Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan

Bharatpur District

European Union
State Partnership Programme

2013

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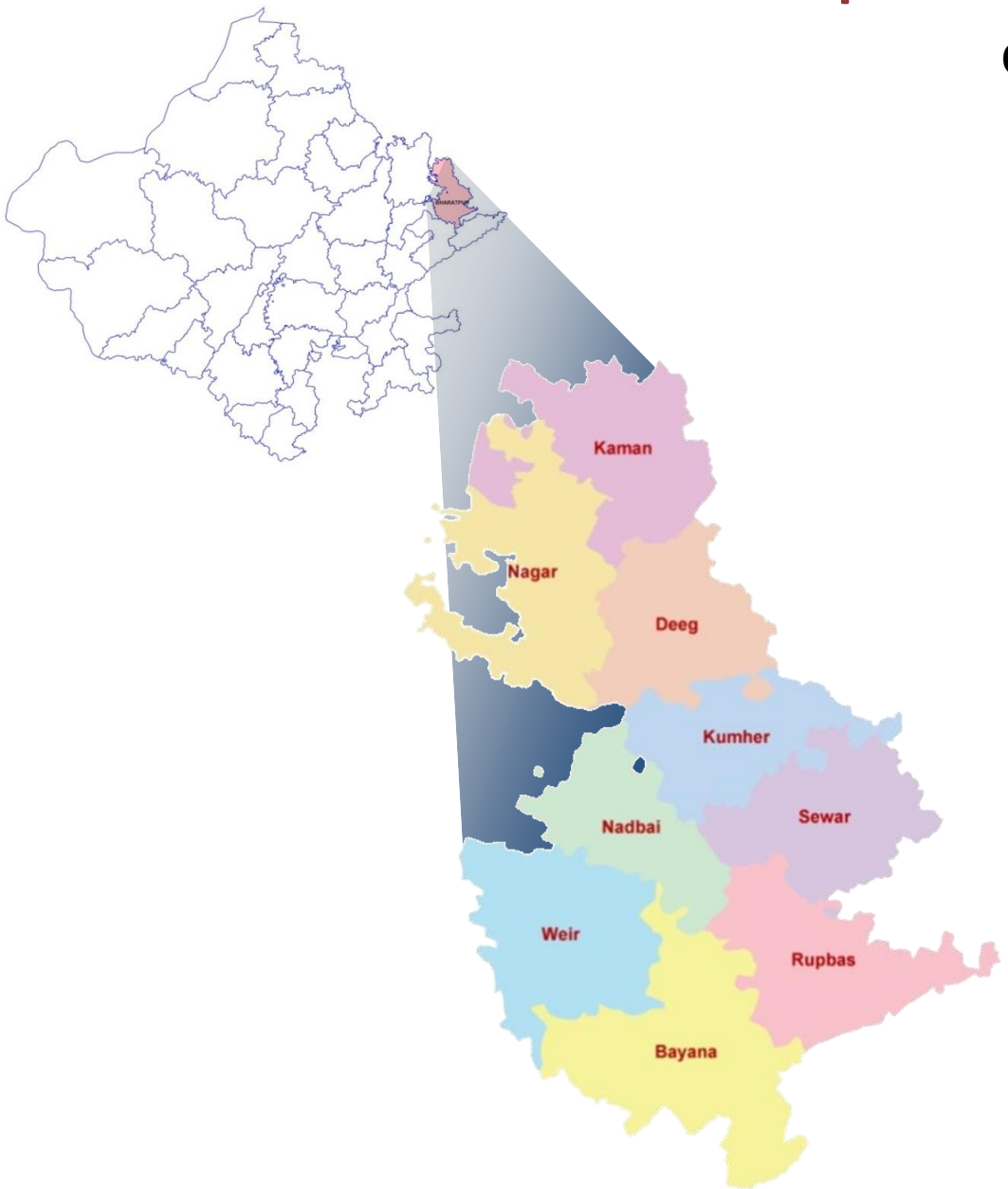
Hydrogeological Atlas of Rajasthan

Bharatpur District



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2013

ADMINISTRATIVE SETUP

DISTRICT – BHARATPUR

Location:

Bharatpur district is located in the eastern part of Rajasthan. It is bounded in the north by state of Haryana, in the east by state of Uttar Pradesh, south by Dhaulpur and Karauli districts of Rajasthan and Alwar district in the West. It stretches between 26° 41' 58.67" to 27° 49' 41.74" north latitude and 76° 52' 06.42'' to 77° 47' 05.51'' east longitude covering area of 5079.4 sq km. Major part of the district has a good drainage system and forms part of 'Ruparail River Basin' in northern part,'Banganga River Basin' in central part and 'Gambhir River Basin' southern part.

Administrative Set-up:

Bharatpur district is administratively divided into nine 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	Bayana	2,25,348	782.5	15.2	178
2	Deeg	1,95,721	497.7	9.8	133
3	Kaman	2,42,932	581.7	11.5	210
4	Kumher	1,75,418	459.8	9.1	125
5	Nadbai	1,82,760	424.6	8.4	118
6	Nagar	2,57,679	635.6	12.5	228
7	Rupbas	2,11,147	561.4	11.1	158
8	Sewar	3,72,228	522.2	10.3	178
9	Weir	2,37,261	613.9	12.1	153
Total		**21,00,494**	**5,079.4**	**100.0**	**1,481**

Bharatpur district has 1,481 towns and villages, out of which nine are block headquarters as well.

Climate:

The climate of the district is being dry becomes extremely hot during summer and extremely cold during winter. The minimum temperature is in the winter season that extends from December to February and is followed by summer from March to June. In the summer season (April to June), the maximum temperature rises to as high as 49°C and the minimum temperature, on the other hand comes down to somewhere around 3.5°C in winters. Mid-September to end of November constitutes post monsoon season. Average annual rainfall of the district is 582.9mm.

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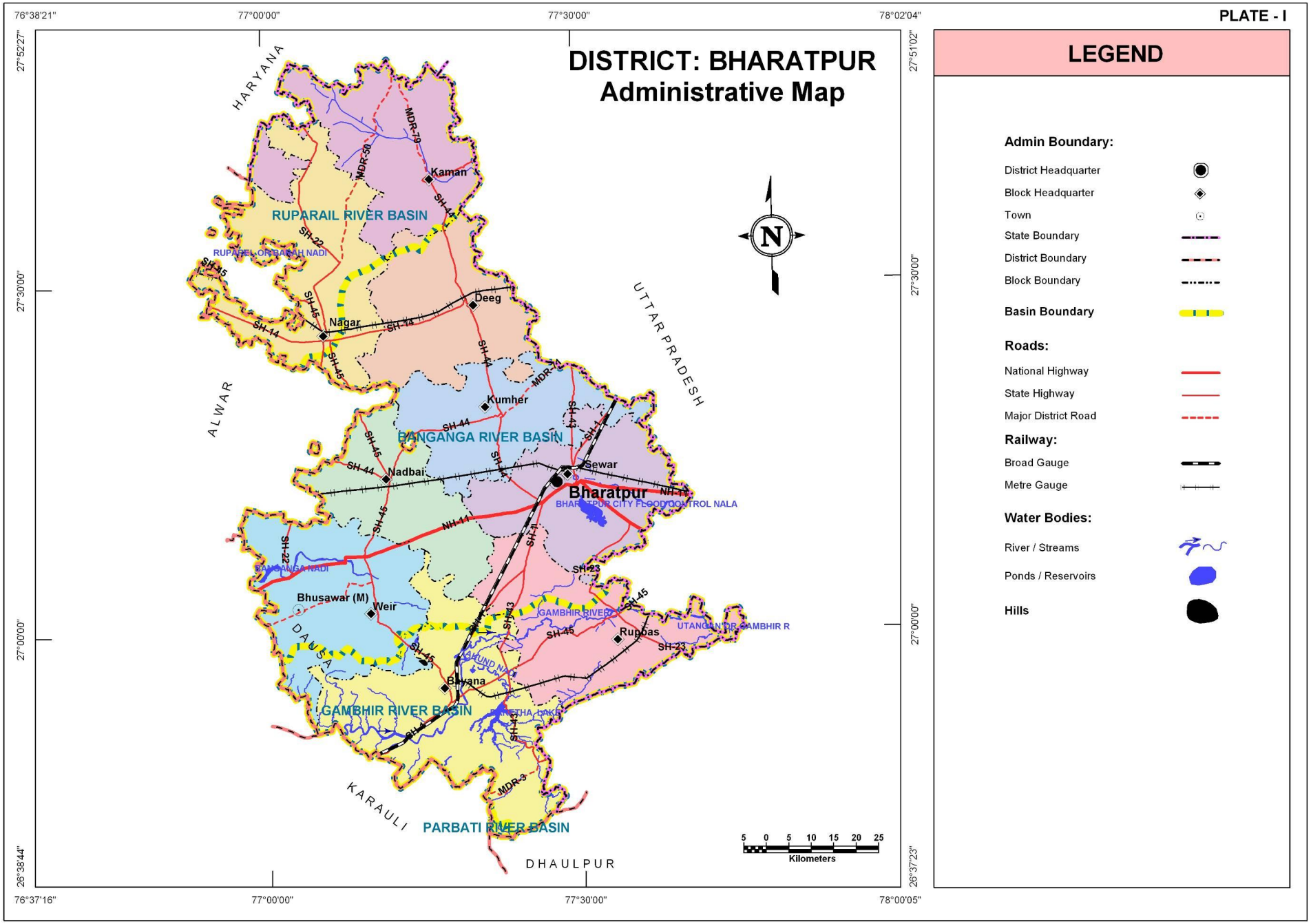
PLATE - I



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:

- Broad Gauge
- Metre Gauge

Water Bodies:

- River / Streams
- Ponds / Reservoirs
- **Hills**

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TOPOGRAPHY

DISTRICT – BHARATPUR

Topographically, isolated hillock found in northern part with vast plain area occupied by alluvium and windblown sand in the central part of the district. Low ridges are found in southern and northern part of the district. The general topographic elevation in the district ranges between 200m above mean sea level to 250m amsl. Elevation ranges from a minimum of 156.5 m amsl in Sewar block in the eastern part of the district and maximum of 416.0 m amsl in Weir block in southwestern part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Minimum Elevation (m amsl)	Maximum Elevation (m amsl)
1	Bayana	182.0	386.8
2	Deeg	173.4	306.0
3	Kaman	178.5	367.8
4	Kumher	159.3	198.9
5	Nadbai	185.7	220.5
6	Nagar	182.5	356.6
7	Rupbas	159.0	285.0
8	Sewar	156.5	222.5
9	Weir	196.0	416.0

RAINFALL

The rainfall is fairly good in the district. The general distribution of rainfall across the district can be visualized from isohyets map presented in the Plate – III where most of the district received rainfall in the range of 700-800 mm in year 2010. The annual average rainfall was 797.8 mm based on the data of available blocks for the year 2010. Nagar block received maximum rainfall (1,188 mm) whereas minimum was in Weir block (587.7 mm). Highest average annual rainfall of about 907.7 mm was recorded in Nagar block.

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)
Bayana	608.1	776.2	699.2
Deeg	781.4	993.8	896.1
Kaman	666.0	1,019.5	856.9
Kumher	757.1	851.6	788.4
Nadbai	707.0	788.0	753.6
Nagar	670.8	1,188.8	907.7
Rupbas	729.4	903.6	816.0
Sewar	754.7	843.2	787.2
Weir	587.7	743.2	675.0

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PLATE - II

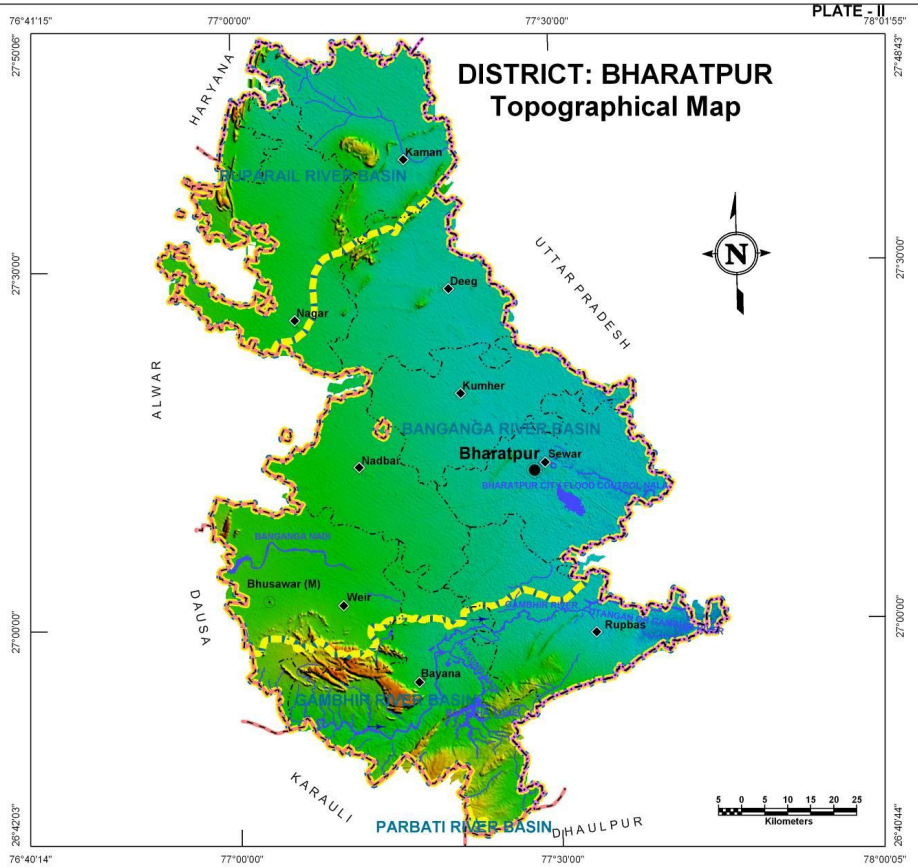
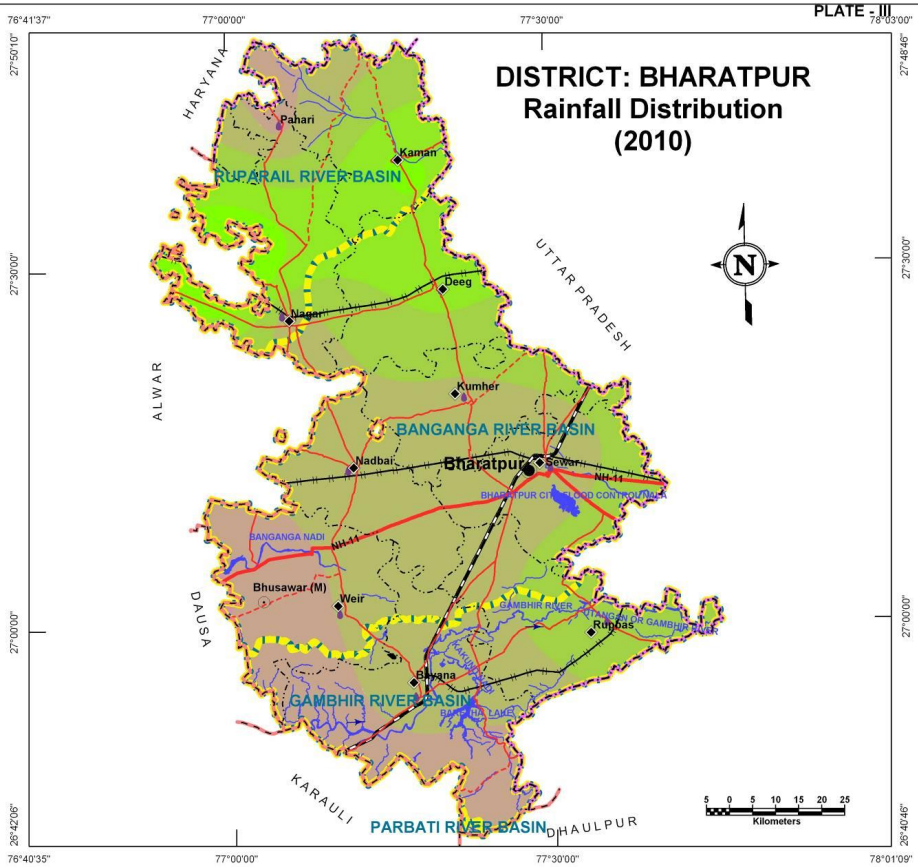


PLATE - III



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):
416, 400, 350, 300, 250, 200, 200

Source : SRTM DEM

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:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Isohyets (mm):
- 500-600
- 600-700
- 700-800
- 800-900
- 900-1000
- > 1000

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GEOLOGY

DISTRICT – BHARATPUR

Geologically, the rocks of Bharatpur district belong to Delhi and Vindhyan Super Group. Almost the entire district is covered by alluvium, with few isolated hills where rocks of schist and quartzites Delhi Super Group are exposed. The lower part of Delhi Super Group is characterized by a thick pile of conglomerate-quartzite assemblage of Alwar Group. Ajabgarh Group unconformably overlies the Alwar Group comprising lithologic assemblage of carbonaceous shale, phyllite ferruginous quartzite & white quartzite. Vindhyan Super Group of rocks is represented by sandstone, limestone etc, which are exposed in the southern part of the district in Bayana and Rupbas blocks.

Super Group	Group	Formation
	Recent & Sub-recent	Alluvium
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Vindhyan	Bhander	Sandstone Limestone etc.
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Delhi	Ajabgarh	Schist, Phyllite, Marble, Gneiss
	Alwar	Quartzite-schist, Conglomerates

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
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.
	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.
	Valley Fill	Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles, gravels, sand, silt and clay. The unit has consolidated sediment deposits.
	Ravine	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.
	Water logged/ Wetland	Area submerged in water or area having very shallow water table. So that it submerges in water during rainy season.
Structural	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys.
	Plateau	Formed over varying lithology with extensive, flat, landscapes, bordered by escarpment on all sides. Essentially formed horizontally layered rocky marked by extensive flat top and steep slopes. It may be criss-crossed by lineament.
Hills	Denudational, Structural Hill, Linear Ridge	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments. Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc. Long narrow low-lying ridge usually barren, having high run off may form over varying lithology with controlled strike.

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PLATE - IV

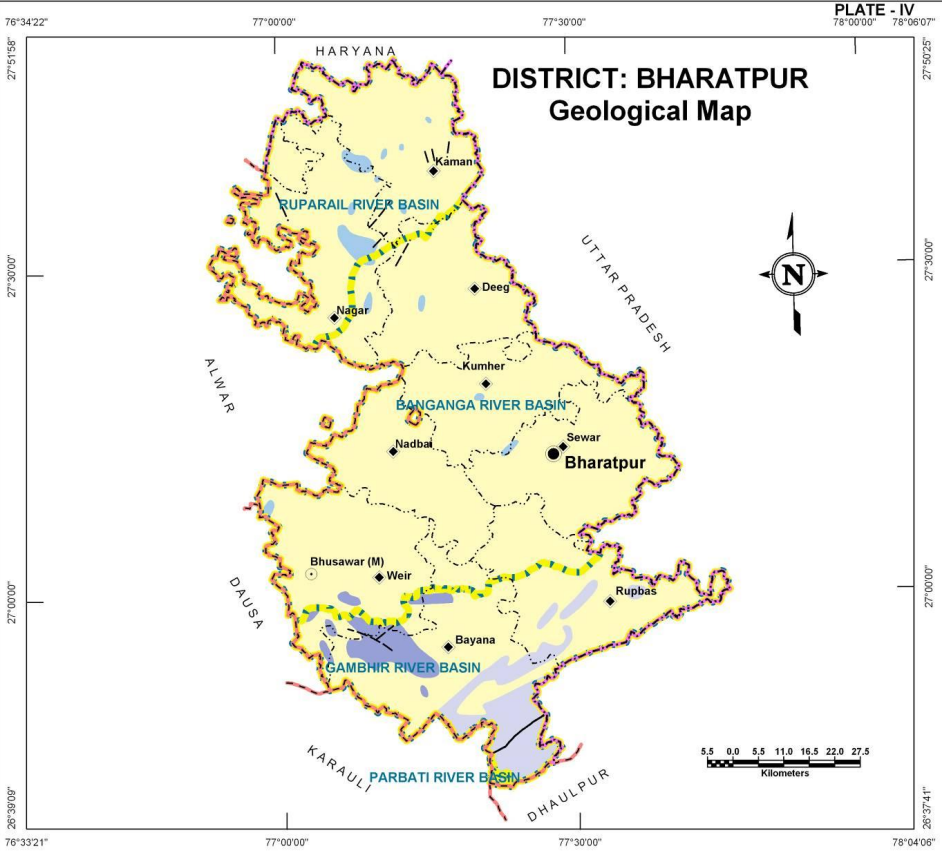
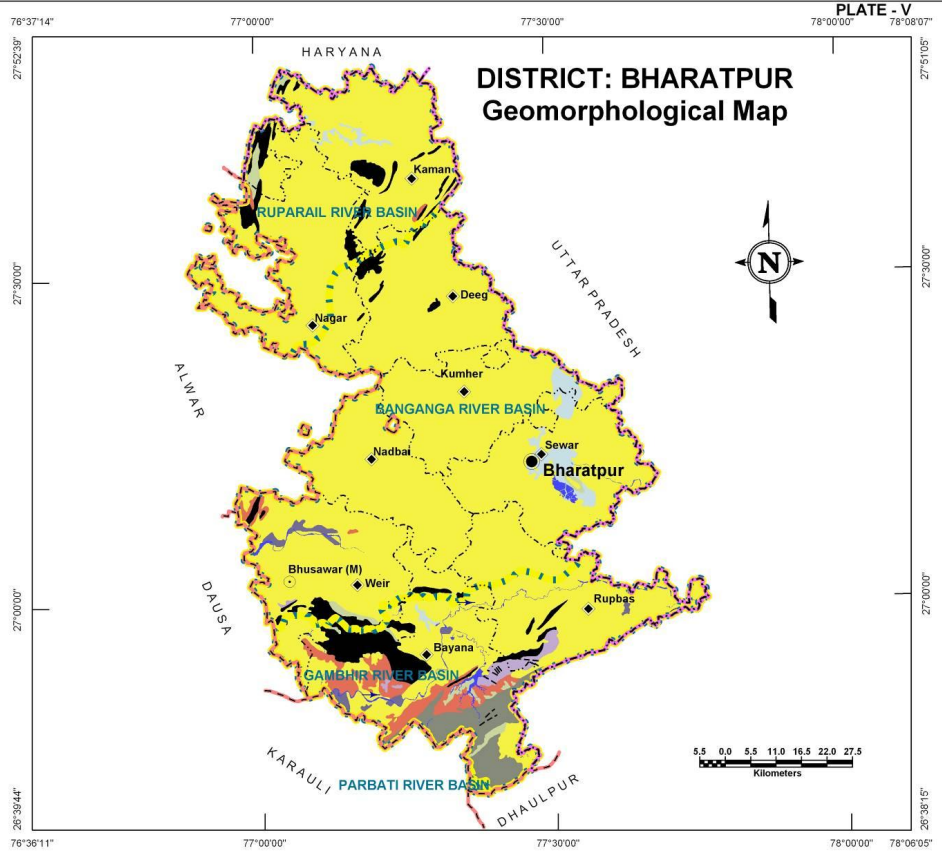


PLATE - V



LEGEND

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

Structural Features:
- Fault
- Great Boundary Fault
- Lineament

Geology:
- Alwar Group
- Alluvium and Wind blown sand
- Bhander Group
- Ajabgarh Group

Source: District Resource Map of Rajasthan - GSI

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

Hills:
- Structural/Denudational/Linear Ridge

Landform Units:

Fluvial Origin:
- Alluvial Plain
- Valley Fill
- Ravine
- Waterlogged Area
- Flood Plain

Structural Origin:
- Plateau
- Dissected Plateau

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

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AQUIFERS

DISTRICT–BHARATPUR

In Bharatpur district, aquifers are formed primarily in alluvial formations which account for about 89% of aquifer coverage in the district. This aquifer consists of lithounits varying granularity from fine sand, medium sand and occasionally of silt. Vindhyan sandstone also constitutes some minor part of aquifers (about 8% of district area) in the southeastern part of the district. Weathered and fractured quartzites occupy just about 158 sq kms of area in the western part of the district adjoining hills and form aquifers there.

Table: aquifer potential zones their area and their description

Aquifer in Potential Zone	Area (sq km)	%age of district	Description of the unit/Occurrence
Older Alluvium	4,505.9	88.7	This lithounits comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Sandstone	415.3	8.2	Fine to medium grained, red colour and compact and at places.
Quartzite	157.7	3.1	Medium to coarse grained and varies from feldspathic grit to sericitic quartzite.
Hills	0.5	0.0	-
Total	**5,079.4**	**100.0**	

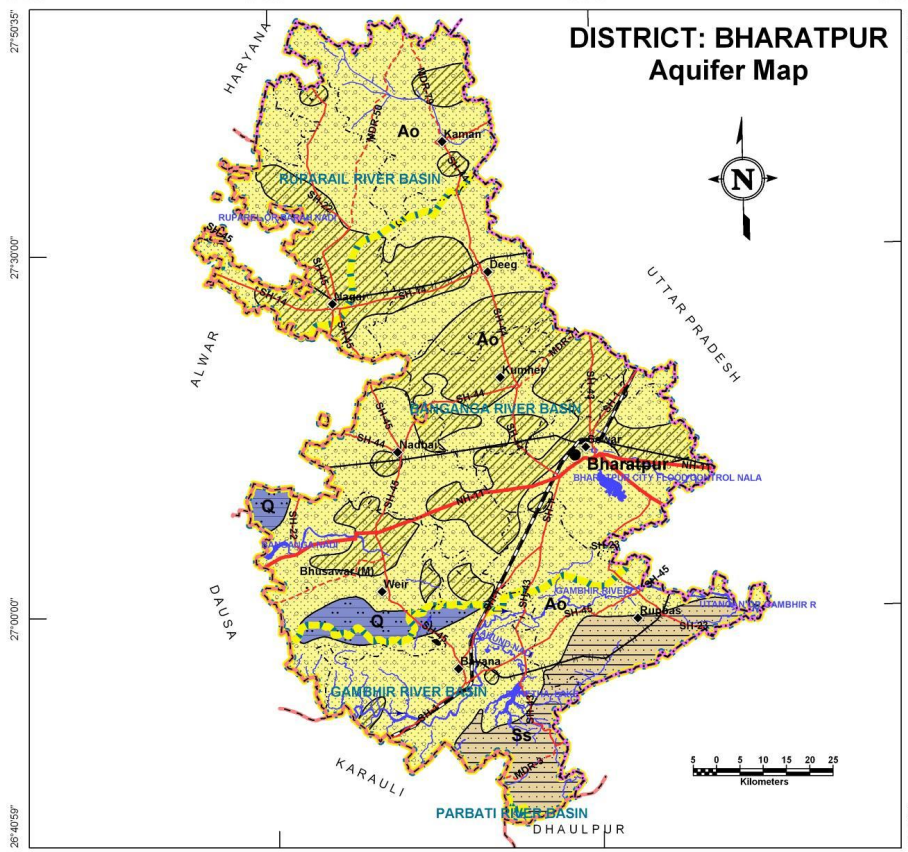
STAGE OF GROUND WATER DEVELOPMENT

Of the nine administrative blocks of the nine blocks, four fall under 'critical' category. This indicates that the ground water recharge has not been able to meet the ongoing extraction and aquifers are stressed. The remaining 5 blocks fall under the 'over Exploited' category indicating that they are under severe stress.

Categorization on the basis of stage of development of ground water	Block Name
Critical	Kaman, Deeg, Bayana, Nagar
Over Exploited	Rupbas, Kumher, Sewar, Weir, Nadbai

Basis for categorization: Ground water development<=100%-Critical and>100%-Over-Exploited.

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

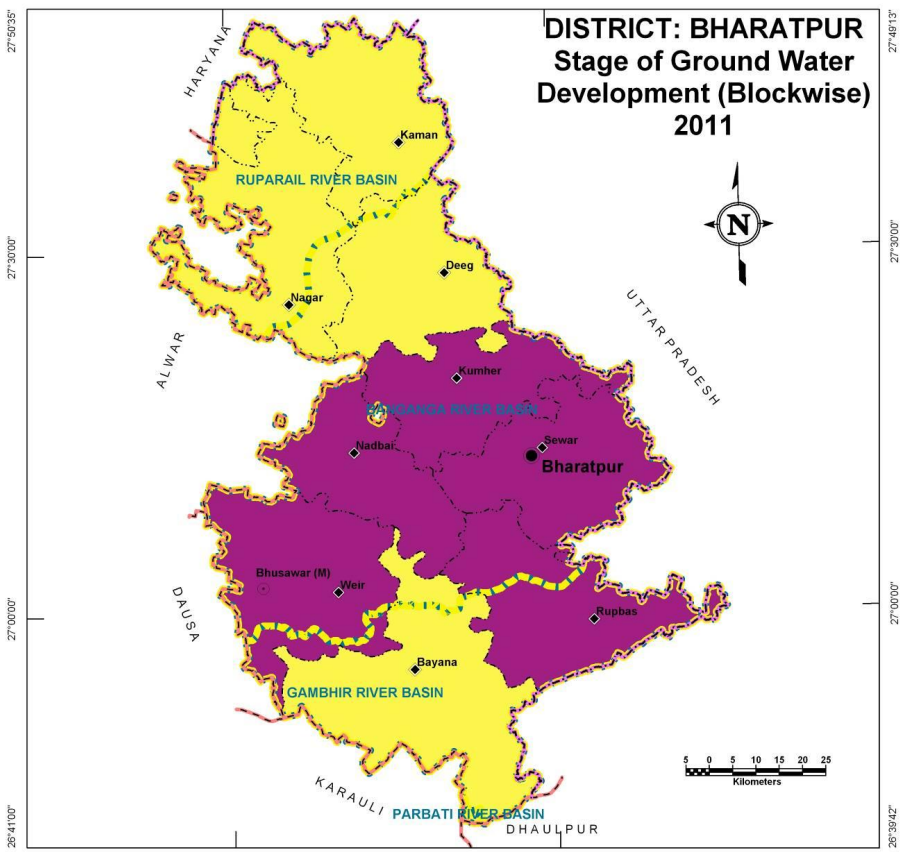
Railway:
- Broad Gauge
- Metre Gauge

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

Aquifer:
- Older Alluvium
- Sandstone
- Quartzite

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:
- Over-Exploited
- Critical

Source: Ground Water Department, Rajasthan

LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS DISTRICT–BHARATPUR

Bharatpur district has a well distributed network of large number of exploratory wells (185) and ground water monitoring stations (233) in the district owned by RGWD (143 and 183 respectively) and CGWB (42 and 50 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 monitoring, about 110 additional wells need to be added to the existing network. This is largely because of wide variation in water quality of ground water where saline patches are intermixed with fresh water pockets, which complicates the situation warranting more data points to be sampled.

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
Bayana	5	11	**16**	6	24	**30**	-	23
Deeg	4	9	**13**	4	21	**25**	-	2
Kaman	4	20	**24**	5	25	**30**	-	23
Kumher	6	9	**15**	4	22	**26**	-	-
Nadbai	2	14	**16**	5	11	**16**	-	8
Nagar	3	18	**21**	8	23	**31**	-	10
Rupbas	6	15	**21**	10	22	**32**	-	20
Sewar	7	32	**39**	4	19	**23**	-	-
Weir	5	15	**20**	4	16	**20**	-	24
Total	**42**	**143**	**185**	**50**	**183**	**233**	-	**110**

DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

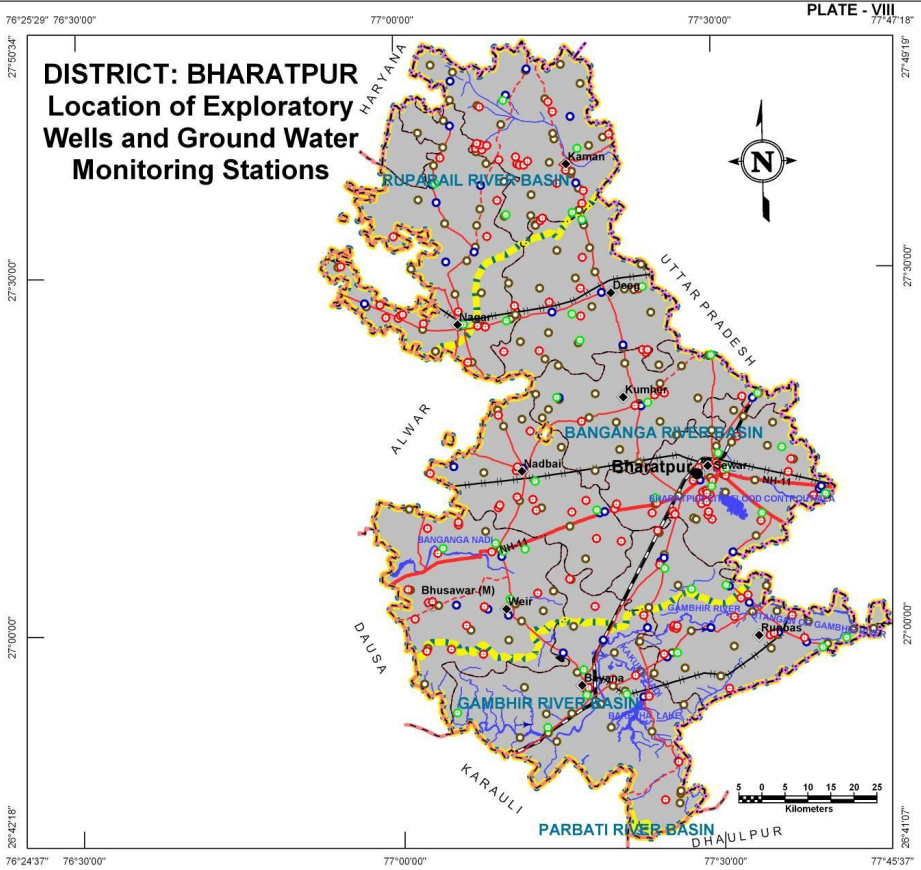
Depth to water level shows variation from less than 10m below ground level to about 30m below ground level. The alluvial aquifers in the eastern parts have shown a generally shallower ground water occurrence measuring less than 10m of depth from ground level. The Ghana Lake has formed due go shallow ground water levels resulting from inland drainages of rivers receiving water from western part of it. The hardrock areas in the western fringe within quartzite aquifer have shown deep water levels reaching upto 40m below ground level. In rest parts of the district the water level are in between 10m bgl to 30m bgl. The sandstone aquifers in the southeastern part have a variable ground water depth of upto 20m bgl.

Table: Block wise area of depth to water level occurrence

Depth to water level (m bgl)	Block wise area coverage (sq km) *									Total Area (sq km)
	Bayana	Deeg	Kaman	Kumher	Nadbai	Nagar	Rupbas	Sewar	Weir	
< 10	218.7	340.0	303.1	264.0	32.1	211.6	249.5	231.4	50.8	**1,901.2**
10-20	459.5	157.7	278.6	195.8	341.0	372.9	311.7	290.8	216.7	**2,624.7**
20-30	104.3	-	-	-	51.5	51.1	0.3	-	326.6	**533.8**
> 30	-	-	-	-	-	-	-	-	19.2	**19.2**
Total	**782.5**	**497.7**	**581.7**	**459.8**	**424.6**	**635.6**	**561.5**	**522.2**	**613.3**	**5,078.9**

* 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
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

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

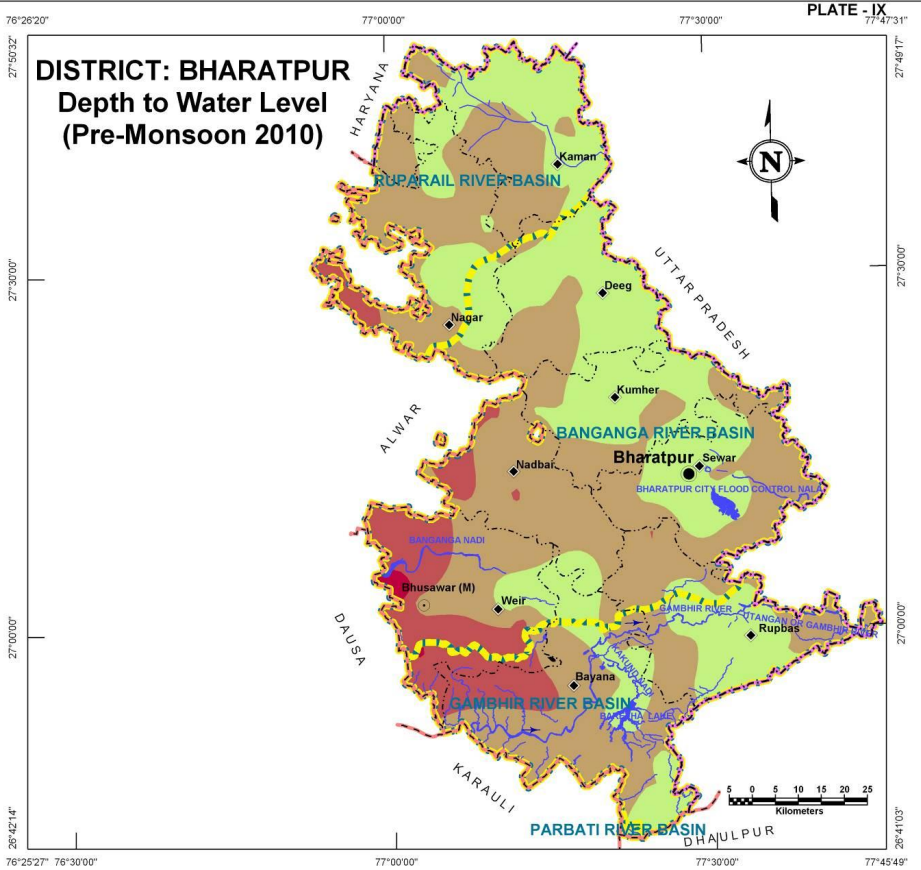
Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- **Hills**

Exploratory Wells:
- CGWB
- RGWD

Ground Water Monitoring Stations:
- CGWB
- RGWD

PLATE - IX



LEGEND

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

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- **Hills**

Depth to Water Level(m bgl):
- < 10
- 10 - 20
- 20 - 30
- > 30

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

General flow direction of ground water is from southwest to northeast andeast within major part of the district. Water table elevation is maximum (>220m amsl) in southern part (Bayana Block) of the district. The water table elevation lowers towardsnortheast and eastern parts reaching a minimum elevation (<180m amsl) in the Rupbas, Sewar, Kumher, Deeg and Kaman blocks.

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

Water table elevation (m amsl) range	Block wise area coverage (sq km)									Total Area (sq km)
	Bayana	Deeg	Kaman	Kumher	Nadbai	Nagar	Rupbas	Sewar	Weir	
< 180	-	370.3	224.0	397.6	24.3	0.1	297.1	522.2	-	**1,835.6**
180 - 200	350.4	127.4	350.0	62.2	400.3	559.8	235.6	-	296.6	**2,382.3**
200 - 220	391.4	-	7.7	-	-	75.7	28.8	-	316.7	**820.3**
> 220	40.7	-		-	-			-	-	**40.7**
Total	**782.5**	**497.7**	**581.7**	**459.8**	**424.6**	**635.6**	**561.5**	**522.2**	**613.3**	**5,078.9**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

Ground water fluctuation varies from less than 0m to more than 12m as seen in Plate – XI. The District area in general, has shown rise of ground water by 0-6 meters. There are also localized pockets southern part of Weir block northern part of Rupbas and eastern part of Kumher, where water level has risen by more than 12m in the post-monsoon period. –ve fluctuation is noticed in small areas within Sewar, Nadbai and Kaman blocks where water level has actually gone down in the post-monsoon period indicating exploitation exceeding the limited recharge the area might have received.

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)
	Bayana	Deeg	Kaman	Kumher	Nadbai	Nagar	Rupbas	Sewar	Weir	
< 0	-	-	7.6	0.4	9.6	4.6	0.4	11.9	-	**34.5**
0 to 2	291.6	126.1	311.1	67.0	240.4	271.2	206.4	326.0	289.7	**2,129.5**
2 to 4	417.9	311.1	205.1	315.2	139.8	291.8	233.5	139.9	203.5	**2,257.8**
4 to 6	56.8	51.5	50.1	65.7	28.3	67.0	87.3	29.4	58.7	**494.8**
6 to 8	15.9	9.0	7.8	5.7	6.5	1.0	23.3	11.4	36.7	**117.3**
8 to 10	0.3	-	-	3.5	-	-	6.2	3.4	17.8	**31.2**
10 to 12	-	-	-	2.2	-	-	4.0	0.2	6.9	**13.3**
> 12	-	-	-	0.1	-	-	0.4	-	-	**0.5**
Total	**782.5**	**497.7**	**581.7**	**459.8**	**424.6**	**635.6**	**561.5**	**522.2**	**613.3**	**5,078.9**

PLATE - X

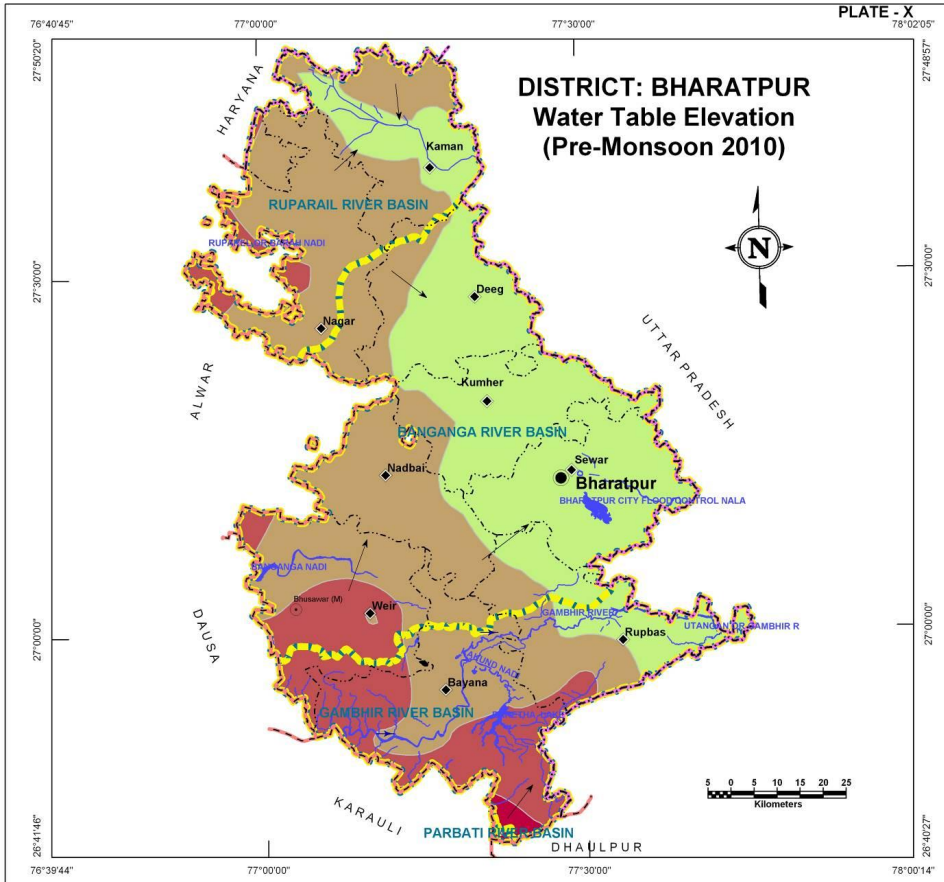
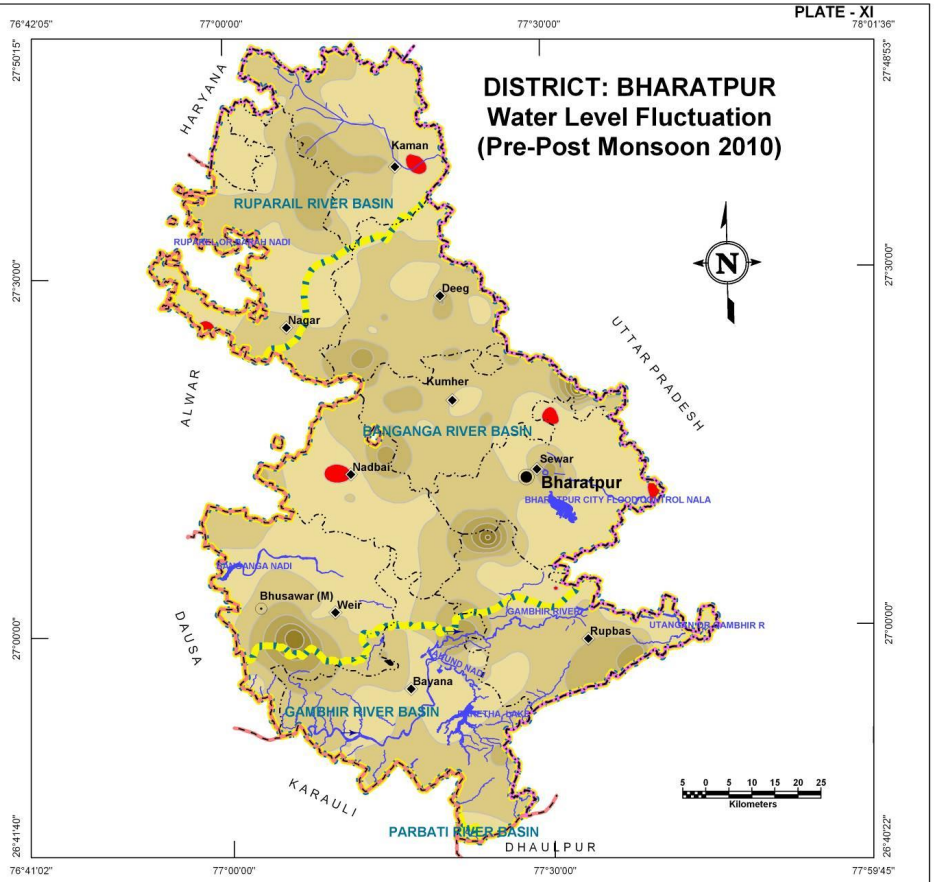


PLATE - XI



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Water Table Elevation

Water Table Elevation(m amsl):

- <180
- 180 - 200
- 200 - 220
- >220

LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Water Level Fluctuation(m):

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

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION — DISTRICT – BHARATPUR

The Electrical conductivity (at 25°C) distribution map is presented in Plate – XII. Apart from some areas in the southern part of the district where aquifers have formed in hardrocks, the district in general, has moderate to high salinity dominating in the central and northern part of the district. The areas with moderately high EC values in ground water (2000-4000 µS/cm) are shown in green color and occupy almost 41% of the district area. The areas with high EC values in ground water (>4000 µS/cm) are shown in green color and occupies 36% of the district area. The ground water in these two regions is unsuitable for domestic purpose. Remaining part of the district approximately 23% has low EC values in ground water (<2000 µS/cm) which is shown in yellow color, largely southern part of the district where the ground water 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)
	Bayana		Deeg		Kaman		Kumher		Nadbai		Nagar		Rupbas		Sewar		Weir		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 2000	665.9	85.1	40.3	8.1	81.8	14.1	4.2	0.9	16.2	3.8	27.6	4.3	138.5	24.7	5.7	1.1	196.4	32.0	**1,176.6**
2000-4000	103.8	13.3	174.3	35.0	277.7	47.7	117.8	25.6	236.3	55.7	258.6	40.7	379.7	67.6	200.6	38.4	319.0	52.0	**2,067.8**
>4000	12.8	1.6	283.1	56.9	222.2	38.2	337.8	73.5	172.1	40.5	349.4	55.0	43.3	7.7	315.9	60.5	97.9	16.0	**1,834.5**
Total	**782.5**	**100.0**	**497.7**	**100.0**	**581.7**	**100.0**	**459.8**	**100.0**	**424.6**	**100.0**	**635.6**	**100.0**	**561.5**	**100.0**	**522.2**	**100.0**	**613.3**	**100.0**	**5,078.9**

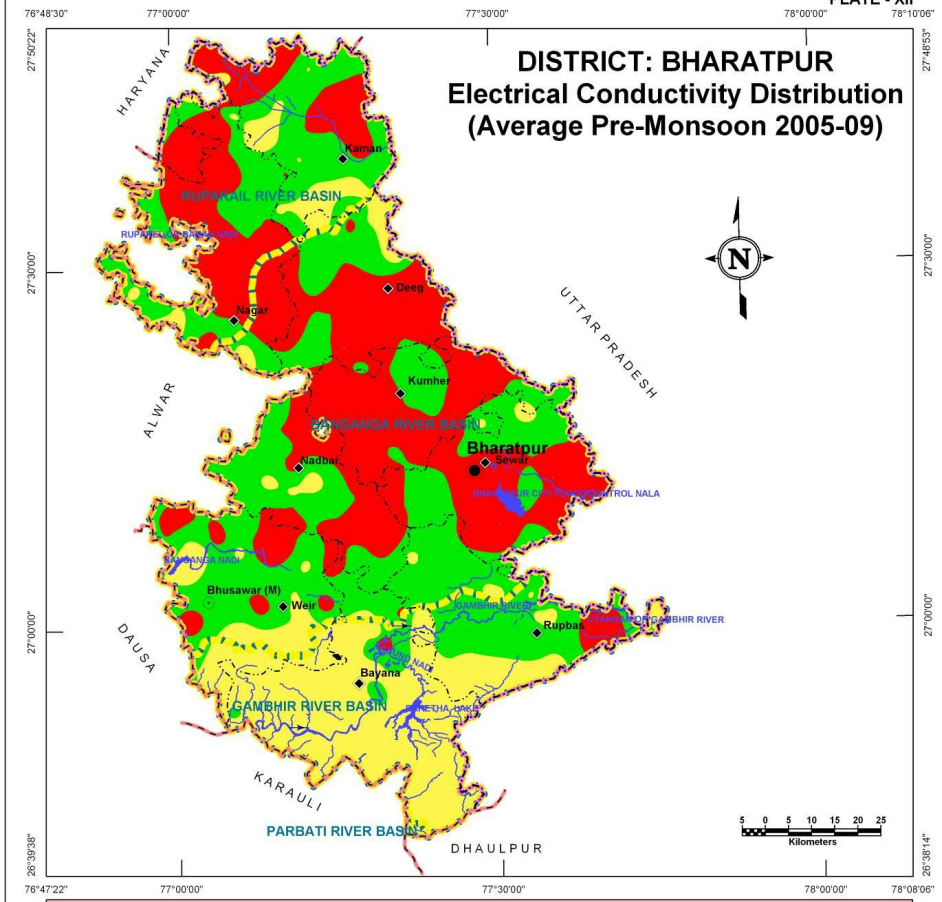
GROUND WATER CHLORIDE DISTRIBUTION

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 (>1000 mg/l) are shown in red color and occupy approximately 34% of the district area. The ground water in this region is not suitable for domestic purpose. Remaining part of the district approximately 18% falls under low chloride concentration (<250 mg/l) area, largely in the southern part of the district where ground water is suitable for domestic purpose.

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)
	Bayana		Deeg		Kaman		Kumher		Nadbai		Nagar		Rupbas		Sewar		Weir		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 250	601.7	77.0	6.3	1.0	14.8	3.0	-	-	2.3	1.0	11.7	2.0	113.0	20.0	-	-	157.0	26.0	**906.8**
250-1000	171.4	22.0	203.8	41.0	344.1	59.0	110.1	24.0	278.6	65.0	317.7	50.0	415.0	74.0	211.6	41.0	408.9	66.0	**2,461.2**
> 1000	9.4	1.0	287.6	58.0	222.8	38.0	349.7	76.0	143.7	34.0	306.2	48.0	33.5	6.0	310.6	59.0	47.4	8.0	**1,710.9**
Total	**782.5**	**100.0**	**497.7**	**100.0**	**581.7**	**100.0**	**459.8**	**100.0**	**424.6**	**100.0**	**635.6**	**100.0**	**561.5**	**100.0**	**522.2**	**100.0**	**613.3**	**100.0**	**5,078.9**

PLATE - XII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

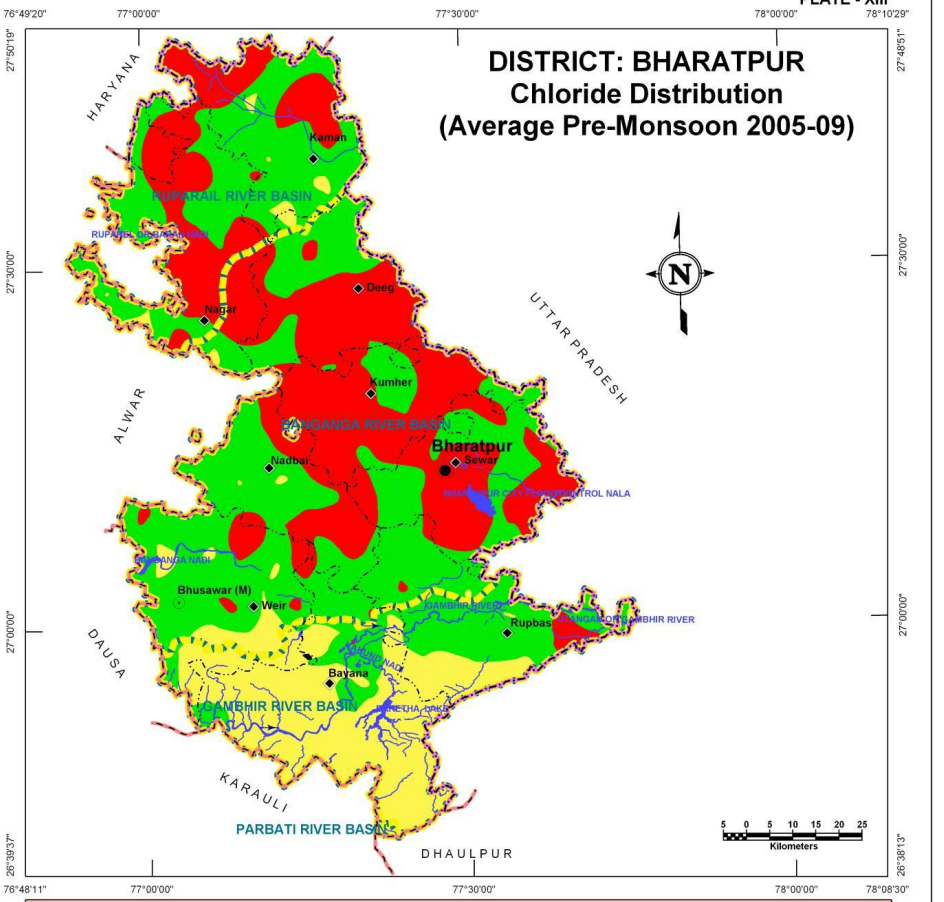
- River / Streams
- Ponds / Reservoirs

Hills

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

- < 2000
- 2000-4000
- > 4000

PLATE - XIII



LEGEND

Admin Boundary:

- District Headquarter
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- Block Boundary

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

GROUND WATER FLUORIDE DISTRIBUTION DISTRICT – BHARATPUR

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 which occupy almost 67% of the district area which is suitable for domestic purpose. The areas with moderately high concentration (1.5-3.0 mg/l, in green color)are seen in patches scattered all over the basin, especially in the northwestand southeastern part of the district. Remaining small part of the district approximately 5% has high Fluoride concentration (>3.0 mg/l) which is shown in red color, largely northern part of Weir and northeastern part of Nagar. The ground water in this high fluoride region 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)
	Bayana		Deeg		Kaman		Kumher		Nadbai		Nagar		Rupbas		Sewar		Weir		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<1.5	626.2	80.0	314.7	63.3	345.0	59.3	340.3	74.0	262.3	61.8	311.9	49.0	369.4	65.8	507.7	97.2	335.4	54.6	**3,412.9**
1.5-3.0	131.1	16.8	121.6	24.4	199.7	34.3	119.5	26.0	150.9	35.5	300.4	47.3	171.7	30.6	14.5	2.8	196.0	32.0	**1,405.4**
>3.0	25.2	3.2	61.4	12.3	37.0	6.4	-	-	11.4	2.7	23.3	3.7	20.4	3.6	-	-	81.9	13.4	**260.6**
Total	**782.5**	**100.0**	**497.7**	**100.0**	**581.7**	**100.0**	**459.8**	**100.0**	**424.6**	**100.0**	**635.6**	**100.0**	**561.5**	**100.0**	**522.2**	**100.0**	**613.3**	**100.0**	**5,078.9**

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. Low nitrate concentration (<50 mg/l) is shown in yellow color patches and occupies approximately 46% of the district area which is 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 approximately 20% is covered with high nitrate concentration (>100 mg/l) which is shown in red colored patches. Combined together, the moderate and high nitrate concentration areas account for about 54% of district area where ground water is not ideally suitable for agriculture. The high EC, Chloride and Nitrate areas when added together, this leaves very small area in the southern part of the basin which 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)
	Bayana		Deeg		Kaman		Kumher		Nadbai		Nagar		Rupbas		Sewar		Weir		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	407.3	52.0	135.3	27.2	277.8	47.7	143.9	31.3	216.5	50.9	250.1	39.4	209.1	37.3	388.6	74.4	302.0	49.2	**2,330.6**
50-100	330.9	42.3	149.5	30.0	197.1	33.9	153.4	33.4	157.7	37.2	260.5	40.9	156.8	27.9	112.3	21.5	211.6	34.5	**1,729.8**
>100	44.3	5.7	212.9	42.8	106.8	18.4	162.5	35.3	50.4	11.9	125.0	19.7	195.6	34.8	21.3	4.1	99.7	16.3	**1,018.5**
Total	**782.5**	**100.0**	**497.7**	**100.0**	**581.7**	**100.0**	**459.8**	**100.0**	**424.6**	**100.0**	**635.6**	**100.0**	**561.5**	**100.0**	**522.2**	**100.0**	**613.3**	**100.0**	**5,078.9**

Ground Water Department,
Rajasthan

European Union
State Partnership Programme

PLATE - XIV

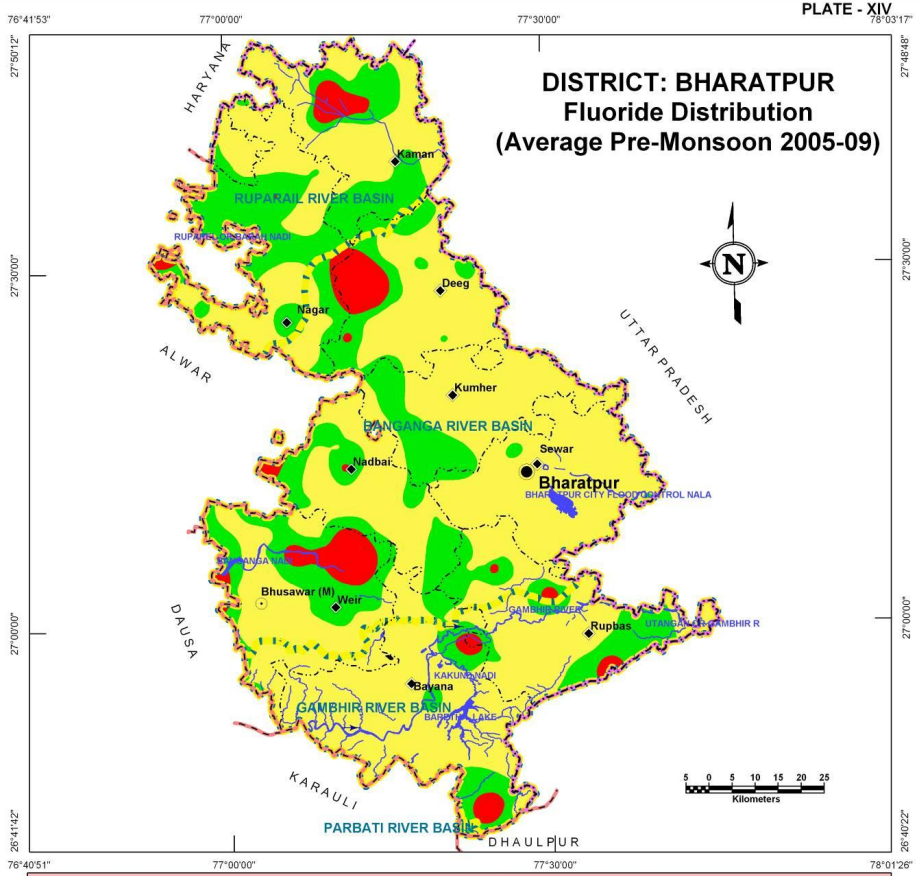
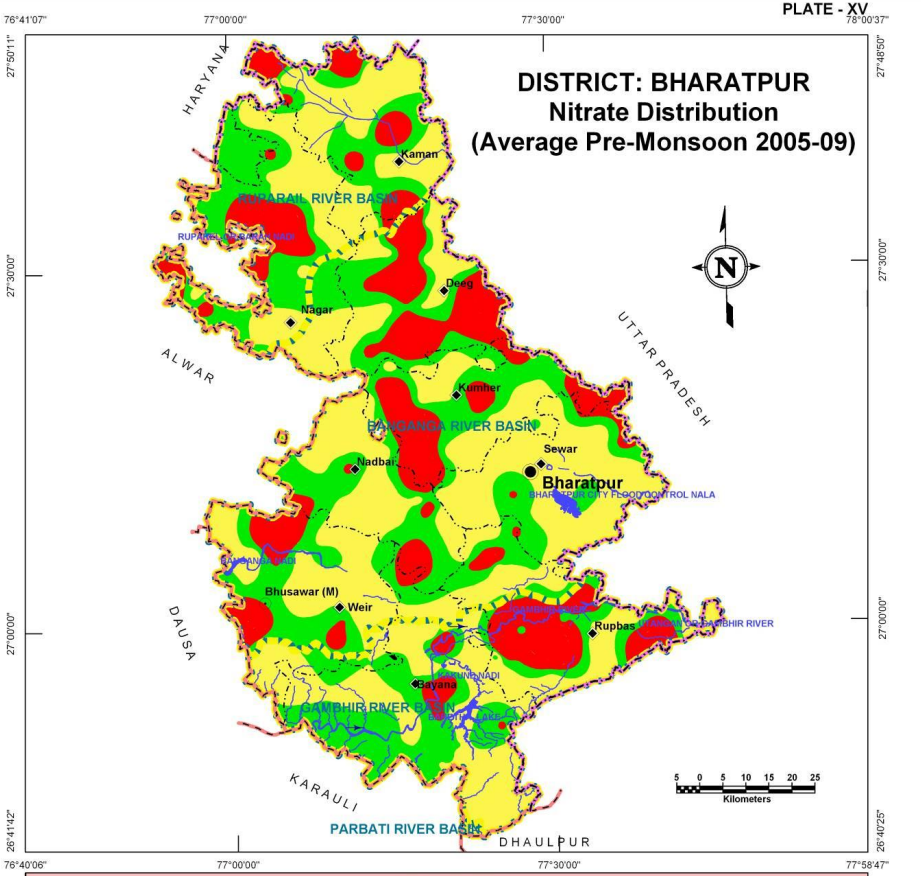


PLATE - XV



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Fluoride Concentration (mg/l):

- < 1.5
- 1.5-3.0
- > 3.0

LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Nitrate Concentration (mg/l):

- < 50
- 50-100
- >100

ROLTA
Rolta India Limited

DEPTH TO BEDROCK

DISTRICT – BHARATPUR

The thick alluvial deposits are underlain by bedrock of different lithology and age. Plate – XVI depicts the distribution of bedrock depth from ground level. From a 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 Sandstones and Quartzites. These rocks are overlain by alluvial deposits of sand, clay, silt and admixture of these in different proportions and thicknesses. It varies from less than 40m bgl to more than 140m bgl in the district. Shallow bedrock depth is found in the southernmost part of Bayana block. Deepest occurrence of bedrock (indicating high alluvial thickness) is found in northern part of district in Kaman block. The areas in the central parts of the district have a moderately deep bedrock varies from 60m bgl to 100m bgl.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)																		Total Area (sq km)
	Bayana		Deeg		Kaman		Kumher		Nadbai		Nagar		Rupbas		Sewar		Weir		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 40	75.3	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**75.3**
40-60	72.1	9.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**72.1**
60-80	600.7	77.0	-	-	-	-	166.3	36.2	203.5	48.0	-	-	269.3	48.0	169.3	32.0	473.7	77.0	**1,882.8**
80-100	34.4	4.0	467.9	94.0	101.4	17.4	293.5	63.8	221.1	52.0	223.8	35.0	292.2	52.0	352.9	68.0	139.6	23.0	**2,126.8**
100-120	-	-	29.8	6.0	325.2	55.9	-	-	-	-	334.4	53.0	-	-	-	-	-	-	**689.4**
120-140	-	-	-	-	128.6	22.1	-	-	-	-	77.4	12.0	-	-	-	-	-	-	**206.0**
> 140	-	-	-	-	26.5	4.6	-	-	-	-	-	-	-	-	-	-	-	-	**26.5**
Total	**782.5**	**100.0**	**497.7**	**100.0**	**581.7**	**100.0**	**459.8**	**100.0**	**424.6**	**100.0**	**635.6**	**100.0**	**561.5**	**100.0**	**522.2**	**100.0**	**613.3**	**100.0**	**5,078.9**

UNCONFINED AQUIFER

Alluvial Areas

The entire district covered with alluvial aquifer under unconfined condition excluding some parts in Bayana, Weir and Rupbas block, with thickness varying from less than 10 meter and reaching upto 80 meter. Most part of the district has unconfined aquifer formed in alluvial material with thickness from 10 to 30 meters. In eastern part of Deeg and Sewar blocks having a good thickness of alluvial aquifer.

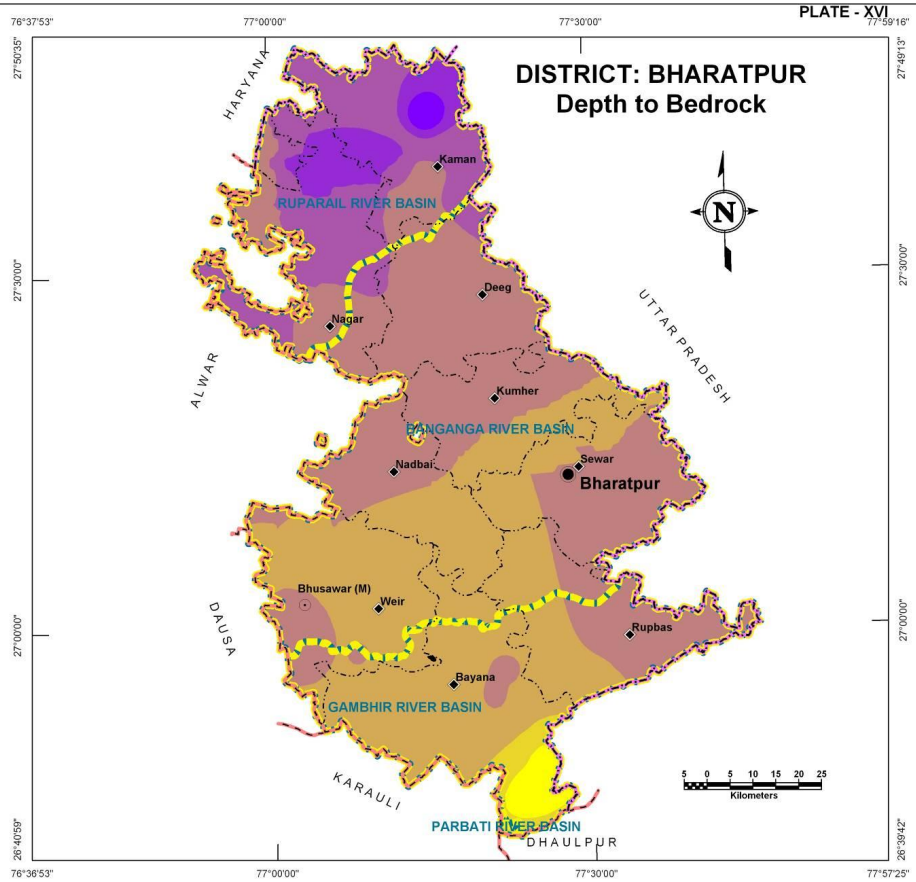
Hard rock Areas

Weathered, fractured and jointed rock formations form the phreatic aquifer in the areas where hard rocks are exposed or occur at shallow depths. Such zone ranges in thickness from less than 10 meter to 30 meter and only limited to southern parts of the district.

Unconfined aquifer Thickness (m)	Block wise area coverage (sq km)									Total Area (sq km)
	Bayana	Deeg	Kaman	Kumher	Nadbai	Nagar	Rupbas	Sewar	Weir	
< 10	180.4	48.1	134.5	3.6	213.3	239.2	150.4	83.5	316.8	**1369.8**
10-20	246.1	169.0	338.5	77.4	96.8	302.7	161.3	98.1	136.9	**1626.8**
20-30	116	196.2	107.7	103.1	83.9	87.5	153.3	120.5	52.2	**1020.4**
30-40	26.2	37.7	1.0	108.7	30.6	6.2	64.3	99.8	14.5	**389**
40-50	-	18.7	-	102.6	-	-	21.7	57.1	-	**200.1**
50-60	-	19.2	-	56.4	-	-	2.0	32.3	-	**109.9**
60-70	-	7.5	-	8.0	-	-	-	28.9	-	**44.4**
> 70	-	1.3	-	-	-	-	-	2.0	-	**3.3**
Total	**568.7**	**497.7**	**581.7**	**459.8**	**424.6**	**635.6**	**553.0**	**522.2**	**520.4**	**4,763.7**

Unconfined aquifer Thickness (m)	Block wise area (sq km) coverage									Total Area (sq km)
	Bayana	Deeg	Kaman	Kumher	Nadbai	Nagar	Rupbas	Sewar	Weir	
< 10	52.5	-	-	-	-	-	-	-	89.6	142.1
10-20	161.1	-	-	-	-	-	8.5	-	3.3	172.9
> 20	0.2	-	-	-	-	-	-	-	-	0.2
Total	**213.8**	**0**	**0**	**0**	**0**	**0**	**8.5**	**0**	**92.9**	**315.2**

PLATE - XVI



LEGEND

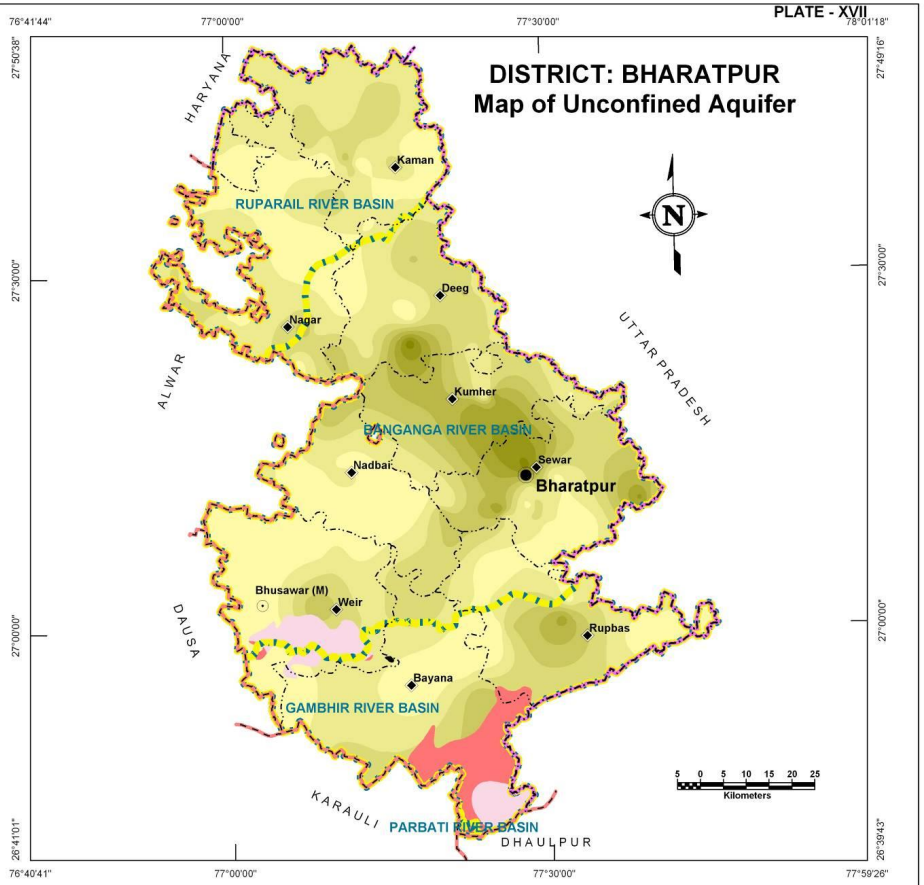
Admin Boundary:

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

Depth to Bedrock(m bgl):

- < 40
- 40-60
- 60-80
- 80-100
- 100-120
- 120-140
- > 140

PLATE - XVII



LEGEND

Admin Boundary:

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

Aquifer Thickness (m):

Alluvial Area	Weathered & Fractured Zone in Hardrock Area
<10	<10
10-20	10-20
20-30	>20
30-40	
40-50	
50-60	
60-70	
>70	

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 its complete saturation.
28	TOTAL DISSOLVED SOLIDS	Total weight of dissolved mineral constituents in water per unit volume (or weight) of water in the sample.

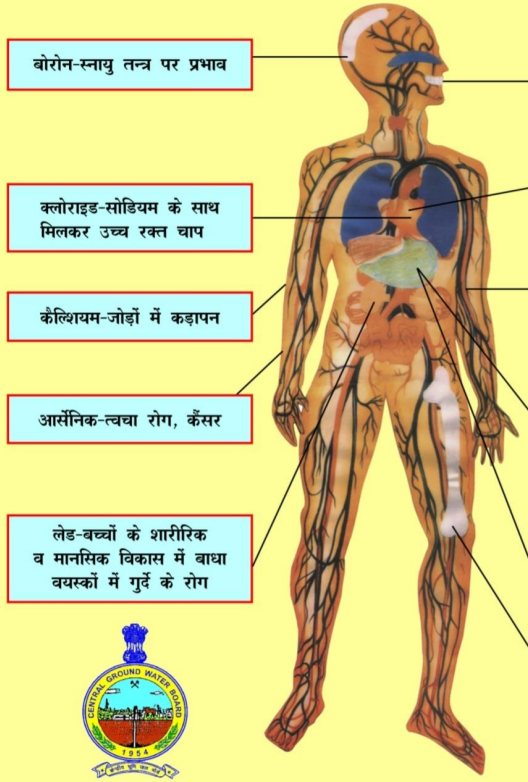
(Contd…)

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
- सोडियम-हृदय, गुर्दा व रक्त परिसंचरण रोगों से ग्रसित लोगों को हानिकारक
- क्लोराइड-सोडियम के साथ मिलकर उच्च रक्त चाप
- नाइट्रेट-नवजात शिशुओं में ब्लू बेबी बीमारी (मेथमोग्लोबिनिमिया)
- कैल्शियम-जोड़ों में कड़ापन
- 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
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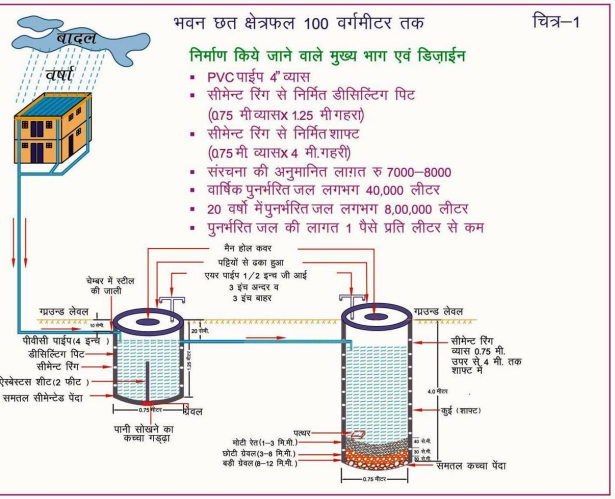
भूजल अमूल्य है इसे प्रदूषित न करें।

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 वर्षों में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

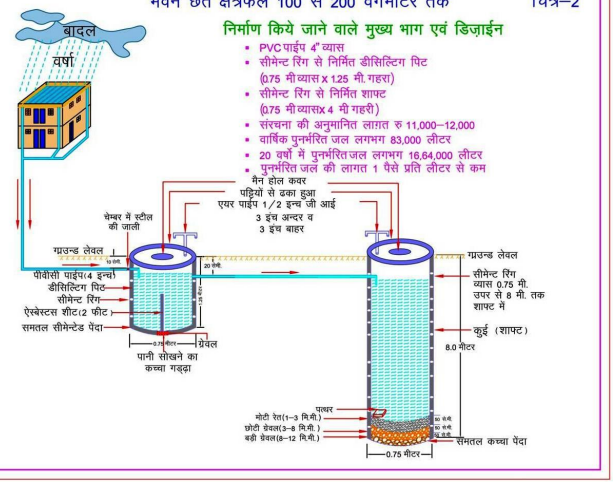


चित्र–2

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 वर्षों में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

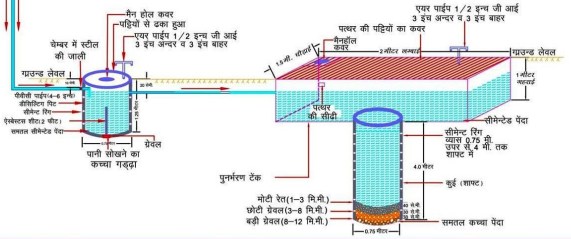


चित्र–3

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 वर्षों में पुनर्भरित जल लगभग 25,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

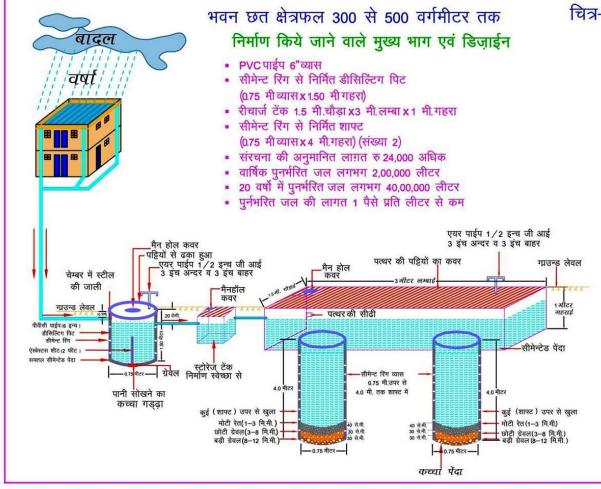


चित्र–4

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 वर्षों 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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