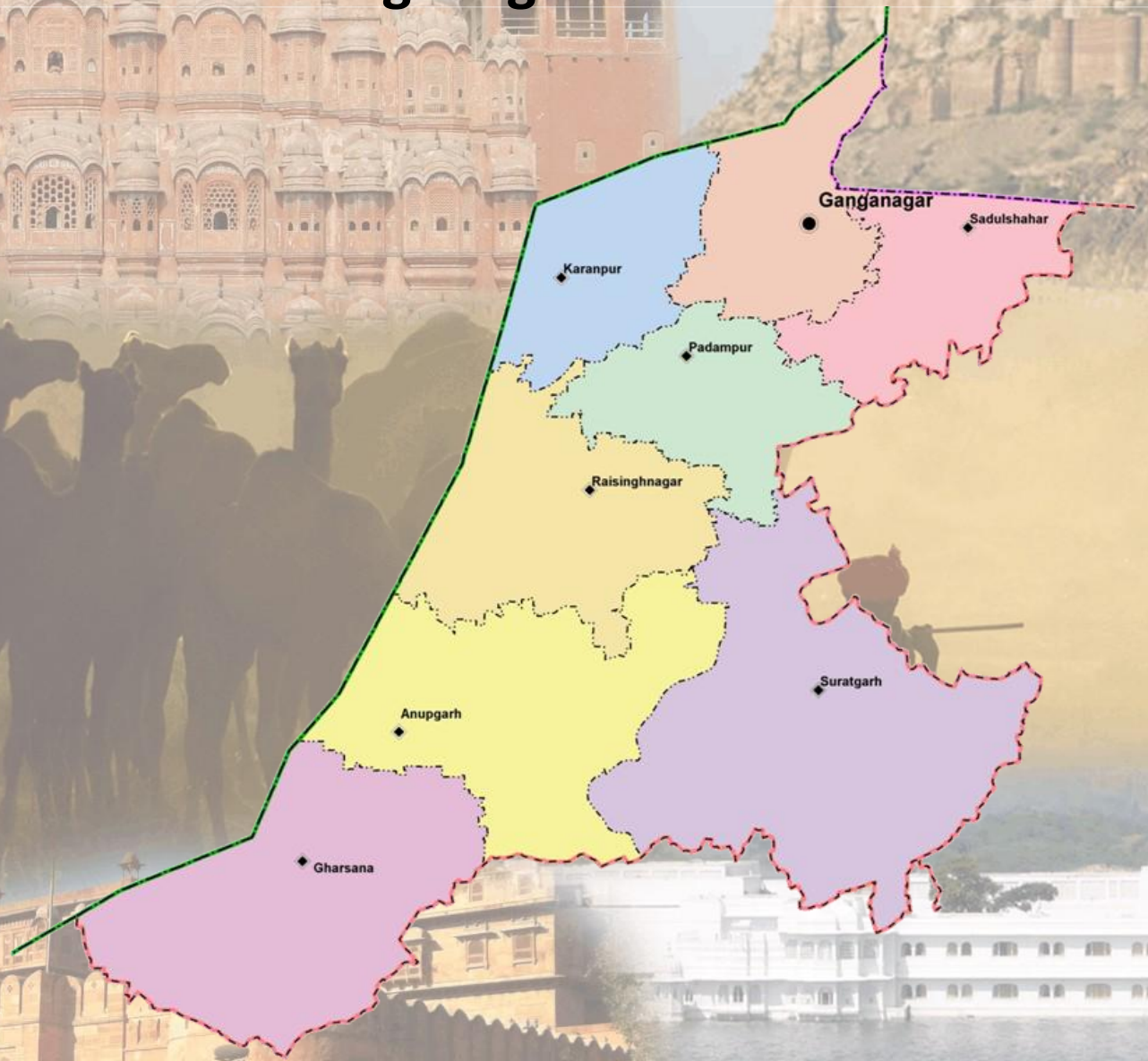
Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan

Ganganagar District

European Union
State Partnership Programme



2013

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Hydrogeological Atlas of Rajasthan

Ganganagar District

Contents:

2013

ADMINISTRATIVE SETUP

DISTRICT – GANGANAGAR

Location:

Ganganagar district is located in the northern part of Rajasthan. It is bounded in the northeast by state of Punjab, in the east by Hanumangarh district, south by Bikaner district and Pakistan in the west and northwest. It stretches between 28° 42' 19.22" to 30° 12' 02.23" north latitude and 72° 37' 57.53'' to 74° 18' 50.47'' east longitude covering area of 10,684.0 sq km. The whole district is part of 'Outside Basin' which does not have any systematic defined stream network and only deranged and disconnected streamlets constitute the drainage system.

Administrative Set-up:

Ganganagar is consists of eight 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	Anupgarh	2,47,058	1,684.8	16.0	560
2	Ganganagar	3,87,230	851.2	8.0	274
3	Gharsana	2,29,051	1,817.7	17.0	574
4	Karanpur	1,36,943	825.2	8.0	239
5	Padampur	1,47,948	864.6	8.0	249
6	Raisinghnagar	1,85,070	1,319.2	12.0	408
7	Sadulshahar	1,68,955	895.4	8.0	253
8	Suratgarh	2,75,023	2,425.9	23.0	469
Total		**17,77,278**	**10,684.0**	**100.0**	**3,026**

This district has 3,026 towns and villages, out of which eight are block headquarters as well.

Climate:

The climate of this district varies to extreme hot to extreme cold. Summer temperature reaches 50 °C and winter temperature dips around 0 °C. Average maximum temperature in summer is 41.2 °C and average minimum temperature in winter is 6°C. The summer months extend from March/April to June/July till the monsoon sets in although with very limited rains which last till end of September. The average annual rainfall is 233.6mm. Months between November and February are cold as winter season sets in with very cold nights and low day temperatures.

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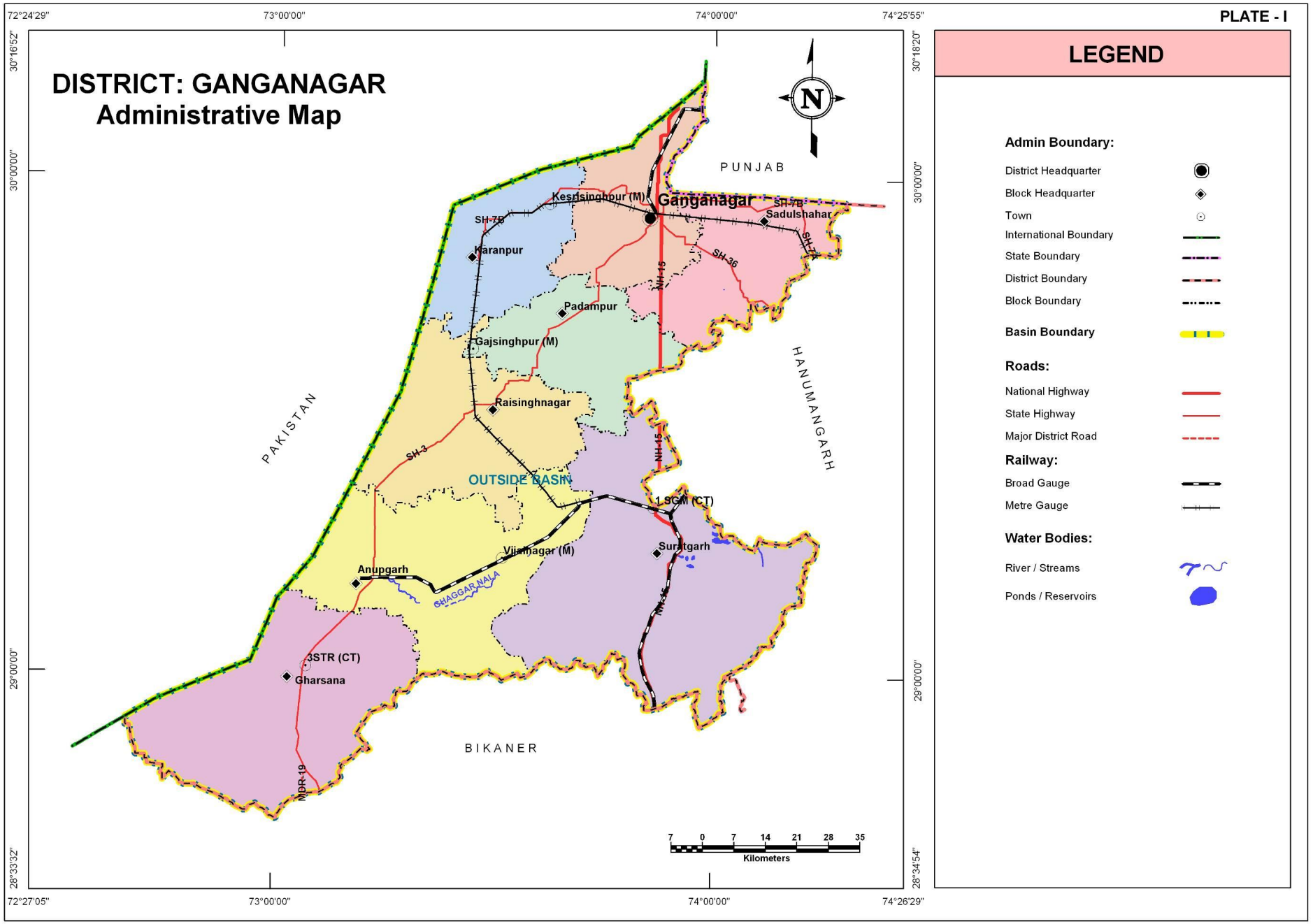
PLATE - I



LEGEND

Admin Boundary:

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

Roads:

- National Highway
- State Highway
- Major District Road

Railway:

- Broad Gauge
- Metre Gauge

Water Bodies:

- River / Streams
- Ponds / Reservoirs

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TOPOGRAPHY

DISTRICT – GANGANAGAR

The district is a part of the Great Thar Desert. District generally has undulating topography in northern and northeast part while dune complex occupies southwestern part of the district. Ganganagar falls under 'Outside Basin'. The Ghaggar River is the only major river in the district which is also locally known as 'Ghaggar Nala'. The general topographic elevation in the district is between 125 m to 150 m above mean sea level in most of the blocks. Elevation ranges from minimum of 104.8 m above mean sea level in Anupgarh block in the SW part of the district to maximum of 230.2 m above mean sea level In Suratgarh in southeastern part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Minimum Elevation (m amsl)	Maximum Elevation (m amsl)
1	Anupgarh	104.8	204.7
2	Ganganagar	166.2	190.8
3	Gharsana	124.4	186.4
4	Karanpur	149.4	180.9
5	Padampur	153.4	186.3
6	Raisinghnagar	145.3	190.0
7	Sadulshahar	164.3	197.7
8	Suratgarh	155.1	230.2

RAINFALL

The district receives scanty and erratic rainfall. The general distribution of rainfall across can be visualized from isohyets presented in the Plate – III, where rainfall gradually increases from west to east. The annual average rainfall was 378.7 mm based on the data of available blocks while highest average annual rainfall is 479.3 mm in Suratgarh block. Lowest of minimum annual rainfall was in Anupgarh block (260.8 mm). Suratgarh block has received highest of maximum annual rainfall of about 582 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)
Anupgarh	260.8	468.8	341.0
Ganganagar	309.0	444.3	369.5
Gharsana	272.3	411.3	335.7
Karanpur	292.1	438.5	340.8
Padampur	339.2	478.9	438.8
Raisinghnagar	267.2	439.2	340.8
Sadulshahar	322.2	450.2	383.8
Suratgarh	401.4	582.0	479.3

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PLATE - II

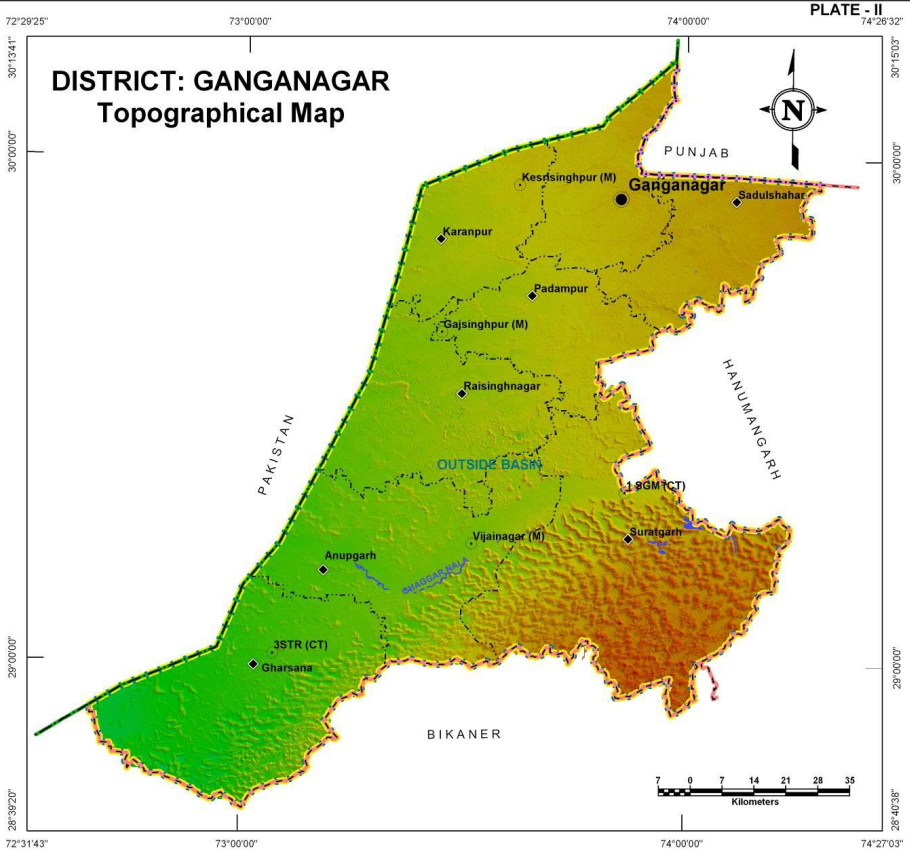
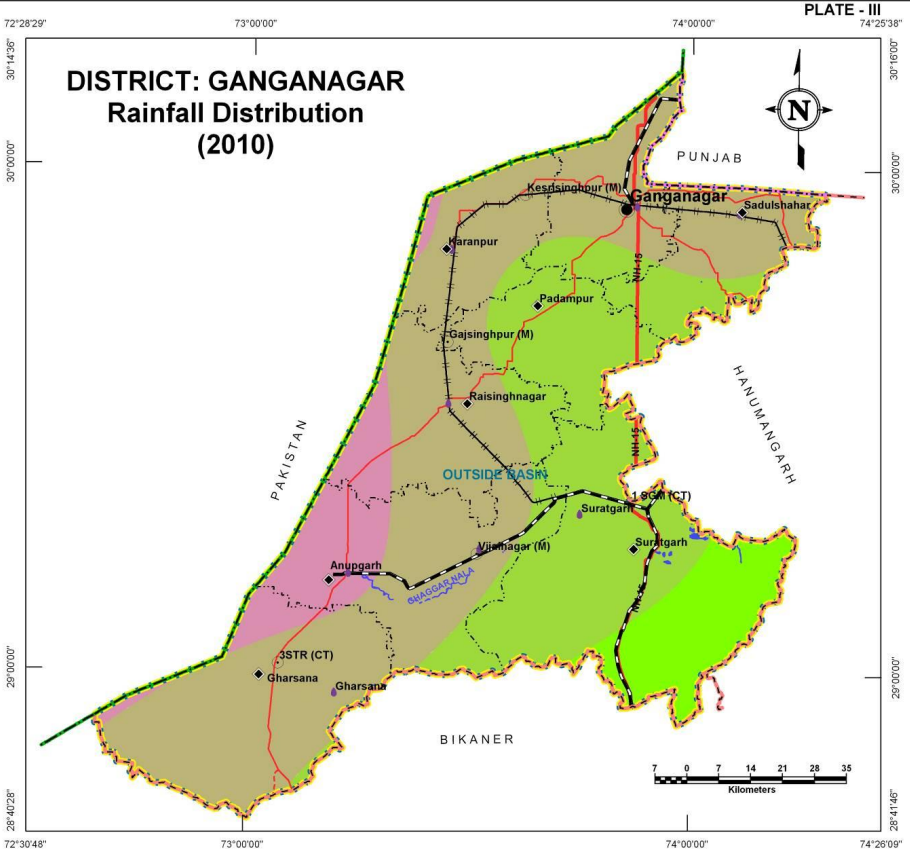


PLATE - III



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- International Boundary
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Source : SRTM DEM

Elevation (m amsl):
230, 225, 200, 175, 150, 125, 105

LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- Raingauge Stations
- International Boundary
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

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

Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Isohyets (mm):
- 200-300
- 300-400
- 400-500
- 500-600

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GEOLOGY

DISTRICT – GANGANAGAR

Geology is marked by a thick cover of blown sand and alluvium.

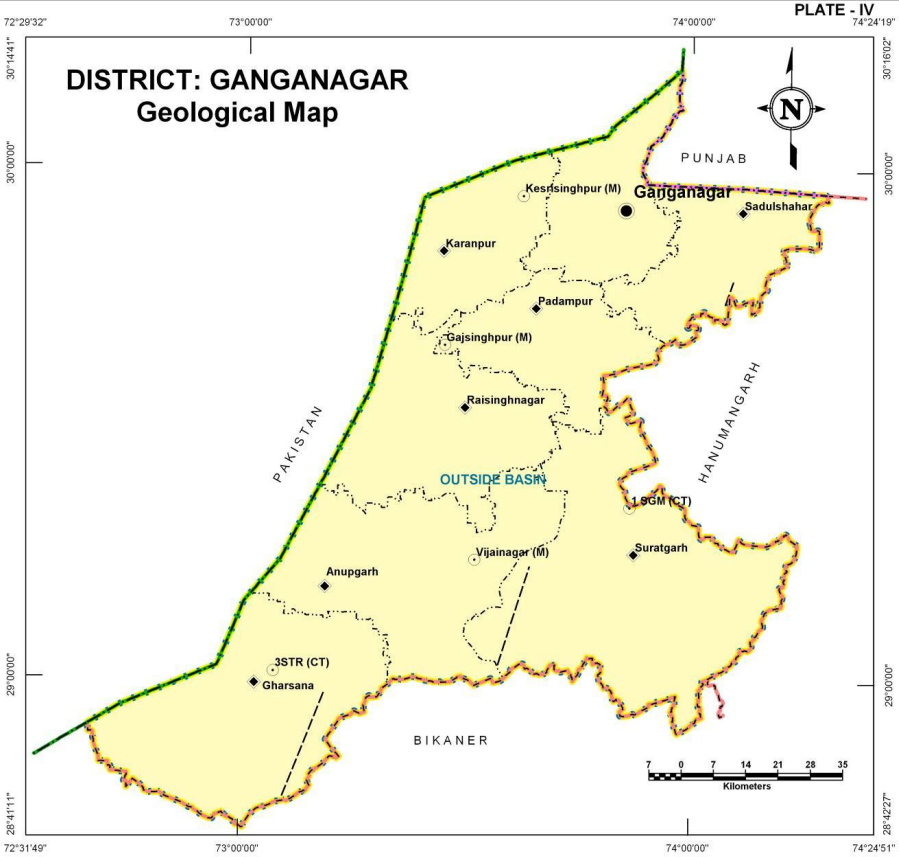
Age	Group	Formation
Recent to Sub-recent	Recent to Sub-recent	Alluvium

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
Aeolian	Dune Complex	An undulating plain composed of number of sand dunes of crescent shape.
	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 (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	Pediplain	Coalescence and extensive occurrence of pediment.
Fluvial	Alluvial Plain	Mainly undulating landscape formed due to fluvial activity, comprising of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.
	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.
	Flood Plain	The surface or strip of relatively smooth land adjacent to a river channel formed by river and covered with water when river over flows its bank. Normally subject to periodic flooding.
	Paleochannel	Mainly buried on abandoned stream/river courses, comprising of coarse textured material of variable sizes.

PLATE - IV



LEGEND

Admin Boundary:

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

Structural Features:

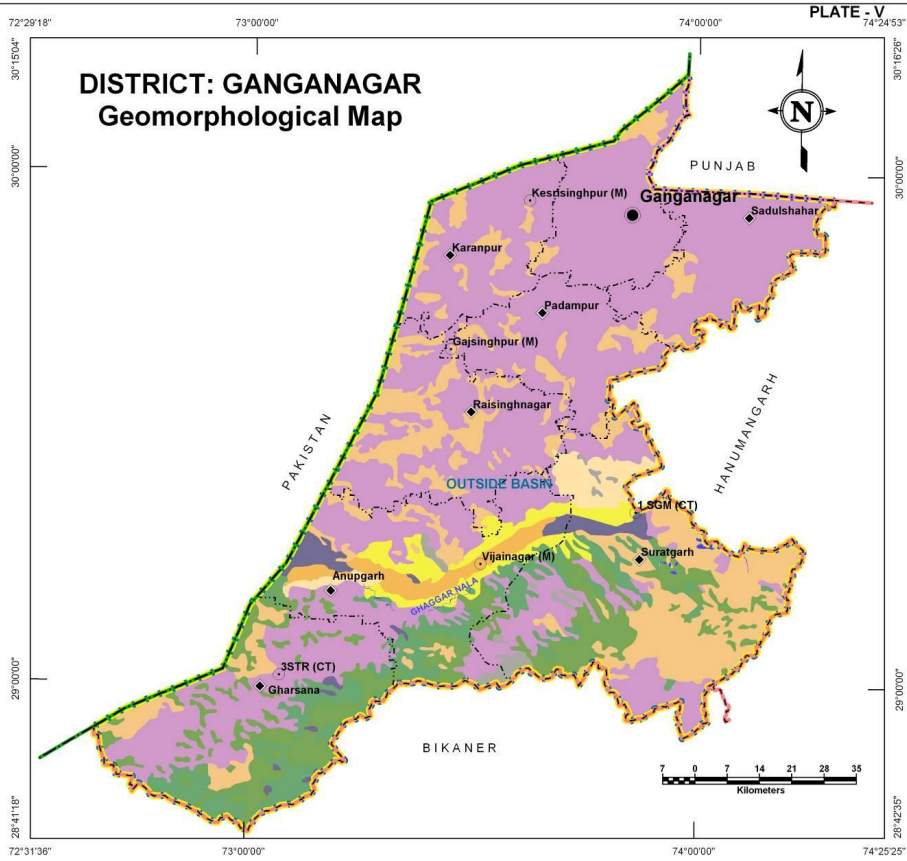
- Fault

Geology:

- Alluvium and Wind blown sand

Source: District Resource Map of Rajasthan - GSI

PLATE - V



LEGEND

Admin Boundary:

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

Water Bodies:

- River/Ponds/Reservoirs

Landform Units:

Fluvial Origin:

- Alluvial Plain
- Alluvial Plain (Sandy)
- Flood Plain
- Palaeochannel

Aeolian Origin:

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

Denudational Origin:

- Pediplain

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

AQUIFERS

DISTRICT – GANGANAGAR

There are no hard rock aquifers mapped in the area as all of the water till explored depth occurs in alluvium only. The alluvium is of two types viz., Younger alluvium which predominantly is wind-blown sand whereas the Older alluvium is more of fluvial origin. More than 90% of the aquifer area is Younger alluvium and the rest is Older alluvium.

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	9,705.8	90.8	It is largely constituted of Aeolian and Fluvial sand, silt, clay, gravel and pebbles in varying proportions.
Older Alluvium	978.2	9.2	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Total	**10,684.0**	**100.0**	

STAGE OF GROUND WATER DEVELOPMENT

All the blocks within the district fall within 'Safe' category from ground water development perspective although significant part of the district does not contain good quality of water for domestic purposes.

Categorization on the basis of stage of development of ground water	Block Name
Safe	Gharsana, Anupgarh, Raisinghnagar, Suratgarh, Padampur, Karanpur,Ganganagar, Sadulshahar

Basis for categorization: Ground water development <= 70% - Safe

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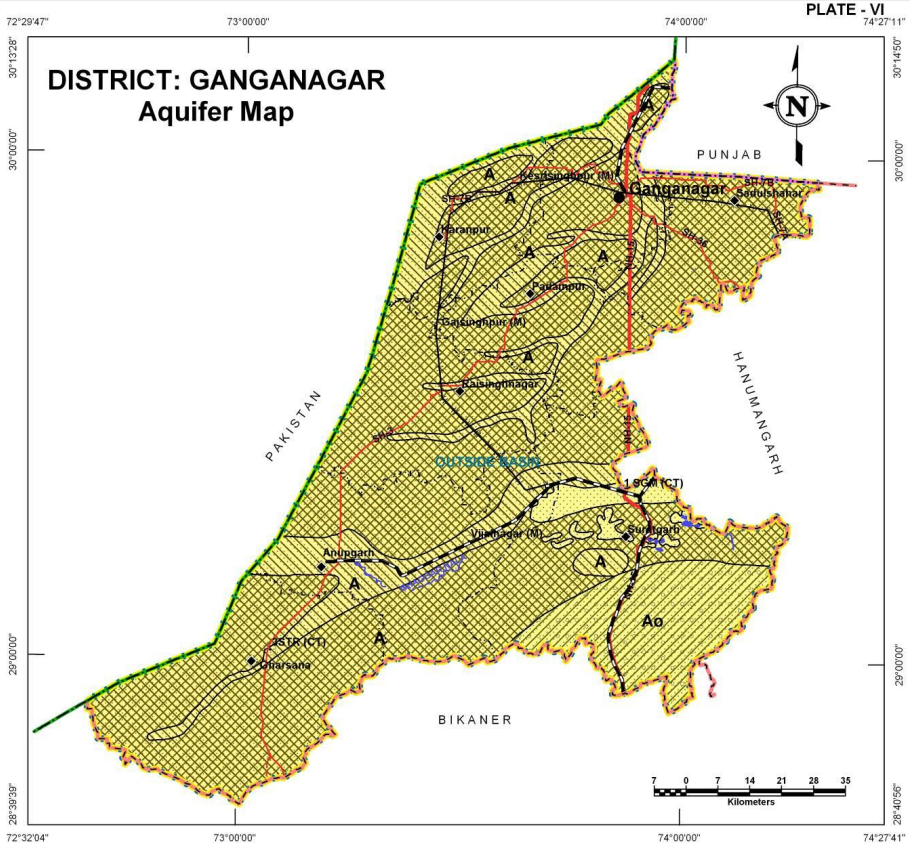
PLATE - VI



LEGEND

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

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

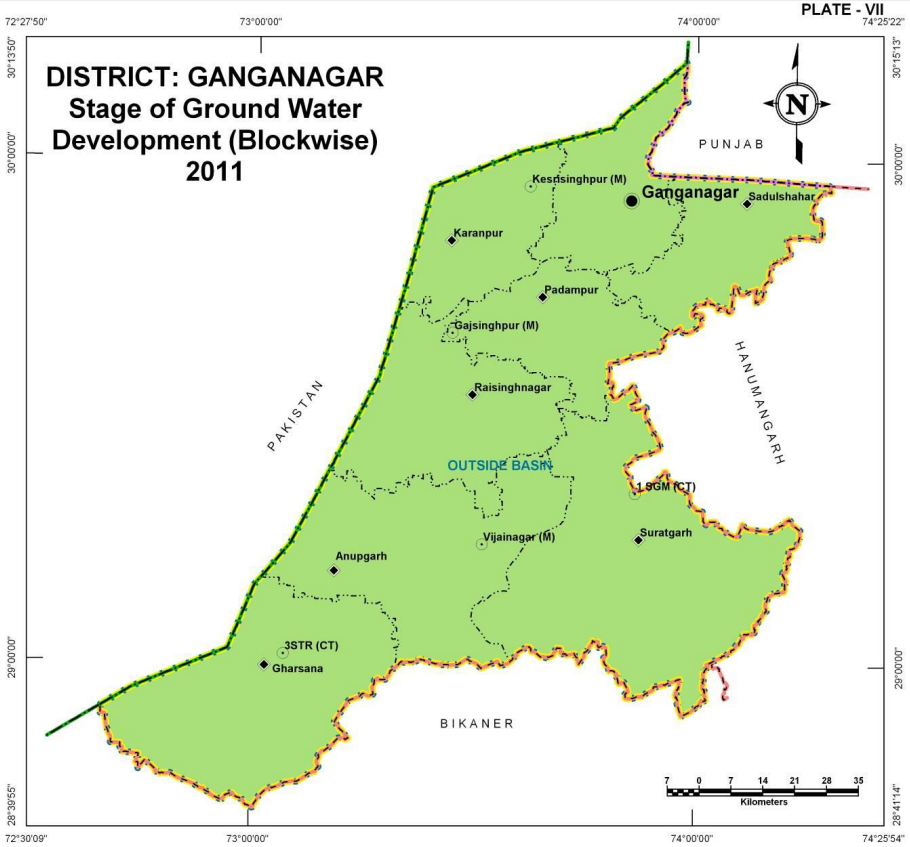
Railway:
- Broad Gauge
- Metre Gauge

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

Aquifer:
- Younger Alluvium
- Older Alluvium

Source: Ground Water Potential Zone Map - GWD, Rajasthan

PLATE - VII



LEGEND

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

Stage of Ground Water Development:
- Safe

Source: Ground Water Department, Rajasthan

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LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS DISTRICT – GANGANAGAR

Ganganagar district has a well distributed network of exploratory wells (36) and ground water monitoring stations (169) in the district owned by RGWD (33 and 127 respectively) and CGWB (3 and 42 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 but for water quality 11 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
Anupgarh	1	2	**3**	10	12	**22**	0	1
Ganganagar	0	5	**5**	3	20	**23**	0	0
Gharsana	0	3	**3**	3	6	**9**	0	1
Karanpur	0	4	**4**	3	23	**26**	0	1
Padampur	0	4	**4**	3	14	**17**	0	0
Raisinghnagar	1	3	**4**	4	19	**23**	0	0
Sadulshahar	1	4	**5**	3	14	**17**	0	0
Suratgarh	0	8	**8**	13	19	**32**	0	8
Total	**3**	**33**	**36**	**42**	**127**	**169**	**0**	**11**

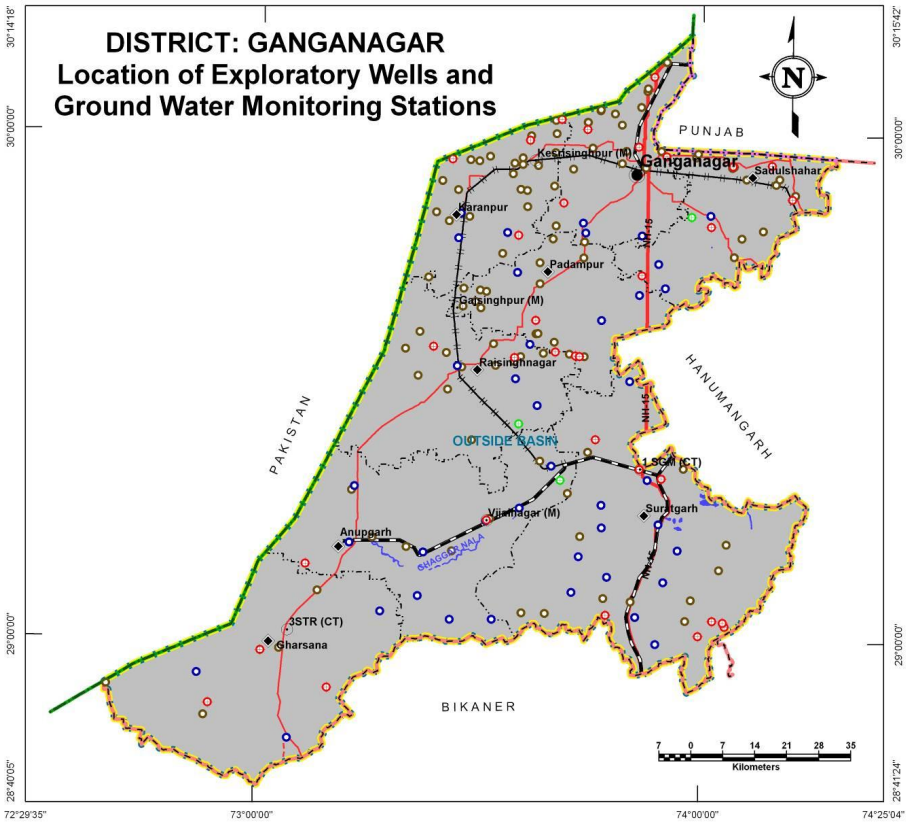
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The entire district is covered with alluvium shows moderate variation in depth to ground water level from less than 10m bgl to more than 40m bgl. Shallow water levels less than 10m below ground level (green colour in Plate – IX) has seen in a strip from north of Gangangar-Karanpur-Raisnghnagar-Sadulshahar-Padampur to southeast of Anupgarh and southwest of Suratgarh block. Deeper water level of more than 40m bgl is found in southwest of Suratgarh block. The moderate depth to water level in between 10m bgl to 30m bgl is found in central and southern parts of the district.

Depth to water level (m bgl)	Block wise area coverage (sq km) *								Total Area (sq km)
	Anupgarh	Ganganagar	Gharsana	Karanpur	Padampur	Raisinghnagar	Sadulshahar	Suratgarh	
<10	876.6	697.5	21.3	780.8	36.1	815.0	54.3	805.3	**4,086.9**
10-20	808.3	153.7	1,321.7	44.4	828.5	504.2	469.8	769.5	**4,900.1**
20-30	-	-	474.6		-	-	371.3	337.0	**1,182.9**
>40	-	-	-	-	-	-	-	514.1	**514.1**
Total	**1,684.9**	**851.2**	**1,817.6**	**825.2**	**864.6**	**1,319.2**	**895.4**	**2,425.9**	**10,684.0**

* 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



LEGEND

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

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

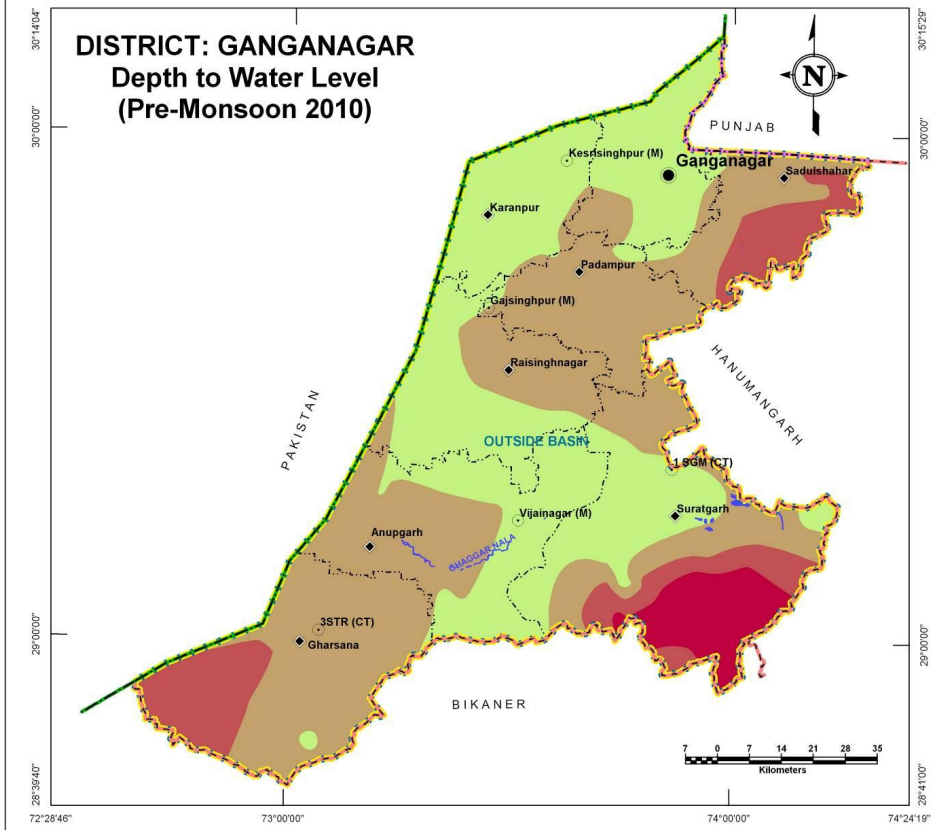
Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Exploratory Wells:
- CGWB
- RGWD

Ground Water Monitoring Stations:
- CGWB
- RGWD

PLATE - IX



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- International Boundary
- 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
- > 40

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

The water level elevation ranges show very limited variation as it is a part of the Great Thar Desert. The north and southeast part of the district (Ganganagar, Sadulshahar and Suratgarh block) show higher elevation i.e., >180m amsl. Maximum parts of the district fall under elevation ranges 140-160m amsl. The southwestern part (Gharsana and lower part of Anupgarh) falls under lower elevation ranges i.e. <140m amsl. The regional ground water flow direction is from NE to SW and the eastern part also flows towards west and ultimately takes a SW direction.

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)
	Anupgarh	Ganganagar	Gharsana	Karanpur	Padampur	Raisinghnagar	Sadulshahar	Suratgarh	
< 140	193.7	-	1,265.7	-	-	-	-	-	**1,459.4**
140 - 160	1,358.1	103.5	455.3	556.4	800.9	1,319.2	393.4	1,134.8	**6,121.6**
160 - 180	131.8	747.7	96.6	268.8	63.7	-	495.9	1,290.5	**3,095.0**
> 180	1.3	-	-	-	-	-	6.1	0.6	**8.0**
Total	**1,684.9**	**851.2**	**1,817.6**	**825.2**	**864.6**	**1,319.2**	**895.4**	**2,425.9**	**10,684.0**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

The district shows a fall of 2m to rise by 6m in different areas as seen in Plate XI. The high –ve fluctuation areas (indicated by red regions) are very limited in spatial distribution as less than 1% of the district area falls within this category. Almost 95% of the district has shown a general fluctuation range from -2m to +2m. Maximum rise of more than 8m is noticed in the eastern part of Suratgarh block.

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)
	Anupgarh	Ganganagar	Gharsana	Karanpur	Padampur	Raisinghnagar	Sadulshahar	Suratgarh	
<-2	3.8	-	-	-	2.9	-	15.5	45.5	**67.7**
-2to0	544.4	233.5	1,756.7	158.8	456.7	123.8	423.4	1,175.6	**4,872.9**
0to2	837.8	591.8	60.9	651.3	405.0	1,125.1	456.5	1,016.4	**5,144.8**
2to4	242.9	25.9	-	15.1	-	68.5	-	130.8	**483.2**
4to6	55.6	-	-	-	-	1.8	-	38.8	**96.2**
6to8	0.4	-	-	-	-	-	-	15.0	**15.4**
>8	-	-	-	-	-	-	-	3.8	**3.8**
Total	**1,684.9**	**851.2**	**1,817.6**	**825.2**	**864.6**	**1,319.2**	**895.4**	**2,425.9**	**10,684.0**

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PLATE - X

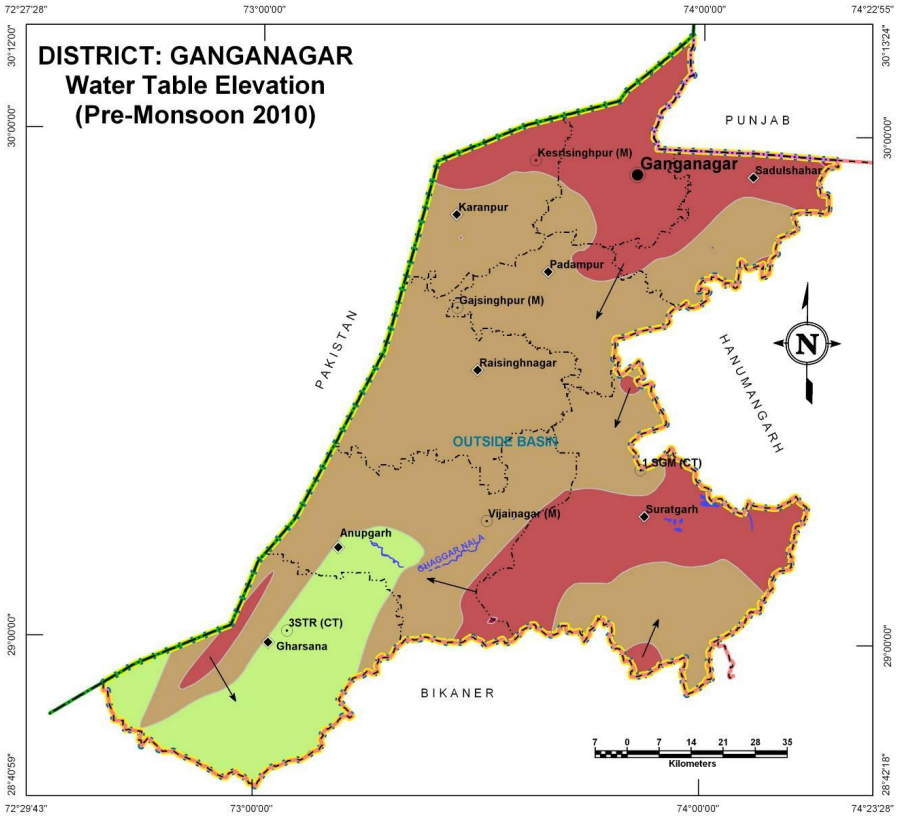
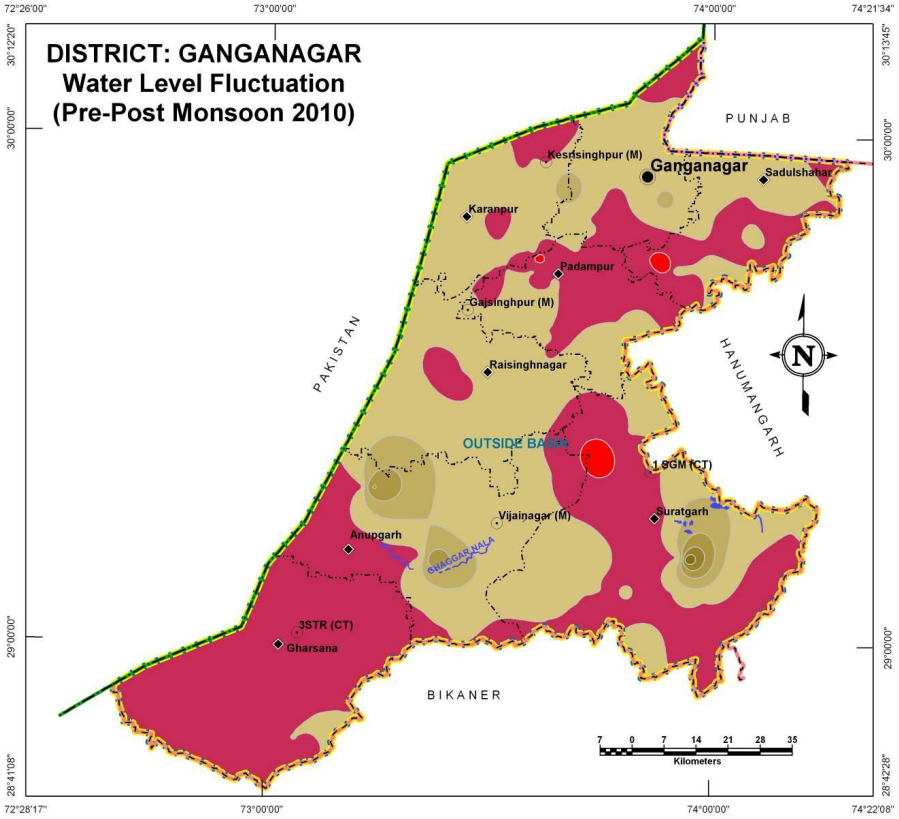


PLATE - XI



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Water Table Elevation

Water Table Elevation (m amsl):

- <140
- 140 - 160
- 160 - 180
- >180

LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- International Boundary
- 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

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GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION DISTRICT – GANGANAGAR

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 almost 53% of the district area indicating that, the ground water in this region is generally unsuitable for domestic purposes. The areas with moderately high EC values (2000 -4000 µS/cm) are shown in green color occupy 33% of the district area. Together these two areas account for 86% of district area that leaves only approximately 14% area where low EC values in ground water (<2000 µS/cm) is recorded as shown in yellow color scattered in the northern and eastern part of the district.

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)
	Anupgarh		Ganganagar		Gharsana		Karanpur		Padampur		Raisinghnagar		Sadulshahar		Suratgarh		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<2000	58.2	3.5	250.9	29.5	-	-	131.8	16.0	49.3	5.7	74.8	5.7	42.8	4.8	837.6	34.5	**1,445.4**
2000-4000	668.4	39.7	372.0	43.7	128.7	7.1	314.0	38.1	324.5	37.5	279.9	21.2	349.4	39.0	1,115.6	46.0	**3,552.5**
>4000	958.3	56.8	228.3	26.8	1,688.9	92.9	379.4	45.9	490.8	56.8	964.5	73.1	503.2	56.2	472.7	19.5	**5,686.1**
Total	**1,684.9**	**100.0**	**851.2**	**100.0**	**1,817.6**	**100.0**	**825.2**	**100.0**	**864.6**	**100.0**	**1,319.2**	**100.0**	**895.4**	**100.0**	**2,425.9**	**100.0**	**10,684.0**

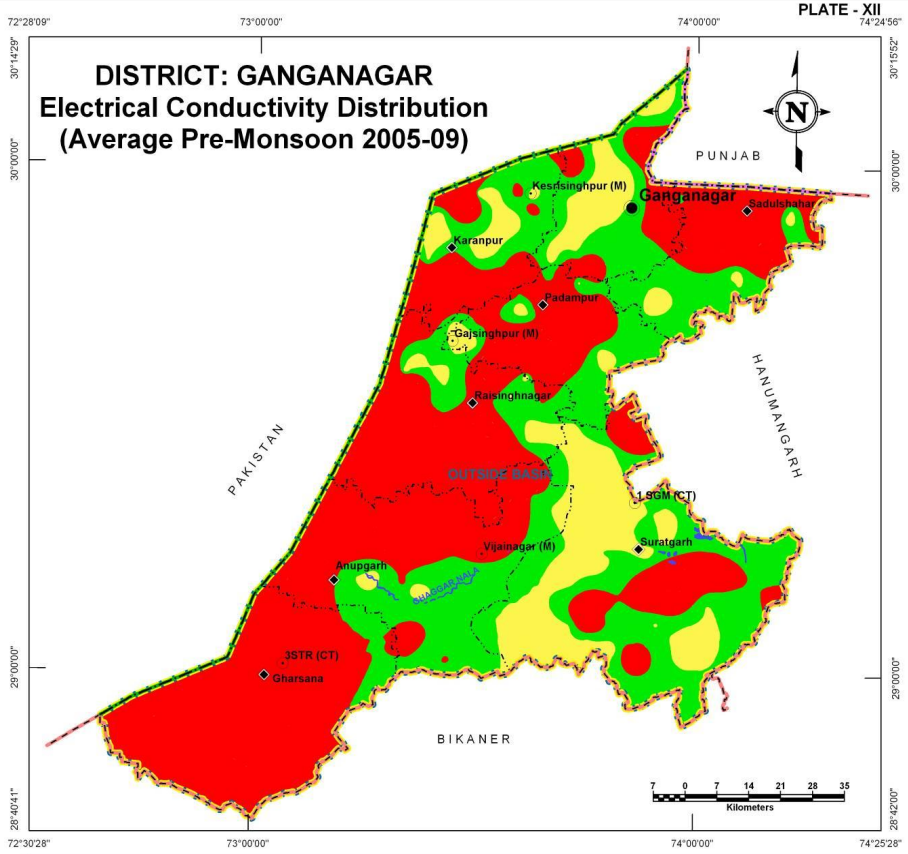
GROUND WATER CHLORIDE DISTRIBUTION

High chloride concentration in ground water also renders it unsuitable for domestic and other purposes. The green colored regions in Plate – XIII are such areas where chloride concentration is moderately high (250-1000 mg/l) occupies approximately 48% of the district area. The areas with high chloride concentration (>1000mg/l) are shown in red color occupy approximately 47% of the district area. The ground water in this region is not suitable for domestic purposes. That leaves only small part of the district (approximately 5%) falling under low chloride concentration (<250 mg/l) area which is shown in yellow occurring as scattered patches in the north and southeastern part of the district where ground water chloride concentration is low and good for domestic purposes.

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)
	Anupgarh		Ganganagar		Gharsana		Karanpur		Padampur		Raisinghnagar		Sadulshahar		Suratgarh		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<250	0.9	-	126.1	15.0	-	-	50.8	6.0	19.7	2.0	4.9	-	19.6	2.0	262.9	11.0	**484.9**
250-1000	811.1	48.0	626.4	73.0	145.8	8.0	466.6	57.0	453.0	52.0	340.5	26.0	402.7	45.0	1,893.3	78.0	**5,139.4**
>1000	872.9	52.0	98.7	12.0	1,671.8	92.0	307.8	37.0	391.9	46.0	973.8	74.0	473.1	53.0	269.7	11.0	**5,059.7**
Total	**1,684.9**	**100.0**	**851.2**	**100.0**	**1,817.6**	**100.0**	**825.2**	**100.0**	**864.6**	**100.0**	**1,319.2**	**100.0**	**895.4**	**100.0**	**2,425.9**	**100.0**	**10,684.0**

PLATE - XII



LEGEND

Admin Boundary:

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

Basin Boundary

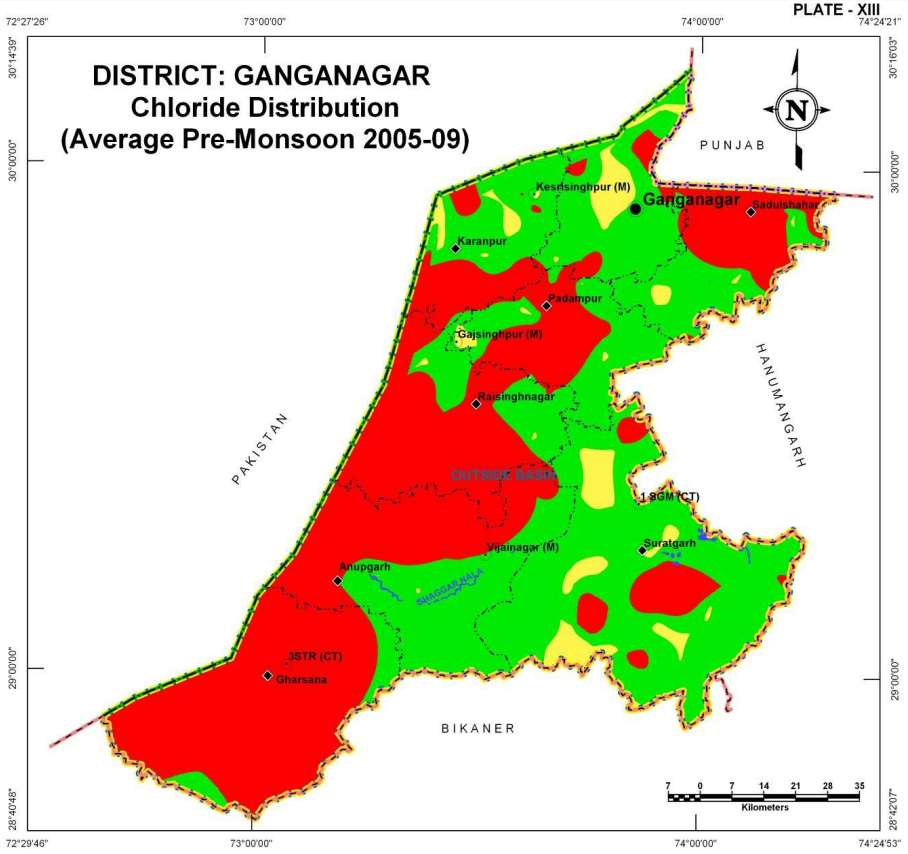
Water Bodies:

- River / Streams
- Ponds / Reservoirs

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

- < 2000
- 2000-4000
- >4000

PLATE - XIII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

GROUND WATER FLUORIDE DISTRIBUTION — DISTRICT – GANGANAGR

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 occupies almost 57% of the 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 approximately 23% of the district area, largely around Anupgarh and Karanpur. Remaining part of the district approximately 20% has high Fluoride concentration (>3.0 mg/l) which is shown in red color, largely around Suratgarh and Gharasana where the ground water is not suitable for domestic purpose.

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)
	Anupgarh		Ganganagar		Gharsana		Karanpur		Padampur		Raisinghnagar		Sadulshahar		Suratgarh		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<1.5	1,009.8	59.9	851.0	100.0	5.3	0.3	558.9	67.7	610.5	70.6	1,103.8	83.6	875.3	97.7	1,119.6	46.2	**6,134.2**
1.5-3.0	649.5	38.6	0.2	-	496.7	27.3	210.5	25.5	183.2	21.2	209.5	15.9	20.1	2.3	645.9	26.6	**2,415.6**
>3.0	25.6	1.5	-	-	1,315.6	72.4	55.8	6.8	70.9	8.2	5.9	0.5	-	-	660.4	27.2	**2,134.2**
Total	**1,684.9**	**100.0**	**851.2**	**100.0**	**1,817.6**	**100.0**	**825.2**	**100.0**	**864.6**	**100.0**	**1,319.2**	**100.0**	**895.4**	**100.0**	**2,425.9**	**100.0**	**10,684.0**

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 occupies approximately 47% 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 34% of the district area. Remaining part of the district area has shown high nitrate concentration (<50 mg/l) in ground water as shown in yellow colored patches seen scattered over the district except in south and southeastern parts of the district. The ground water in this region (19% of district area) 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)
	Anupgarh		Ganganagar		Gharsana		Karanpur		Padampur		Raisinghnagar		Sadulshahar		Suratgarh		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<50	248.1	14.7	251.8	29.6	64.2	3.5	476.0	57.7	269.3	31.2	341.9	25.9	117.8	13.2	345.3	14.2	**2,114.4**
50-100	801.8	47.6	261.6	30.7	41.3	2.3	262.6	31.8	543.2	62.8	501.8	38.0	475.5	53.1	702.4	29.0	**3,590.2**
>100	635.0	37.7	337.8	39.7	1,712.1	94.2	86.6	10.5	52.1	6.0	475.5	36.1	302.1	33.7	1,378.2	56.8	**4,979.4**
Total	**1,684.9**	**100.0**	**851.2**	**100.0**	**1,817.6**	**100.0**	**825.2**	**100.0**	**864.6**	**100.0**	**1,319.2**	**100.0**	**895.4**	**100.0**	**2,425.9**	**100.0**	**10,684.0**

PLATE - XIV

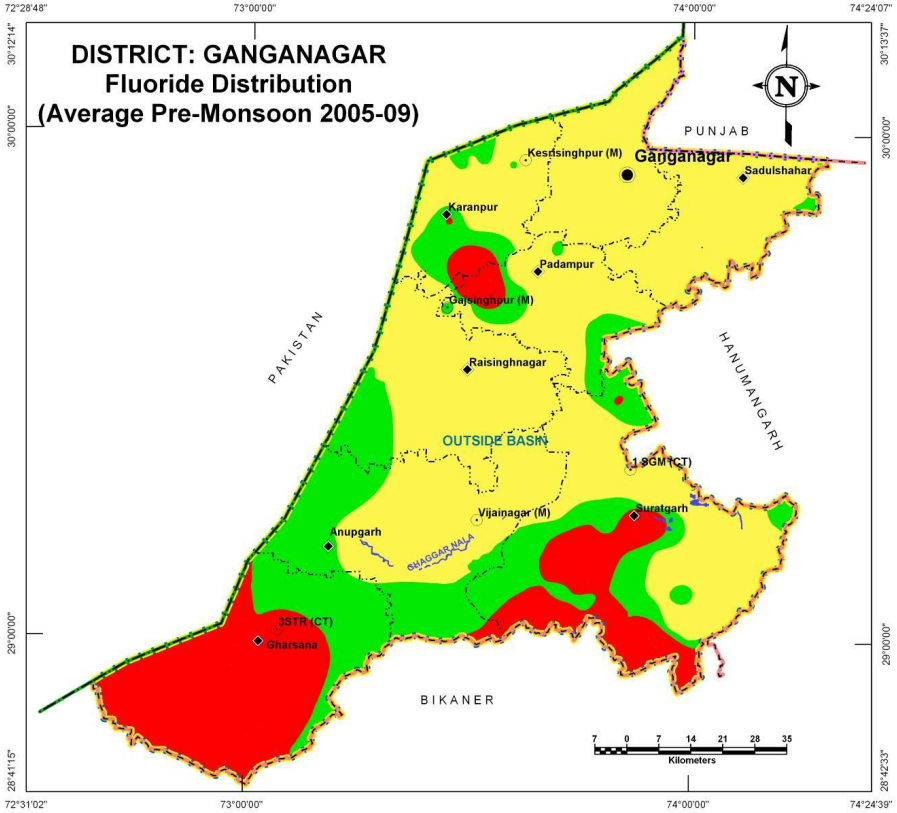
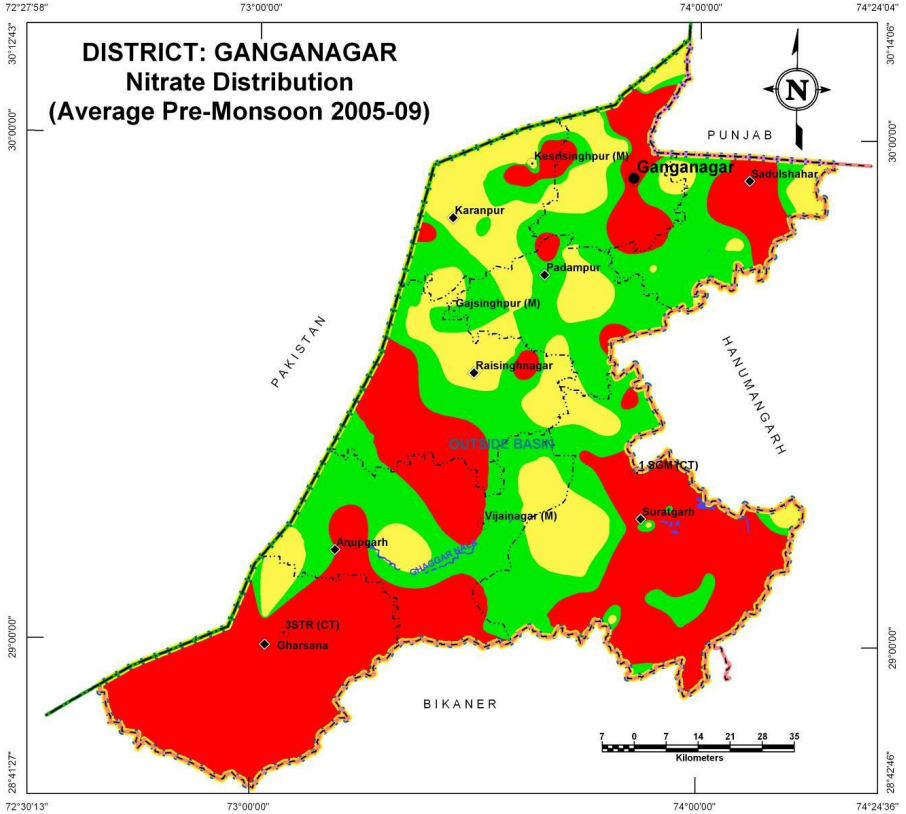


PLATE - XV



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Fluoride Concentration (mg/l):

- < 1.5
- 1.5-3.0
- >3.0

LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Nitrate Concentration (mg/l):

- < 50
- 50-100
- >100

DEPTH TO BEDROCK

DISTRICT – JODHPUR

The beginning of massive bedrock has been considered for defining top of bedrock surface. Plate – XVI reveals that maximum depth to bedrock is about 200 meters below ground level and such areas are seen in the southwestern fringe of Gharsana block. The bedrock is overlain by alluvial deposits of primarily aeolian origin. Moderately deep bedrock has spread all over the district between the ranges of 140m bgl to 180m bgl. Eastern side of Ganganagar, Padampur, Sadulshahar and Suratgarh blocks are reported to have shallow depth to bedrock (less than 140 meter bgl) as compare to other parts of the district.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)																Total Area (sq km)
	Anupgarh		Ganganagar		Gharsana		Karanpur		Padampur		Raisinghnagar		Sadulshahar		Suratgarh		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<140	-	-	549.3	64.5	-	-	-	-	26.7	3.1	-	-	858.2	95.8	927.9	38.3	**2,362.1**
140-160	189.9	11.3	301.9	35.5	-	-	689.2	83.5	801.3	92.7	249.7	18.9	37.2	4.2	1,445.7	59.6	**3,714.9**
160-180	1,495.0	88.7	-	-	419.1	23.1	136.0	16.5	36.6	4.2	1,069.5	81.1	-	-	52.3	2.2	**3,208.5**
180-200	-	-	-	-	1,131.4	62.2	-	-	-	-	-	-	-	-	-	-	**1,131.4**
>200	-	-	-	-	267.1	14.7	-	-	-	-	-	-	-	-	-	-	**267.1**
Total	**1,684.9**	**100.0**	**851.2**	**100.0**	**1,817.6**	**100.0**	**825.2**	**100.0**	**864.6**	**100.0**	**1,319.2**	**100.0**	**895.4**	**100.0**	**2,425.9**	**100.1**	**10,684.0**

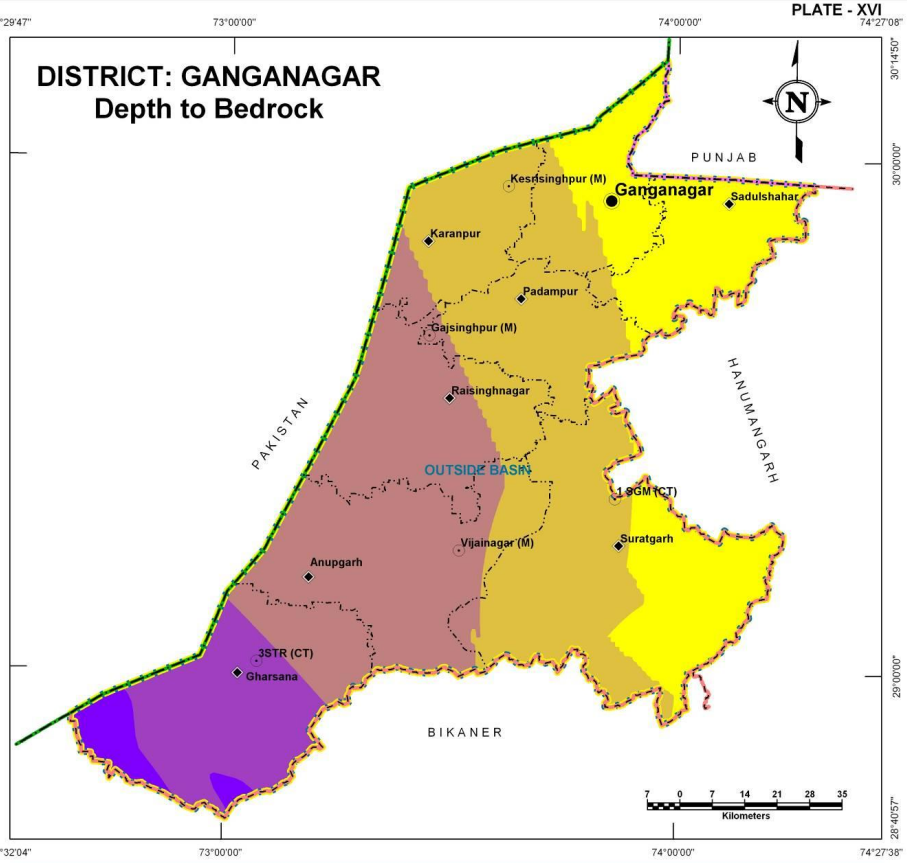
UNCONFINED AQUIFER

The entire district has thick cover of alluvium both Younger and Older in unconfined conditions and the alluvial aquifers attain a thickness of more than 80m. Perusal of Plate – XVII reveals that the thickness of unconfined aquifer varies from less than 10 m to about 90m with the thickest parts lying to the south and northeast of Sadulshahar and Suratgarh block. Rest of the blocks have moderate to low thickness of aquifers in alluvium under unconfined condition. The general thickness of the district is upto 60m.

Alluvial Areas

Unconfined aquifer Thickness (m)	Block wise area coverage (sq km)								Total Area (sq km)
	Anupgarh	Ganganagar	Gharsana	Karanpur	Padampur	Raisinghnagar	Sadulshahar	Suratgarh	
< 10	199.3	31.6	70	70.8	21.6	-	30.6	18.6	**442.5**
10-20	905.8	192.4	533.7	183.1	383.0	298.6	95.7	41.9	**2,634.2**
20-30	434.3	135.5	451.4	289.8	244.7	362.7	115.4	190.2	**2,224.0**
30-40	70.8	106.7	550	250.8	138.6	243.4	128.7	457.7	**1,946.7**
40-50	47.7	100.9	190.8	30.7	60.4	195.6	136.4	556.5	**1,319.0**
50-60	21.3	101.6	21.7	-	16.2	180.5	199.2	659.9	**1,200.4**
60-70	5.7	150.7	-	-	0.1	38.4	138.6	380.0	**713.5**
70-80	-	31.1	-	-	-	-	47.6	94.8	**173.5**
> 80	-	0.7	-	-	-	-	3.2	26.3	**30.2**
Total	**1,684.9**	**851.2**	**1,817.6**	**825.2**	**864.6**	**1,319.2**	**895.4**	**2,425.9**	**10,684.0**

PLATE - XVI



LEGEND

Admin Boundary:

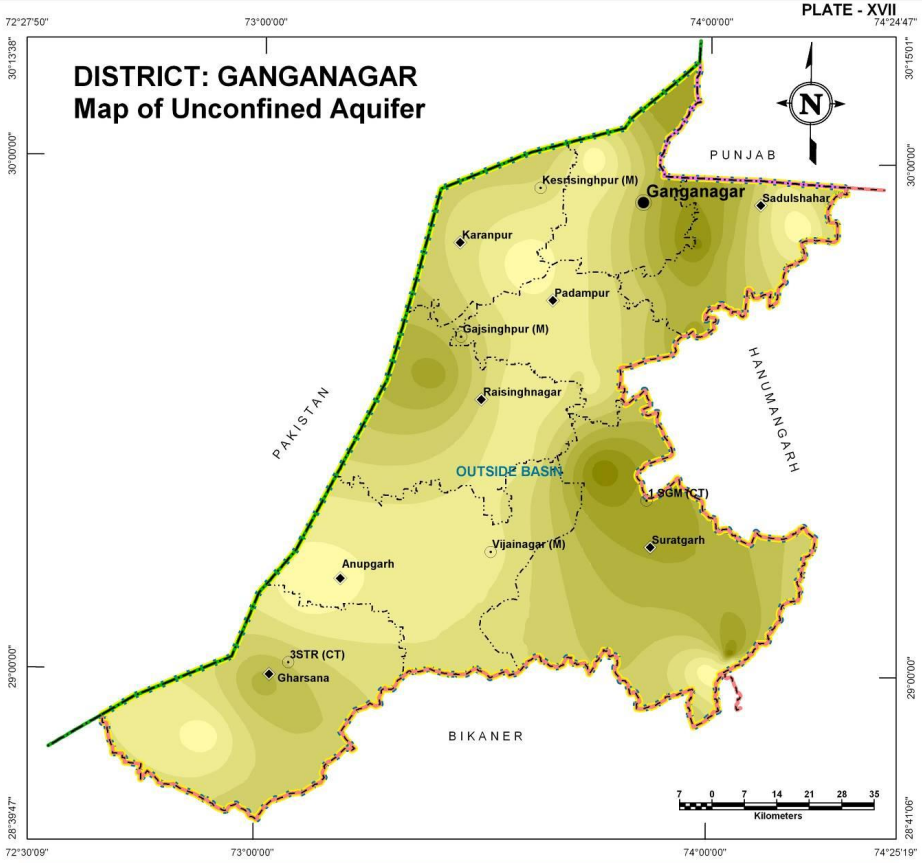
- District Headquarter
- Block Headquarter
- Town
- International Boundary
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Depth to Bedrock(m bgl):

- <140
- 140-160
- 160-180
- 180-200
- >200

PLATE - XVII



LEGEND

Admin Boundary:

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

Basin Boundary

Aquifer Thickness (m):

Alluvial Area

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

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 manmade 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.

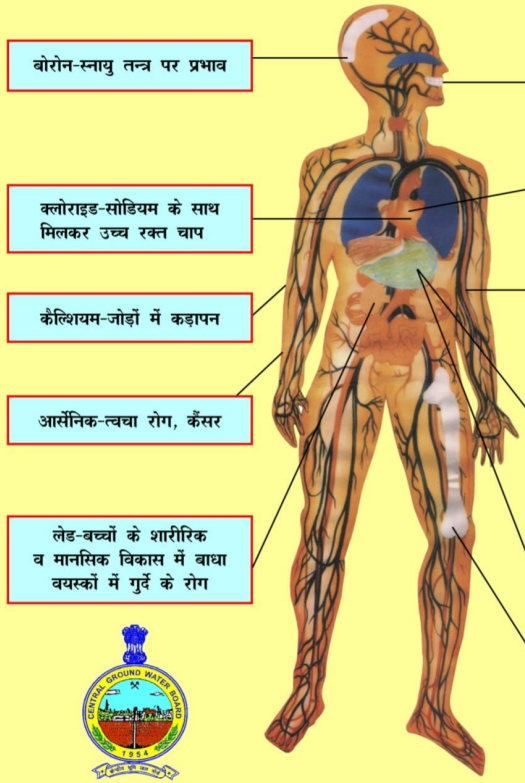
(Contd...)

S. No.	Technical Terms	Definition
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

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

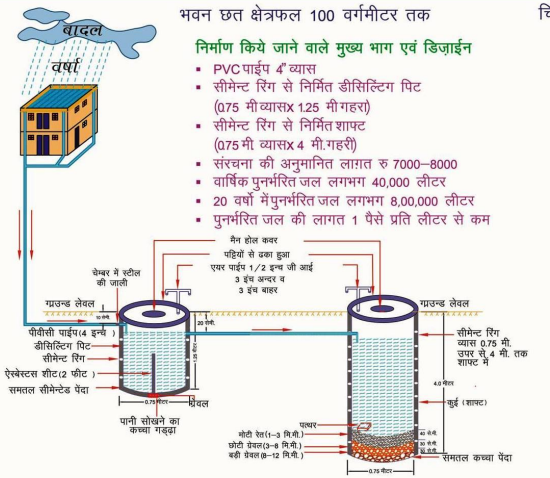
केन्द्रीय भूमि जल बोर्ड,
पश्चिमी क्षेत्र, जयपुर
जल संसाधन मंत्रालय
भारत सरकार
e-mail:cgwbwr@sancharnet.in

भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–1 भवन छत क्षेत्रफल 100 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

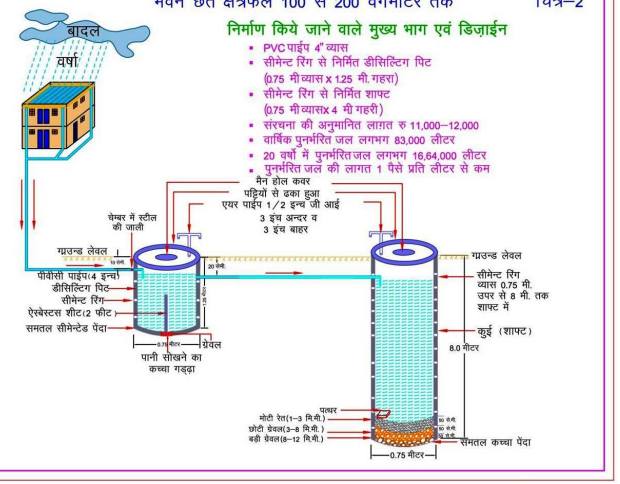
- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 7000–8000
- वार्षिक पुनर्भरित जल लगभग 40,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित जल की लागत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



चित्र–2 भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

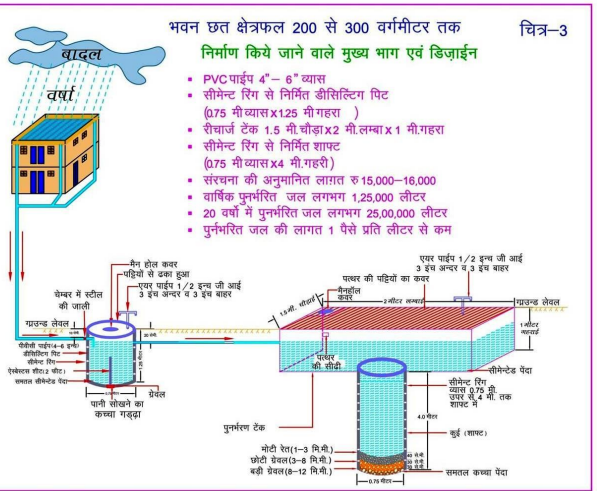
- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी. गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी गहरी)
- संरचना की अनुमानित लाग़त रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की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

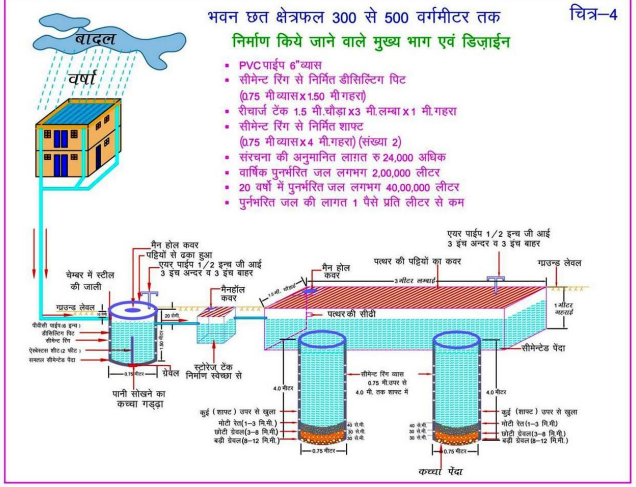
- PVC पाईप 4"– 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 2 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षो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