-	-	490.3	-	624.1	-	**1,114.4**
> 300	-	-	7.0	-	635.0	-	**642.0**
Total	**1,573.6**	**2,199.4**	**1,602.0**	**3,864.8**	**2,736.3**	**1,868.1**	**13,844.2**

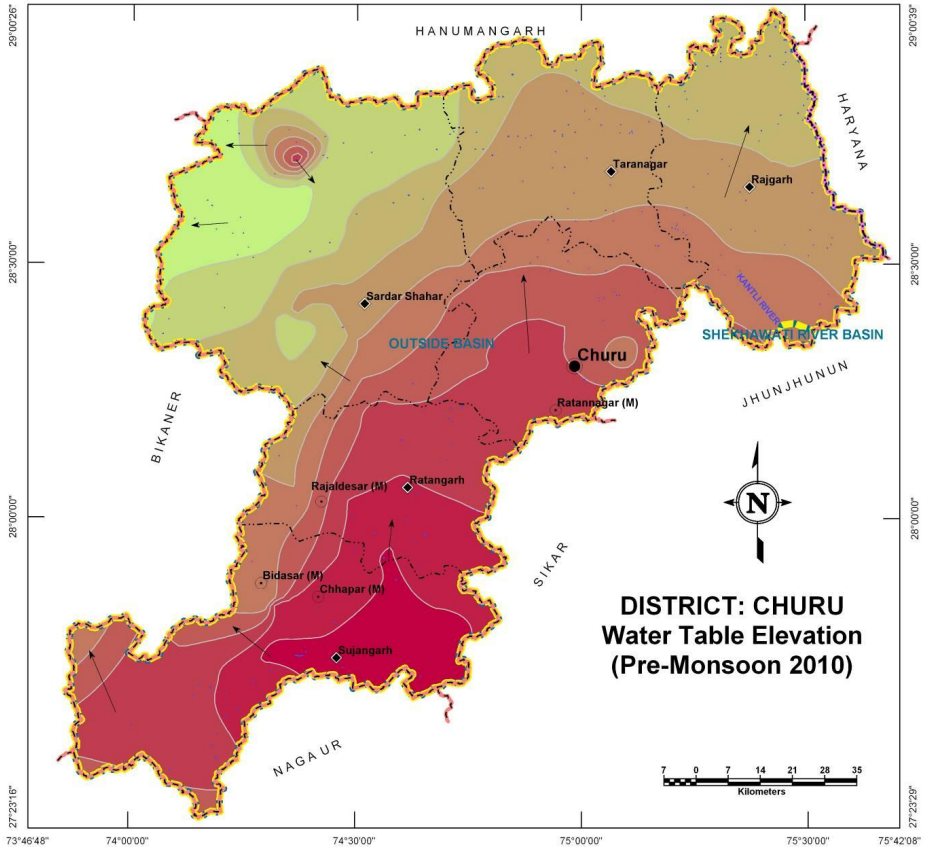
WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

A 2m contour interval adopted to visualize the ground water level fluctuation reveals a fall of 2 m in one area to rise in other areas reaching upto more than16m, as seen in Plate – XI. The negative fluctuation areas are the areas where overexploitation is taking place and even after monsoon recharge the water level has not risen but has actually gone down with respect to pre-monsoon levels. Such large ground water depletion areas are seen in western and northeastern parts of the district. Rest of the district has shown a general to significant rise in ground water level in the post monsoon season with respect to pre monsoon region. Maximum rise of more than 16m is noticed around Ratangarh.

Table: Block wise area covered in each water fluctuation zone

Water level fluctuation range (m)	Block wise area coverage (sq km)						Total Area (sq km)
	Churu	Rajgarh	Ratangarh	SardarShahar	Sujangarh	Taranagar	
<-2	-	-	-	22.8	-	13.8	**36.6**
-2to0	298.0	841.2	857.7	2,290.8	935.5	526.8	**5,750.0**
0to2	1,275.6	1,345.4	538.7	1,549.2	1,779.2	1,327.5	**7,815.6**
2to4	-	12.8	88.6	2.0	21.6	-	**125.0**
4to6	-	-	49.0	-	-	-	**49.0**
6to8	-	-	29.8	-	-	-	**29.8**
8to10	-	-	18.4	-	-	-	**18.4**
10to12	-	-	10.9	-	-	-	**10.9**
12to14	-	-	6.0	-	-	-	**6.0**

PLATE - X



DISTRICT: CHURU
Water Table Elevation
(Pre-Monsoon 2010)

LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

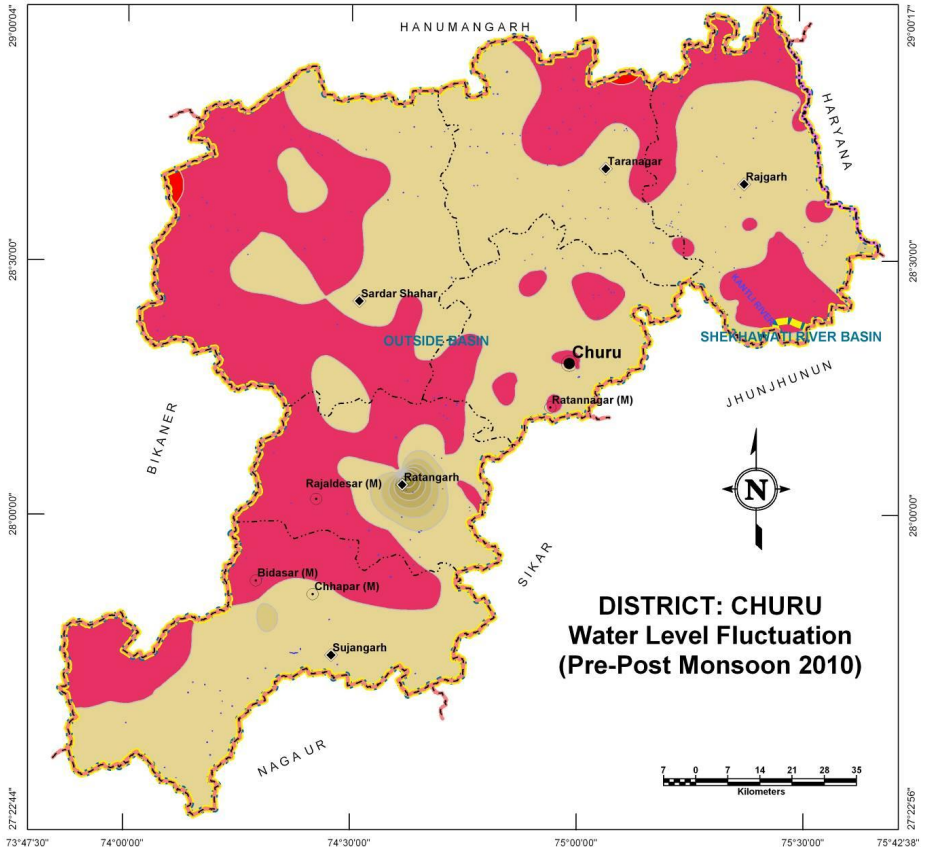
Water Bodies:

- River
- Ponds / Reservoirs
- Water Table Elevation

Water Table Elevation(m amsl):

- <160
- 160 - 180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- >300

PLATE - XI



DISTRICT: CHURU
Water Level Fluctuation
(Pre-Post Monsoon 2010)

LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Water Level Fluctuation(m):

- < -2
- -2 to 0
- 0 to 2
- 2 to 4
- 4 to 6
- 6 to 8
- 8 to 10
- 10 to 12
- 12 to 14
- 14 to 16
- >16

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION DISTRICT – CHURU

The Electrical Conductivity (at 25°C) distribution map is presented in plate XII. The areas with high EC values in ground water (>4000 µS/cm) are shown in red color and occupies very large area, almost 56% of the district, indicating that the ground water in this region is not suitable for domestic purpose. The areas with moderately high EC values (2000 -4000 µS/cm) are shown in green color occupy 36% of the district. Remaining small part of the district approximately 8% has low EC values in ground water (<2000 µS/cm) which is shown in yellow color, largely northern and southern part of the district. The ground water in this region is suitable for domestic purpose.

Table: Block wise area of Electrical conductivity distribution

Electrical Conductivity Ranges (µS/cm at 25°C) (Ave. of years 2005-09)	Block wise area coverage (sq km)												Total Area (sq km)
	Churu		Rajgarh		Ratangarh		SardarShahar		Sujangarh		Taranagar		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<2000	15.2	1.0	162.5	7.4	31.2	2.0	44.4	1.2	412.8	15.1	450.4	24.1	**1,116.5**
2000-4000	238.7	15.2	591.4	26.9	932.8	58.2	1,575.2	40.8	1,201.2	43.9	414.0	22.2	**4,953.3**
>4000	1,319.7	83.8	1,445.5	65.7	638.0	39.8	2,245.2	58.0	1,122.3	41.0	1,003.7	53.7	**7,774.4**
Total	**1,573.6**	**100.0**	**2,199.4**	**100.0**	**1,602.0**	**100.0**	**3,864.8**	**100.0**	**2,736.3**	**100.0**	**1,868.1**	**100.0**	**13,844.2**

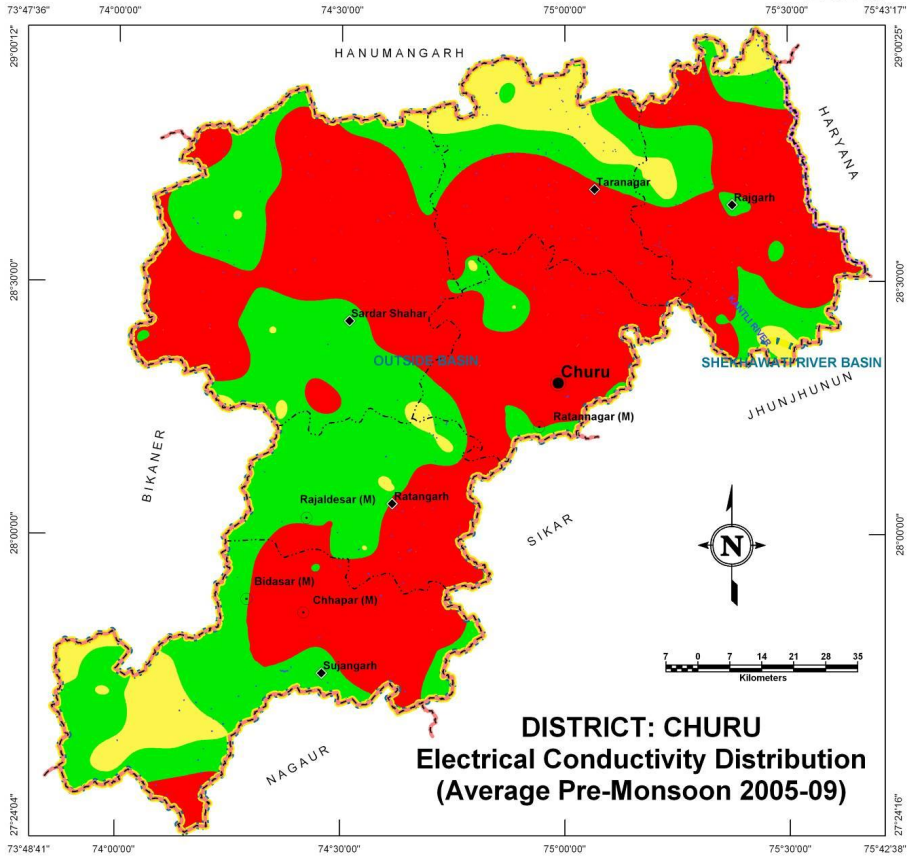
GROUND WATER CHLORIDE DISTRIBUTION

High chloride concentration in ground water also renders it unsuitable for domestic and other purposes. The red colored regions in Plate – XIII are such areas where chloride concentration is high (>1000 mg/l) occupies approximately 46% of the district area which is not suitable for domestic purposes. The areas with moderately high chloride concentration (250-1000 mg/l) are shown in green color and occupy approximately 49%of the district area. That leaves just about 5% of the district the area with low chloride concentration (<250 mg/l shown in yellow colour) where ground water is suitable for domestic purposes and distributed largely in the northern and southwestern part of the district.

Table: Block wise area of Chloride distribution

Chloride Concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)												Total Area (sq km)
	Churu		Rajgarh		Ratangarh		SardarShahar		Sujangarh		Taranagar		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<250	3.6	-	62.2	3.0	3.9	-	9.6	-	243.2	9.0	370.1	20.0	**692.6**
250-1000	517.5	33.0	1,027.2	47.0	1,059.5	66.0	1,976.4	51.0	1,744.7	64.0	407.5	22.0	**6,732.8**
>1000	1,052.5	67.0	1,110.0	50.0	538.6	34.0	1,878.8	49.0	748.4	27.0	1,090.5	58.0	**6,418.8**
Total	**1,573.6**	**100.0**	**2,199.4**	**100.0**	**1,602.0**	**100.0**	**3,864.8**	**100.0**	**2,736.3**	**100.0**	**1,868.1**	**100.0**	**13,844.2**

PLATE - XII



DISTRICT: CHURU
Electrical Conductivity Distribution
(Average Pre-Monsoon 2005-09)

LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

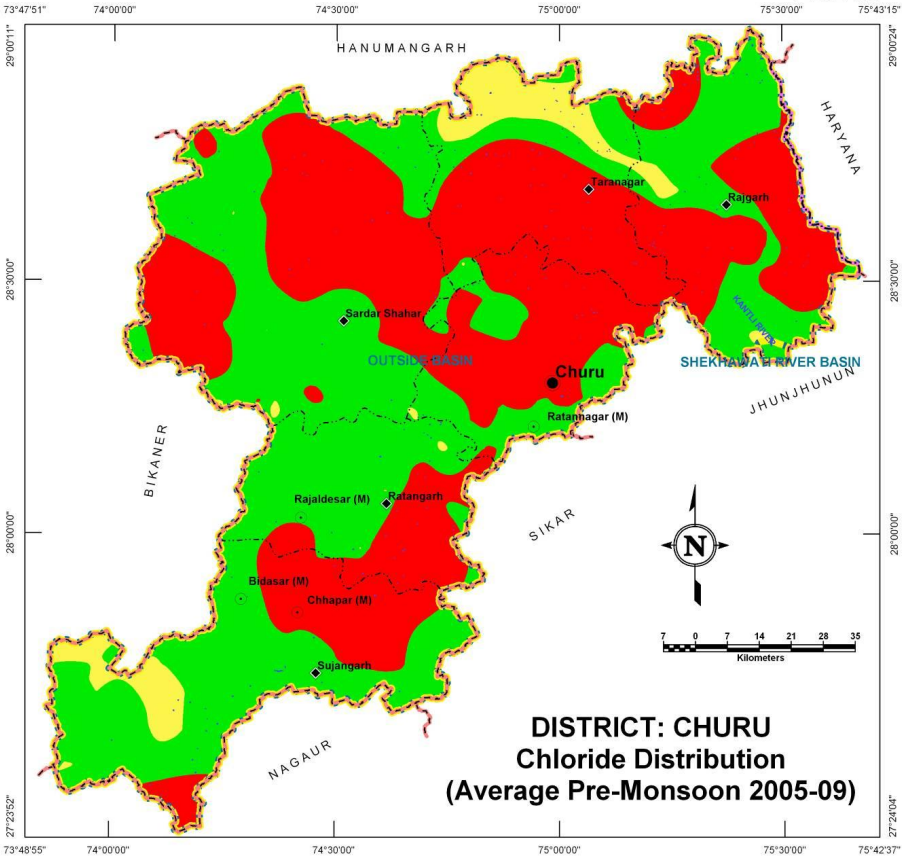
Water Bodies:

- River
- Ponds / Reservoirs

Electrical Conductivity (µS/cm at 25°C):

- < 2000
- 2000-4000
- >4000

PLATE - XIII



DISTRICT: CHURU
Chloride Distribution
(Average Pre-Monsoon 2005-09)

LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

- River
- Ponds / Reservoirs

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

GROUND WATER FLUORIDE DISTRIBUTION

DISTRICT – CHURU

The Fluoride concentration map is presented in Plate – XIV. The areas with low concentration (i.e.,>1.5 mg/l) are shown in yellow color and occupy approximately 47% of the total district area, which is suitable for domestic purpose. The areas with moderately high concentration (1.5-3.0 mg/l) are shown in green color and occupy 43% of the district area. Remaining part of the district (approximately 10%) falls under high concentration (<3.0 mg/l) which is shown in red color where ground water is not suitable for domestic purpose. Such high fluoride areas are mostly seen in eastern and southeastern part of the district and partly in western part.

Table: Block wise area of Fluoride distribution

Fluoride concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)												Total Area (sq km)
	Churu		Rajgarh		Ratangarh		SardarShahar		Sujangarh		Taranagar		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 1.5	991.1	63.0	474.5	21.6	916.3	57.2	2,143.4	55.4	1,565.3	57.2	347.2	18.6	**6,437.8**
1.5-3.0	581.9	37.0	1,077.0	48.9	662.0	41.3	1,479.5	38.3	691.0	25.3	1,503.5	80.5	**5,994.9**
> 3.0	0.6	-	647.9	29.5	23.7	1.5	241.9	6.3	480.0	17.5	17.4	0.9	**1,411.5**
Total	**1,573.6**	**100.0**	**2,199.4**	**100.0**	**1,602.0**	**100.0**	**3,864.8**	**100.0**	**2,736.3**	**100.0**	**1,868.1**	**100.0**	**13,844.2**

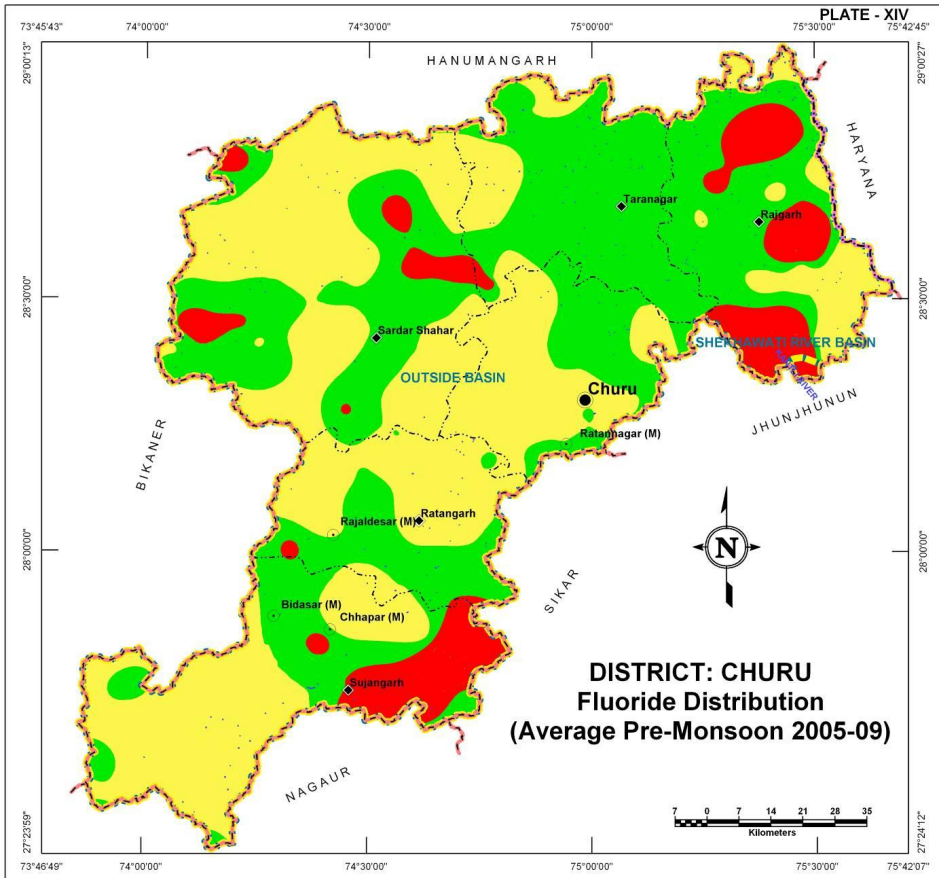
GROUND WATER NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate – XV shows distribution of Nitrate in ground water. High nitrate concentration (>100 mg/l) is shown in red color and occupies approximately 86% of the district area which is not suitable for agriculture purpose. The areas with moderately high nitrate concentration (50-100 mg/l) are shown in green color and occupy approximately 11% of the district area, largely northern part of Taranagar western part of the district. Remaining just 3% of the district area has shown low nitrate concentration (<50 mg/l) in ground water which is shown in yellow colored patches, largely northern part of Taranagar where the ground water is suitable for agriculture purpose.

Table: Block wise area of Nitrate distribution

Nitrate concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)												Total Area (sq km)
	Churu		Rajgarh		Ratangarh		SardarShahar		Sujangarh		Taranagar		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	14.5	0.9	77.2	3.5	20.7	1.3	47.9	1.2	6.3	0.2	264.8	14.2	**431.4**
50-100	40.8	2.6	335.6	15.3	86.0	5.4	486.1	12.6	32.7	1.2	490.4	26.3	**1,471.6**
>100	1,518.3	96.5	1,786.6	81.2	1,495.3	93.3	3,330.8	86.2	2,697.3	98.6	1,112.9	59.5	**11,941.2**
Total	**1,573.6**	**100.0**	**2,199.4**	**100.0**	**1,602.0**	**100.0**	**3,864.8**	**100.0**	**2,736.3**	**100.0**	**1,868.1**	**100.0**	**13,844.2**

PLATE - XIV



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

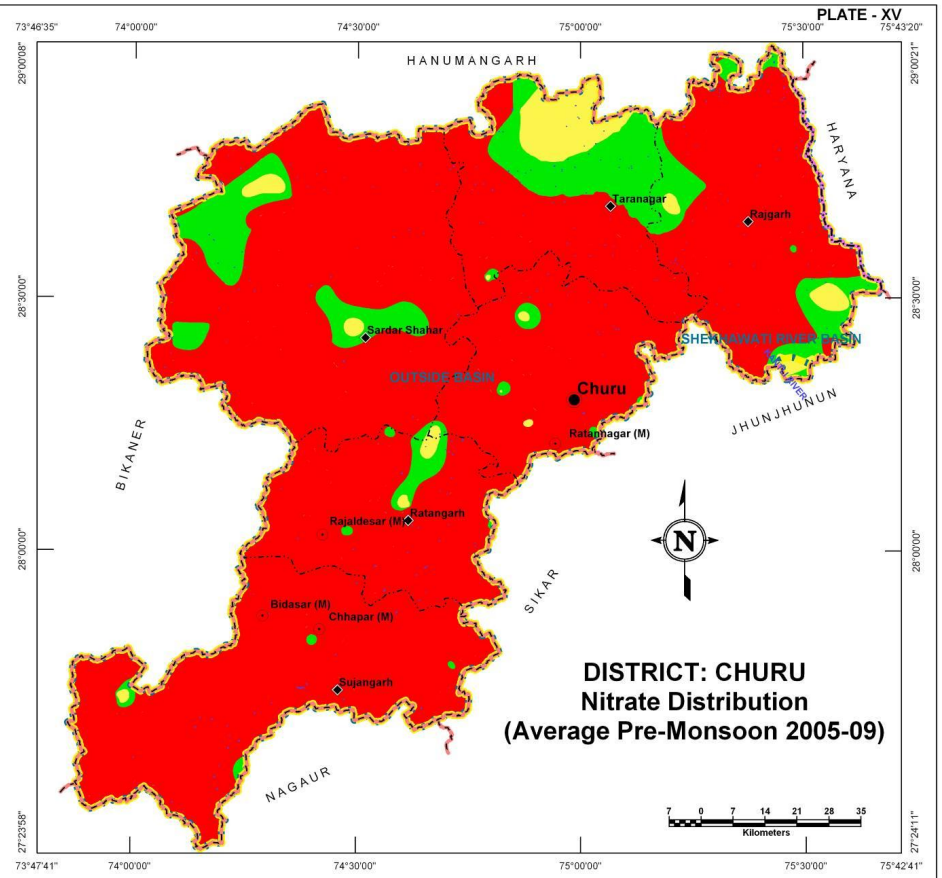
Water Bodies:

- River
- Ponds / Reservoirs

Fluoride Concentration (mg/l):

- < 1.5
- 1.5-3.0
- > 3.0

PLATE - XV



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

- River
- Ponds / Reservoirs

Nitrate Concentration (mg/l):

- < 50
- 50-100
- >100

DEPTH TO BEDROCK

DISTRICT – CHURU

From hydrogeological perspective, the beginning of massive bedrock has been considered for defining top of bedrock surface. The major rocks types occurring in the district are Sandstone, Limestone and Schist. These rocks are overlain by alluvial deposits of sand, clay, silt and admixture of these in different proportions and thicknesses. Perusal of the map reveals that the bedrock occurs at shallow depths in southern parts whereas if we move to north and southwestern parts, the depth to bedrock increases reaching to depth of more than 240m bgl. Areas around Churu, Rajgarh, Ratangarh, SardarShahar, Sujangarh and Taranagar blocks indicates the occurrence of bedrock in between 20m bgl to 140m bgl covering maximum area of the district. Bedrocks at deeper level (in between 140m bgk to 240m bgl) viz. north part of Taranagar, southwest parts of SardarShahar and western fringe of Sujangarh block including towns like Chhapar, Bidasar and Rajaldesar.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)												Total Area (sq km)
	Churu		Rajgarh		Ratangarh		SardarShahar		Sujangarh		Taranagar		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<20	-	-	-	-	-	-	-	-	0.6	-	-	-	**0.6**
20-40	-	-	-	-	-	-	-	-	25.8	1.0	-	-	**25.8**
40-60	-	-	-	-	113.4	7.1	-	-	171.5	6.0	-	-	**284.9**
60-80	-	-	-	-	482.5	30.1	61.0	1.6	511.5	19.0	-	-	**1,055.0**
80-100	575.1	37.0	97.6	4.0	620.6	38.7	928.9	23.9	686.9	25.0	537.8	29.0	**3,446.9**
100-120	929.2	59.0	1,868.6	85.0	333.3	20.8	896.0	23.2	428.5	16.0	559.2	30.0	**5,014.8**
120-140	65.7	4.0	233.2	11.0	31.0	1.9	749.4	19.4	579.5	21.0	463.1	25.0	**2,121.9**
140-160	3.6	-	-	-	12.7	0.8	620.7	16.1	243.6	9.0	190.0	10.0	**1,070.6**
160-180	-	-	-	-	7.3	0.5	432.3	11.2	38.7	1.0	101.1	5.0	**579.4**
180-200	-	-	-	-	1.2	0.1	147.2	3.8	18.8	1.0	16.9	1.0	**184.1**
200-220	-	-	-	-	-	-	25.9	0.7	14.5	1.0	-	-	**40.4**
220-240	-	-	-	-	-	-	3.4	0.1	10.0	-	-	-	**13.4**
>240	-	-	-	-	-	-	-	-	6.4	-	-	-	**6.4**
Total	**1,573.6**	**100.0**	**2,199.4**	**100.0**	**1,602.0**	**100.0**	**3,864.8**	**100.0**	**2,736.3**	**100.0**	**1,868.1**	**100.0**	**13,844.2**

UNCONFINED AQUIFER

Most part of the district has thick cover of both Younger and Older Alluvium. In unconfined conditions the alluvial aquifer attains a thickness of more than 100m. Alluvial material forms aquifers in most of northern and southeastern parts of the district mainly covers Churu, Rajgarh, Taranagar and partly in Sujangarh blocks, and its extent is also spread towards western parts of the district especially in the SardarShahar block. The thickness of unconfined aquifer varies from less than 10 m to about 110m with the thickest parts lying to the west of SardarShahar block. The general thickness reaches upto 70m. Weathered, fractured and jointed rock formations occurring at shallower depths constitute good unconfined aquifers. Such zone ranges in thickness from less than 10 meter to around 30 meter. Such aquifers under unconfined conditions are located in the southwestern and northwestern parts of the district as a narrow strip in Ratangarh, SadarShahar and Sujangarh blocks.

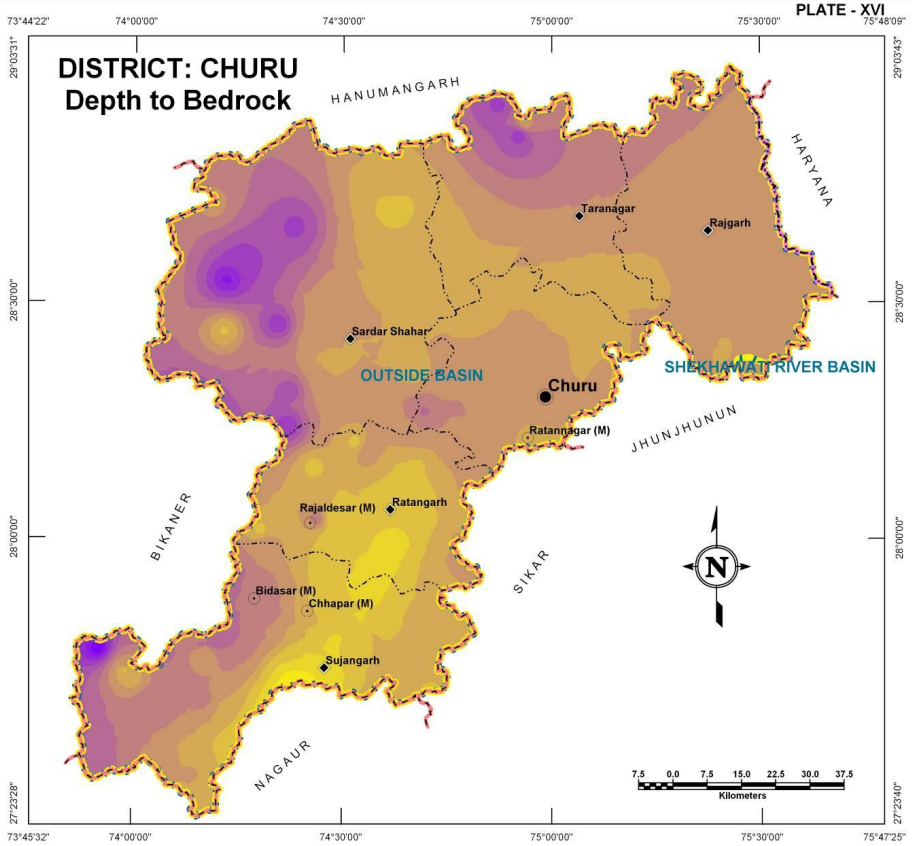
Alluvial aquifers

Unconfined aquifer Thickness (m)	Block wise area coverage (sq km)						Total Area (sq km)
	Churu	Rajgarh	Ratangarh	SardarShahar	Sujangarh	Taranagar	
< 10	411.7	256.8	513.1	449.5	65.3	562.6	**2,259.0**
10-20	332.9	603.1	333.3	633.6	77.5	930.5	**2,910.9**
20-30	340.7	543.6	114.4	461.0	190.6	231.1	**1,881.4**
30-40	192.9	479.2	77.7	294.1	66.6	89.5	**1,200.0**
40-50	131.5	203.9	32.6	226.7	0.7	36.5	**631.9**
50-60	112.2	76.0	12.1	155.7	-	2.3	**358.3**
60-70	37.1	22.3	2.0	80.6	-	-	**142.1**
70-80	13.9	9.9	-	35.6	-	-	**59.4**
80-90	0.7	4.6	-	19.1	-	-	**24.4**
90-100	-	0	-	6.4	-	-	**6.4**
> 100	-	-	-	0.1	-	-	**-**
Total	**1,573.6**	**2,199.4**	**1,085.2**	**2,362.4**	**400.7**	**1,852.5**	**9,473.8**

Hardrock aquifers

Unconfined aquifer Thickness (m)	Block wise area coverage (sq km)						Total Area (sq km)
	Churu	Rajgarh	Ratangarh	SardarShahar	Sujangarh	Taranagar	
< 10	-	-	485.8	1,403.2	1,608.2	15.6	**3,512.8**
10-20	-	-	31.0	99.2	628.2	-	**758.4**
> 20	-	-	-	-	99.2	-	**99.2**
Total	**-**	**-**	**516.8**	**1,502.4**	**2,335.6**	**15.6**	**4,370.4**

PLATE - XVI



LEGEND

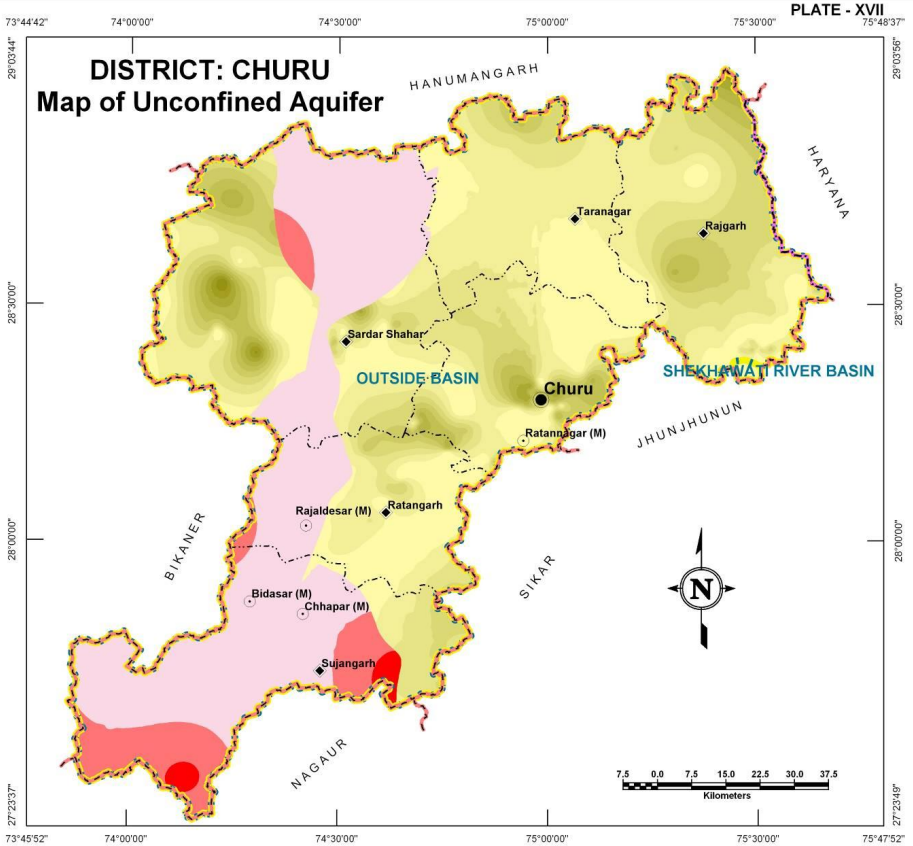
Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Depth to Bedrock(m bgl):

<20	140-160
20-40	160-180
40-60	180-200
60-80	200-220
80-100	220-240
100-120	>240
120-140	

PLATE - XVII



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Aquifer Thickness (m):

Alluvial Area:

<10	60-70
10-20	70-80
20-30	80-90
30-40	90-100
40-50	>100
50-60	

Weathered & Fractured Zone in Hardrock Area:

- <10
- 10-20
- >20

Glossary of terms

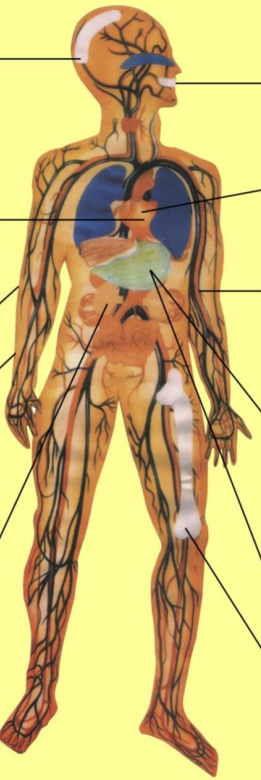
S. No.	Technical Terms	Definition
1	AQUIFER	A saturated geological formation which has good permeability to supply sufficient quantity of water to a Tube well, well or spring.
2	ARID CLIMATE	Climate characterized by high evaporation and low precipitation.
3	ARTIFICIAL RECHARGE	Addition of water to a ground water reservoir by man-made activity
4	CLIMATE	The sum total of all atmospheric or meteorological influences principally temperature, moisture, wind, pressure and evaporation of a region.
5	CONFINED AQUIFER	A water bearing strata having confined impermeable overburden. In this aquifer, water level represents the piezometric head.
6	CONTAMINATION	Introduction of undesirable substance, normally not found in water, which renders the water unfit for its intended use.
7	DRAWDOWN	The drawdown is the depth by which water level is lowered.
8	FRESH WATER	Water suitable for drinking purpose.
9	GROUND WATER	Water found below the land surface.
10	GROUND WATER BASIN	A hydro-geologic unit containing one large aquifer or several connected and interrelated aquifers.
11	GROUND WATER RECHARGE	The natural infiltration of surface water into the ground.
12	HARD WATER	The water which does not produce sufficient foam with soap.
13	HYDRAULIC CONDUCTIVITY	A constant that serves as a measure of permeability of porous medium.
14	HYDROGEOLOGY	The science related with the ground water.
15	HUMID CLIMATE	The area having high moisture content.
16	ISOHYET	A line of equal amount of rainfall.
17	METEOROLOGY	Science of the atmosphere.
18	PERCOLATION	It is flow through a porous substance.
19	PERMEABILITY	The property or capacity of a soil or rock for transmitting water.
20	pH	Value of hydrogen-ion concentration in water. Used as an indicator of acidity (pH < 7) or alkalinity (pH > 7).
21	PIEZOMETRIC HEAD	Elevation to which water will rise in a piezometers.
22	RECHARGE	It is a natural or artificial process by which water is added from outside to the aquifer.
23	SAFE YIELD	Amount of water which can be extracted from ground water without producing undesirable effect.
24	SALINITY	Concentration of dissolved salts.
25	SEMI-ARID	An area is considered semiarid having annual rainfall between 10-20 inches.
26	SEMI-CONFINED AQUIFER	Aquifer overlain and/or underlain by a relatively thin semi-pervious layer.
27	SPECIFIC YIELD	Quantity of water which is released by a formation after it's complete saturation.
28	TOTAL DISSOLVED SOLIDS	Total weight of dissolved mineral constituents in water per unit volume (or weight) of water in the sample.
29	TRANSMISSIBILITY	It is defined as the rate of flow through an aquifer of unit width and total saturation depth under unit hydraulic gradient. It is equal to product of full saturation depth of aquifer and its coefficient of permeability.
30	UNCONFINED AQUIFER	A water bearing formation having permeable overburden. The water table forms the upper boundary of the aquifer.
31	UNSATURATED ZONE	The zone below the land surface in which pore space contains both water and air.
32	WATER CONSERVATION	Optimal use and proper storage of water.
33	WATER RESOURCES	Availability of surface and ground water.
34	WATER RESOURCES MANAGEMENT	Planned development, distribution and use of water resources.
35	WATER TABLE	Water table is the upper surface of the zone of saturation at atmospheric pressure.
36	ZONE OF SATURATION	The ground in which all pores are completely filled with water.
37	ELECTRICAL CONDUCTIVITY	Flow of free ions in the water at 25C mu/cm.
38	CROSS SECTION	A Vertical Projection showing sub-surface formations encountered in a specific plane.
39	3-D PICTURE	A structure showing all three dimensions i.e. length, width and depth.
40	GWD	Ground Water Department
41	CGWB	Central Ground Water Board
42	CGWA	Central Ground Water Authority
43	SWRPD	State Water Resources Planning Department
44	EU-SPP	European Union State Partnership Programme
45	TOPOGRAPHY	Details of drainage lines and physical features of land surface on a map.
46	GEOLOGY	The science related with the Earth.
47	GEOMORPHOLOGY	The description and interpretation of land forms.
48	PRE MONSOON SURVEY	Monitoring of Ground Water level from the selected DKW/Piezometer before Monsoon (carried out between 15th May to 15th June)
49	POST-MONSOON SURVEY	Monitoring of Ground Water level from the selected DKW/Piezometer after Monsoon (carried out between 15th October to 15th November)
50	PIEZOMETER	A non-pumping small diameter bore hole used for monitoring of static water level.
51	GROUND WATER FLUCTUATION	Change in static water level below ground level.
52	WATER TABLE	The static water level found in unconfined aquifer.
53	DEPTH OF BED ROCK	Hard & compact rock encountered below land Surface.
54	G.W. MONITORING STATION	Dug wells selected on grid basis for monitoring of state water level.
55	EOLIAN DEPOSITS	Wind-blown sand deposits

(Contd…)

Ground Water Department,
Rajasthan

European Union
State Partnership Programme

भूजल में घुले मुख्य तत्वों की अधिकता का मानव शरीर पर दुष्प्रभाव



- बोरोन-स्नायु तन्त्र पर प्रभाव
- क्लोराइड-सोडियम के साथ मिलकर उच्च रक्त चाप
- कैल्शियम-जोड़ों में कड़ापन
- आर्सेनिक-त्वचा रोग, कैंसर
- लेड-बच्चों के शारीरिक व मानसिक विकास में बाधा वयस्कों में गुर्दे के रोग
- फ्लोराइड - दंत क्षरण
- सोडियम-हृदय, गुर्दा व रक्त परिसंचरण रोगों से ग्रसित लोगों को हानिकारक
- नाइट्रेट-नवजात शिशुओं में ब्लू बेबी बीमारी (मेथमोग्लोबिनिमिया)
- सल्फेट-अधिकता में मैग्नेशियम के साथ मिलकर दस्तावर
- आयरन-आयरन जीवाणु से आमाशय संबंधी रोग
- फ्लोराइड-जोड़ों में अकड़न, हड्डियों में मुड़ाव

केन्द्रीय भूमि जल बोर्ड,
पश्चिमी क्षेत्र, जयपुर
जल संसाधन मंत्रालय
भारत सरकार
e-mail:cgwbwr@sancharnet.in

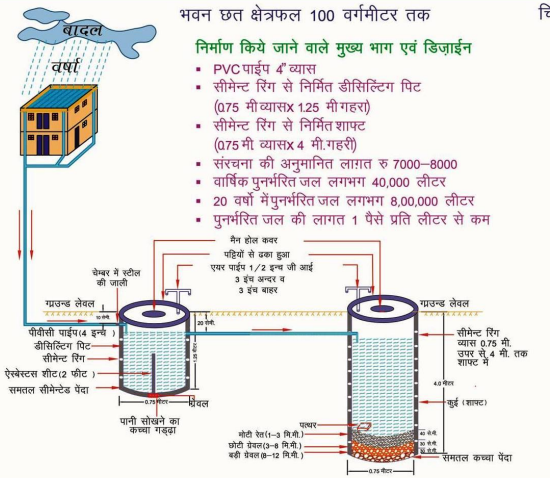
भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–1

भवन छत क्षेत्रफल 100 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 7000–8000
- वार्षिक पुनर्भरित जल लगभग 40,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

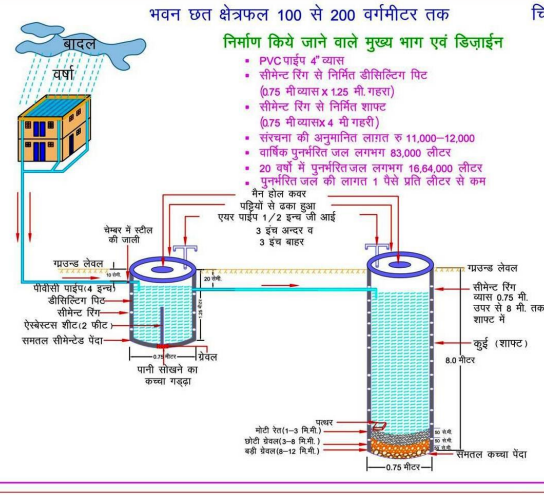


चित्र–2

भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी. गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी गहरी)
- संरचना की अनुमानित लाग़त रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

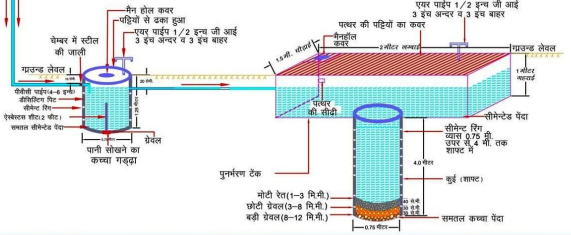


चित्र–3

भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4"– 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 2 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 25,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

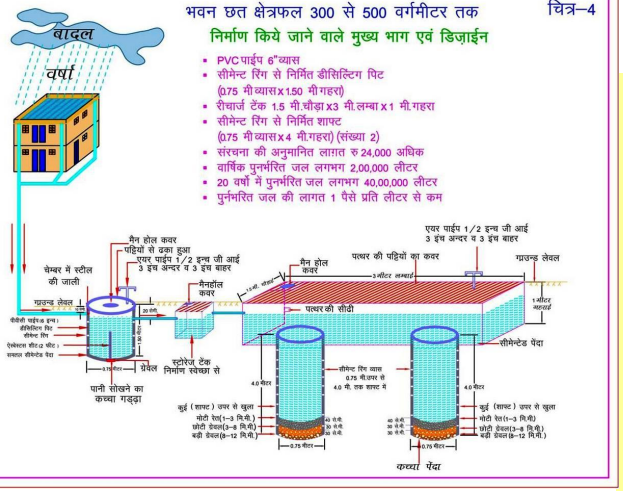


चित्र–4

भवन छत क्षेत्रफल 300 से 500 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.50 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 3 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरा) (संख्या 2)
- संरचना की अनुमानित लाग़त रु 24,000 अधिक
- वार्षिक पुनर्भरित जल लगभग 2,00,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 40,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम



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Myths and Facts about Ground Water

S No	Myths	Facts
1	What is Ground Water • an underground lake • a net work of underground rivers • a bowl filled with water	Water which occurs below the land in geological formations/rocks is Ground water
2	Ground Water occurs everywhere beneath the Land Surface	Not really, it depends on the nature of rock formation
3	There is a relationship between ground water and surface water	Not all the places. Near streams/rivers there is relation
4	Groundwater is not renewable resource	It is renewable source and every year it is being recharged through rain/applied irrigation etc
5	Ground water is unlimited and deeper you drill more discharge	It is limited to annual recharge from rain/applied irrigation. The discharge may not increase if you go deeper
6	Ground Water moves rapidly	The movement of ground water is very slow
7	Ground water pumped from wells is thousands of years old	Generally the ground water being tapped through wells is a few years old
8	If water taste good—it is safe to drink	It may have other chemicals e.g. fluoride, nitrates etc which are harmful
9	Water from free flowing tube wells is very pure	This water can also be contaminated so test before use
10	If I recharge my TW/DW/HP it will not benefit me	It will also benefit you and also adjoing wells
11	There is no static ground water resources in Rajasthan	Rajasthan is also having Static GW resources, and being tapped in most of areas as GW annual withdrawal is more than annual recharge
12	I cannot meet annual cooking and drinking water requirement by rain water harvesting	The water requirement for drinking and cooking is only 8 lit/day. You can harvest this water for family of 5 persons from roof top or paved area of 75 Sq m to meet annual requirement
13	You can increase ground water recharge	This can be done by harvesting the rain water and storing in sub surface reservoir (GW) by constructing the recharge structures
14	You cannot use abandoned TW/HP/DW for ground water recharge	These should be used as recharge structures as harvested rain water is directly put into GW reservoir
15	Putting waste near HP/TW will not cause any problem	Such actions will pollute wells and water

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