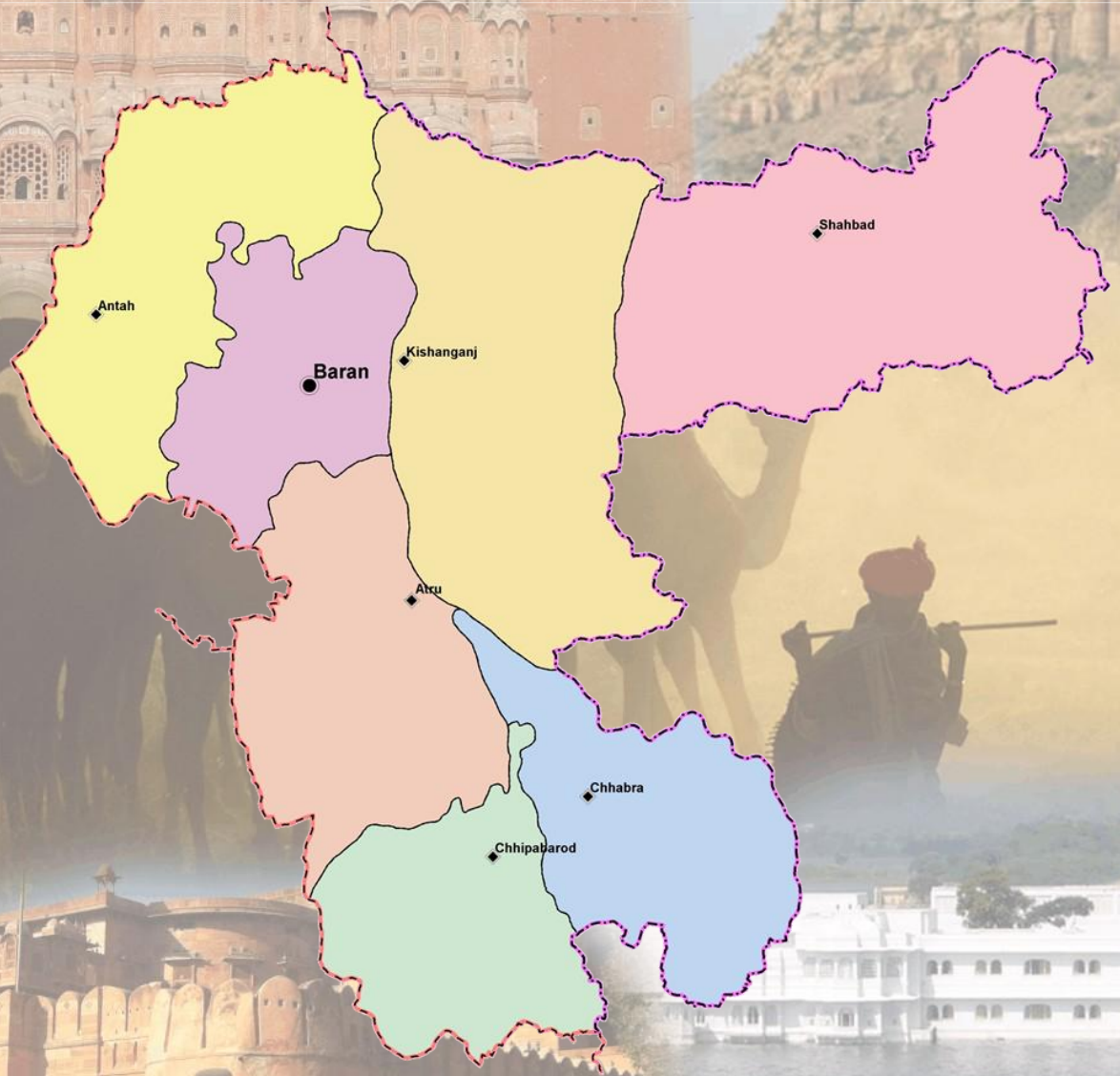
Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan

Baran District

European Union
State Partnership Programme



2013

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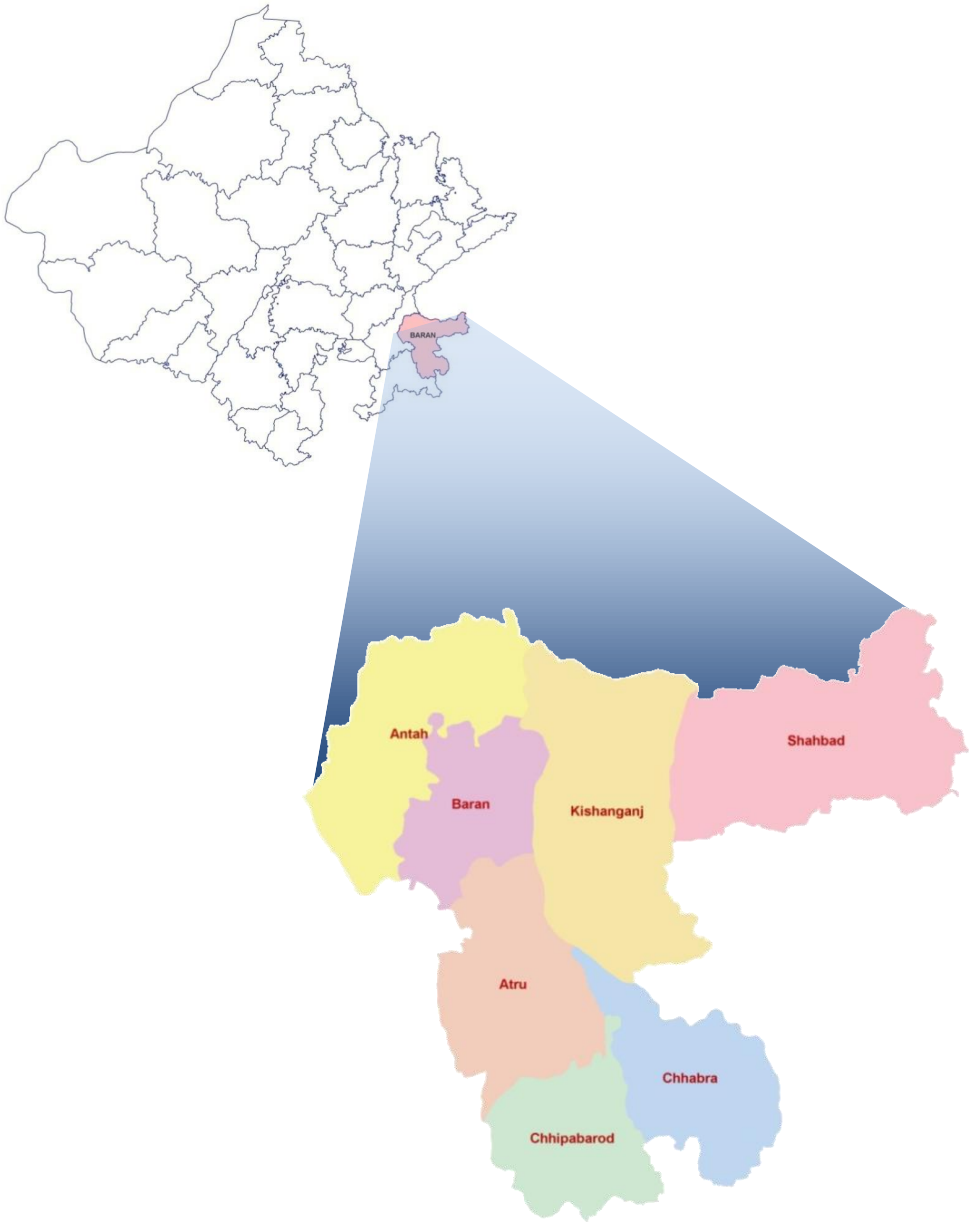
Hydrogeological Atlas of Rajasthan

Baran District



Contents:

2013

ADMINISTRATIVE SETUP

DISTRICT – BARAN

Location:

Baran district is located in the southeastern part of Rajasthan. It is bounded in the east by state of Madhya Pradesh, southwest by Jhalawar district and northwest by Kota district. It stretches between 24^{o} 23' 35.85" to 25^{o} 26' 39.94" North latitude and 76^{o} 11' 34.16'' to 77^{o} 25' 56.74'' East longitude covering area of 6,994 sq kms. Major part of the district has a systematic drainage system, as whole district is part of 'Chambal River Basin'.

Administrative Set-up:

Baran district is administratively divided into seven 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	Antah	1,97,385	1,033.3	14.8	158
2	Atru	1,32,944	946.4	13.5	139
3	Baran	1,81,807	638.8	9.1	103
4	Chhabra	1,22,268	798.9	11.4	193
5	Chhipabarod	1,43,885	684.3	9.8	181
6	Kishanganj	1,35,218	1,450.4	20.7	203
7	Shahbad	1,08,146	1,441.9	20.7	236
Total		**10,21,653**	**6,994.0**	**100.0**	**1,213**

Baran district has 1,213 towns and villages, of which seven are block headquarters as well.

Climate:

The district has a sub-humid climate, moderately dry and receives fairly good rainfall in monsoon seasons. The winter season extends from November to February and summer season from March to mid of June. The period from mid of June to September is the monsoon season followed by the months October to mid of November constitutes the post monsoon or the retreating monsoon. The mean annual rainfall in the district is 838.7mm. January is the coldest month with the average daily maximum temperature of 24.3 ^{o}C and the average daily minimum temperature in the range of 8-10 ^{o}C.

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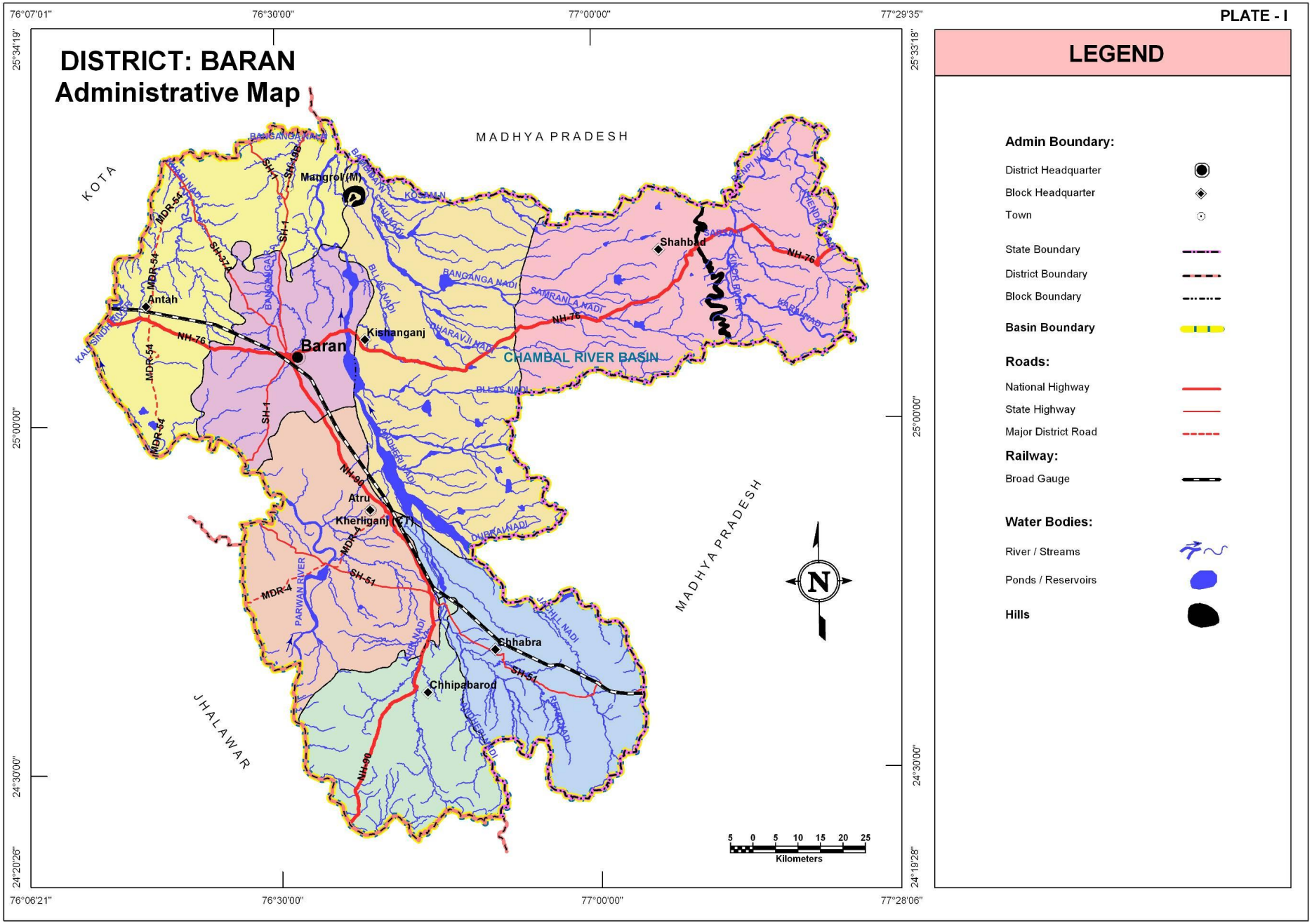
PLATE - I



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

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

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TOPOGRAPHY

DISTRICT – BARAN

The topography of Baran district is in general, undulating in in the western part, but hilly in the eastern and southern parts constituting predominant landforms visible in Shahbad, Chhabra and Chhipabarod blocks. The general topographic elevation in the district is between 250 m to 450 m above mean sea level. The narrow elongated hills rise up to 548.8 m elevation in eastern part of the district. Apart from the well-known Chambal River, the other rivers that flow through the districts are Andheri and Kali Sindh and their tributaries are Bambidai, Kui, Kosam, Khari, Bllas and Samranla. Elevation ranges from a minimum of 200 m above mean sea level in Antah block in the northwestern part of the district to a maximum of 548.8 m above mean sea level In Shahbad block in eastern part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Minimum Elevation (m amsl)	Maximum Elevation (m amsl)
1	Antah	200.0	288.3
2	Atru	252.2	429.5
3	Baran	207.7	293.5
4	Chhabra	281.0	488.9
5	Chhipabarod	290.5	471.5
6	Kishanganj	212.2	442.9
7	Shahbad	283.9	548.8

RAINFALL

The rainfall is very scanty and erratic. The general distribution of rainfall across can be visualized from isohyets presented in the Plate – III where most of the district received rainfall in the range of 600-700 mm in year 2010. The annual average rainfall was 621.2 mm based on the data of available blocks. Maximum Annual rainfall was noticed in Atru block (724.4 mm) whereas minimum was in Antah block (562.0 mm). The highest average annual rainfall noticed in Chhipabarod 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)
Antah	445.2	697.8	614.9
Atru	584.6	724.4	667.9
Baran	512.8	639.8	599.5
Chhabra	557.1	685.8	590.6
Chhipabarod	616.3	705.5	675.2
Kishanganj	578.0	669.1	616.0
Shahbad	568.3	612.0	584.0

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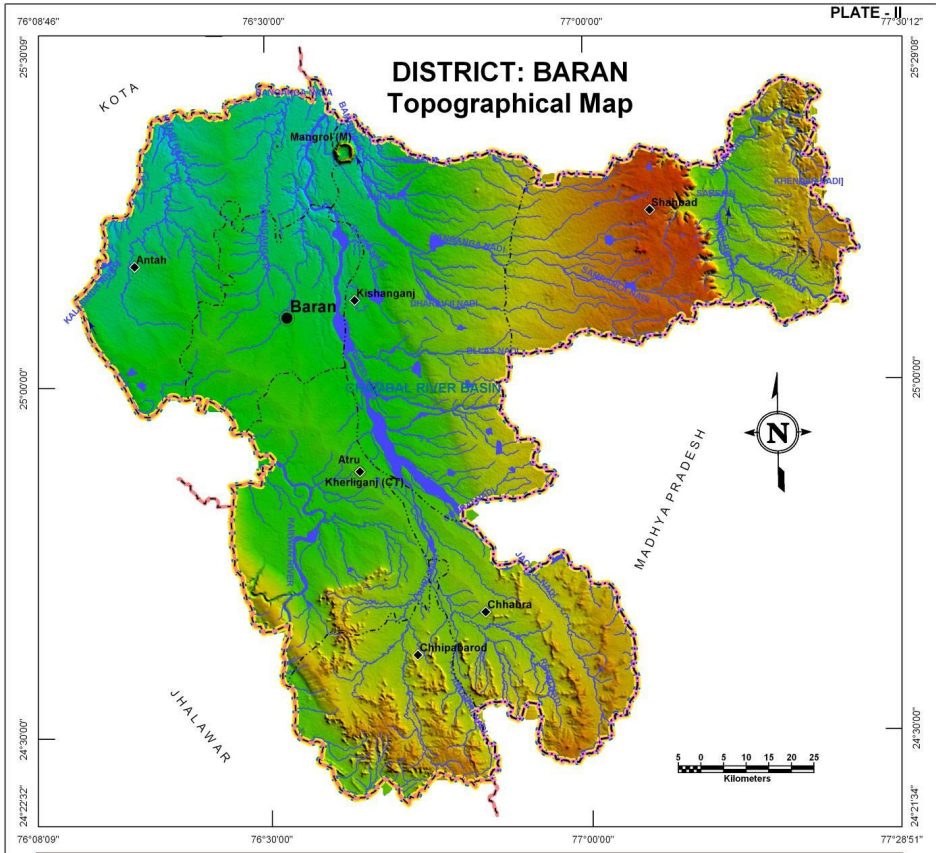
PLATE - II



LEGEND

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

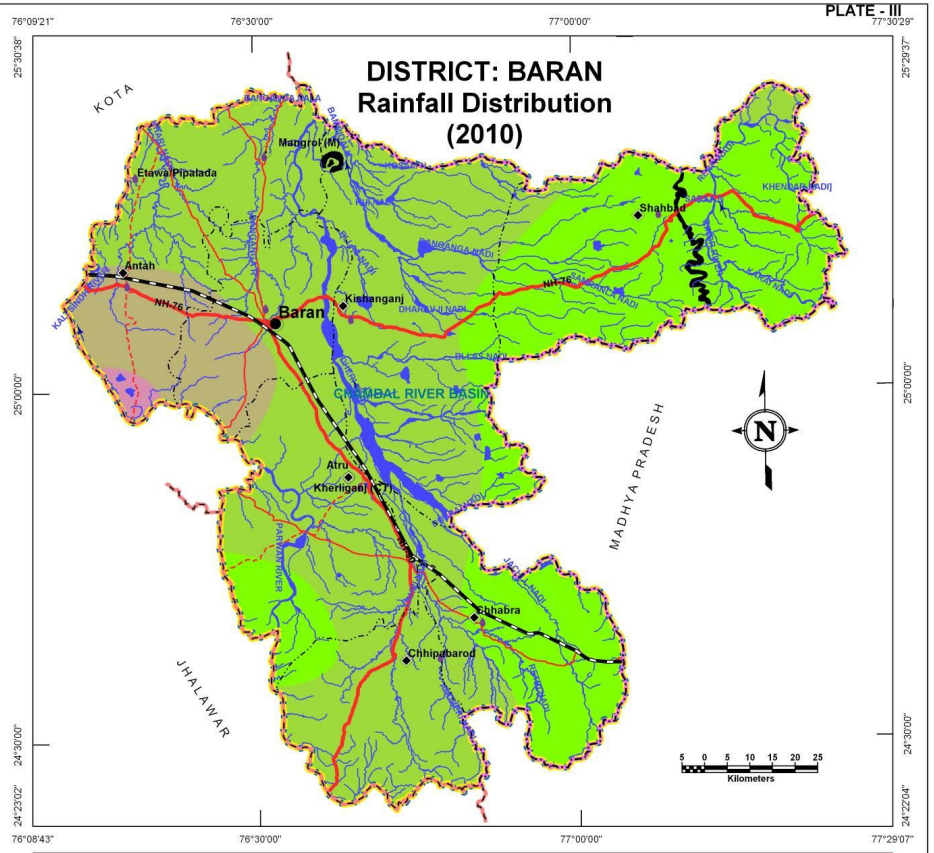
Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation (m amsl):
549, 500, 450, 400, 350, 300, 250, 200

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

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Isohyets (mm):
- 400-500
- 500-600
- 600-700
- 700-800

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GEOLOGY

DISTRICT – BARAN

Most of the part of Baran district is occupied by rocks of Vindhyan Super Group. On the basis of different rock-units the Vindhyans of the area have been divided in to Bhander, Rewa and Khorip Groups comprising Shale, Limestone and Sandstones. The Khorip Group is separated from Rewa Group by conglomerate horizon. The Southern part of Chhabra and Chhipabarod block is occupied by Deccan trap basalt. Bhander Group occupies most part of the district.

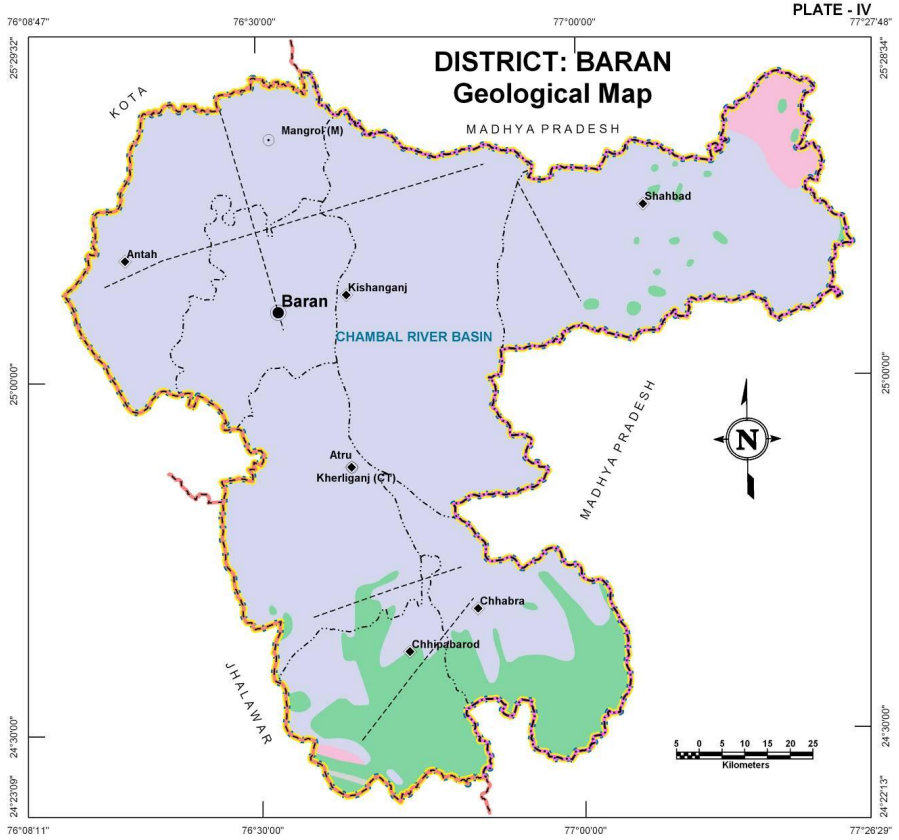
Super Group	Group	Formation
	Recent	Alluvium (Sand, Silt, Clay)
	Deccan trap	Basalt
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Vindhyan	Bhander	Shale, Limestone, Sandstone
	Rewa	Shale
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Lower Vindhyan	Khorip	Shale, Limestone, Sandstone

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
Denudational	Buried Pediment	Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.
	Pediment	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss-crossed by fractures and faults.
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.
	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.
Structural	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys.
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.

PLATE - IV



LEGEND

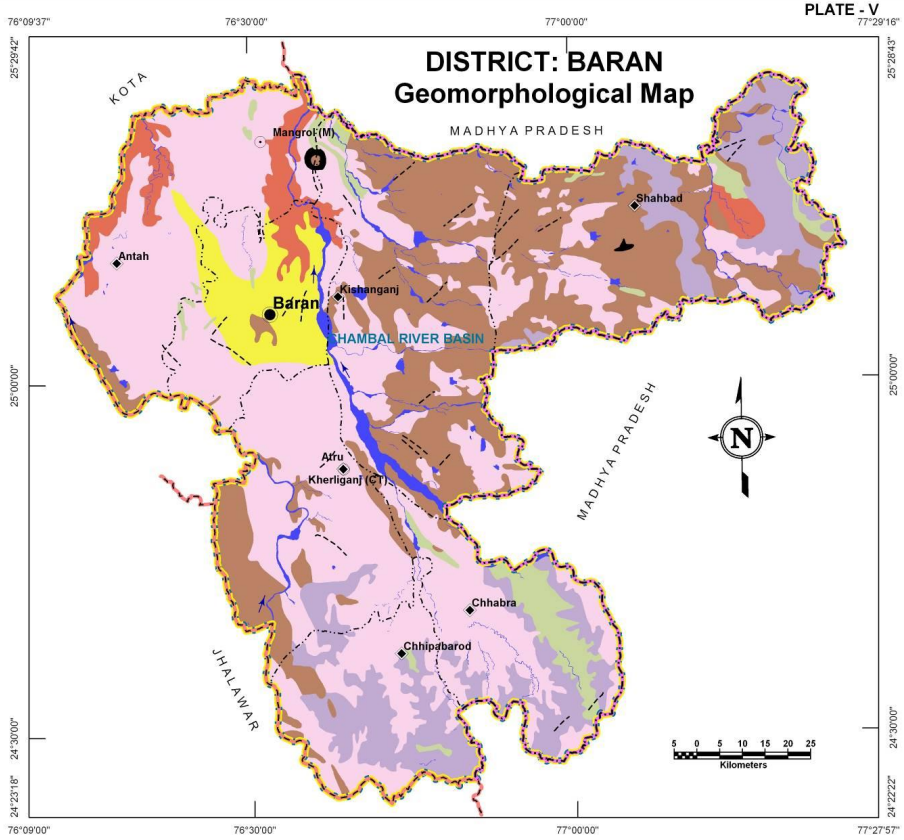
Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Structural Features:
- Lineament

Geology:
- Bhander Group
- Rewa Group
- Khorip Group
- Deccan Traps

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

Hills:
- Structural/Denudational/Linear Ridge

Landform Units:

Fluvial Origin:
- Alluvial Plain
- Valley Fill
- Ravine

Denudational Origin:
- Burried Pediment
- Pediment

Structural Origin:
- Dissected Plateau

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

AQUIFERS

DISTRICT – BARAN

Aquifers in Baran district are formed in Sandstone, Limestone, Basalt, Shale and Younger alluvium. Weathered and fractured parts of the massive rocks along with primary and secondary openings in Sandstones and Limestone respectively, contribute to aquifer formation whereas the sandy, gravelly and other granular parts of alluvium constitute aquifers. Vindhyan sandstones are the most prevalent aquifer types with more than 52% spatial coverage and present prominently in the central part of the district. The Basalt aquifers occupy about 16% of the district area and present in southern part of the district. Shales and Limestones constitute aquifers in the eastern and western parts of the district respectively. Alluvium constitutes small patch of sandy aquifers around Baran contributing to less than 5% of aquifer area to 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	327.1	4.7	It is largely constituted of Aeolian and Fluvial sand, silt, clay, gravel and pebbles in varying proportions.
Limestone	1204.3	17.2	In general, it is fine to medium grained, grey, red yellowish, pink or buff in colour.
Sandstone	3670.0	52.5	Fine to medium grained, red colour and compact and at places.
Shale	622.8	8.9	Grey, light green and purple in colour and mostly splintery in nature.
Basalt	1,141.7	16.3	Dark grey, olive green and green colour, compact, vesicular, amygdaloidal and weathered.
Hills	28.1	0.4	
Total	**6,994.0**	**100.0**	

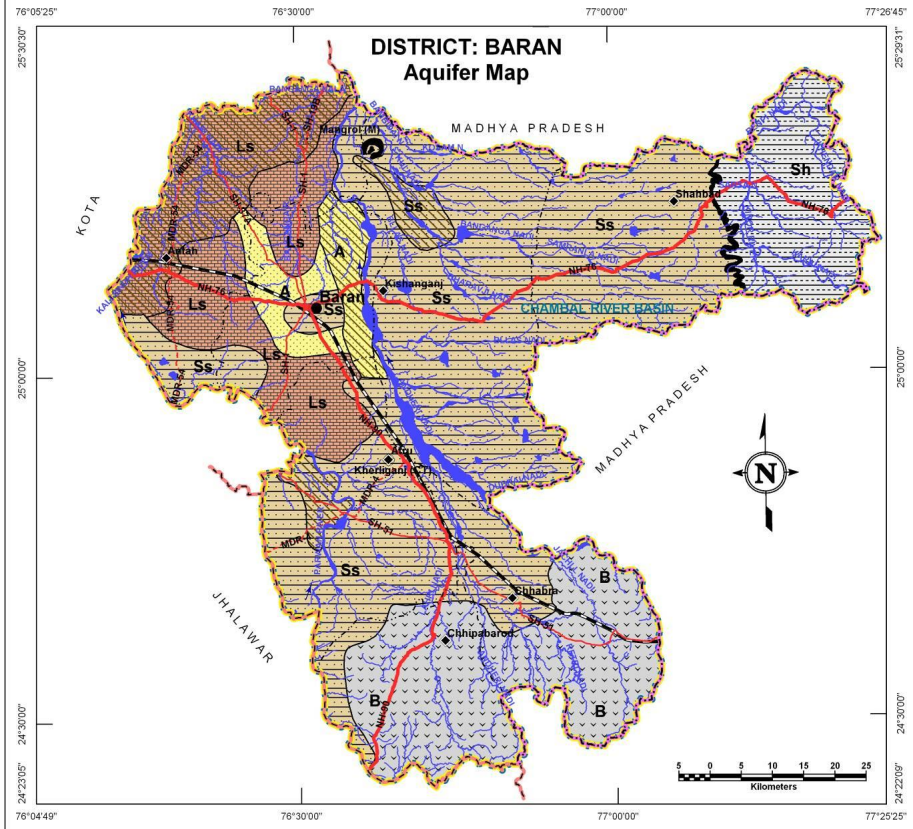
STAGE OF GROUND WATER DEVELOPMENT

The different blocks of the district fall into three categories of ground water development stages. Shahbad, the easternmost block falls into ‘safe’ category whereas further west the Kishangarh block is under ‘semi-critical’ category. The rest of the blocks constituting a strip along the western part of the district, fall under over-exploited category indicating the areas where steps need to be taken to reduce stress on ground water due to exploitation.

Categorization on the basis of stage of development of ground water	Block Name
Safe	Shahbad
Semi- Critical	Kishanganj
Over Exploited	Antah, Baran, Atru, Chhipabarod, Chhabra.

Basis for categorization: Ground water development <= 70% - Safe; >70%; >90% - Semi 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

Water Bodies:
- River / Streams
- Ponds / Reservoirs

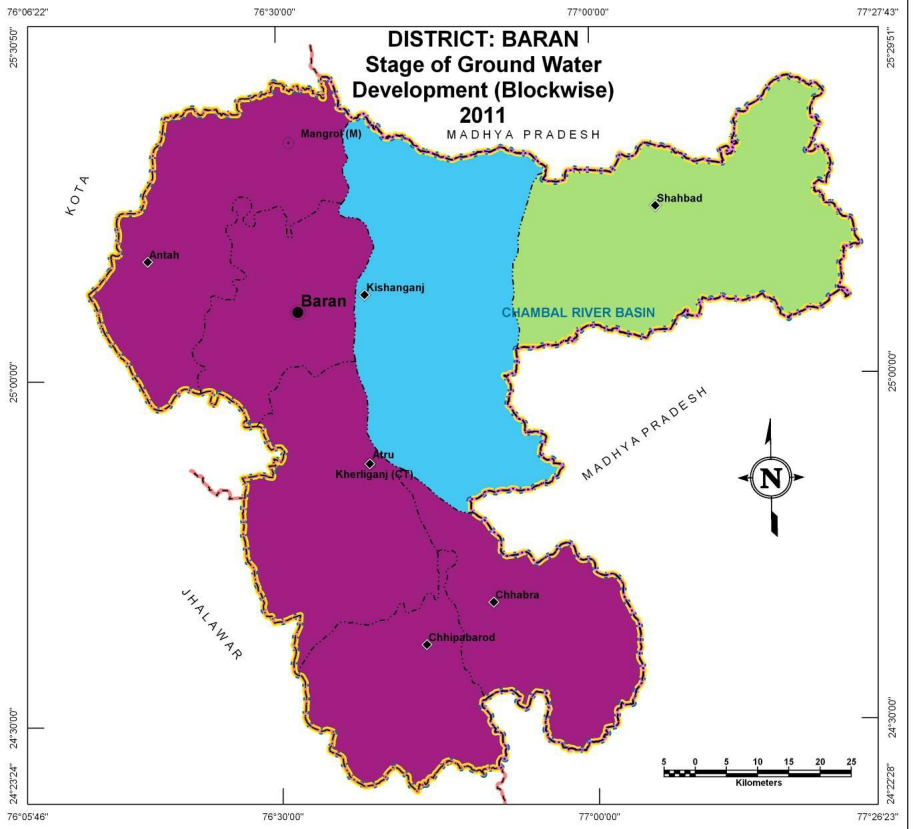
Hills

Command Area

Aquifer:
- Younger Alluvium
- Limestone
- Sandstone
- Shale
- Basalt

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

Source: Ground Water Department, Rajasthan

LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS DISTRICT – BARAN

The district has a well distributed network of large number of exploratory wells (47) and ground water monitoring stations (170) in the district owned by RGWD (43 and 154 respectively) and CGWB (4 and 16 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 levels are being well monitored through existing network but for better monitoring of ground water quality five wells need to be added to existing network in Baran block.

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
Antah	1	9	**10**	2	31	**33**	-	-
Atru	1	7	**8**	3	25	**28**	-	-
Baran	1	6	**7**	2	24	**26**	-	5
Chhabra	1	5	**6**	1	15	**16**	-	-
Chhipabarod	-	5	**5**	3	19	**22**	-	-
Kishanganj	-	7	**7**	2	19	**21**	-	-
Shahbad	-	4	**4**	3	21	**24**	-	-
Total	**4**	**43**	**47**	**16**	**154**	**170**	**0**	**5**

DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The district shows variation in depth to ground water levels from less than 10m bgl to around 60m bgl. Ground water occurs at shallow depths of less than 10m below ground level in almost half of the district area. 10 – 20m deep water levels are also found in about 38% of the district. Combined together, the areas having less than 20m depth to water level occupy almost 83% of the district. The deeper water levels are seen distributed in the western part of Chambal river in Atru, Baran, Chhipabarod blocks and small area in Shahbad towards eastern part of the district.

Depth to water level (m bgl)	Block wise area coverage (sq km) *							Total Area (sq km)
	Antah	Atru	Baran	Chhabra	Chhipabarod	Kishanganj	Shahbad	
<10	492.1	14.4	75.1	415.0	290.9	674.8	1,148.6	**3,110.9**
10-20	498.8	464.3	234.1	269.1	316.3	653.9	235.7	**2,672.2**
20-30	41.8	242.7	153.6	93.7	39.9	116.0	19.6	**707.3**
30-40	-	134.8	136.5	21.1	32.1	-	9.5	**334.0**
40-50	-	73.3	32.5	-	5.0	-	5.2	**116.0**
>50	-	16.7	7.0	-	-	-	1.8	**25.5**
Total	**1,032.7**	**946.2**	**638.8**	**798.9**	**684.2**	**1,444.7**	**1,420.4**	**6,965.9**

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

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Rajasthan

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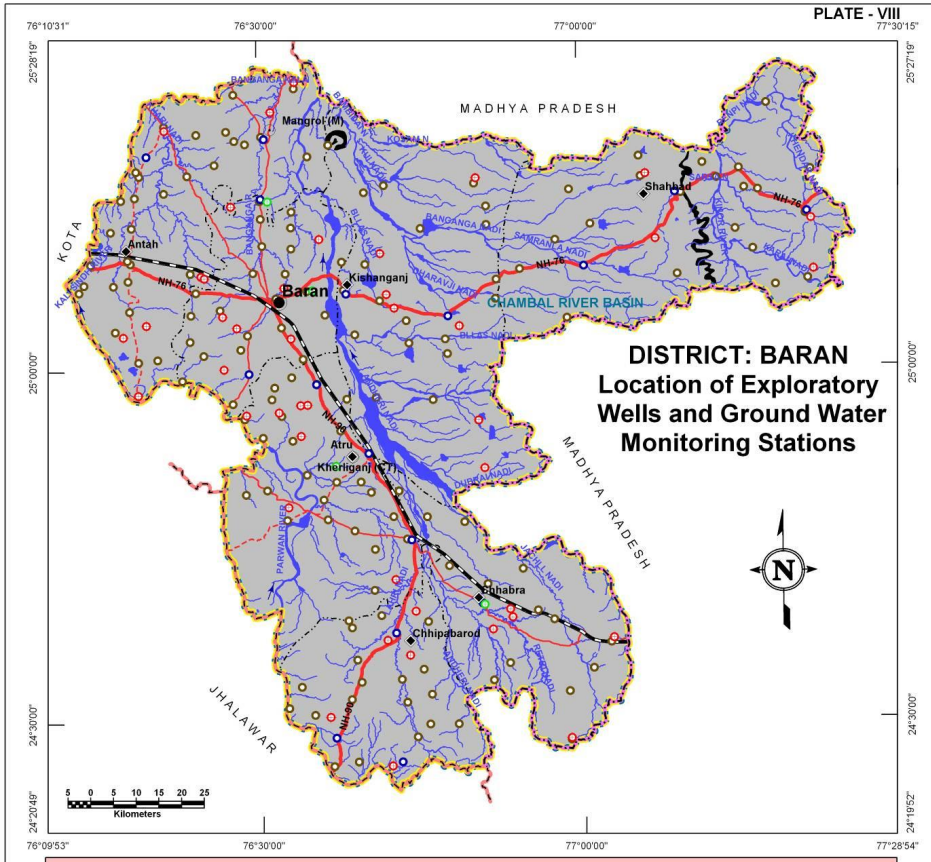
PLATE - VIII



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

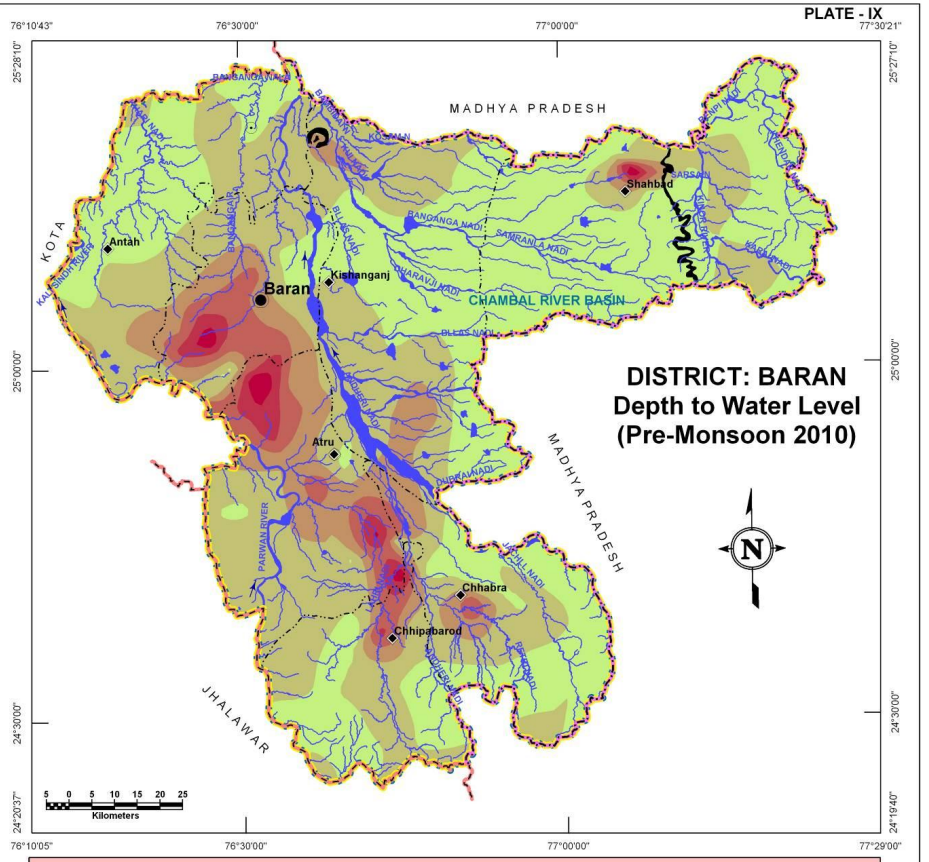
Water Bodies:
- River / Streams
- Ponds / Reservoirs

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 - 40
- 40 - 50
- > 50

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

Water table contour map reveals the general flow direction of ground water in the district which is indicated to be in a broadly east/southeast to northwestern direction following topography as well as the direction of rivers. Variation in water table elevation seems to be high in the district as the maximum water table seen is >440m amsl in northeastern part in Shahbad block and minimum is in Antah block (<180m amsl) in the northwestern part of the district. The major part of the district shows water table in the range of 220m amsl to 380m amsl.

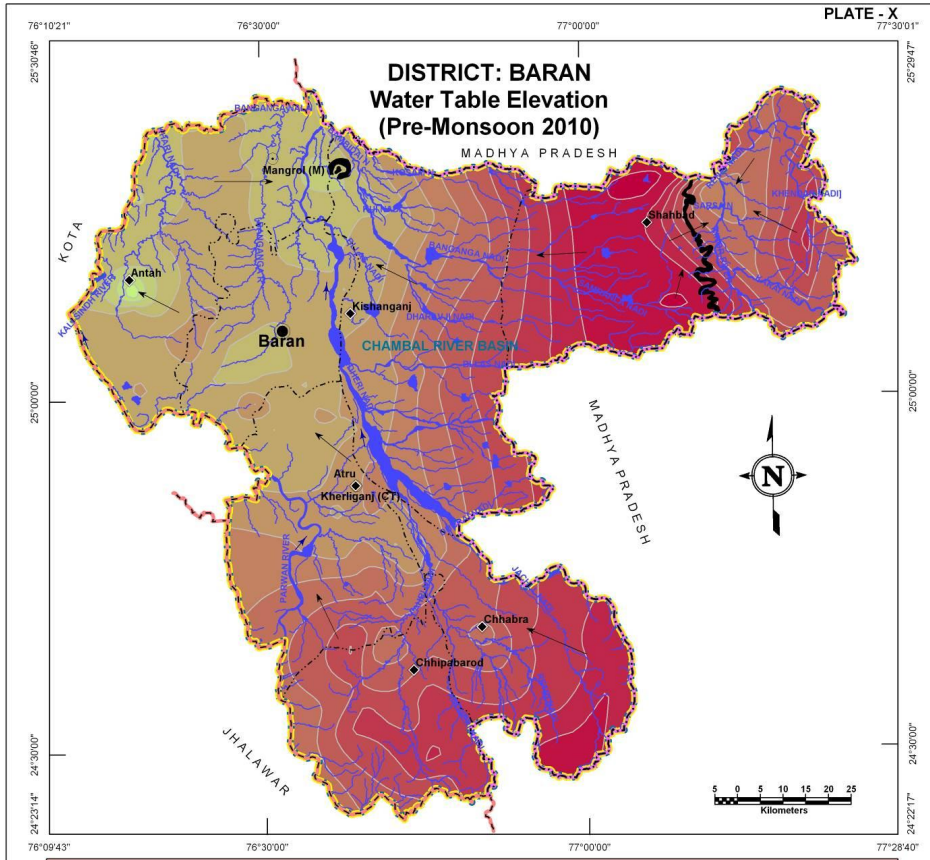
Block Name	Block wise area coverage (sq km) per water table elevation (m amsl) range														Total Area (sq km)
	< 180	180 - 200	200 - 220	220 - 240	240 - 260	260 - 280	280 - 300	300 - 320	320 - 340	340 - 360	360 - 380	380 - 400	400 - 440	> 440	
Antah	3.2	11.9	52.2	459.1	482.4	23.9	-	-	-	-	-	-	-	-	**1,032.7**
Atru	-	-	-	-	203.9	268.1	185.0	166.2	104.1	18.8	0.1	-	-	-	**946.2**
Baran	-	-	-	139.2	467.0	32.6	-	-	-	-	-	-	-	-	**638.8**
Chhabra	-	-	-	-	-	22.4	30.5	33.3	147.2	133.2	198.2	161.5	72.6	-	**798.9**
Chhipabarod	-	-	-	-	-	-	0.8	98.8	203.4	191.1	186.5	3.6	-	-	**684.2**
Kishanganj	-	-	5.3	61.6	155.5	257.3	253.3	257.5	261.0	175.2	18.0	-	-	-	**1,444.7**
Shahbad	-	-	-	-	-	-	38.7	126.8	259.9	212.1	190.1	154.7	406.3	31.8	**1,420.4**
Total	**3.2**	**11.9**	**57.5**	**659.9**	**1,308.8**	**604.3**	**508.3**	**682.6**	**975.6**	**730.4**	**592.9**	**319.8**	**478.9**	**31.8**	**6,965.9**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

A 2m contour interval adopted to visualize the ground water level fluctuation reveals a fall of 6 m in one area while rise in other areas reaching upto more than 14m, as seen in Plate XI. The –ve fluctuation areas (indicated by red colored regions) are the areas where overexploitation is taking place and even after monsoon recharge water level has not risen and has actually gone down with respect to pre-monsoon levels. Such large ground water depletion areas are located in the northern and southern part 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 14m is noticed at northern part of Chhabra.

Block Name	Blockwise area coverage (sq km) per Water level fluctuation range (m)												Total Area (sq km)
	<-6	-6 - -4	-4 - -2	-2 - 0	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	>14	
Antah	3.5	7.8	30.1	308.8	440.5	149.8	65.4	26.5	0.3	-	-	-	**1,032.7**
Atru	-	-	44.1	149.1	254.7	212.4	141.1	84.3	39.6	18.7	2.2	-	**946.2**
Baran	-	0.7	21.8	185.1	224.2	134.5	57.3	10.6	2.0	2.6	-	-	**638.8**
Chhabra	-	-	-	164.3	319.2	162.9	81.0	37.8	20.5	9.1	3.7	0.4	**798.9**
Chhipabarod	-	0.9	18.2	160.7	249.3	222.3	28.0	4.0	0.8	-	-	-	**684.2**
Kishanganj	-	-	-	61.9	691.9	469.0	180.0	41.9	-	-	-	-	**1,444.7**
Shahbad	-	-	-	13.6	451.9	771.5	174.5	8.9	-	-	-	-	**1,420.4**
Total	**3.5**	**9.4**	**114.2**	**1,043.5**	**2,631.7**	**2,122.4**	**727.3**	**214.0**	**63.2**	**30.4**	**5.9**	**0.4**	**6,965.9**

PLATE - X



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

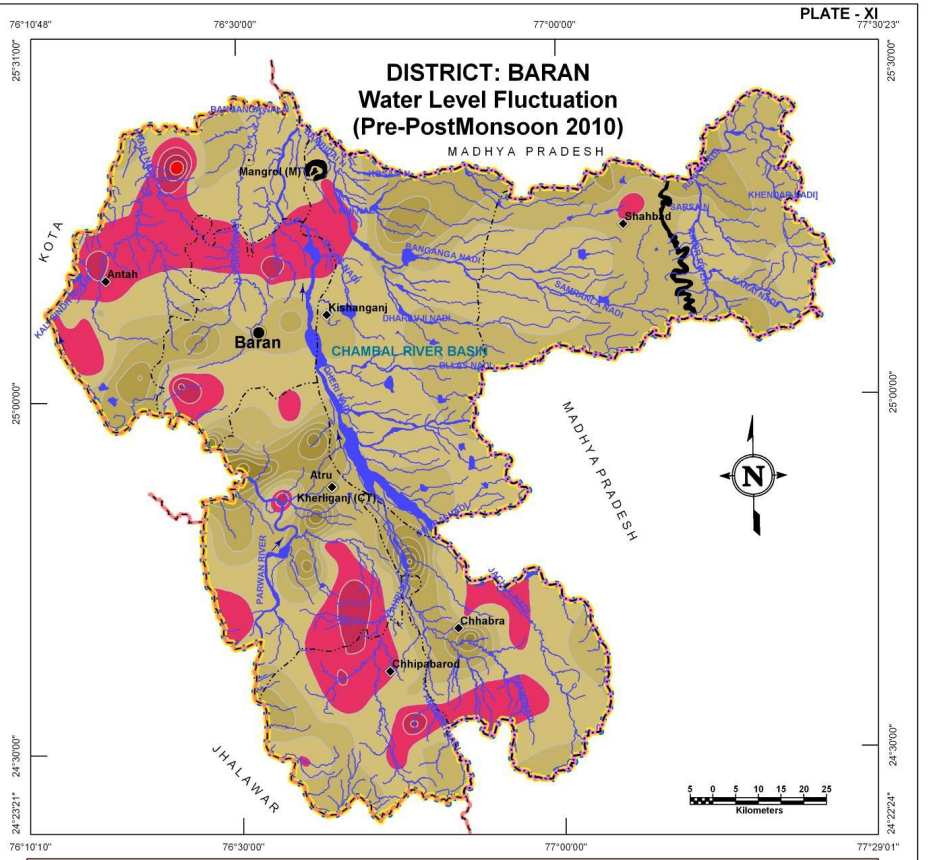
Hills

Water Table Elevation

Water Table Elevation(m amsl):

- <180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- 300 - 320
- 320 - 340
- 340 - 360
- 360 - 380
- 380 - 400
- 400 - 440
- >440

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 Level Fluctuation(m):

- < -6
- -6 to -4
- -4 to -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

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION — DISTRICT – BARAN

The Electrical conductivity (at 25°C) distribution map is presented in plate XII. The areas with low EC values in ground water (<2000 µS/cm) are shown in yellow color and occupies approximately 93% of the district area indicating that, by and large the ground water in this region is suitable for domestic purpose. The area with moderately high EC values (2000-4000 µS/cm) is shown in green color occupies approximately 7% of the district area, largely around Mangrol and Baran. In this district the areas with high EC values (>4000 µS/cm) occupy negligibly small area as shown in red color in parts of Baran, Antah and Atru blocks.

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)
	Antah		Atru		Baran		Chhabra		Chhipabarod		Kishanganj		Shahbad		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<2000	839.7	81.3	933.1	98.6	456.1	71.4	795.8	99.6	684.2	100.0	1,391.6	96.3	1,357.9	95.6	**6,458.4**
2000-4000	178.5	17.3	11.1	1.2	170.0	26.6	3.1	0.4	-	-	53.1	3.7	62.5	4.4	**478.3**
>4000	14.5	1.4	2.0	0.2	12.7	2.0	-	-	-	-	-	-	-	-	**29.2**
Total	**1,032.7**	**100.0**	**946.2**	**100.0**	**638.8**	**100.0**	**798.9**	**100.0**	**684.2**	**100.0**	**1,444.7**	**100.0**	**1,420.4**	**100.0**	**6,965.9**

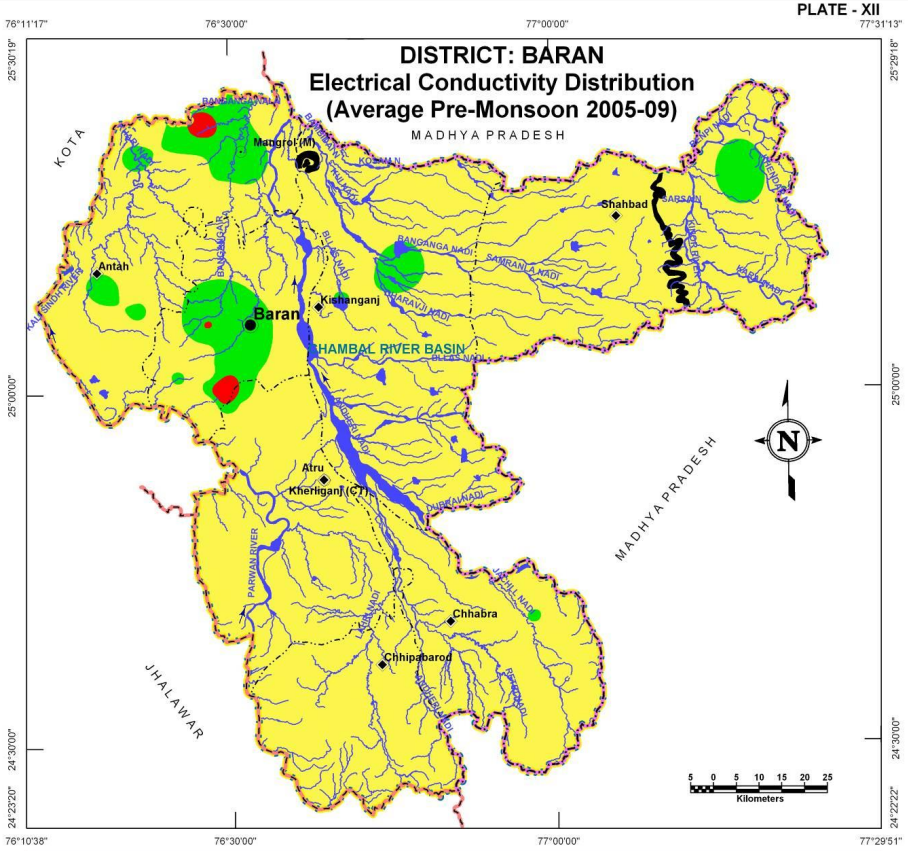
GROUND WATER CHLORIDE DISTRIBUTION

Chloride distribution map is presented in Plate XIII. The yellow colored regions in map are such areas where chloride concentration is low (<250 mg/l) and such areas occupy approximately 92% of the district area which is suitable for domestic purposes. The areas with moderately high chloride concentration (250-1000 mg/l) are shown in green color and occupy approximately 8%of the district area, largely around Mangrol and Baran. In this district the area with high chloride concentration (>1000 mg/l) occupies negligibly small areas seen in baran block only.

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)
	Antah		Atru		Baran		Chhabra		Chhipabarod		Kishanganj		Shahbad		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<250	900.1	87.0	934.6	99.0	435.9	68.0	798.9	100.0	684.2	100.0	1,351.4	94.0	1,242.0	87.0	**6,347.1**
250-1000	132.6	13.0	11.6	1.0	198.8	31.0	-	-	-	-	93.3	6.0	178.4	13.0	**614.7**
>1000	-	-	-	-	4.1	1.0	-	-	-	-	-	-	-	-	**4.1**
Total	**1,032.7**	**100.0**	**946.2**	**100.0**	**638.8**	**100.0**	**798.9**	**100.0**	**684.2**	**100.0**	**1,444.7**	**100.0**	**1,420.4**	**100.0**	**6,965.9**

PLATE - XII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

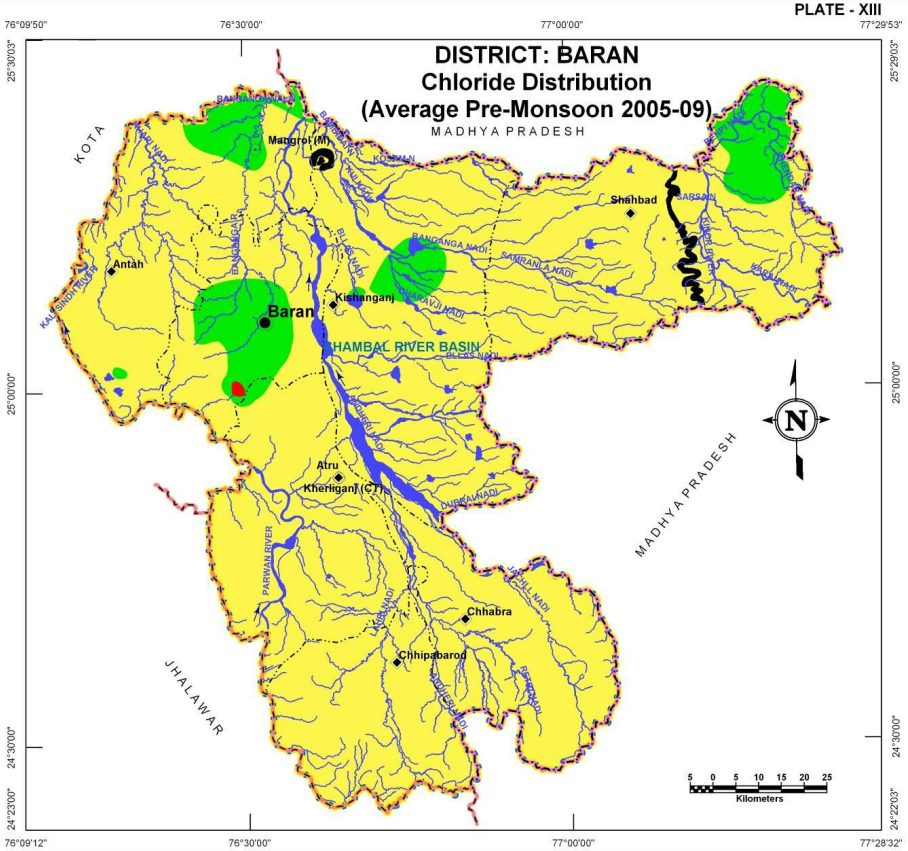
- River / Streams
- Ponds / Reservoirs

Hills

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

- < 2000
- 2000-4000
- >4000

PLATE - XIII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

GROUND WATER FLUORIDE DISTRIBUTION — DISTRICT – BARAN

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 97% of the total district area indicating that, by and large the ground water in this district is suitable for domestic purpose. The areas with moderately high concentration (1.5 – 3.0 mg/l) are shown in green color, largely northeastern part of the district. There is no area that had shown very high fluoride concentration in ground water.

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)
	Antah		Atru		Baran		Chhabra		Chhipabarod		Kishanganj		Shahbad		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<1.5	1,032.7	100.0	946.2	100.0	638.8	100.0	798.9	100.0	684.2	100.0	1,444.7	100.0	1,180.0	83.1	6,725.5
1.5-3.0	-	-	-	-	-	-	-	-	-	-	-	-	240.4	16.9	240.4
Total	**1,032.7**	**100.0**	**946.2**	**100.0**	**638.8**	**100.0**	**798.9**	**100.0**	**684.2**	**100.0**	**1,444.7**	**100.0**	**1,420.4**	**100.0**	**6,965.9**

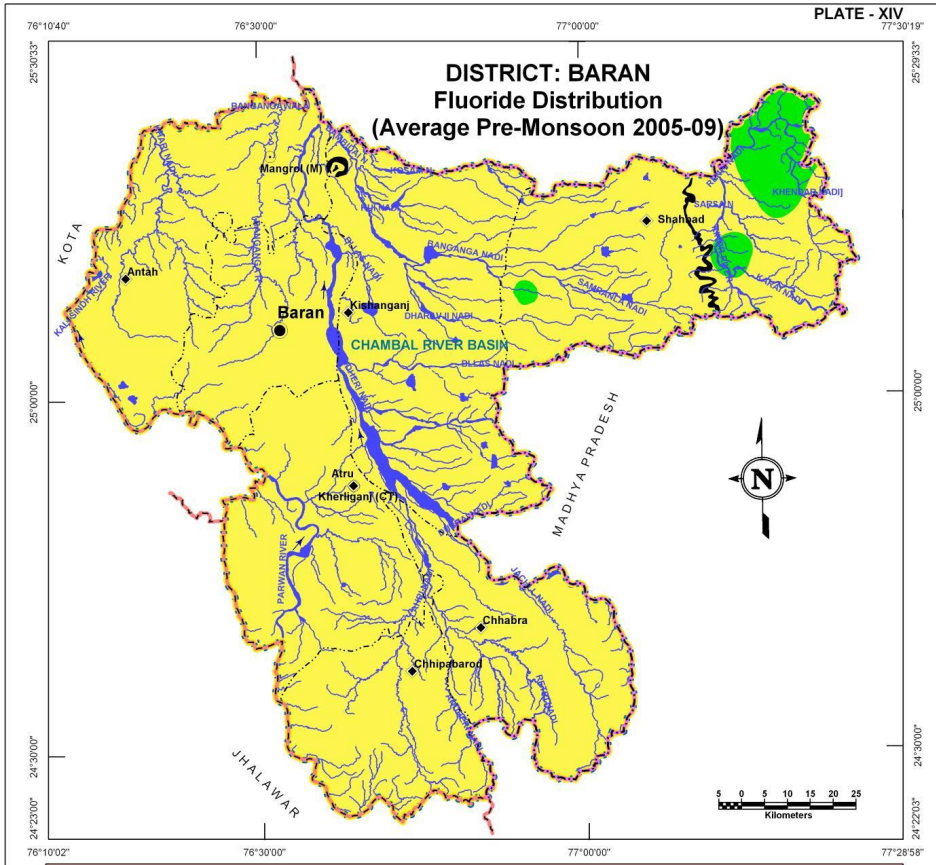
GROUND WATER NITRATE DISTRIBUTION

Plate XV shows distribution of Nitrate in ground water. Low nitrate concentration (<50 mg/l) is shown in yellow color and occupies approximately 77% 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 19% of the district area, largely in eastern part of Chhabra and around Kishanganj, Mangrol and Atru. That leaves only about 4% of the district area that has high nitrate concentration (>100 mg/l) which is shown in red colored patches, largely northern part of Atru and eastern part of Kishanganj where the ground water is not suitable for agriculture.

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)
	Antah		Atru		Baran		Chhabra		Chhipabarod		Kishanganj		Shahbad		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<50	825.6	79.9	674.4	71.3	500.3	78.4	656.7	82.2	551.0	80.5	883.3	61.1	1,283.0	90.3	**5,374.3**
50-100	205.3	19.9	224.4	23.7	101.2	15.8	142.2	17.8	132.8	19.4	423.3	29.3	129.0	9.1	**1,358.2**
>100	1.8	0.2	47.4	5.0	37.3	5.8	-	-	0.4	0.1	138.1	9.6	8.4	0.6	**233.4**
Total	**1,032.7**	**100.0**	**946.2**	**100.0**	**638.8**	**100.0**	**798.9**	**100.0**	**684.2**	**100.0**	**1,444.7**	**100.0**	**1,420.4**	**100.0**	**6,965.9**

PLATE - XIV



LEGEND

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

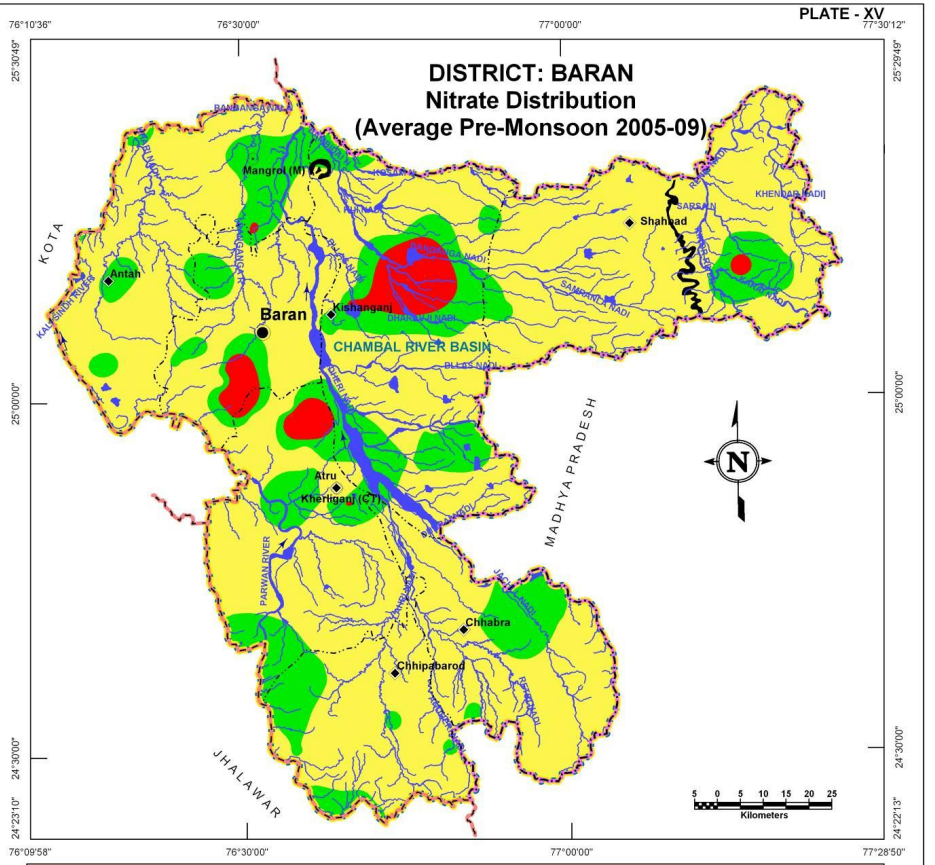
Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Fluoride Concentration (mg/l):
- < 1.5
- 1.5-3.0

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

Nitrate Concentration (mg/l):
- < 50
- 50-100
- >100

ROLTA
Rolta India Limited

DEPTH TO BEDROCK

DISTRICT – BARAN

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, Shale and Basalt. Depth to bedrock map of Baran district (Plate – XVI) reveals that occurrence of bedrock at very shallow depth less than 20m below ground level in major part of the district excluding in the southwestern and northwestern parts of the district where the depth to bedrock varies from 20m bgl to 40m bgl. The maximum depth of bedrock (more than 40m bgl) found in Antru block.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)														Total Area (sq km)
	Antah		Atru		Baran		Chhabra		Chhipabarod		Kishanganj		Shahbad		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
<20	519.0	50.3	205.2	21.7	603.3	94.4	612.4	76.7	192.2	28.0	1,239.6	85.8	1,420.4	100.0	**4,792.1**
20-40	513.7	49.7	712.5	75.3	35.5	5.6	186.5	23.3	492.0	72.0	205.1	14.2	-	-	**2,145.3**
>40	-	-	28.5	3.0	-	-	-	-	-	-	-	-	-	-	**28.5**
Total	**1,032.7**	**100.0**	**946.2**	**100.0**	**638.8**	**100.0**	**798.9**	**100.0**	**684.2**	**100.0**	**1,444.7**	**100.0**	**1,420.4**	**100.0**	**6,965.9**

UNCONFINED AQUIFER

Alluvial areas

Aquifer formed from alluvial materials covers only 327 sq km and mainly concentrated on Baran block and a very limited presence has observed in Antah and Atru block. The thickness of alluvial zone is less than 10 meter.

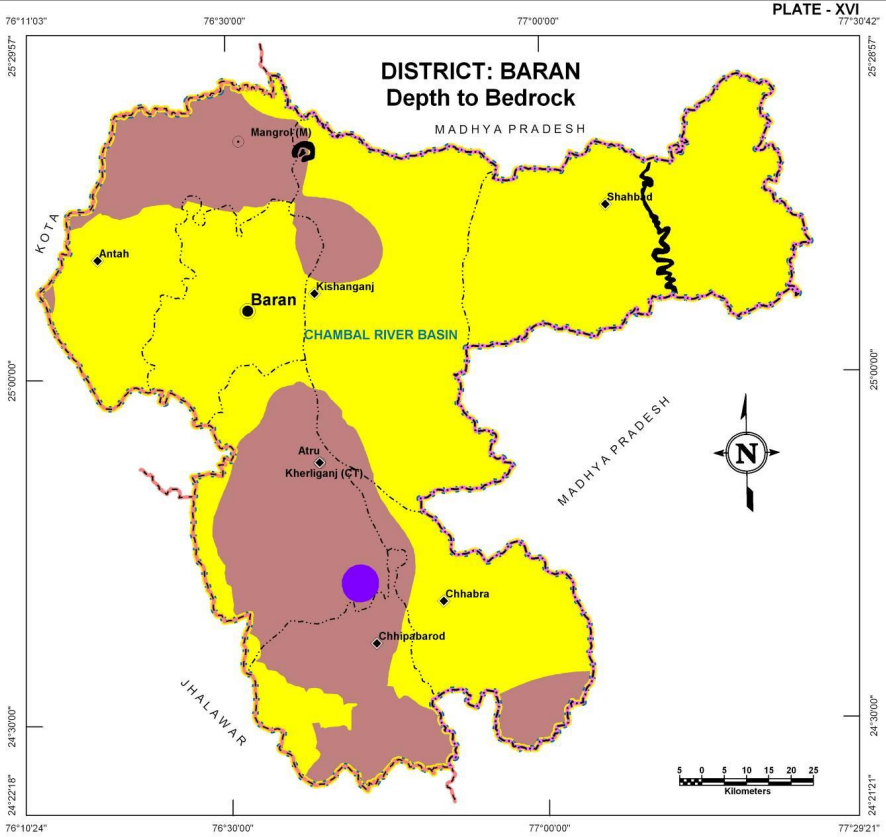
Unconfined aquifer Thickness (m)	District Area (sq km) coverage							Total Area (sq km)
	Antah	Atru	Baran	Chhabra	Chhipabarod	Kishanganj	Shahbad	
< 10	27.6	9.9	283.4	-	-	6.0	-	**326.9**
Total	**27.6**	**9.9**	**283.4**	**-**	**-**	**6.0**	**-**	**326.9**

Hardrock areas

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 20m covering almost entire parts of the district. Central part of Atru and a small sport in Antah block have weathered/fractured hardrock thickness upto 20m.

Unconfined aquifer Thickness (m)	District Area (sq km) coverage							Total Area (sq km)
	Antah	Atru	Baran	Chhabra	Chhipabarod	Kishanganj	Shahbad	
< 10	1,004.6	796.7	355.4	798.9	684.2	1,438.7	1,420.4	**6,498.9**
> 10	0.5	139.6	-	-	-	-	-	**140.1**
Total	**1,005.1**	**936.3**	**355.4**	**798.9**	**684.2**	**1,438.7**	**1,420.4**	**6,639.0**

PLATE - XVI



LEGEND

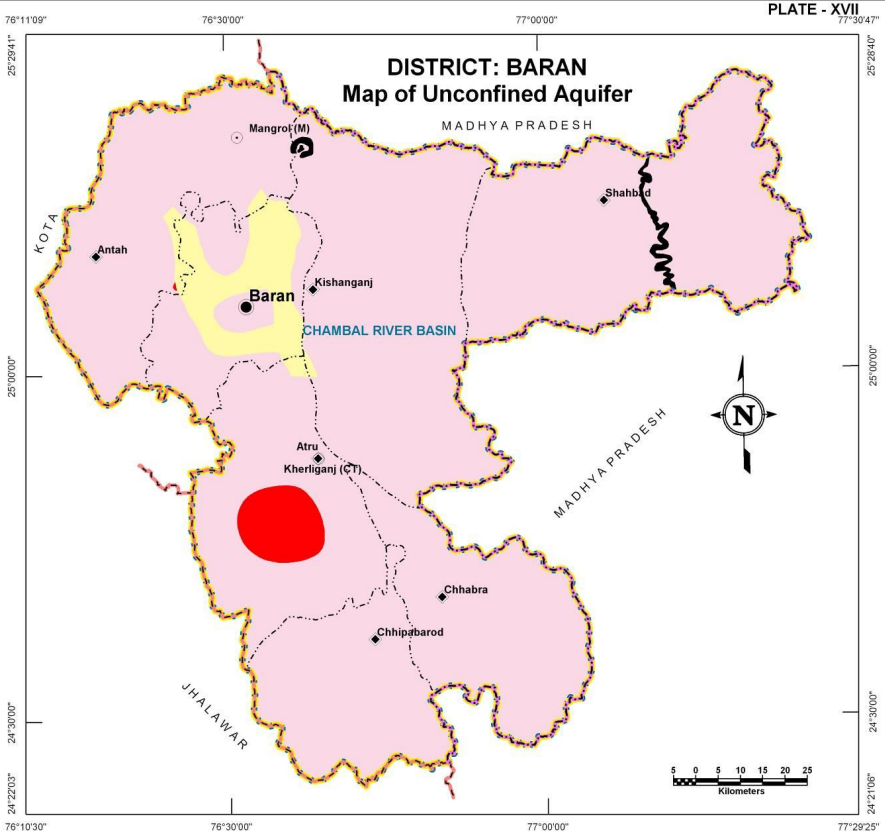
Admin Boundary:

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

Depth to Bedrock (mg/l):

- <20
- 20-40
- >40

PLATE - XVII



LEGEND

Admin Boundary:

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

Aquifer Thickness(m):

Alluvial Areas	Weathered & Fractured Zone in Hardrock Area
<10	<10
	>10

Glossary of terms

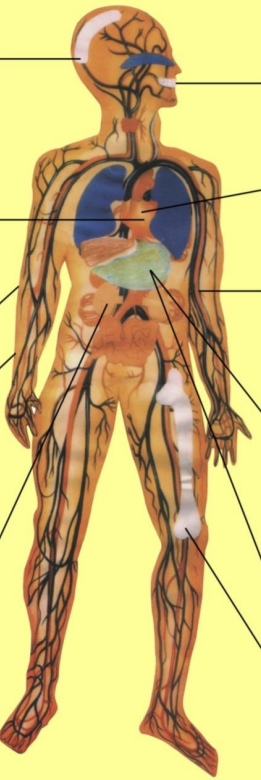
S. No.	Technical Terms	Definition
1	AQUIFER	A saturated geological formation which has good permeability to supply sufficient quantity of water to a Tube well, well or spring.
2	ARID CLIMATE	Climate characterized by high evaporation and low precipitation.
3	ARTIFICIAL RECHARGE	Addition of water to a 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.
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
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e-mail:cgwbwr@sancharnet.in

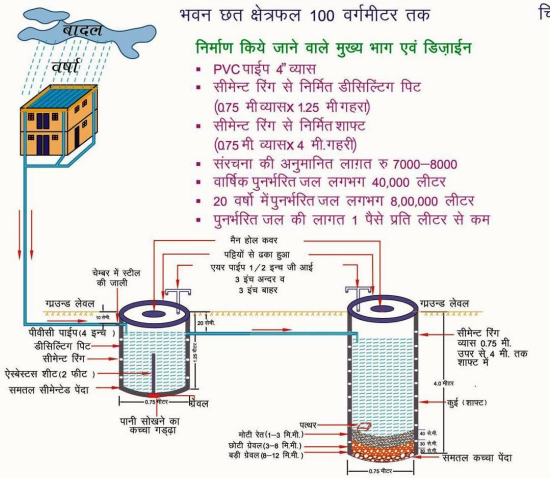
भूजल अमूल्य है इसे प्रदूषित न करें।

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

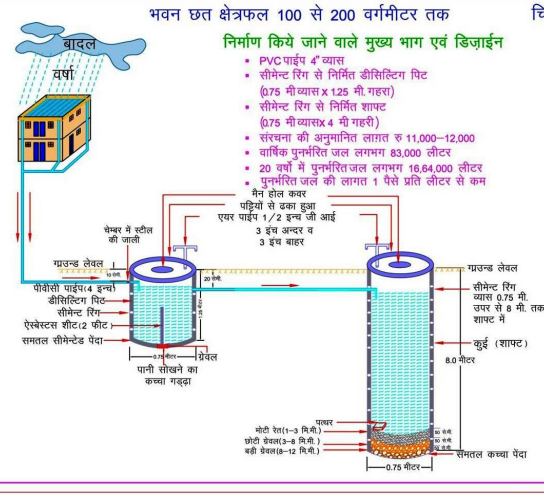


चित्र–2

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

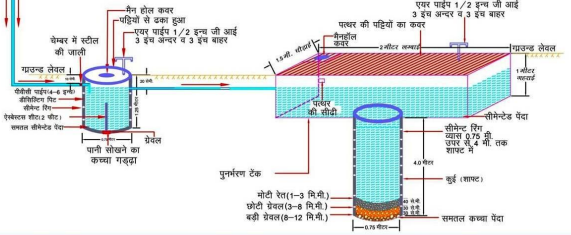


चित्र–3

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

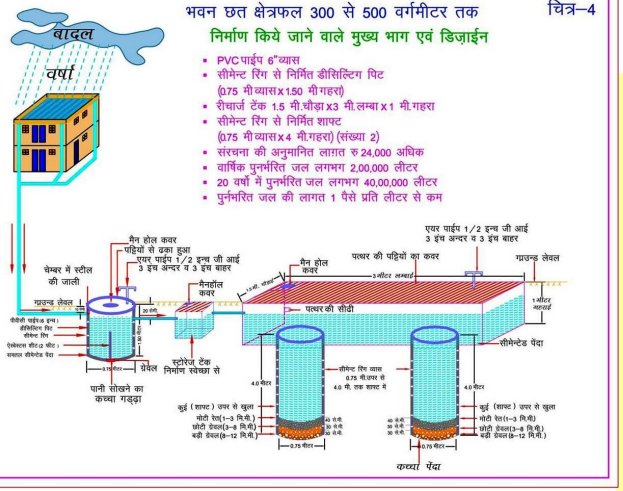


चित्र–4

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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