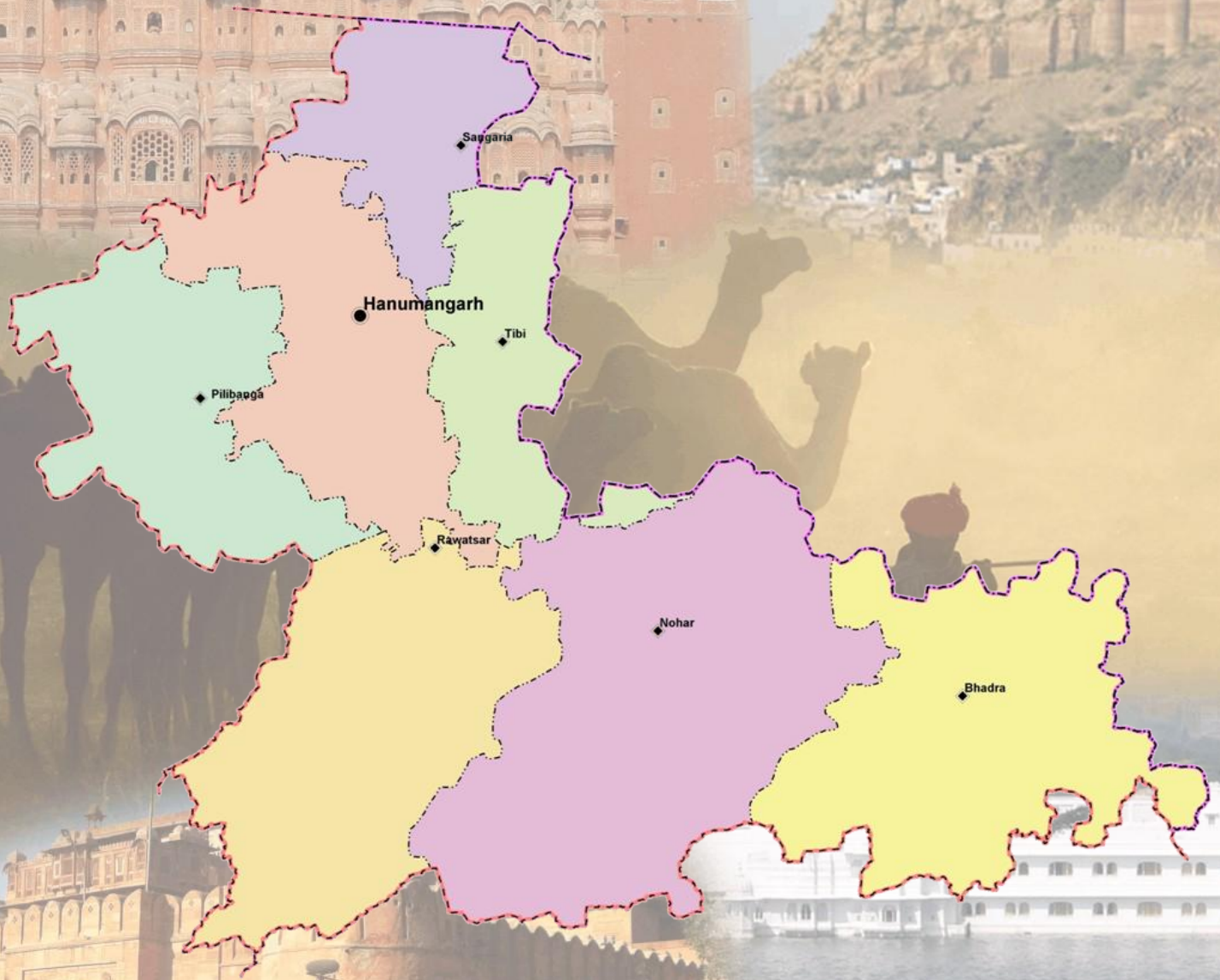
Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan

Hanumangarh District

European Union
State Partnership Programme



2013

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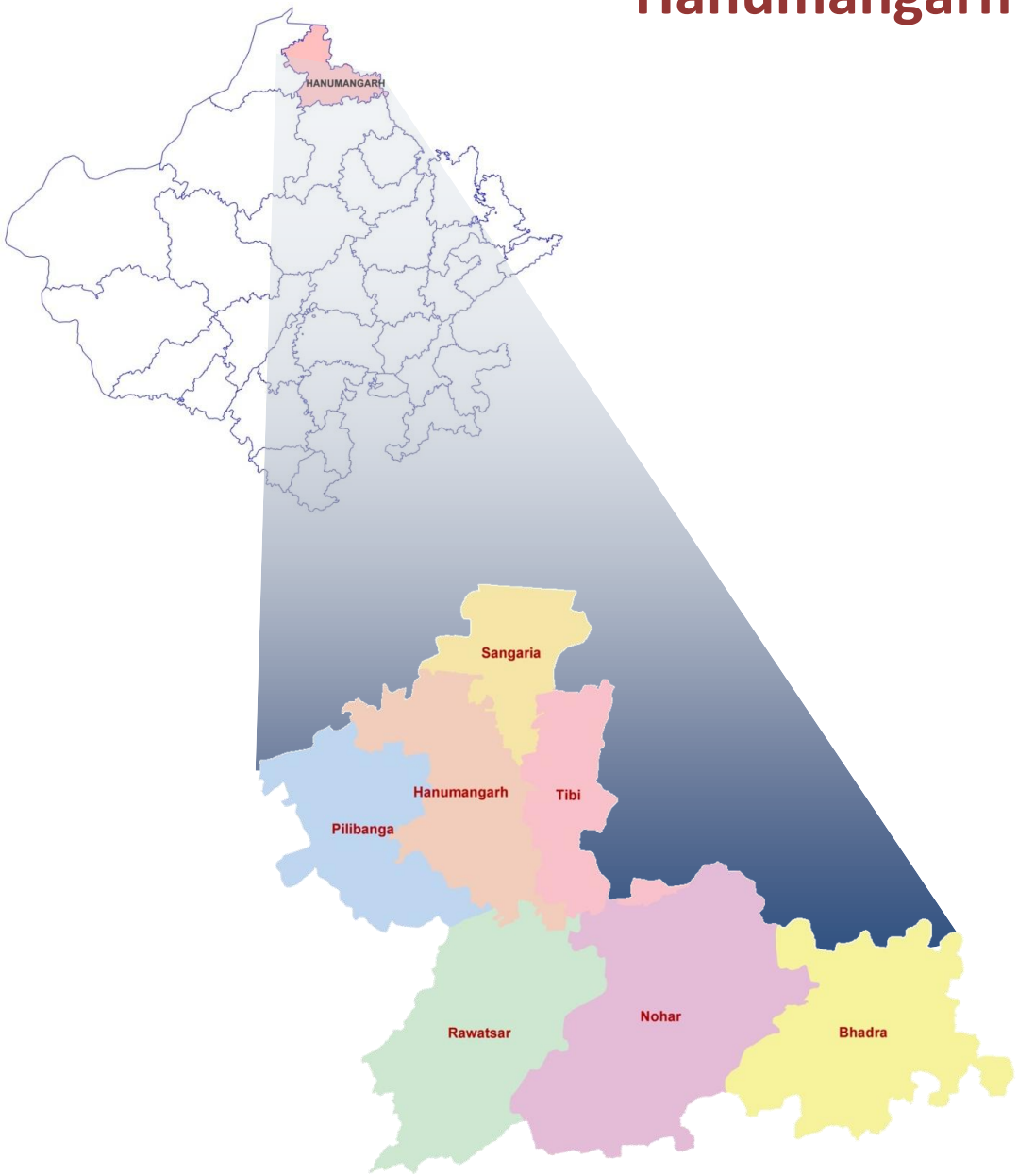
Hydrogeological Atlas of Rajasthan

Hanumangarh District



Contents:

2013

ADMINISTRATIVE SETUP

DISTRICT – HANUMANGARH

Location:

Hanumangarh district is located in the northern part of Rajasthan. It is bounded in the north and east by states of Punjab and Haryana, in the south by Churu district and by Bikaner and Ganganagar districts in the west. It stretches between 28° 46' 25.07" to 29° 57' 26.90" north latitude and 73° 47' 41.74'' to 75° 31' 58.70'' east longitude covering area of 9,929.3 sq kms. This district does not have a systematically evolved drainage system and forms part of an 'Outside' Basin. The only known river in the district is Ghaghar River that flows near the city of Hanumangarh.

Administrative Set-up:

Hanumangarh 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	Bhadra	2,55,723	1,737.3	17.0	215
2	Hanumangarh	3,31,994	1,273.1	13.0	362
3	Nohar	2,67,000	2,432.9	25.0	225
4	Pilibanga	2,10,872	1,195.8	12.0	352
5	Rawatsar	1,69,458	1,768.2	18.0	316
6	Sangaria	1,41,580	711.4	7.0	187
7	Tibi	1,41,378	810.6	8.0	254
	Total	**15,18,005**	**9,929.3**	**100.0**	**1,911**

Hanumangarh district has 1,911 town and villages, of which seven are block headquarters as well.

Climate:

The climate of the district is largely arid, that turns extremely hot during the summer and extremely cold during winter. The maximum average temperature ranges between 18°C to 48°C and minimum average between 2°C to 28°C. The annual rainfall gradually decreases from southern part to northern part. 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. Average annual rainfall of the district is 303.0 mm. Months between November and February are cold as winter season sets in with very cold nights and low day temperatures.

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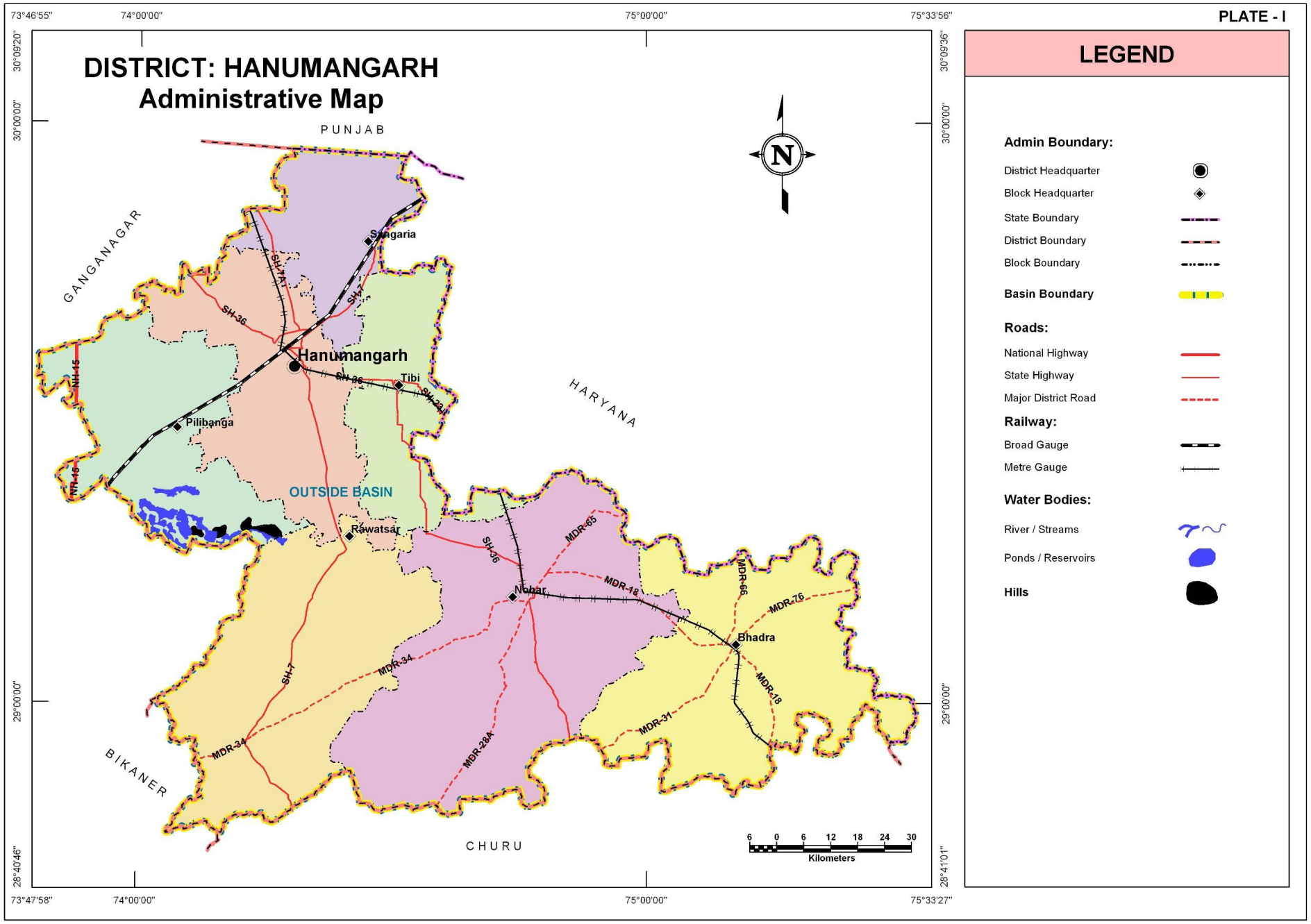
PLATE - I



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- 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 – HANUMANGARH

The whole district is an undulating plain covered with a thick layer of wind-blown sand which forms the part of the Great Indian Thar Desert. Northwestern parts of this district have broader plains and southeastern part of this district has comparatively more hilly. The Ghaggar River is the only major river in the district which locally known as Ghaggar Nala. Elevation ranges from a minimum of 164.1m above mean sea level in Pilibanga block in western part of the district and highest elevation of 239m found in Rawatsar block in northwestern part of the district The sand dunes are generally 4 to 5 metres high except in the south western part where they are more intensely developed, being sometimes 10 to 15 metres in height.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
1	Bhadra	189.4	225.4
2	Hanumangarh	169.0	209.1
3	Nohar	180.2	221.4
4	Pilibanga	164.1	221.3
5	Rawatsar	170.7	239.0
6	Sangaria	169.8	202.1
7	Tibi	179.6	210.4

RAINFALL

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 500-600mm in year 2010 except Pilibanga. The average annual rainfall was 528.6 mm based on the data of available blocks while highest average annual rainfall is 648.1 mm in Bhadra block. Lowest annual rainfall was seen in Sangaria block (368.5 mm). Bhadra block has received highest maximum annual rainfall of about 736.7 mm. The district apparently had received more than the average rainfall in most parts of the district in the year 2010.

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)
Bhadra	554.4	736.7	648.1
Hanumangarh	410.5	546.4	507.1
Nohar	502.5	648.4	557.2
Pilibanga	442.4	530.7	485.3
Rawatsar	519.2	620.3	554.1
Sangaria	368.5	529.5	435.1
Tibi	468.4	536.4	513.4

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PLATE - II

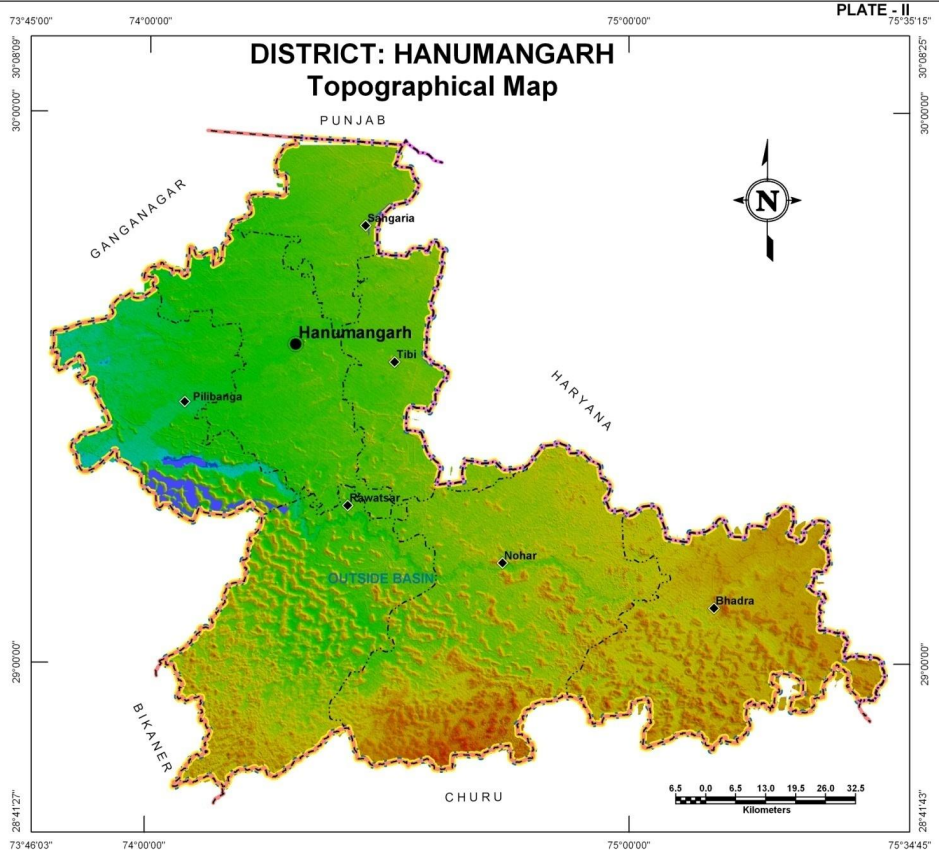
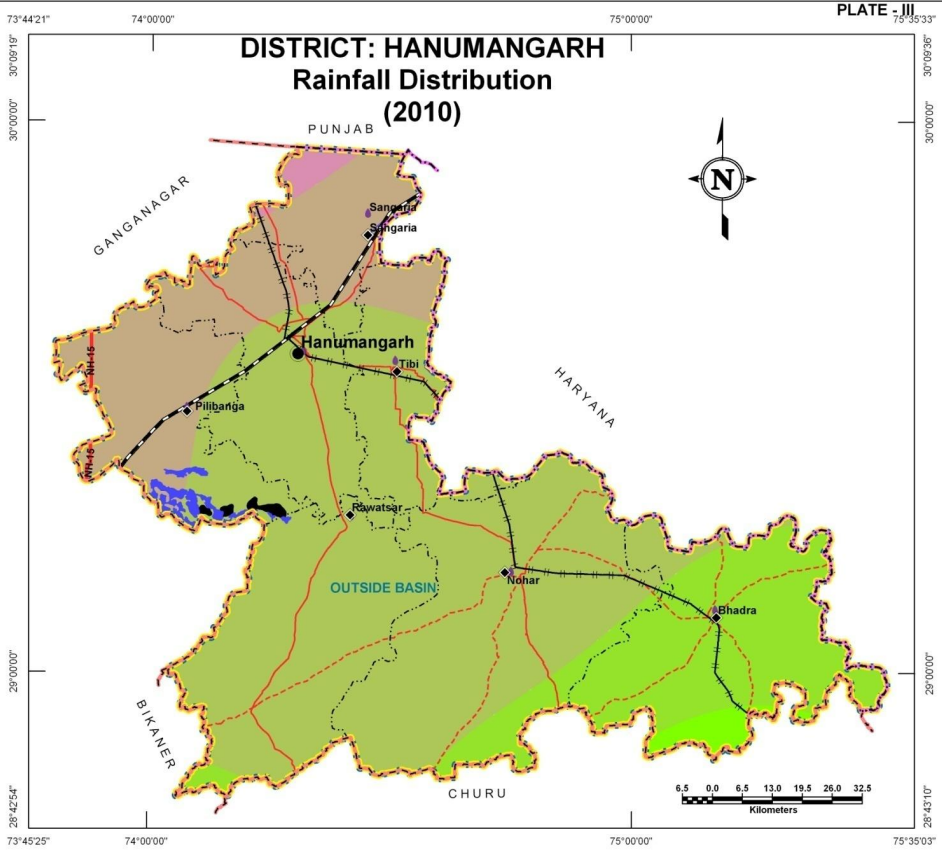


PLATE - III



LEGEND

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

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation (m amsl):

239
230
220
210
200
190
180
170
164

Source : SRTM DEM

LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- 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):
- 300-400
- 400-500
- 500-600
- 600-700
- 700-800

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GEOLOGY

DISTRICT – HANUMANGARH

Surface geology is marked by a thick cover of blown sand and alluvium except for a few isolated patches of Recent calcareous and sandy sediments. However, the sub surface geology built up with the help of data obtained from dug wells reveal that the oldest rocks in the area belong to the Aravalli Super Group which includes phyllite, shale and quartz veins. These are overlain by the rocks of upper Vindhyans which are entirely made up of bright to pale red, fine and medium grained, compact sandstone and siltstone which are seen in dug wells near Dalenan, Jaitsar, Pichgarain and many other places. The wind-blown sand of Recent to sub-Recent periods is mainly consists of quartz with minor biotite and magnetite. Gypsite rich beds are found in shallow depression surrounded by sand dunes.

Age	Group	Formation
Recent to Sub-recent	Recent to Sub-recent	Blown sand, alluvium, isolated calcareous and sandy sediments associated with gypsite

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

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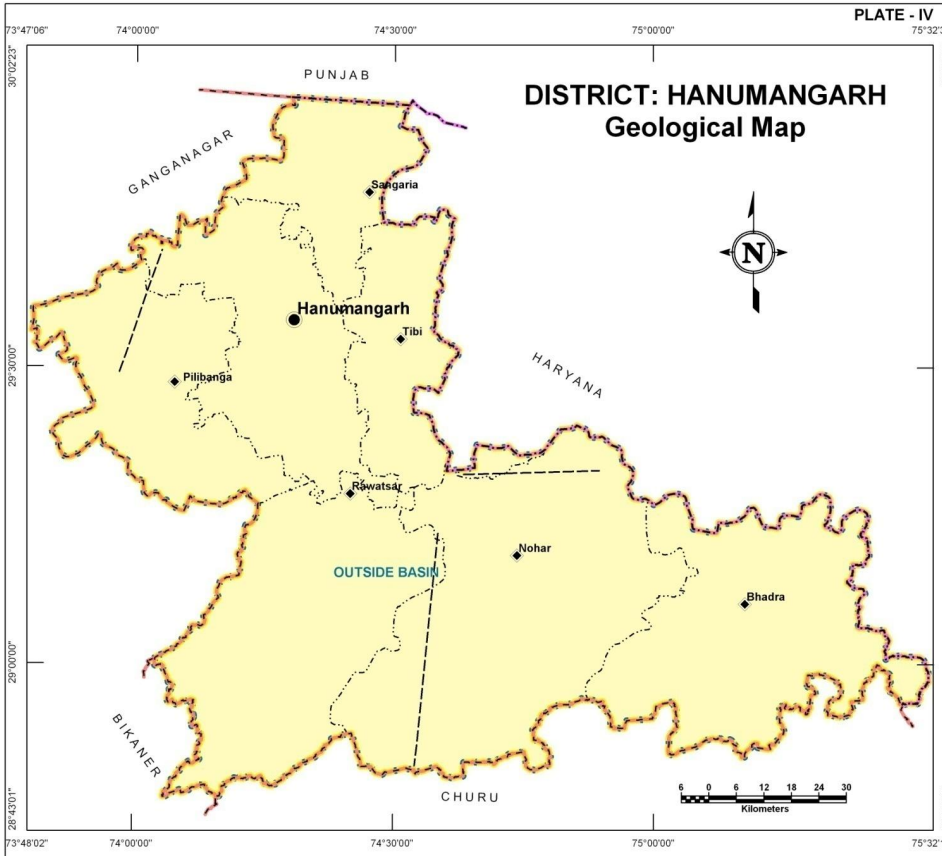
PLATE - IV



LEGEND

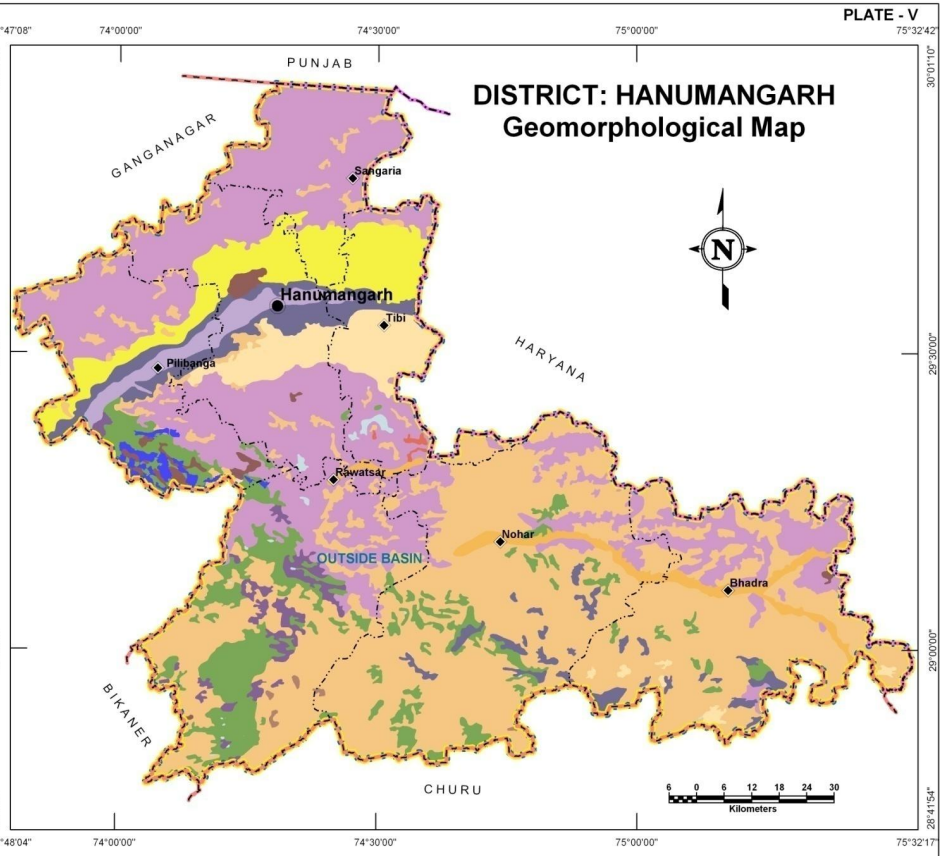
Admin Boundary:
- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

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
- 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
- Waterlogged Area
- Ravine

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

Denudational Origin:
- Burried Pediment

Structural Origin:
- Dissected Plateau

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

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AQUIFERS

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 as top layer followed by thick alluvium whereas the Older alluvium is more of fluvial origin. More than 77% of the aquifer area is Younger alluvium and the Older alluvium accounts for another 22.5% of aquifer area. About 20 sq km area is covered by low hills.

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	7,674.9	77.3	It is largely constituted of Aeolian and Fluvial sand, silt, clay, gravel and pebbles in varying proportions.
Older Alluvium	2,234.8	22.5	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Hills	19.6	0.2	
Total	**9,929.3**	**100.0**	

STAGE OF GROUND WATER DEVELOPMENT

Ground water resource assessment studies reveal that all the blocks in the district fall within 'Safe' category from the stage of development perspective. Less than 70% of the available ground water resources have been developed so far and there is potential for further development. Water quality maps however reveal the limited spatial extent of fresh water areas where further development is possible and also the fact that the area primarily being arid and dunal in nature, agriculture potential is also very limited.

Categorization on the basis of stage of development of ground water	Block Name
Safe	Tibi, Bhadra, Nohar, Rawatsar, Pilibanga, Hanumangarh, Sangaria

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

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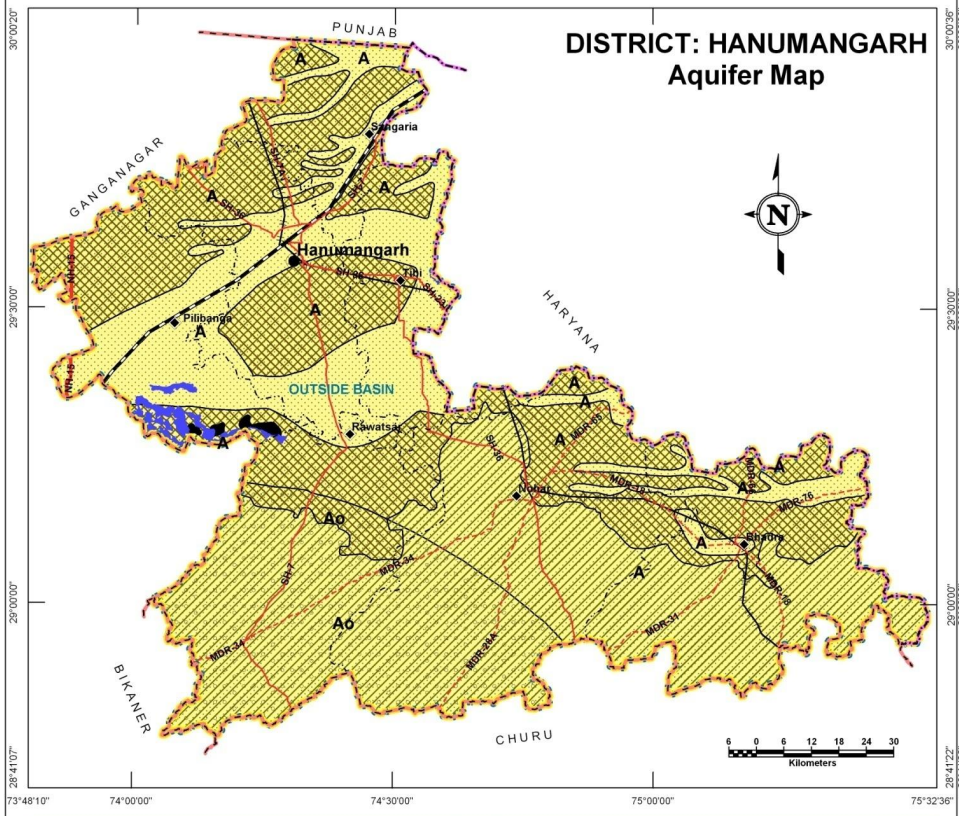
PLATE - VI

DISTRICT: HANUMANGARH
Aquifer Map



LEGEND

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

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

Railway:
- Broad Gauge
- Metre Gauge

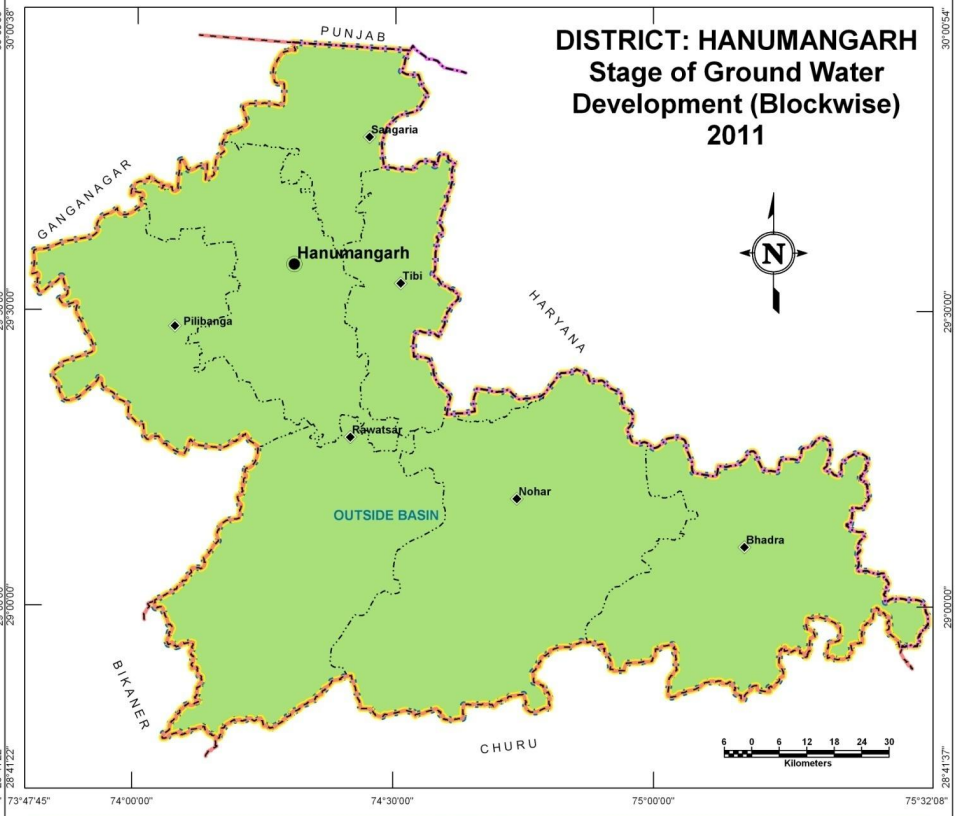
Water Bodies:
- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Command Area**
- **Saline Area**

Aquifer:
- Younger Alluvium
- Older Alluvium

Source: Ground Water Potential Zone Map - GWD, Rajasthan

PLATE - VII

DISTRICT: HANUMANGARH
Stage of Ground Water Development (Blockwise) 2011



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- 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 – HANUMANGARH

Hanumangarh district has a well distributed network of exploratory wells (36) and ground water monitoring stations (158) in the district owned by RGWD (28 and 113 respectively) and CGWB (8 and 45 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 30 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
Bhadra	1	5	**6**	4	25	**29**	0	2
Hanumangarh	4	5	**9**	14	22	**36**	0	2
Nohar	1	7	**8**	5	19	**24**	0	7
Pilibanga	1	1	**2**	3	11	**14**	0	5
Rawatsar	1	3	**4**	12	13	**25**	0	10
Sangaria	-	6	**6**	1	16	**17**	0	3
Tibi	-	1	**1**	6	7	**13**	0	1
Total	**8**	**28**	**36**	**45**	**113**	**158**	**0**	**30**

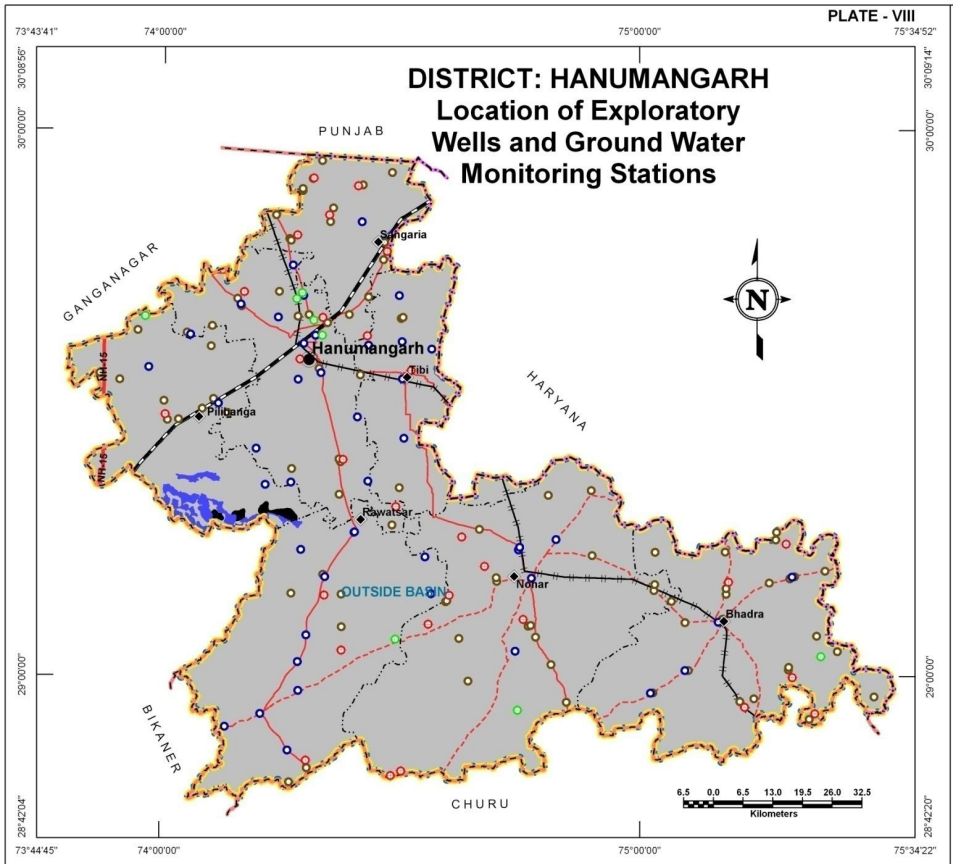
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

10m interval has been adopted to depict the depth to ground water levels in Hanumangarh district as shown in Plate – IX. The aquifers formed in alluvium show the depth to water level variation from less than 10m below ground level to more than 50m bgl. Central part of the district i.e., the Hanumangarh-Pilibanga-Rawatsar-Nohar region shows shallow water levels of less than 10m and also in isolated patches in Bhadra, Nohar and Tibi regions. Southwards, the water level is quite deep around (40-50m bgl) in Nohar and Rawatsar blocks, the deepest water level is seen in the extreme southwestern part of the district in Rawatsar.

Depth to water level range (m bgl)	Block wise area coverage (sq km) *							Total Area (sq km)
	Bhadra	Hanumangarh	Nohar	Pilibanga	Rawatsar	Sangaria	Tibi	
< 10	124.8	421.8	6.7	99.3	464.8	150.4	240.9	**1,508.7**
10-20	1,608.2	474.1	1,328.9	746.5	305.1	434.6	515.0	**5,412.4**
20-30	4.2	377.2	884.9	330.5	301.2	126.5	54.7	**2,079.2**
30-40	-	-	-	-	-	-	-	**-**
40-50	-	-	212.3	-	657.2	-	-	**869.5**
> 50	-	-	-	-	39.9	-	-	**39.9**
Total	**1,737.2**	**1,273.1**	**2,432.8**	**1,176.3**	**1,768.2**	**711.5**	**810.6**	**9,909.7**

* 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
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

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

Railway:
- Broad Gauge
- Metre Gauge

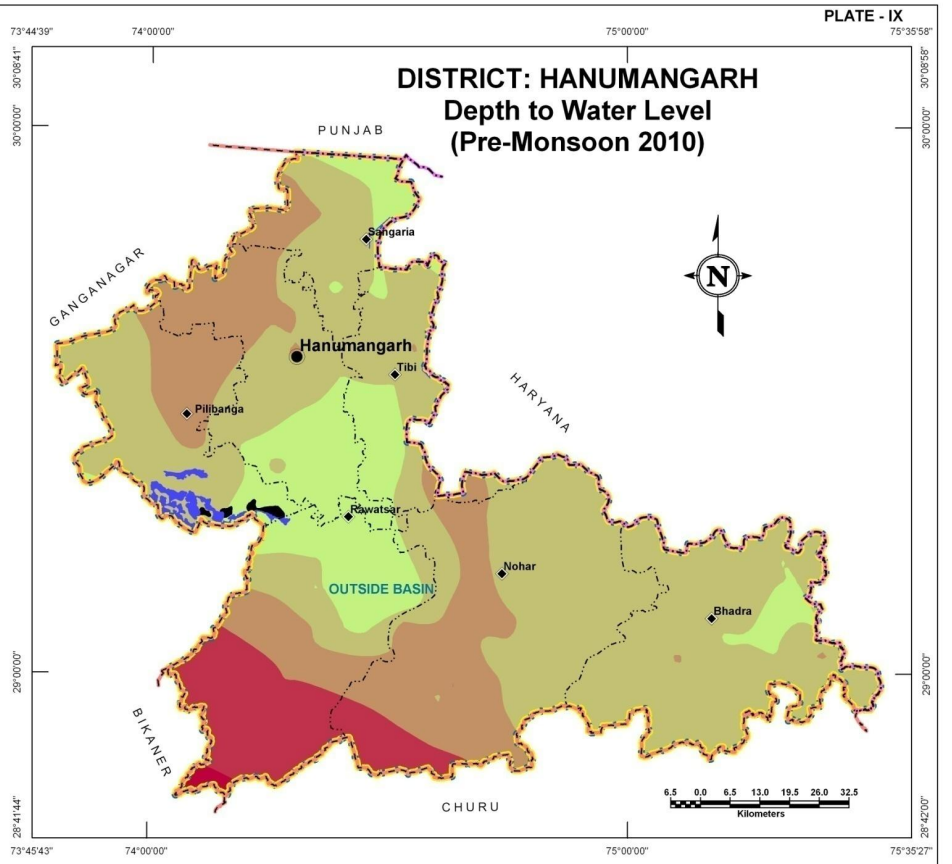
Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Exploratory Wells:
- CGWB
- RGWD

Ground Water Monitoring Stations:
- CGWB
- RGWD

PLATE - IX



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- 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

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

The district constitutes part of the Great Indian Thar Desert. The eastern part of the district shows higher elevations and western part lower elevations as a result the regional ground water flow direction is from east to west and then towards northwest and southwest. The highest water table elevation of >200m amsl is noticed in the easternmost part of the district in Bhadra Block whereas minimum elevation (<160m amsl) in the Pilibanga, Hanumangarh and Rawatsar blocks in the northwestern and southwestern parts of the district respectively. The general water table elevation in the district is between 160 to 200m amsl in the district that is a variation of just 40m.

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

Water table elevation Range (amsl)	Block wise area coverage (sq km)							Total Area (sq km)
	Bhadra	Hanumangarh	Nohar	Pilibanga	Rawatsar	Sangaria	Tibi	
< 160	-	369.8	-	689.5	586.3	54.6	26.8	**1,727.0**
160 - 180	-	849.0	1,823.0	486.8	1,086.0	458.3	506.5	**5,209.6**
180 - 200	1,641.5	54.3	609.8	-	95.9	198.6	277.3	**2,877.4**
> 200	95.7	-	-	-	-	-	-	**95.7**
Total	**1,737.2**	**1,273.1**	**2,432.8**	**1,176.3**	**1,768.2**	**711.5**	**810.6**	**9,909.7**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

Plate – XI presents water level fluctuation map for the district at 2m interval. It reveals a fall of 6 m in one area and rise in other areas by 6m. The –ve fluctuation areas (indicated by pink and red regions) occupy large areas in central, northern and southern parts of the district which indicate extraction exceeding the monsoon recharge to ground water. 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. Maximum rise is by more than 6m as noticed in southern part of Hanumangarh block north of hills.

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)
	Bhadra	Hanumangarh	Nohar	Pilibanga	Rawatsar	Sangaria	Tibi	
< -6	-	-	-	-	4.4	-	-	**4.4**
-6 to -4	15.0	-	34.2	-	41.9	-	-	**91.1**
-4 to -2	87.6	38.5	227.5	21.7	160.9	9.8	51.8	**597.8**
-2 to 0	869.1	649.1	1,086.2	505.5	1,130.7	437.9	545.8	**5,224.3**
0 to 2	756.4	441.9	825.6	570.0	409.2	263.8	213.0	**3,479.9**
2 to 4	9.1	80.8	233.3	60.2	21.1	-	-	**404.5**
4 to 6	-	46.8	26.0	18.9	-	-	-	**91.7**
> 6	-	16.0	-	-	-	-	-	**16.0**
Total	**1,737.2**	**1,273.1**	**2,432.8**	**1,176.3**	**1,768.2**	**711.5**	**810.6**	**9,909.7**

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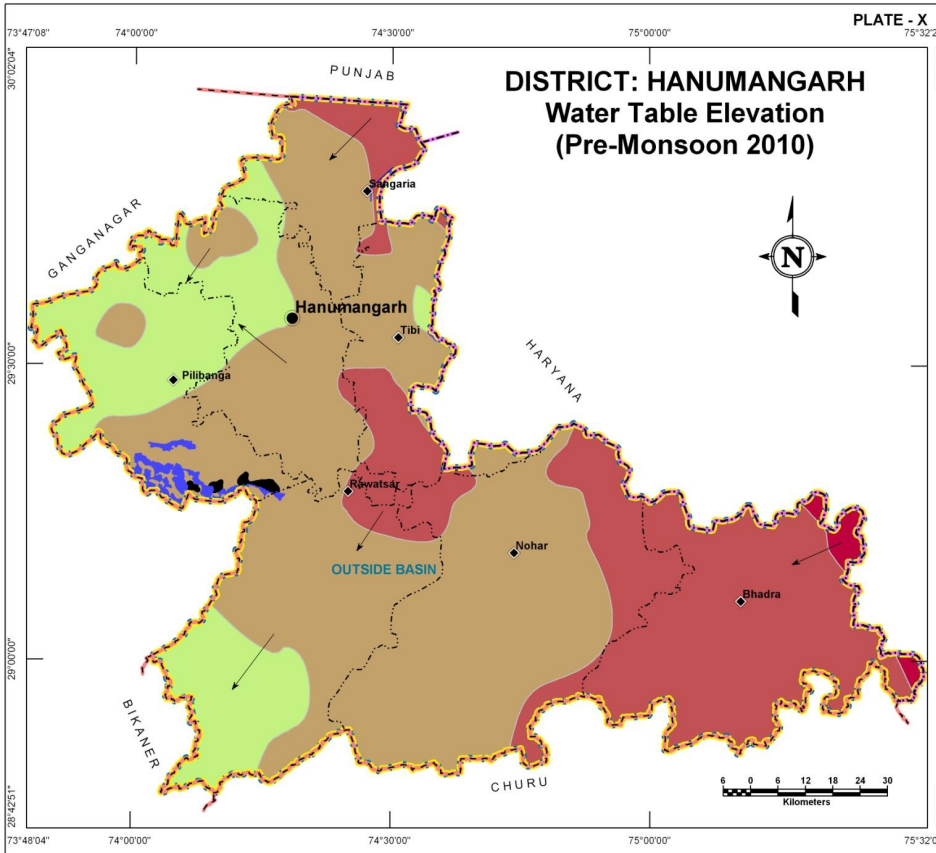
PLATE - X



LEGEND

Admin Boundary:

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

Basin Boundary

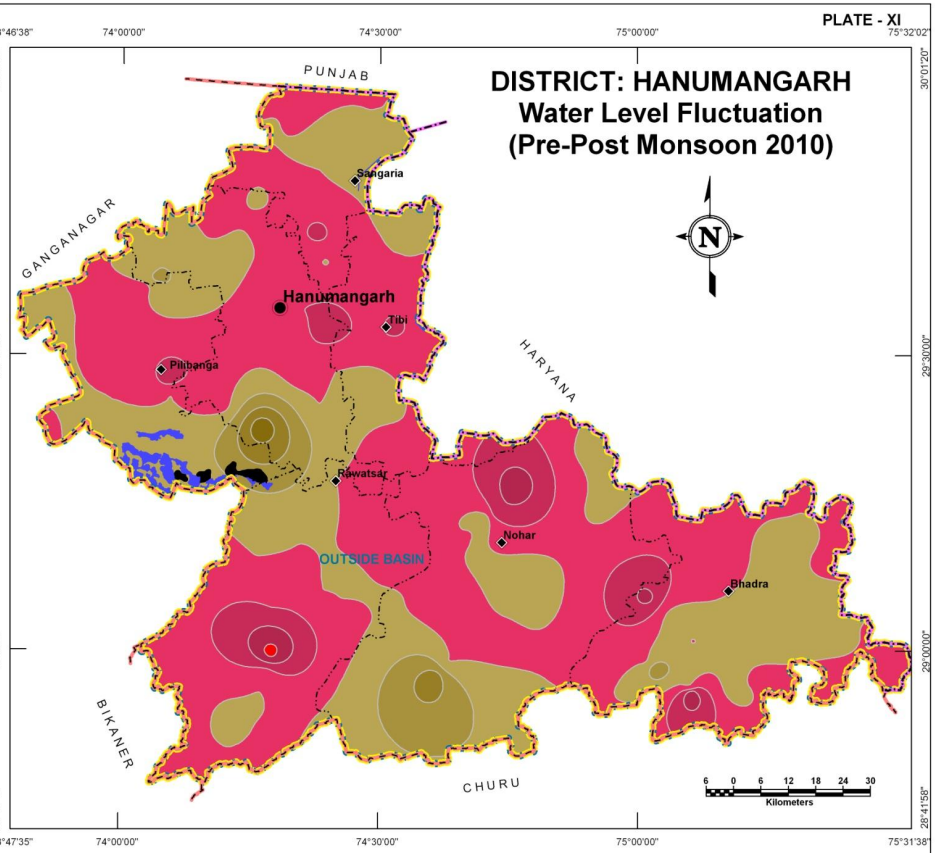
Water Bodies:

- River / Streams
- Ponds / Reservoirs
- Hills
- Water Table Elevation

Water Table Elevation (m amsl):

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

PLATE - XI



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- 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

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Rolta India Limited

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION DISTRICT – HANUMANGARH

The Electrical conductivity (at 25°C) distribution map is presented in Plate – XII. The areas with moderately high EC values in ground water (2000 – 4000 µS/cm) are shown in green colors which occupy about 40% of the district area. The areas with low EC values (<2000 µS/cm) are shown in yellow color and occupy approximately 34% of the district area. The water in this region is suitable for domestic purpose. Remaining part of the district has the high EC values (>4000µS/cm) are shown in red color and occupies approximately 26% of the district area, largely around Sangaria, Rawatsar, Nohar and Bhadra where the ground water is not 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)
	Bhadra		Hanumangarh		Nohar		Pilibanga		Rawatsar		Sangaria		Tibi		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 2000	537.3	30.9	601.6	47.3	1315.5	54.1	358.1	30.4	194.4	11	31	4.4	286.1	35.3	**3,324.0**
2000-4000	434.7	25	502.2	39.5	776.7	31.9	709.2	60.3	1006.9	57	243.3	34.2	329	40.6	**4,002.0**
>4000	765.2	44.1	169.3	13.2	340.6	14	109	9.3	566.9	32	437.2	61.4	195.5	24.1	**2,583.7**
Total	**1,737.2**	**100.0**	**1,273.1**	**100.0**	**2,432.8**	**100.0**	**1,176.3**	**100.0**	**1,768.2**	**100.0**	**711.5**	**100.0**	**810.6**	**100.0**	**9,909.7**

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) occupied approximately 69% of the district area. The area with high chloride concentration (>1000 mg/l) which is shown in red color occupies approximately 20% of the district area, largely around Sangaria, Rawatsar, Nohar and Bhadra. The ground water in this region is not suitable for domestic purpose. Remaining part of the district area has low chloride concentration (< 250 mg/l) which is shown in yellow color and occupying only 16% of the district area, largely around Hanumangarh and Tibi. The ground water in this region is suitable for domestic purpose. By and large the ground water in whole of the district is unsuitable 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)
	Bhadra		Hanumangarh		Nohar		Pilibanga		Rawatsar		Sangaria		Tibi		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 250	158.8	9.0	247.9	19.5	370.4	15.2	43.3	4.0	82.6	4.7	0.7	-	225.0	28.0	**1,128.7**
250-1000	781.0	45.0	918.1	72.0	1,738.8	71.5	1,110.5	94.0	1,424.6	80.6	401.3	56.0	416.2	51.0	**6,790.5**
> 1000	797.4	46.0	107.1	8.5	323.6	13.3	22.5	2.0	261.0	14.7	309.5	44.0	169.4	21.0	**1,990.5**
Total	**1,737.2**	**100.0**	**1,273.1**	**100.0**	**2,432.8**	**100.0**	**1,176.3**	**100.0**	**1,768.2**	**100.0**	**711.5**	**100.0**	**810.6**	**100.0**	**9,909.7**

PLATE - XII

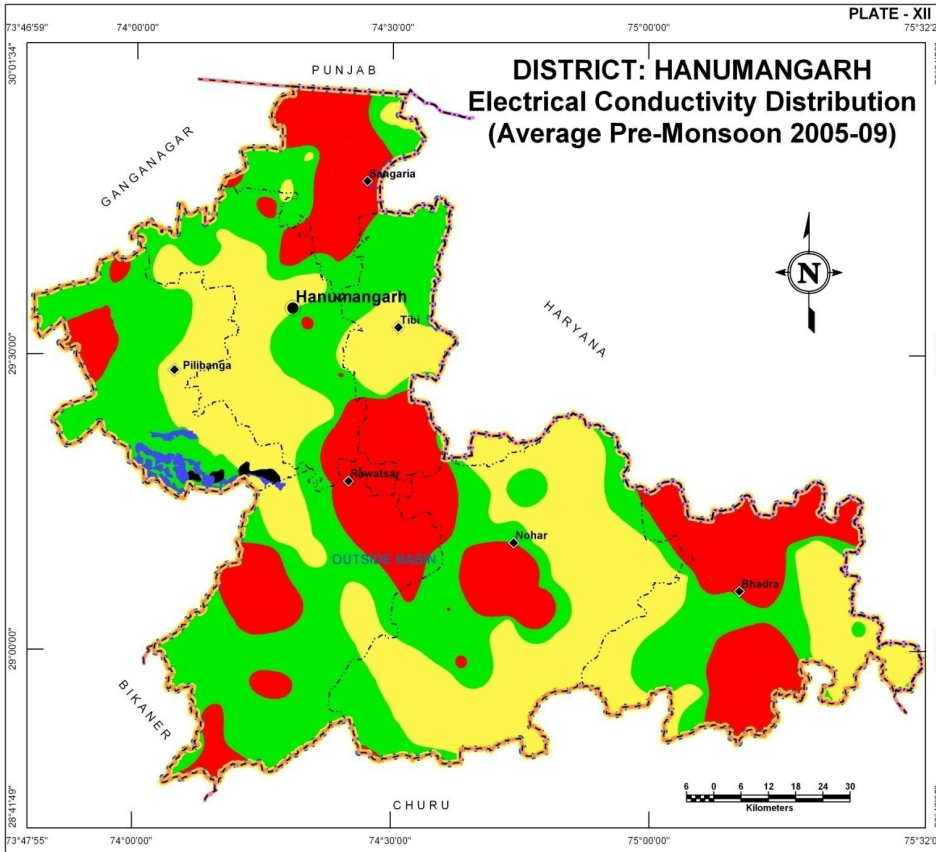
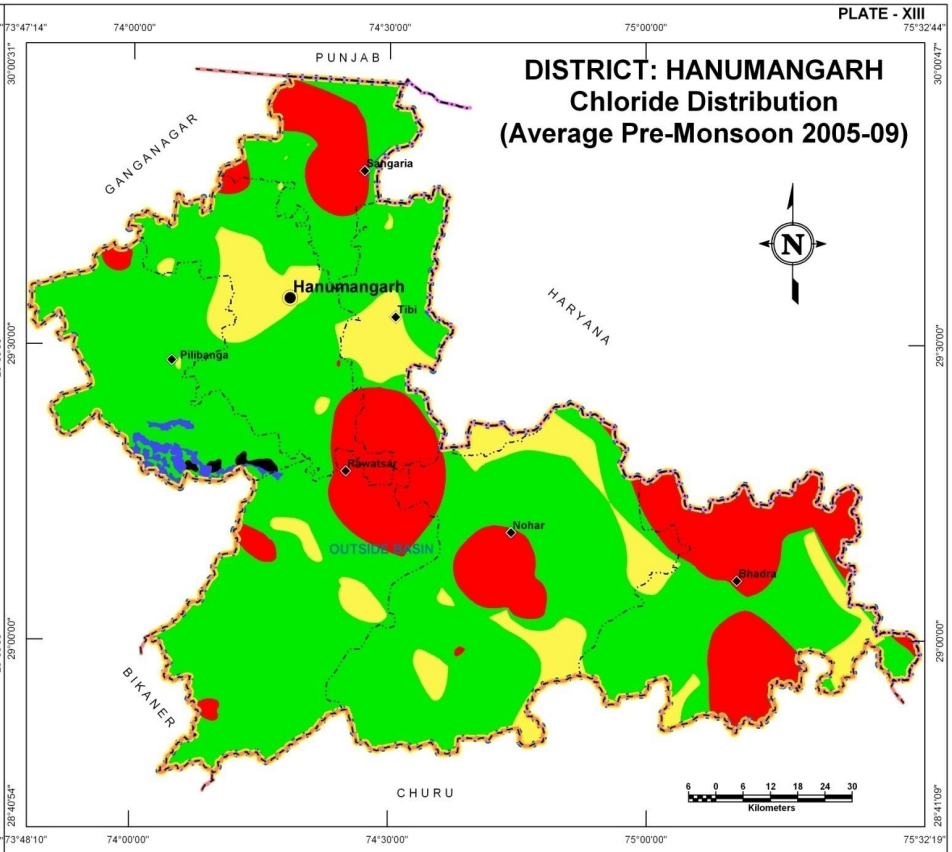


PLATE - XIII



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- 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

LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- 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 – HANUMANGARH

The Fluoride concentration map is presented in Plate – XIV. The areas with moderately high fluoride concentration (1.5-3.0 mg/l) are shown in green color and the areas with high fluoride concentration (i.e., >3.0 mg/l) area is shown with red color, largely in the central and southern parts of the district which together account for about 44% area. The ground water in this region is not recommended for domestic usage. The areas with low concentration (i.e., <1.5 mg/l) are shown in yellow color and occupy approximately 56% of the district area which is 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)
	Bhadra		Hanumangarh		Nohar		Pilibanga		Rawatsar		Sangaria		Tibi		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 1.5	1,452.8	83.6	713.9	56.1	1,166.2	47.9	823.4	70	528	29.9	550.7	77.4	318.1	39.3	**5,553.1**
1.5-3.0	283.6	16.3	337.7	26.5	731.5	30.1	334.5	28.4	657.7	37.2	154.4	21.7	319.5	39.4	**2,818.9**
> 3.0	0.8	0.1	221.5	17.4	535.1	22	18.4	1.6	582.5	32.9	6.4	0.9	173	21.3	**1,537.7**
Total	**1,737.2**	**100.0**	**1,273.1**	**100.0**	**2,432.8**	**100.0**	**1,176.3**	**100.0**	**1,768.2**	**100.0**	**711.5**	**100.0**	**810.6**	**100.0**	**9,909.7**

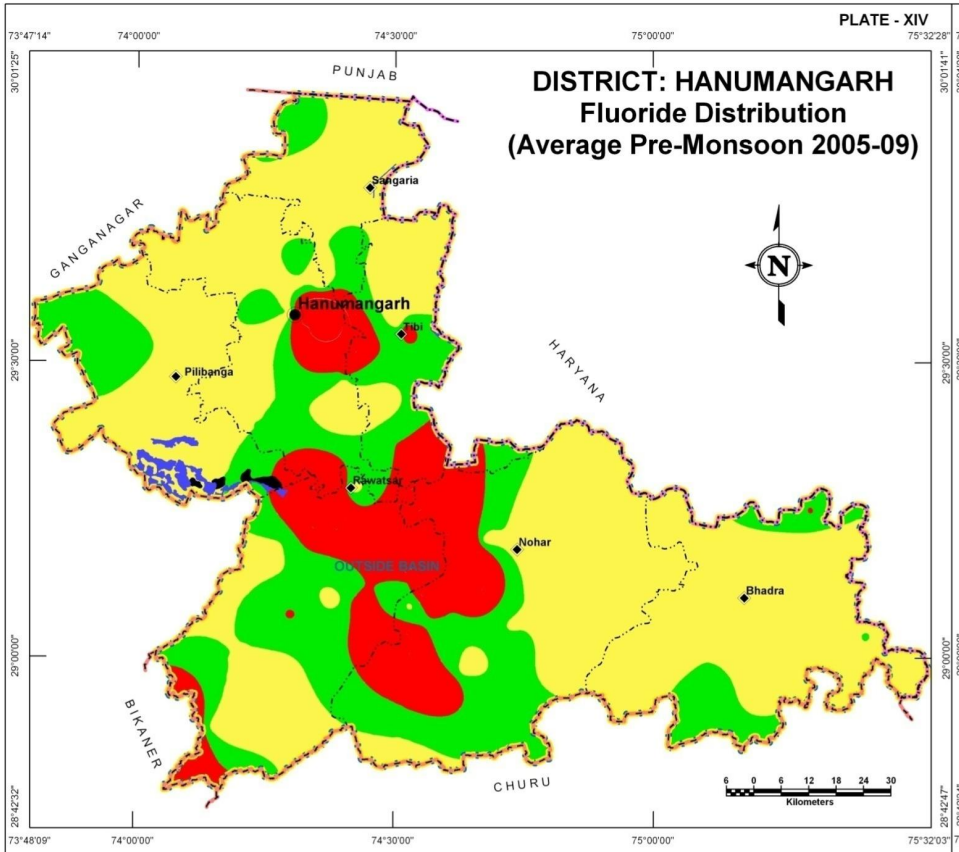
GROUND WATER NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate – XV shows distribution of Nitrate in ground water. The high nitrate concentration (>100 mg/l) is shown in red color and occupies approximately 50% of the district area. The ground water in this region 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 35% of the district area and together with high Nitrate concentration areas about 85% of the district area has ground water that is not recommended for cropping. The area with low concentration (<50 mg/l) in yellow color patches scattered largely central parts of the district where the ground water is suitable for agriculture purpose.

Table: Block wise area of Nitrate distribution

Nitrate concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)														Total Area (sq km)
	Bhadra		Hanumangarh		Nohar		Pilibanga		Rawatsar		Sangaria		Tibi		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	306.8	17.7	282.0	22.2	24.7	1.0	241.8	20.5	87.5	5.0	90.7	12.7	386.1	47.6	**1,419.6**
50-100	625.7	36.0	689.4	54.1	722.0	29.7	604.5	51.4	152.7	8.6	381.1	53.6	327.0	40.3	**3,502.4**
>100	804.7	46.3	301.7	23.7	1,686.1	69.3	330.0	28.1	1,528.0	86.4	239.7	33.7	97.5	12.1	**4,987.7**
Total	**1737.2**	**100.0**	**1273.1**	**100.0**	**2432.8**	**100.0**	**1176.3**	**100.0**	**1768.2**	**100.0**	**711.5**	**100.0**	**810.6**	**100.0**	**9,909.7**

PLATE - XIV



LEGEND

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

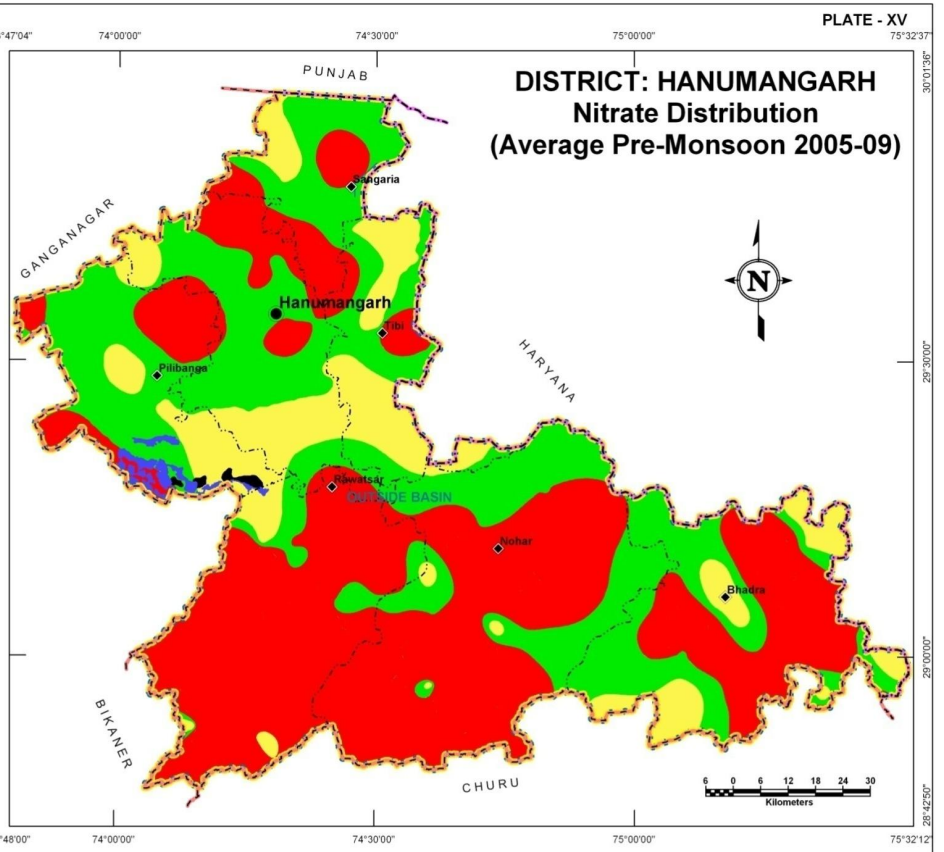
Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

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

PLATE - XV



LEGEND

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

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

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

DEPTH TO BEDROCK

DISTRICT – HANUMANGARH

The thick alluvial deposits are underlain by bedrock of different lithology and age as mentioned in geological map section. Plate – XVI depicts the distribution of bedrock depth from at least 100 meter below ground level. The beginning of massive bedrock has been considered for defining top of bedrock surface. These rocks are overlain by alluvial and aeolian deposits of sand, clay, silt and admixture of these in different proportions and thicknesses. The deepest bedrock (more than 160m bgl) is encountered in southern parts of Nohar block and southwestern part of Bhadra block. Moderately deep bedrock (120 – 140m bgl) is most common and spread all over the district suggesting a relatively flat bedrock surface.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)														Total Area (sq km)
	Bhadra		Hanumangarh		Nohar		Pilibanga		Rawatsar		Sangaria		Tibi		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 100	-	-	-	-	12.2	0.5	-	-	-	-	-	-	-	-	**12.2**
100-120	54.4	3.1	-	-	251.4	10.3	-	-	-	-	-	-	-	-	**305.8**
120-140	1,526.3	87.9	1,273.1	100.0	1,897.5	78.0	1,009.2	85.8	1,768.2	100.0	711.5	100.0	810.6	100.0	**8,996.4**
140-160	141.3	8.1	-	-	245.1	10.1	167.1	14.2	-	-	-	-	-	-	**553.5**
> 160	15.2	0.9	-	-	26.6	1.1	-	-	-	-	-	-	-	-	**41.8**
Total	**1,737.2**	**100.0**	**1,273.1**	**100.0**	**2,432.8**	**100.0**	**1,176.3**	**100.0**	**1,768.2**	**100.0**	**711.5**	**100.0**	**810.6**	**100.0**	**9,909.7**

UNCONFINED AQUIFER

The entire district has thick cover of both Younger and Older alluvium. In unconfined conditions the alluvial aquifer attains a thickness of more than 110m forming a very productive water bearing horizon in the entire district. Perusal of Plate – XVII reveals that the thickness of unconfined aquifer varies from less than 10 m to more than 120m with the thickest zone lying in the easternmost part of the district in Bhadra block. Rest of the blocks have moderate to low thickness of aquifers in alluvium under unconfined condition less than 90m thickness. The general thickness of the district is upto 70m bgl. The lower thickness of saturated alluvium found in the isolated locations of Bhadra, Hanumangarh, Nohar and Sangaria blocks with less than 10m thickness. 86% of the district aquifers have their thicknesses ranging between 10m to 50ms.

Unconfined Aquifer Thickness (m)	Block wise area coverage (sq km)							Total Area (sq km)
	Bhadra	Hanumangarh	Nohar	Pilibanga	Rawatsar	Sangaria	Tibi	
< 10	45.4	13.1	256.4	-	81.7	5.6	-	**402.2**
10-20	430.9	25.2	261.2	-	666.5	38.4	-	**1422.2**
20-30	469.8	96.1	603.9	0.4	470.4	124.2	36.5	**1801.3**
30-40	227.3	744.1	1,128.3	322.9	388.3	450.8	375.2	**3636.9**
40-50	142.0	277.0	142.7	606.3	73.9	76.0	398.9	**1716.8**
50-60	94.4	88.8	25.4	194.8	33.5	16.5	-	**453.4**
60-70	84.5	28.8	9.7	51.6	26.4	-	-	**201**
70-80	95.9	-	4.4	0.3	16.6	-	-	**117.2**
80-90	67.2	-	0.8	-	9.2	-	-	**77.2**
90-100	41.0	-	-	-	1.7	-	-	**42.7**
100-110	35.0	-	-	-	-	-	-	**35**
> 110	3.8	-	-	-	-	-	-	**3.8**
Total	**1,737.2**	**1,273.1**	**2,432.8**	**1,176.3**	**1,768.2**	**711.5**	**810.6**	**9,909.7**

Ground Water Department,
Rajasthan

European Union
State Partnership Programme

PLATE - XVI

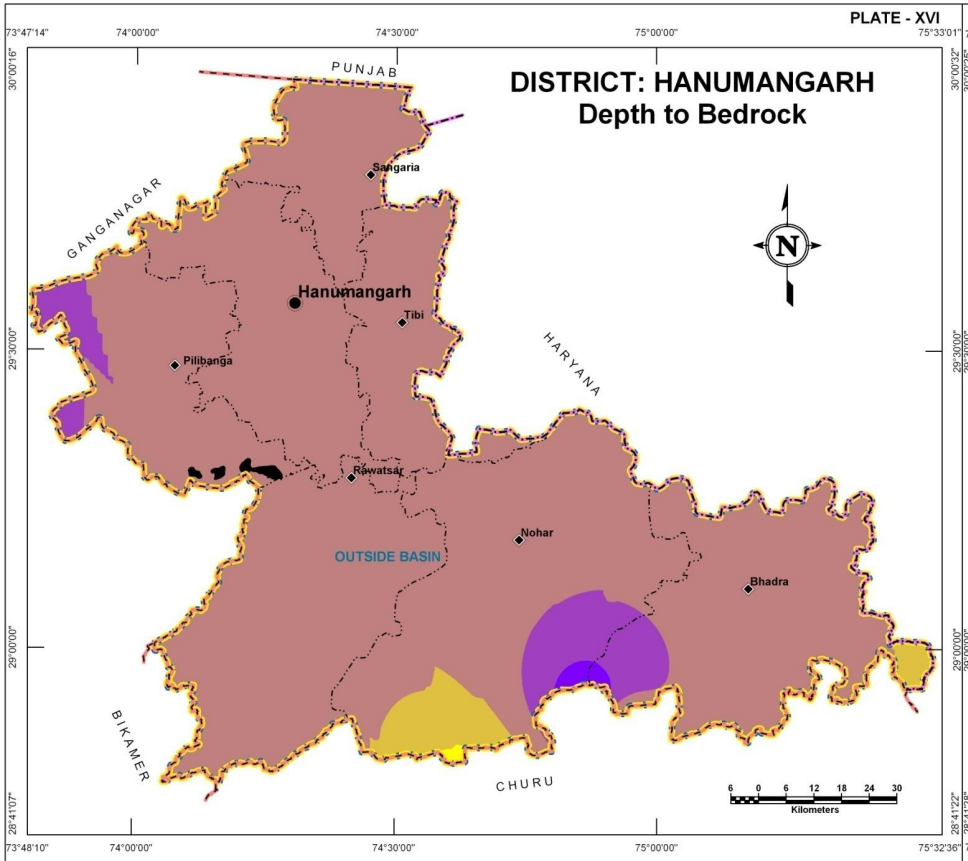
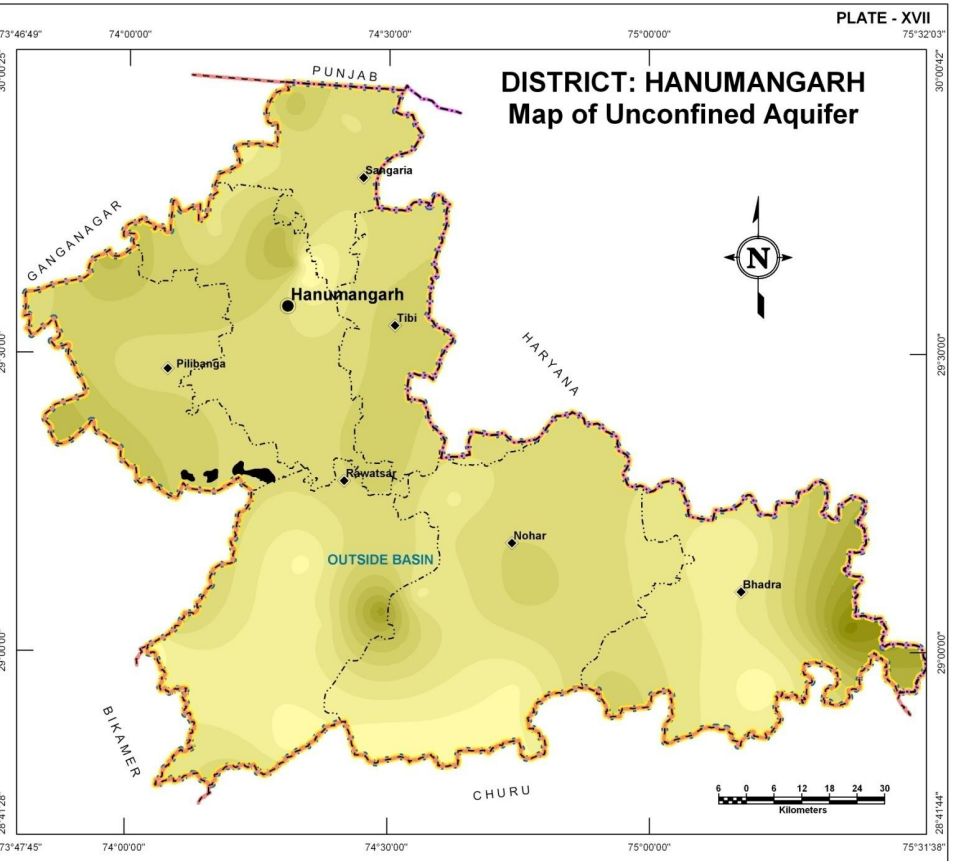


PLATE - XVII



LEGEND

Admin Boundary:

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

Basin Boundary

Hills

Depth to Bedrock(m bgl):

- <100
- 100-120
- 120-140
- 140-160
- >160

LEGEND

Admin Boundary:

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

Basin Boundary

Hills

Aquifer Thickness (m):

Alluvial Area

- <10
- 10-20
- 20-30
- 30-40
- 40-50
- 50-60
- 60-70
- 70-80
- 80-90
- 90-100
- 100-110
- >110

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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.

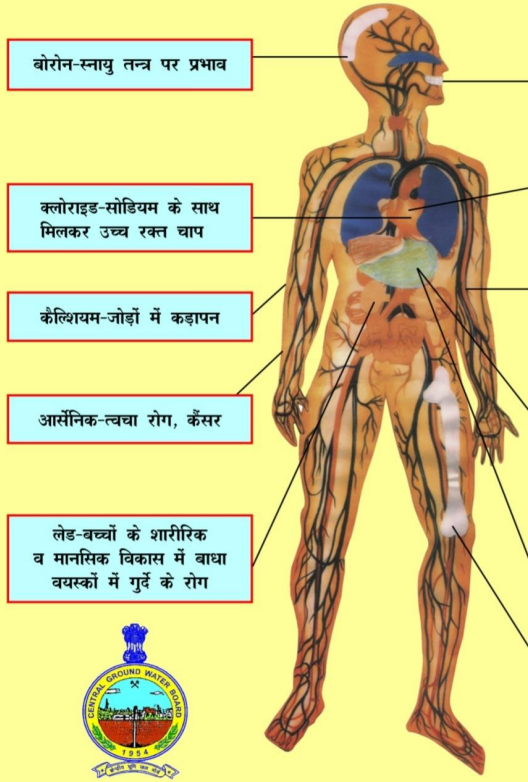
(Contd…)

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
- 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

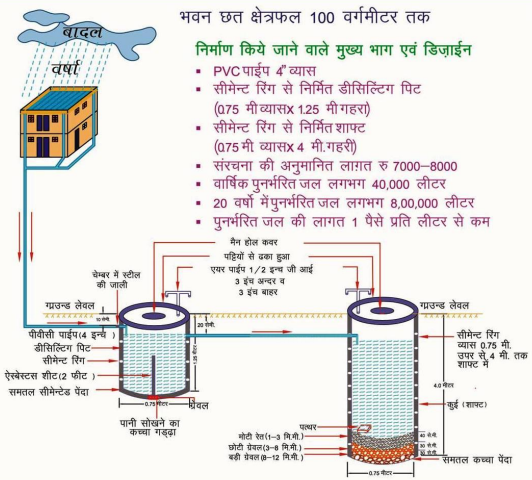
भूजल अमूल्य है इसे प्रदूषित न करें।

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 लागत 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

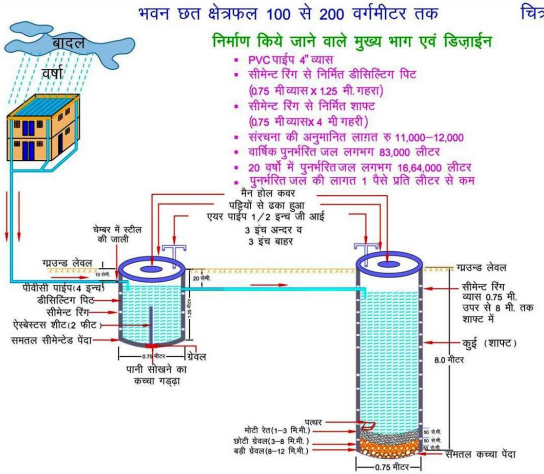


चित्र–2

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 लागत 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

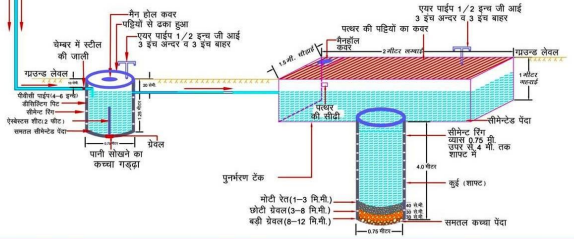


चित्र–3

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 लागत 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

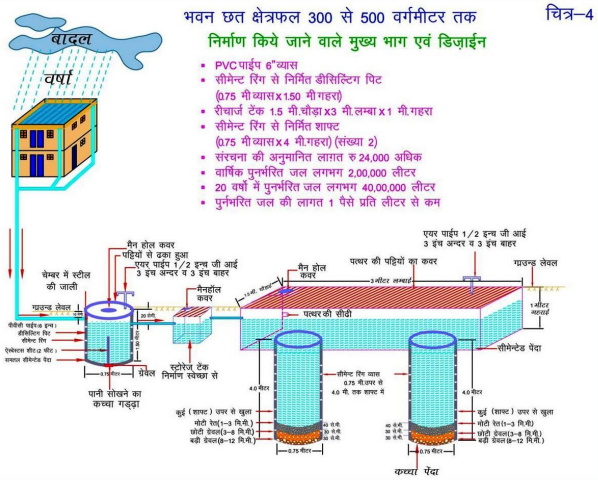


चित्र–4

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 लागत 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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