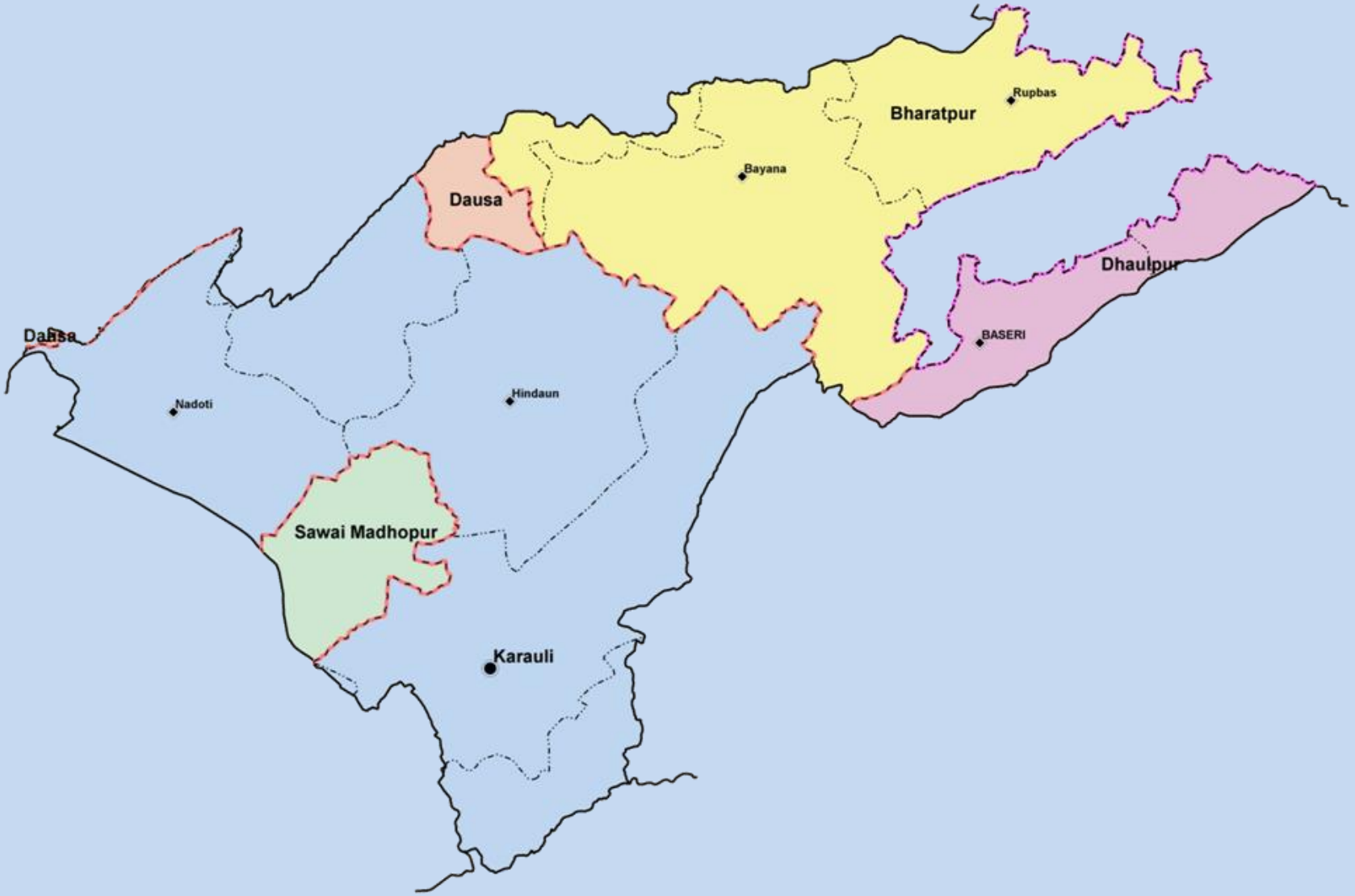
Ground Water Department,
Rajasthan

European Union
State Partnership Programme

Hydrogeological Atlas of Rajasthan

Gambhir River Basin



2013

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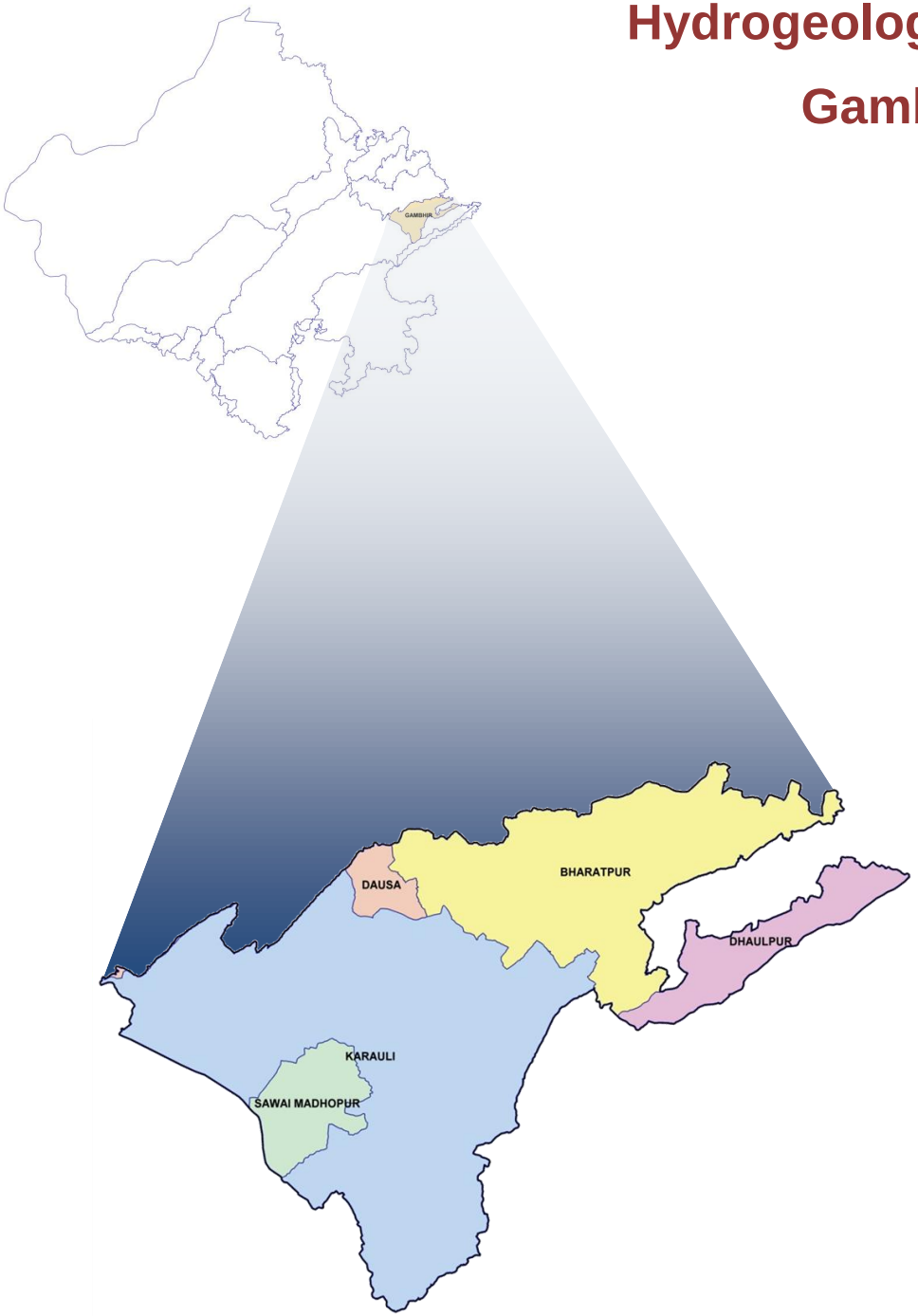
Hydrogeological Atlas of Rajasthan

Gambhir River Basin



Contents:

2013

ADMINISTRATIVE SETUP GAMBHIR RIVER BASIN

Location:

Gambhir River Basin is located in northeastern part of Rajasthan. It stretches between 26° 16' 07.47" to 27° 05' 23.88"North latitude and 76° 31' 56.35'' to 77° 52' 25.31'' East longitudes. It is bounded by the Banganga river basin in the north, Banas river basin in the south west, Chambal and Parbati in the southeast; Uttar Pradesh state constitutes part of the boundary in the northeast. The Basin extends over parts of Bharatpur, Dausa, Dhaulpur, Karauli and Sawai Madhopur Districts. Gambhir is a small river basin and its approximate total catchment area is 4,316 km^2.

River Gambhir originates in the hills near Karauli village in Sawai Madhopur District. It flows from south to north up to Kanjoli village (Toda Bhim), then towards northeast up to village Mertha of Roopbas Block, before entering Uttar Pradesh. The river again enters Rajasthan near Catchapaura village in Dhoulpur District and forms the boundary between UP and Rajasthan. It then enters Mainpuri District in UP to finally joins River Yamuna. The river is ephemeral, but becomes perennial after its confluence with the Parbati, outside Dhoulpur District. The total length of the river in Rajasthan is 288 km. important tributaries of the Gambhir are Sesa, and Kher.

Administrative Set-up:

Gambhir river basin extends over parts of Bharatpur, Dausa, Dhaulpur, Karauli and Sawai Madhopur Districts and divided into 13 Blocks and encompassing 896 towns and villages.

S. No.	District Name	Area (sq km)	% of Basin Area	Total Number of Blocks	Total Number of Towns and Villages
1	Bharatpur	1,210.5	28.0	3	279
2	Dausa	100.1	2.3	2	27
3	Dhaulpur	321.6	7.5	2	105
4	Karauli	2,426.5	56.2	5	450
5	Sawai Madhopur	257.6	6.0	1	35
Total		4,316.3	100.0	13	896

Climate:

Gambhir basin is small and falls within Sub-Humid climatic region receiving moderate to good rainfall resembling more to Uttar Pradesh than to semi-arid Rajasthan. It is very cold from November to February while warming up between March-April and the months of May-June are very hot when temperatures reaches high of 49-50^oC. The mean annual rainfall over Gambhir river basin was 616 mm, of which around 95% is received during the Monsoon months of June-September.

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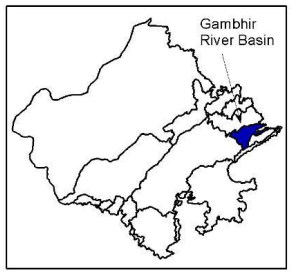
PLATE - I

GAMBHIR RIVER BASIN

Administrative Map



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary

Railway:

- Broad Gauge
- Metre Gauge

Roads:

- National Highway
- State Highway

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

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TOPOGRAPHY

The central and northeastern parts of the Basin falling within Sawai Madhopur, western parts of Karauli district and in Bharatpur and Dhaulpur districts is marked by undulating plains. Areas around Bayana, southwestern part of Dausa (within basin) and Karauli are hilly which belong to the Aravali range. Plate II depicts the topography of the basin.

Table: District wise minimum and maximum elevation

District Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
Bharatpur	157.0	390.0
Dausa	203.5	491.4
Dhaulpur	156.5	295.3
Karauli	200.5	492.6
Sawai Madhopur	224.7	362.0

RAINFALL

Perusal of Plate III reveals the distribution of total annual rainfall in the basin which seem to have ranged from 600-800mm in the year 2010. The northeastern parts of the basin adjoining Uttar Pradesh had received highest rainfall of the basin i.e., in the range of 900-100mm whereas western part around Nadbai in Karauli district had received least in the basin which ranged between 500-600mm of total annual rainfall.

Table: District wise total annual rainfall (based on year 2010 meteorological station recordings (http://waterresources.rajasthan.gov.in)

S. No.	Rain gauge Stations	Total Monsoon Rainfall (mm)	Total Non-Monsoon Rainfall (mm)	Total Annual Rainfall (mm)
1	Baseri	442.0	126.0	568.0
2	Bayana	618.0	115.0	733.0
3	Hindon	592.0	38.0	630.0
4	Nadoti	474.0	86.0	560.0
5	Roopwas	840.0	65.0	905.0

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Rajasthan

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PLATE - II

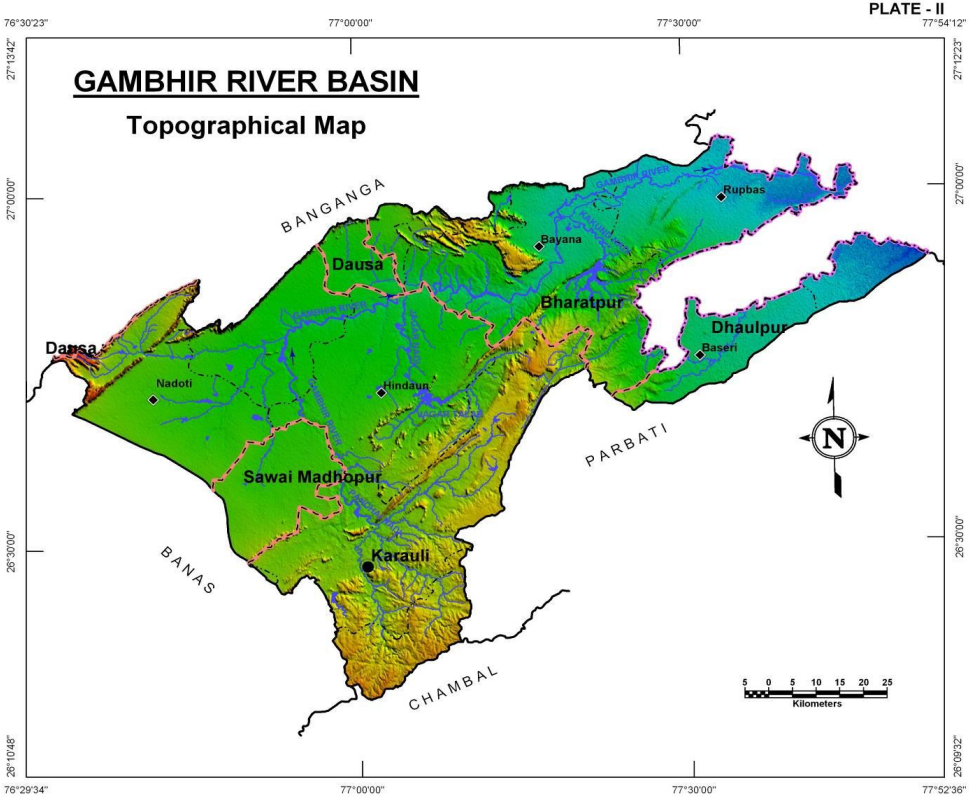
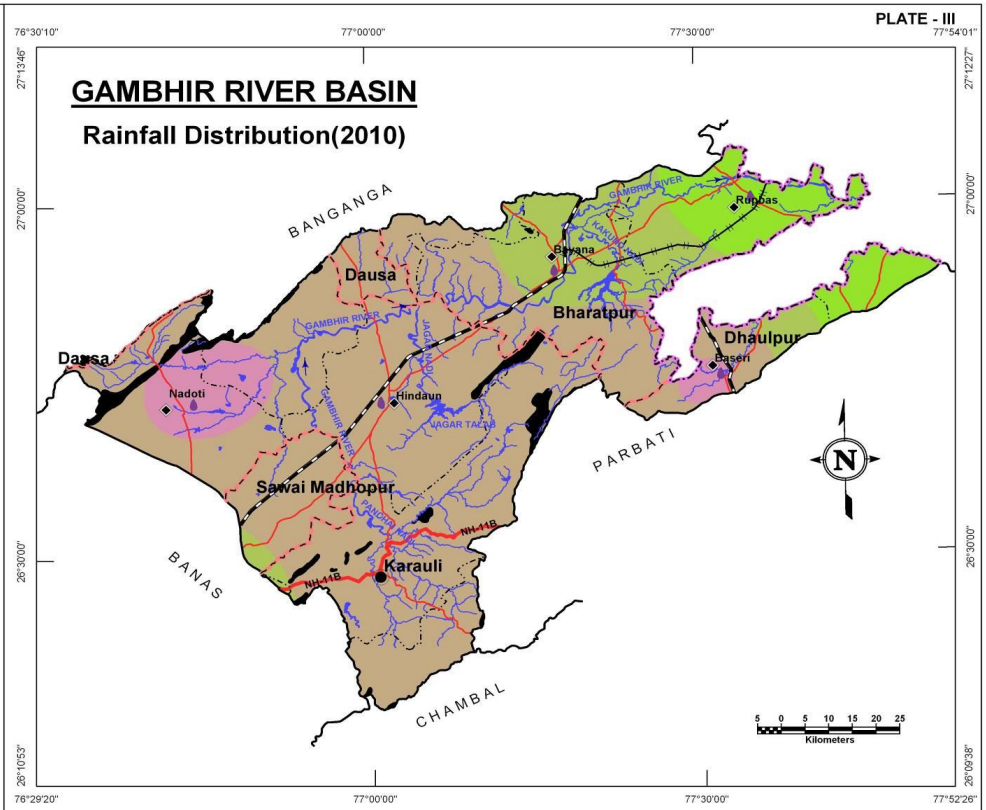


PLATE - III



LEGEND

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

River Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation(m amsl):
494 m
450 m
400 m
350 m
300 m
250 m
200 m
150 m

Source : SRTM DEM

LEGEND

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

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

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

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GEOLOGY

GAMBHIR RIVER BASIN

The Gambhir river basin is covered mainly by rocks belonging to the oldest (Bhilwara Super Group, Archean Period) to the youngest rocks (Aeolian and Fluvial deposits of Recent to Sub-Recent age).Delhi Super Group is represented both by Ajabgarh and Alwar Groups whereas Vindhyan Super Group rocks belong to Bhander, Rewa, Kaimur and Sand Group.

Age	Super Group	Group/Formation	Rock Types
Recent to Sub-Recent			Alluvium and blown sand, clay, loose sand
---------- Unconformity ----------			
Upper Precambrian To Lower Precambrian	Upper Vindhyan	Bhander	Sandstone, Shale, Limestone
	Lower Vindhyan	Rewa	Sandstone, Shale
		Kaimur	Conglomerate, sandstone
		Sand	Sandstone, Shale, Limestone
---------- Unconformity ----------			
Proterozoic	Delhi	Ajabgarh	Quartzite, Schist, Phyllite
		---------- Unconformity ----------	
		Alwar	Quartzite, schist
---------- Unconformity ----------			
Archean	Bhilwara	Mangalwar Complex	Amphibolites, greywacke, quartzite, marble,

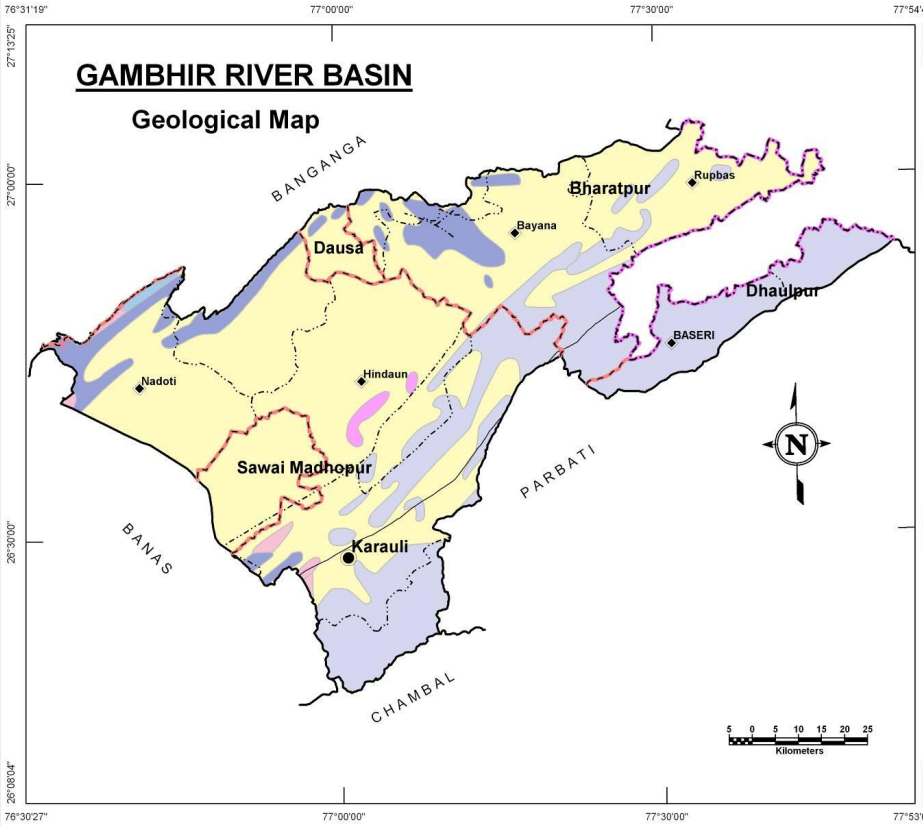
GEOMORPHOLOGY

Origin	Landform Unit	Description
Aeolian	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.
	Intermontane Valley	Depression between mountains, generally broad & linear, filled with colluvial deposits.
	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.
	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys.
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.
	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	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		Hills and intervening valleys in hilly areas

PLATE - IV

GAMBHIR RIVER BASIN

Geological Map



LEGEND

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

River Basin Boundary

Structural Features:
- Fault
- Great Boundary Fault

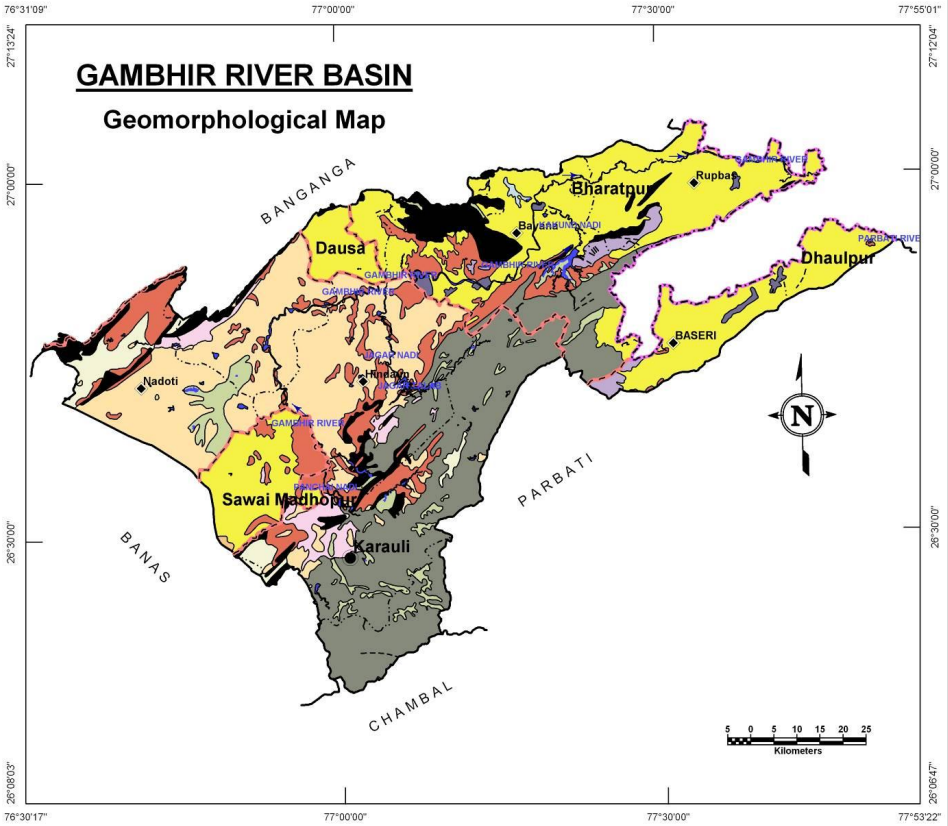
Geology:
- Ajabgarh Group
- Alluvium and Wind blown sand
- Alwar Group
- Bhander Group
- Kaimur Group
- Mangalwar Complex
- Ranthambhor Group
- Rewa Group
- Sand Group

Source : District Resource Map of Rajasthan - GSI

PLATE - V

GAMBHIR RIVER BASIN

Geomorphological Map



LEGEND

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

River Basin Boundary

Water Bodies:
- River/Ponds / Reservoirs

Structural Features:
- Fault/Fractures/Lineament

Hills:
- Structural/Denudational/Linear Ridge

Landforms Units:

Fluvial Origin:
- Alluvial plain
- Alluvial Plain (Sandy)
- Ravine
- Flood Plain
- Valley Fill
- Waterlogged Area

Denudational Origin:
- Burried Pediment
- Pediment
- Intermontane Valley
- Dissected Plateau

Aeolian Origin:
- Sandy Plain

Structural Origin:
- Plateau

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

AQUIFERS

GAMBHIR RIVER BASIN

Coverage wise, the alluvium forms the predominant aquifer type contributing to more than 66% of aquifers in the basin. This is followed by Sandstones of Vindhyan Super Group that is close to 28% of the basin. Quartzites constitute small part of the basin's aquifer area within its weathered and fractured zone.

Aquifer in Potential Zone	Area (sq km)	% of Basin Area	Description of the unit/Occurrence
Older Alluvium	2,867.4	66.4	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Sandstone	1,199.5	27.8	Fine to medium grained, red colour and compact and at places.
Quartzite	145.7	3.4	Medium to coarse grained and varies from feldspathic grit to sericitic quartzite.
Non Potential Zone (Hills)	103.7	2.4	Hills and reserve forests
TOTAL	4,316.3	100.0	

LOCATION OF GROUNDWATER MONITORING WELLS

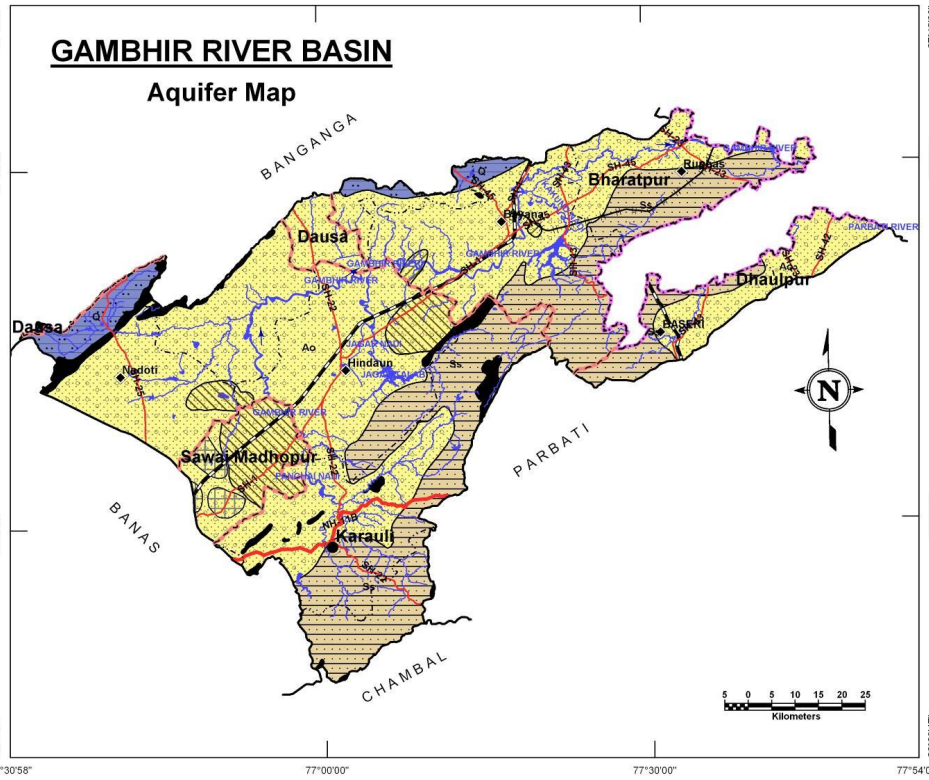
The basin has a well distributed network of groundwater monitoring stations (140) in the basin owned by RGWD (107) and CGWB (33). Apart from existing network, it has been recommended that 197 wells be added to strengthen the network for a more effective ground water level and quality in the basin.

District Name	Existing Ground Water Monitoring Stations			Recommended Additional Ground Water Monitoring Stations	
	CGWB	RGWD	Total	Water Level	Water quality
Bharatpur	12	43	**55**		40
Dausa	2	9	**11**		4
Dhaulpur	2	15	**17**		9
Karauli	15	36	**51**	7	65
Sawai Madhopur	2	4	**6**		9
Total	**33**	**107**	**140**	**7**	**127**

PLATE - VI

GAMBHIR RIVER BASIN

Aquifer Map



LEGEND

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

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Command Area

Non Potential Zone

Saline Area

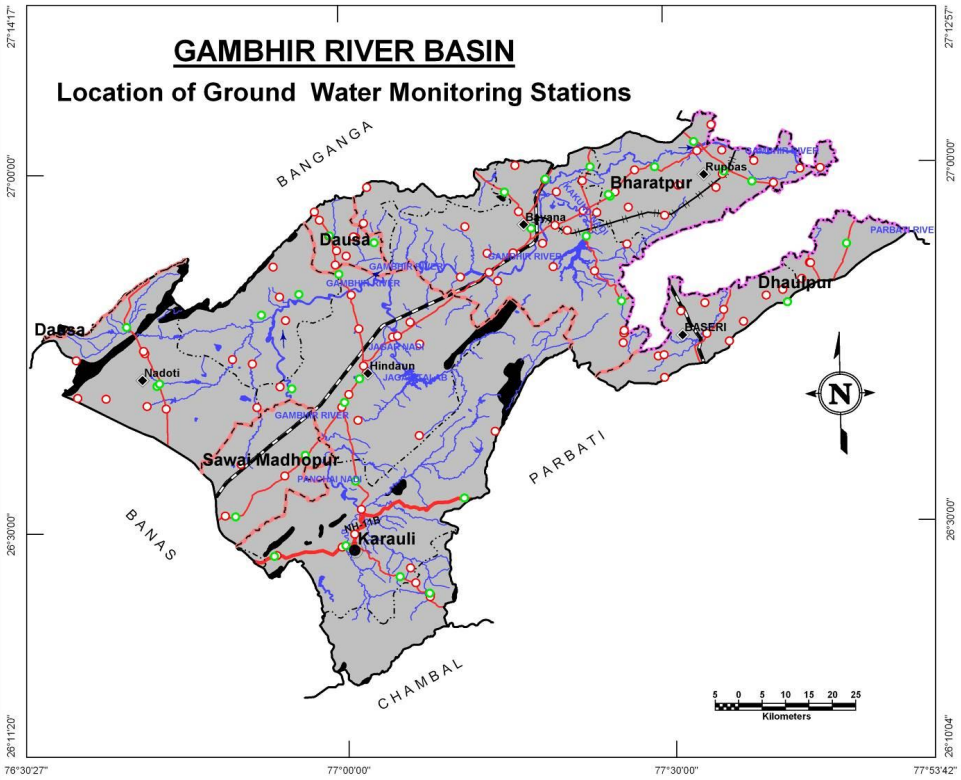
Aquifer:
- Older Alluvium
- Sandstone
- Quartzite

Source: Ground Water Potential Zone Map - GWD,Rajasthan

PLATE - VII

GAMBHIR RIVER BASIN

Location of Ground Water Monitoring Stations



LEGEND

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

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Ground Water Monitoring Stations:
- CGWB
- RGWD

LOCATION OF EXPLORATORY WELLS

GAMBHIR RIVER BASIN

In all there are 78 exploratory wells present in the Gambhir river basin drilled in the past by RGWD (46) and CGWB (32) that form basis for delineation of sub-surface aquifers and understanding their distribution.

District Name	Exploratory Wells		
	CGWB	RGWD	Total
Bharatpur	8	24	**32**
Dausa	-	1	**1**
Dhaulpur	2	4	**6**
Karauli	19	13	**32**
Sawai Madhopur	3	4	**7**
Total	**32**	**46**	**78**

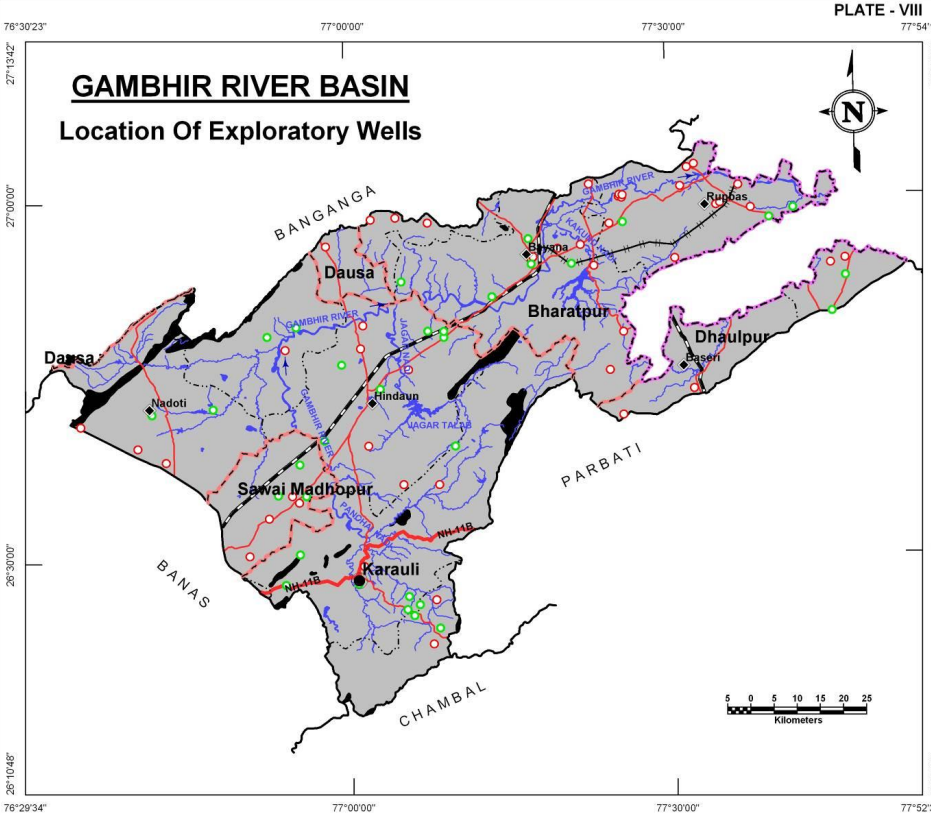
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The general depth to water level in the basin ranges from 10 to 40 meters below ground level, as seen on northeastern, central, western and southwestern parts of the basin. There are however, two pockets; one in the central part around Hindaun and in the other in western part north of Nadoti, where water levels are quite deep (below 40m bgl).

Depth to water level (m bgl) (Pre Monsoon – 2010)	District wise area coverage (sq km)*					Total Area (sq km)
	Bharatpur	Dausa	Dhaulpur	Karauli	Sawai Madhopur	
< 10	392.2	-	130.7	51.3	34.5	**608.7**
10 - 20	624.7	55.2	107.4	1,436.0	131.2	**2,354.5**
20 - 30	191.3	41.5	47.0	545.6	67.9	**893.3**
30 - 40	1.6	-	36.6	199.8	23.7	**261.7**
40 - 50	-	-	-	70.1	0.2	**70.3**
50 - 60	-	-	-	18.3	-	**18.3**
60 - 70	-	-	-	5.6	-	**5.6**
> 70	-	-	-	0.1	-	**0.1**
Total	**1,209.8**	**96.7**	**321.7**	**2,326.8**	**257.5**	**4,212.5**

* The area covered in the derived maps is less than the total basin 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
- River Basin Boundary

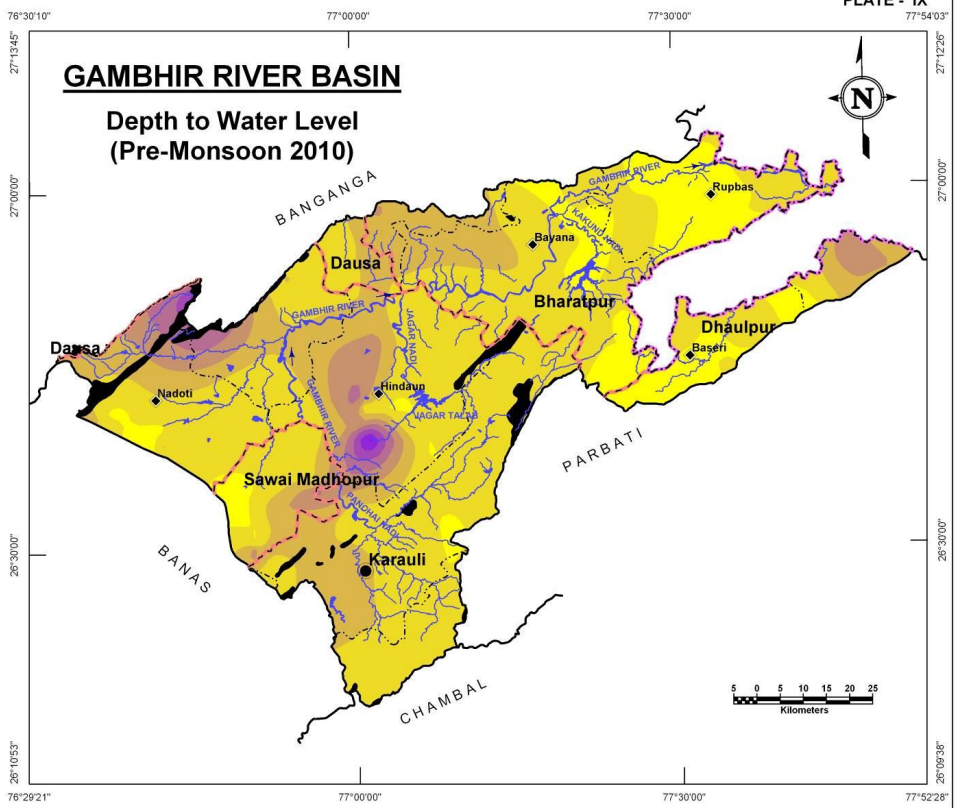
Roads:
- National Highway
- State Highway

Railway:
- Broad Gauge
- Metre Gauge

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

Exploratory Wells:
- CGWB
- RGWD

PLATE - IX



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River 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 - 60
- 60 - 70
- > 70

WATER TABLE ELEVATION (PRE MONSOON 2010) GAMBHIR RIVER BASIN

Water table elevation shows variation of about 160m ranging from about 160m amsl to 320m amsl. Since the water table generally follows the topography, such variations are normal. A perusal of Plate – X reveals that water table is very high to the northeast of Karauli where topography is also high and is the source of Gambhir river as well. The general gradient of water table is from southwest to northeast and water table elevation decreases from about 260m amsl to 160m amsl in northeast where the river joins Parbati river.

Water Table Elevation (m amsl) Pre Monsoon - 2010	District wise area coverage (sq km)					Total Area (sq km)
	Bharatpur	Dausa	Dhaulpur	Karauli	Sawai Madhopur	
< 160	-	-	54.2	-	-	**54.2**
160 - 180	194.8	-	92.7	-	-	**287.5**
180 - 200	473.6	2.7	134.9	18.9	-	**630.1**
200 - 220	507.8	87.3	26.4	611.8	48.3	**1,281.6**
220 - 240	33.6	6.7	13.5	464.1	104.8	**622.7**
240 - 260	-	-	-	488.5	85.7	**574.2**
260 - 280	-	-	-	347.4	18.7	**366.1**
280 - 300	-	-	-	226.8	-	**226.8**
300 - 320	-	-	-	146.6	-	**146.6**
< 320	-	-	-	22.7	-	**22.7**
Total	**1,209.8**	**96.7**	**321.7**	**2,326.8**	**257.5**	**4,212.5**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

The water level fluctuation map is presented in Plate – XI. The Basin has aquifers formed in hardrock as well as those formed within thick cover of alluvium. On comparing this map with that of aquifer map of the area, it can be noticed that the fluctuation has been in the range of -2 to +6 m in most of the areas occupied by alluvial aquifers and the adjacent hardrock areas whereas in the interior parts of hardrock aquifers, northeast and southwest of Karauli the levels have shown larger variation to the extent of -6 and +16m.

District Name	District wise area coverage (sq km) within fluctuation range (m)													Total Area (sq km)
	< -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 to 16	> 16	
Banswara	-	-	-	-	393.1	635.2	130.9	46.0	4.6	-	-	-	-	**1,209.8**
Chittaurgarh	-	-	-	-	7.0	84.7	5.0	-	-	-	-	-	-	**96.7**
Dungarpur	-	22.1	15.7	44.2	168.5	71.2	-	-	-	-	-	-	-	**321.7**
Pratapgarh	2.2	23.6	62.1	216.0	949.8	500.8	226.6	160.1	94.6	53.9	27.1	9.6	0.4	**2,326.8**
Udaipur	-	-	-	-	113.6	143.9	-	-	-	-	-	-	-	**257.5**
Total	**2.2**	**45.7**	**77.8**	**260.2**	**1,632.0**	**1,435.8**	**362.5**	**206.1**	**99.2**	**53.9**	**27.1**	**9.6**	**0.4**	**4,212.5**

PLATE - X

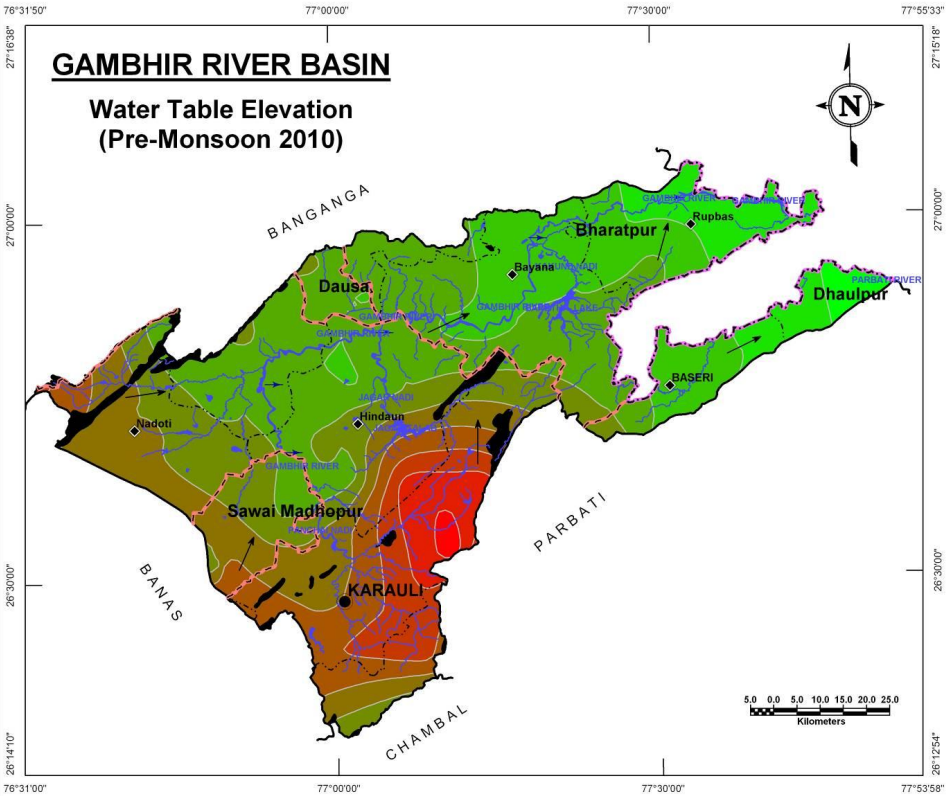
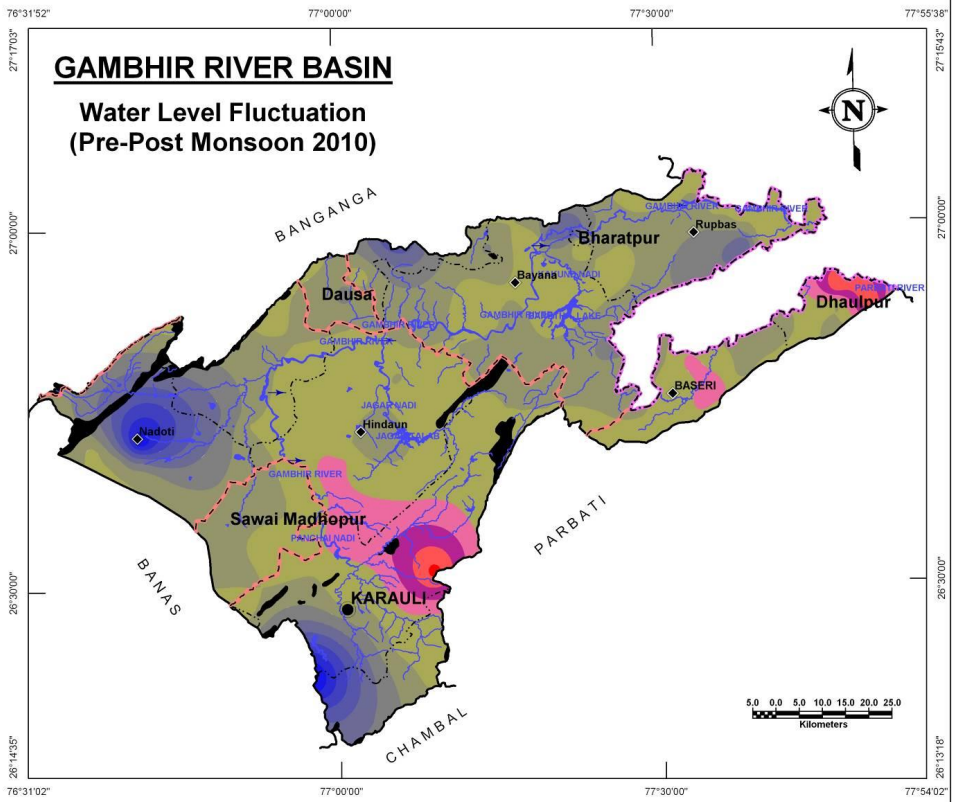


PLATE - XI



LEGEND

Admin Boundary:

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

River Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Water Table Elevation

Water Table Elevation(m amsl):

- <160
- 160 - 180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- 300 - 320
- >320

LEGEND

Admin Boundary:

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

River 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 to 16
- >16

ELECTRICAL CONDUCTIVITY DISTRIBUTION GAMBHIR RIVER BASIN

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 colour and occupy almost 70% of the basin area indicating that bye and large, the water in the basin is suitable for all purposes. The moderately high EC region (2000 – 4000 µS/cm, green coloured region) occupies most of the remaining part of the basin whereas the high EC concentration areas (>4000 µS/cm) are seen as small pockets in the east and west of Hindaun in Karauli district and near Bayana and Rupbas in Bharatpur district.

Electrical Conductivity Ranges (µS/cm at 25°C) (Ave. of years 2005-09)	District wise area coverage (sq km)										Total Area (sq km)
	Bharatpur		Dausa		Dhaulpur		Karauli		Sawai Madhopur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 2000	875.7	72.4	67.0	69.3	259.8	80.8	1,607.2	69.1	132.0	51.2	**2,941.7**
2000-4000	290.0	24.0	29.7	30.7	60.7	18.8	674.4	29.0	116.4	45.3	**1,171.2**
> 4000	44.1	3.6	-	-	1.2	0.4	45.2	1.9	9.1	3.5	**99.6**
Total	**1,209.8**	**100.0**	**96.7**	**100.0**	**321.7**	**100.0**	**2,326.8**	**100.0**	**257.5**	**100.0**	**4,212.5**

CHLORIDE DISTRIBUTION

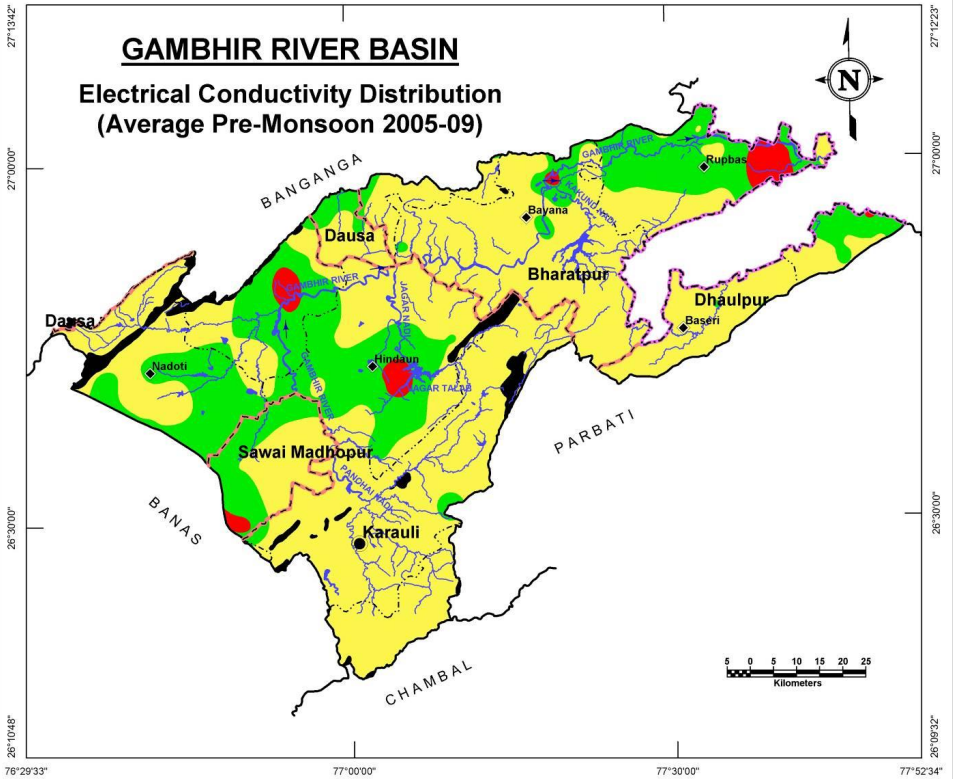
High chloride concentration in ground water also renders it unsuitable for domestic and other purposes. The red coloured regions in Plate XIII are such areas where Chloride concentration is very high (> 1000 mg/l) which are largely found in alluvial aquifers to the east of Rupbas in Bharatpur district. Rest of the basin has either low (<250 mg/l) or moderately high (250 – 1000 mg/l) which together occupy more than 99% of the basin area.

Chloride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)										Total Area (sq km)
	Bharatpur		Dausa		Dhaulpur		Karauli		Sawai Madhopur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 250	787.1	65.1	29.9	30.9	244.7	76.1	1,309.7	56.3	120.9	46.9	**2,492.3**
250 - 1000	396.1	32.7	66.8	69.1	75.7	23.5	1,017.1	43.7	136.6	53.1	**1,692.3**
> 1000	26.6	2.2	-	-	1.3	0.4	-	-	-	-	**27.9**
Total	**1,209.8**	**100.0**	**96.7**	**100.0**	**321.7**	**100.0**	**2,326.8**	**100.0**	**257.5**	**100.0**	**4,212.5**

PLATE - XII

GAMBHIR RIVER BASIN

Electrical Conductivity Distribution
(Average Pre-Monsoon 2005-09)



LEGEND

Admin Boundary:

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

River Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

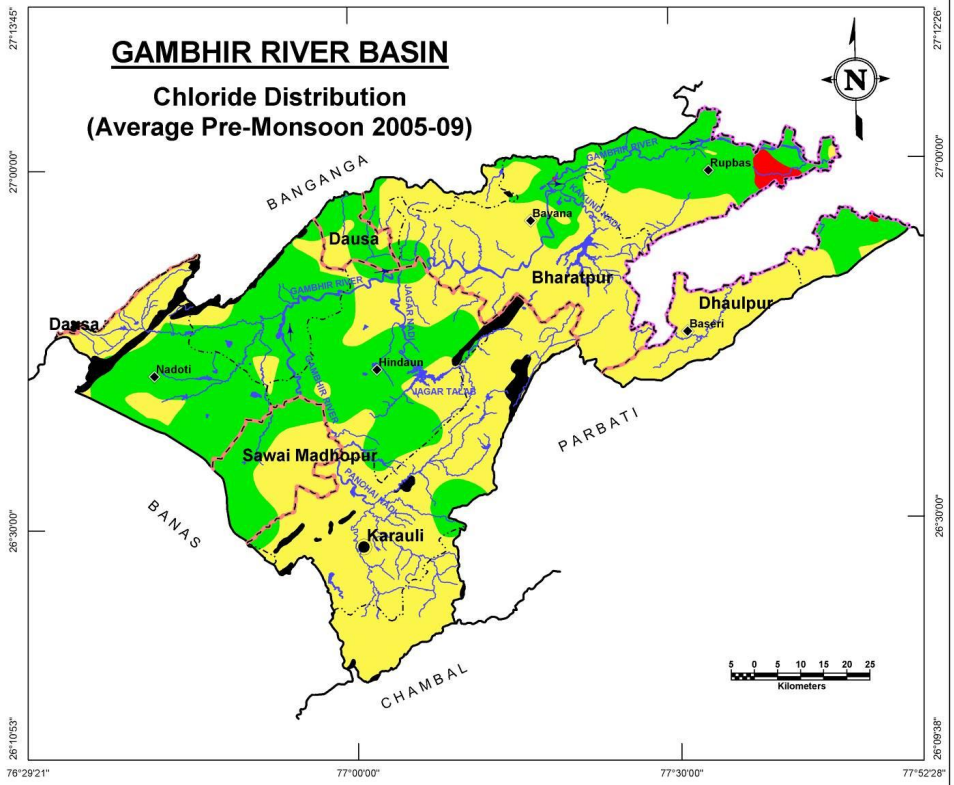
Electrical Conductivity (µS/cm at 25°C):

- < 2000
- 2000-4000
- > 4000

PLATE - XIII

GAMBHIR RIVER BASIN

Chloride Distribution
(Average Pre-Monsoon 2005-09)



LEGEND

Admin Boundary:

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

River Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

FLUORIDE DISTRIBUTION

The Fluoride concentration map (Plate – XIV) displays a number of scattered patches of high fluoride concentration (>3 mg/l) which is surrounded but an larger areas having 1.5 – 3.0 mg/l of fluoride in ground water as seen around Hindaun, southwest and northeast of Baseri, north of Bayana and southeast of Rupbas. Together these two areas combined (i.e., > 1.5 mg/l), occupy close to 22% of the basin rendering the ground water within these areas, of limited use from fluoride concentration point of view. The areas showing low concentration of fluoride in ground water are seen in rest of the 78% of the area which is widespread within the basin which is suitable for all purposes.

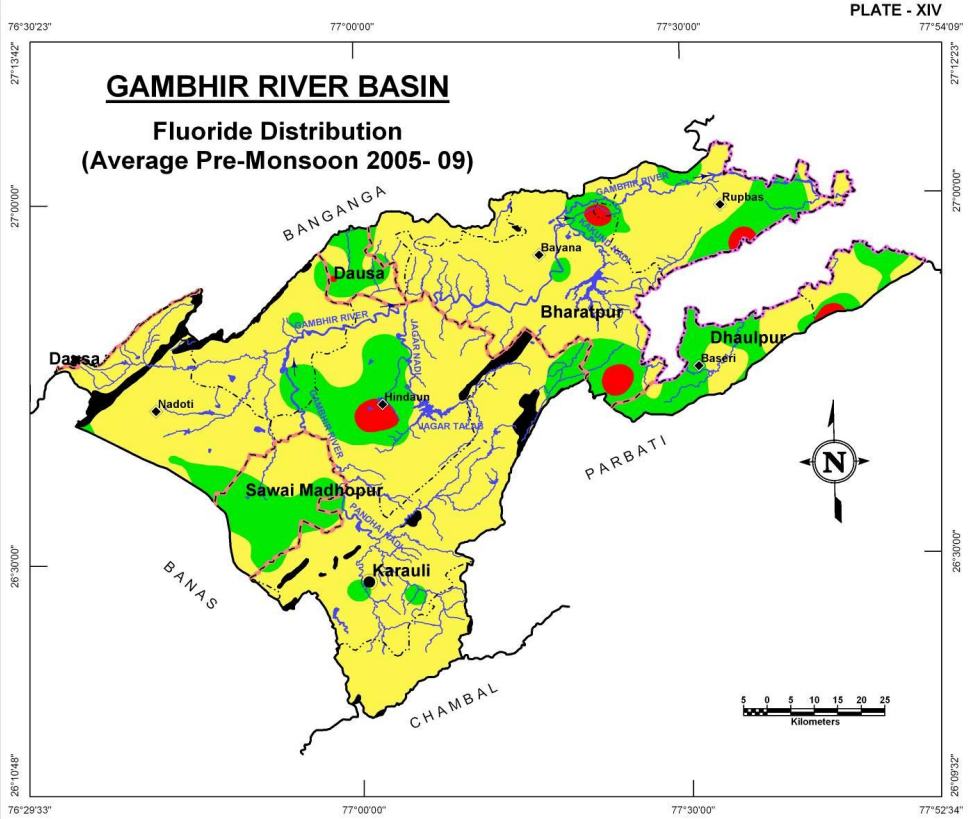
Fluoride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)										Total Area (sq km)
	Bharatpur		Dausa		Dhaulpur		Karauli		Sawai Madhopur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 1.5	951.5	78.7	38.1	39.4	151.2	47.0	2,001.6	86.0	111.9	43.4	**3,254.3**
1.5-3.0	219.2	18.1	57.8	59.8	164.4	51.1	298.8	12.8	145.6	56.6	**885.8**
> 3.0	39.1	3.2	0.8	0.8	6.1	1.9	26.4	1.2	-	-	**72.4**
Total	**1,209.8**	**100.0**	**96.7**	**100.0**	**321.7**	**100.0**	**2,326.8**	**100.0**	**257.5**	**100.0**	**4,212.5**

NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate XV shows distribution of Nitrate in groundwater. The Nitrate concentration in the basin is, in general, high as seen by the red and green coloured regions occupying about 81% basin area. Low Nitrate areas limited in area and found in parts of Dhaulpur and Bharatpur districts in the north and the hilly areas if Karauli district.

Nitrate Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)										Total Area (sq km)
	Bharatpur		Dausa		Dhaulpur		Karauli		Sawai Madhopur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 50	564.1	46.6	43.7	45.2	239.5	74.5	496.2	21.3	51.8	20.1	**1,395.3**
50-100	429.5	35.5	50.8	52.5	70.3	21.8	1,352.3	58.1	102.8	39.9	**2,005.7**
> 100	216.2	17.9	2.2	2.3	11.9	3.7	478.3	20.6	102.9	40.0	**811.5**
Total	**1,209.8**	**100.0**	**96.7**	**100.0**	**321.7**	**100.0**	**2,326.8**	**100.0**	**257.5**	**100.0**	**4,212.5**

PLATE - XIV



LEGEND

Admin Boundary:

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

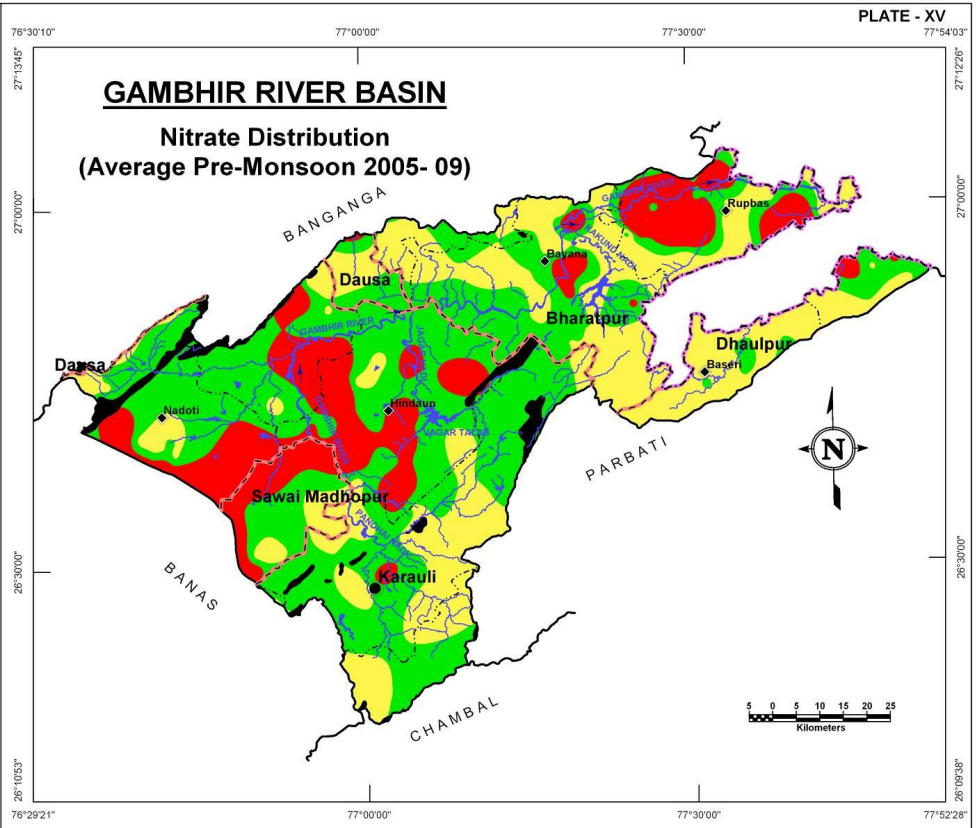
Water Bodies:

- 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
- **River Basin Boundary**

Water Bodies:

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

Nitrate Concentration (mg/l):

- < 50
- 50-100
- > 100

DEPTH TO BEDROCK

GAMBHIR RIVER BASIN

Apart from surface exposures, the bedrock is encountered below soil cover and thick pile alluvial material at different depths. The beginning of massive bedrocks below the alluvium and weathered/fractured hard rocks is taken as depth to bedrock and presented in Plate – XVI as depth in meters below the ground level.

Depth to Bedrock (m bgl)	District wise area coverage (sq km)					Total Area (sq km)
	Bharatpur	Dausa	Dhaulpur	Karauli	Sawai Madhopur	
< 20	75.2	-	-	467.3	-	**542.5**
40-60	65.2	-	293.9	1,167.3	210.7	**1,737.1**
60-80	753.8	83.2	27.8	658.9	46.8	**1,570.5**
> 80	315.6	13.5	-	33.3	-	**362.4**
Total	**1,209.8**	**96.7**	**321.7**	**2,326.8**	**257.5**	**4,212.5**

UNCONFINED AQUIFER

Hydrogeological properties are different for alluvial and hard rock aquifers and therefore, this aquifer has been mapped as two separate regions viz., unconfined aquifers in alluvial and in hard rock areas.

In Gambhir basin the alluvial material is predominantly fluvial in origin and composed of sand, clay and gravel. The thickness of the alluvial aquifer is in general not very think and varies in thickness to less than 10m, however in the Bayana – Rupbas region if reaches a higher thickness to 50m.

The hardrock aquifers are formed in weathered and fractured part of the hard rocks that can sustain water under unconfined conditions. Such aquifers are formed predominantly in Sandstones and Quartzites and constitute good aquifers in Karauli district and partly in Bharatpur and Dhaulpur districts. General thickness of this aquifer ranges between <10 to 40m and reaches maximum of 70m.

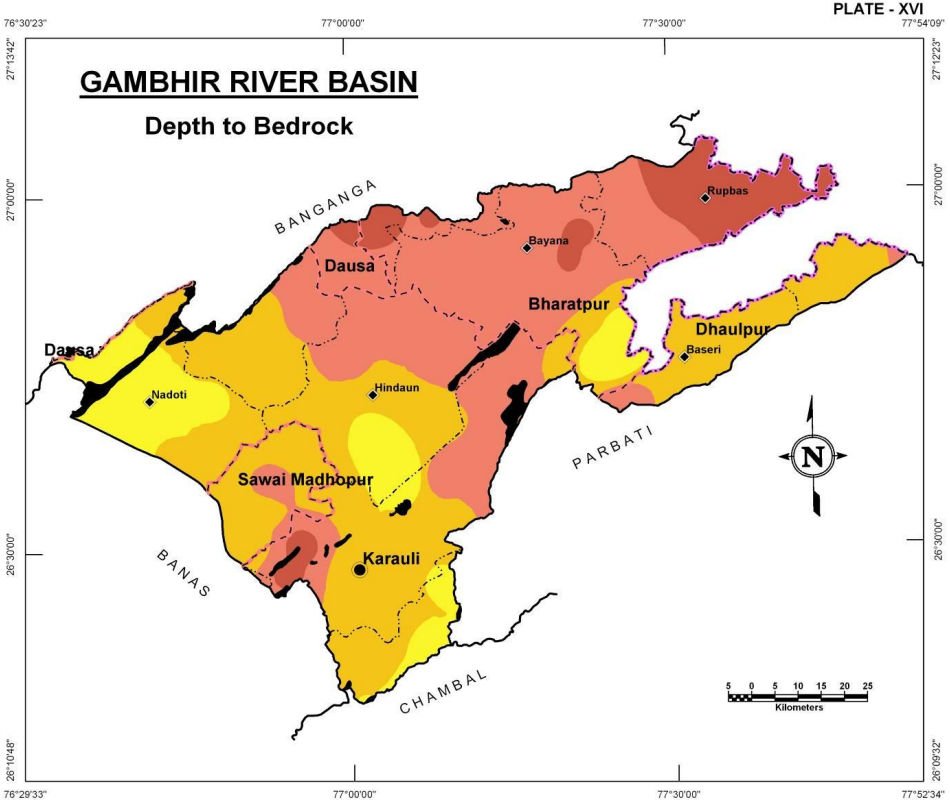
Alluvial areas:

Unconfined aquifer Thickness (m)	District wise area coverage (sq km)					Total Area (sq km)
	Bharatpur	Dausa	Dhaulpur	Karauli	Sawai Madhopur	
< 10	321.6	96.7	61.2	1,101.4	83.2	**1,664.1**
10-20	344.6	-	90.9	303.0	100.0	**838.5**
20-30	196.3	-	64.3	127.9	74.3	**462.8**
30-40	88.8	-	-	11.8	-	**100.6**
40-50	21.7	-	-	-	-	**21.7**
> 50	2.0	-	-	-	-	**2.0**
Total	**975.0**	**96.7**	**216.4**	**1,544.1**	**257.5**	**3,089.7**

Hardrock areas:

Unconfined aquifer Thickness (m)	District wise area coverage (sq km)					Total Area (sq km)
	Bharatpur	Dausa	Dhaulpur	Karauli	Sawai Madhopur	
<10	69.5	-	55.5	282.3	-	**407.3**
10-20	165.1	-	49.8	162.2	-	**377.1**
20-30	0.2	-	-	87.2	-	**87.4**
30-40	-	-	-	170.5	-	**170.5**
40-50	-	-	-	37.7	-	**37.7**
50-60	-	-	-	31.9	-	**31.9**
60-70	-	-	-	10.5	-	**10.5**
> 70	-	-	-	0.4	-	**0.4**
Total	**234.8**	**-**	**105.3**	**782.7**	**-**	**1,122.8**

PLATE - XVI



LEGEND

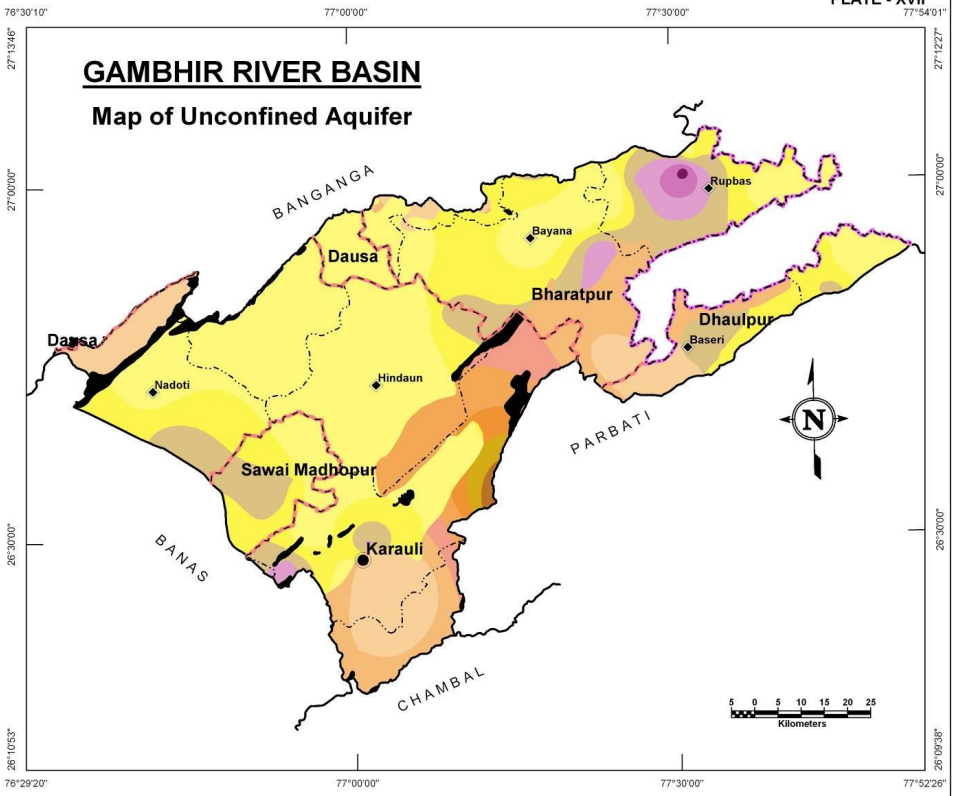
Admin Boundary:

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

Depth to Bedrock(m bgl):

- <20
- 40-60
- 60-80
- >80

PLATE - XVII



LEGEND

Admin Boundary:

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

Aquifer Thickness(m):

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

CROSS SECTIONS

GAMBHIR RIVER BASIN

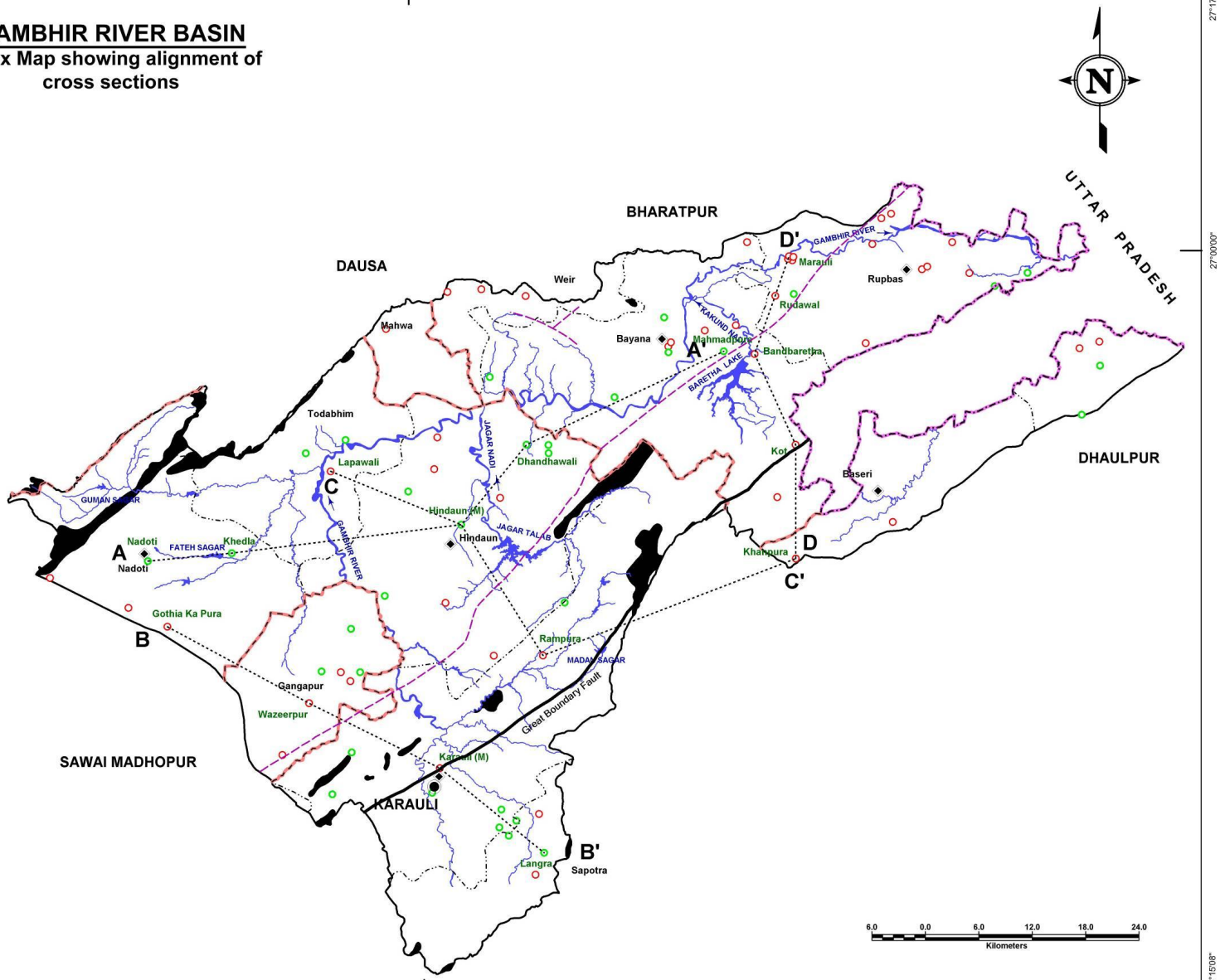
Several hydrogeologic cross sections have been drawn to better depict the sub-surface distribution of lithology. These sections have been overlaid with geological maps and structural faults if there are any have been transferred for verification of their impact on sub-surface material disposition. The alignment of the cross sections is shown in Plate XVIII and corresponding sections are presented in Plates – XIX to XXII. The broad alignment of the sections is as given below:

Name of Section Line	Orientation
Section AA’	SW – NE
Section BB’	NW – SE
Section CC’	NW – SE
Section DD’	N – S

PLATE - XVIII

GAMBHIR RIVER BASIN

Index Map showing alignment of cross sections



Legend

- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Fault
- Great Boundary Fault
- Section Line
- Major Streams / River
- Pond / Reservoir
- Hills

Exploratory Wells

- Kot — Well location for Sections
- CGWB
- RGWD

Section A-A':

Section A-A' ***(Plate – XIX)*** is drawn from SW to NE direction covering a distance of about 75km. The lithologs of 5 bore wells were used for preparing the cross section. The river Gambhir cuts across through the section twice in the eastern part where the thickness of alluvial material is maximum, however the sub-surface is dominated by clay and sand of limited thickness is present from west to east. In the Sandstone, Schist, Phyllite and Quartzite are present as deepest layers till the drilled depth of which Schist and Phyllite are most prominent.

Water table elevation in this section varies from 210m to 185m amsl.

Section B-B':

Section B-B' (***Plate – XX***) is from NW to SE in the southwestern part of the basin covering a length of about 50km. The lithologs of 4 boreholes utilized for preparing this section are marked on the section line. The section reveals the presence of thick sand layer of about 50m thick which is underlain by quartzite and shales at different places. The GBF marks the limit of alluvial cover and on the other side of the fault the shales and sandstones are present as consistently thick layers and are also exposed.

Water table elevation varies from 240m to 250m amsl.

PLATE - XIX

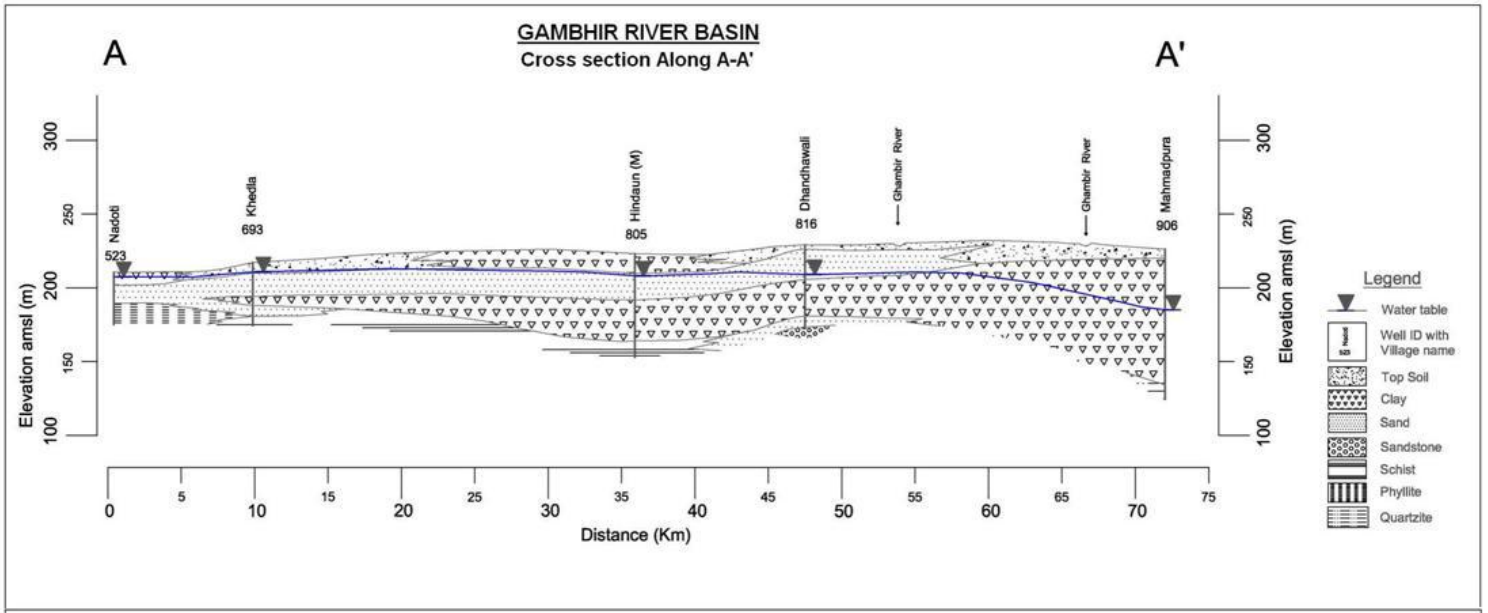
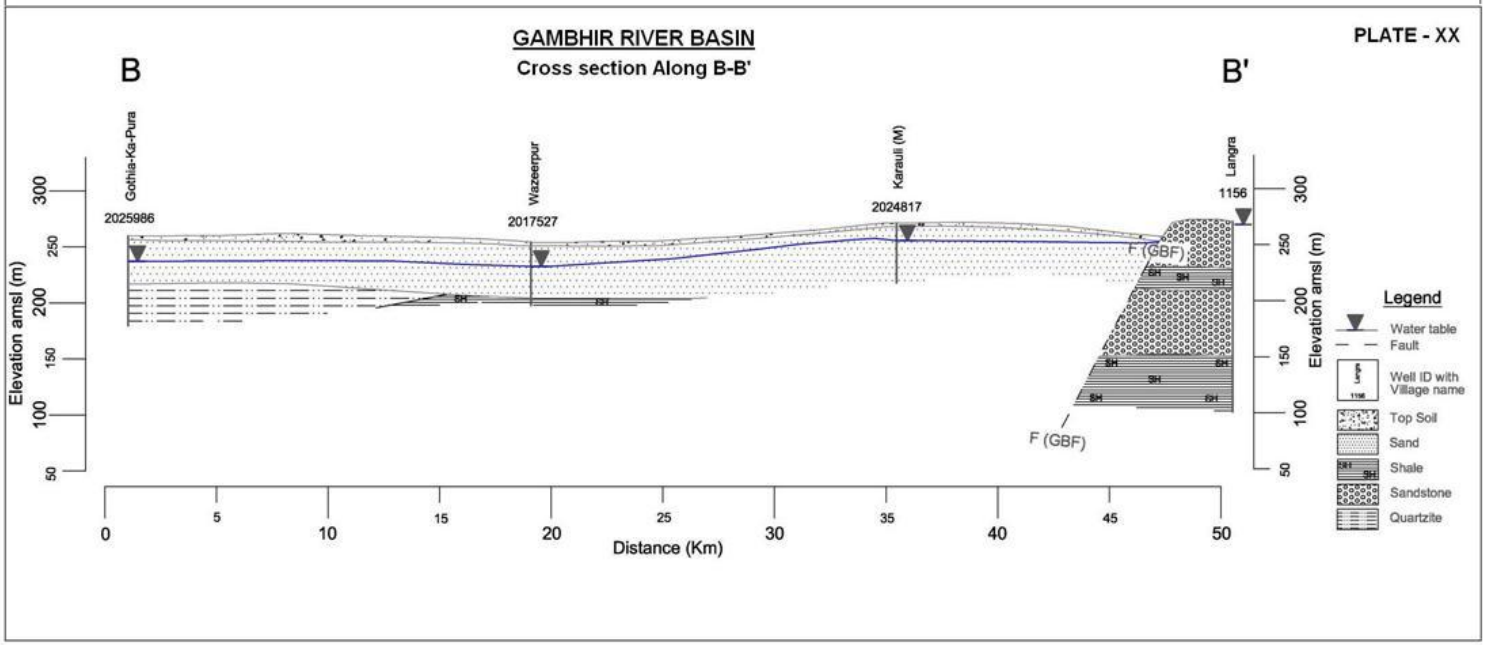


PLATE - XX



Section C-C':

Section C-C' (***Plate – XXI***) is from NW to SE direction in the central portion of the basin covering a length of about 65km. The lithologs of 4 bore wells are marked on the section. Major formations in the section are Older Alluvium followed by Shale, Sandstone and Schist. Schist is seen in the bottommost layer (till drilled depth) in the western part which seem to hit against the Vindhyan shales to its east, separated by GBF. Shale and Sandstone are predominant lithologies in the eastern part of the section and a thick sand layer also marks the eastern end of the section.

Section D-D':

Section D-D' (***Plate – XXII***) is approximately oriented in N-S direction covering a length of about 40km. The lithologs of 5 boreholes have been utilized for preparation of this section and the same are marked on the section below. In this section, major portion is covered by sandstone and sandy alluvium. Compact sandstone is encountered at the bottom of the wells in the southern portion. The sand layer attains approximately 100m thickness in the southern most part and in one well a thick (>20m) but localized clay layer is encountered.

Water table elevation in this section ranges from 175m amsl to 225m amsl.

PLATE - XXI

GAMBHIR RIVER BASIN
Cross section Along C-C'

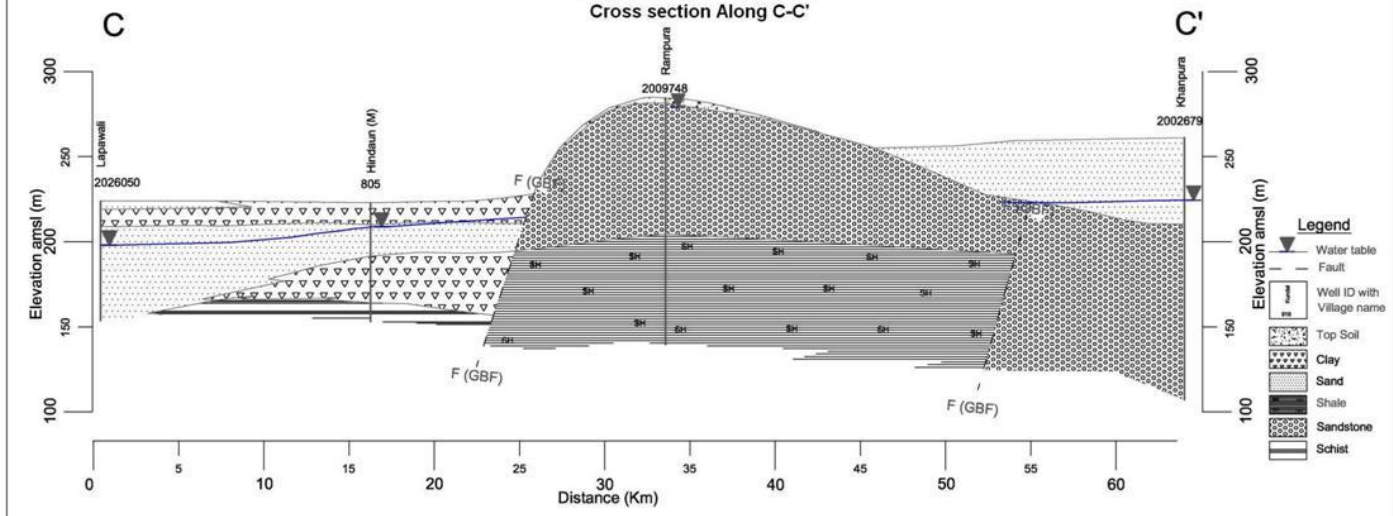
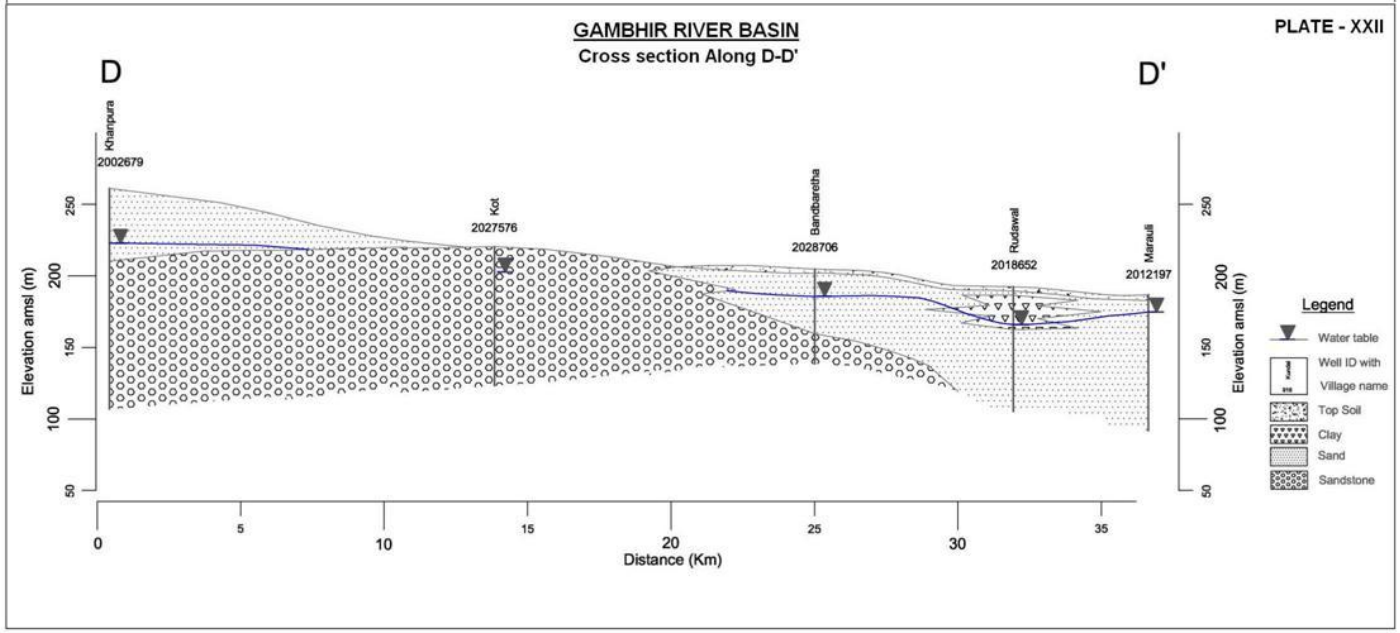


PLATE - XXII

GAMBHIR RIVER BASIN
Cross section Along D-D'

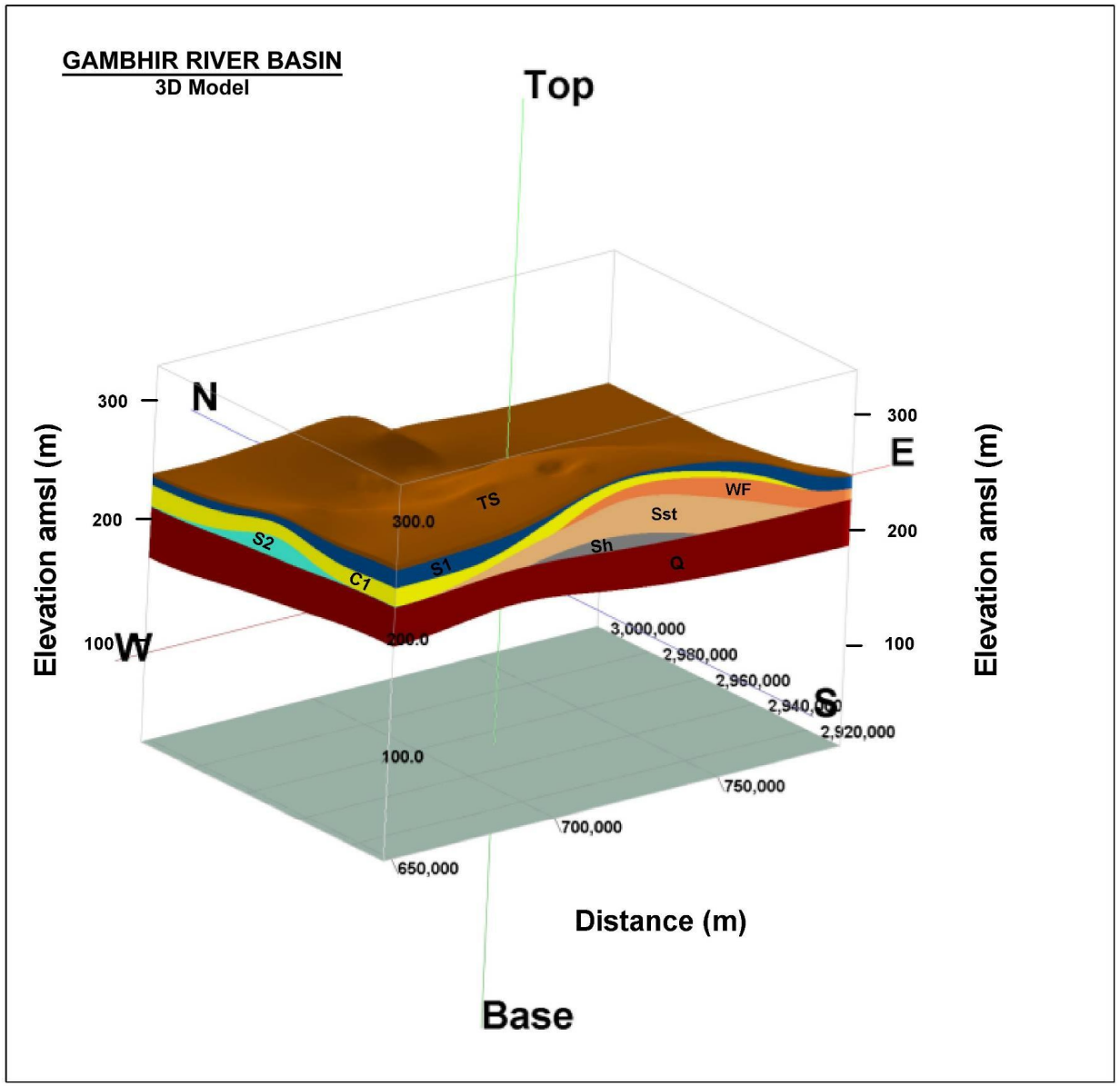


3D MODEL OF AQUIFERS GAMBHIR RIVER BASIN

The continuous litho-stratigraphic model has been developed using Rockworks software for the Gambhir river basin using interpolation techniques on the data of scattered wells given as an input.

The (Plate – XXIII) presents the 3D model depicting the various litho-stratigraphic units in the entire river basin. From this model it appears that alluvium formation consisting of sand and clay is present throughout the area overlain by top soil. Quartzite having a significant thickness is present throughout the area and it is overlain by alluvium, shale and sandstone. Weathered and fractured zone of quartzite is present in the southeast part of the area. The second sandy aquifer is found in the northern part and extends to west to east part of the basin within alluvium. The depth of weathered and fractured hard rock is shallow in the southern part as compared to the eastern part of the basin.

PLATE - XXIII



Legend

TS	Top Soil
S1	Sand
C1	Clay
S2	Sand
C2	Clay
WF	Weathered & Fractured Zone
SSt	Sandstone
Sh	Shale
Sc	Schist
Ph	Phyllite
Q	Quartzite

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 groundwater 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	GROUNDWATER 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 groundwater 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.

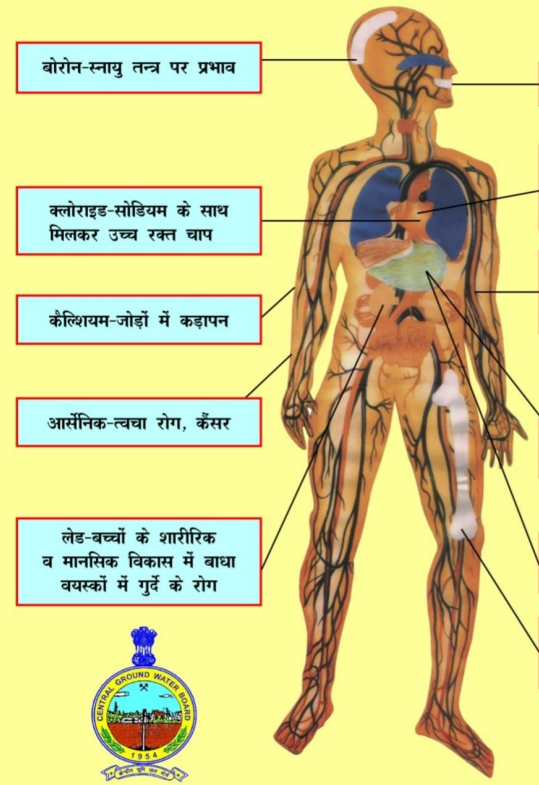
(Contd…)

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

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

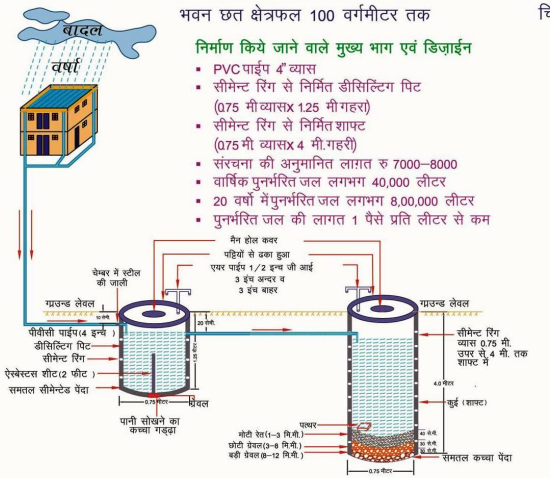
भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–1

भवन छत क्षेत्रफल 100 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

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

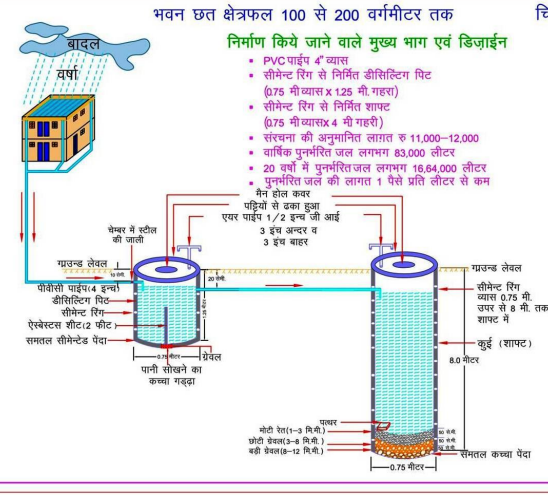


चित्र–2

भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

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

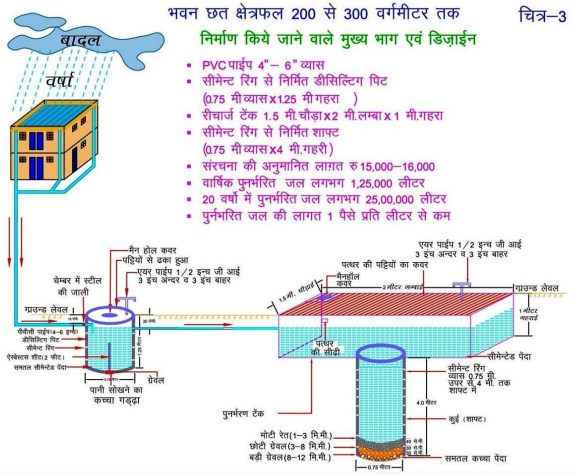


चित्र–3

भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

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

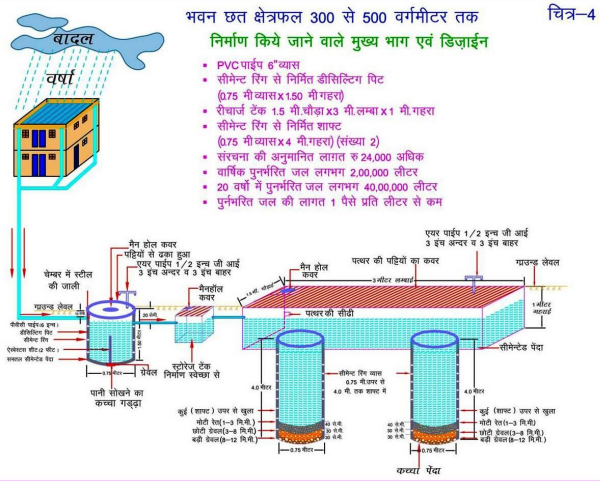


चित्र–4

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
- पुर्नभरित 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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