



Hydrogeological Atlas of Rajasthan Banganga River Basin





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Banganga River Basin





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ADMINISTRATIVE SETUP

BANGANGA RIVER BASIN

Location:

Banganga River Basin is located in the northeastern part of Rajasthan state, encompassing area between 26° 38' 57.21" to 27° 37' 25.10" North latitudes and 75° 48' 23.37" to 77° 41' 31.27" East Longitudes. The total catchment area of the Basin is 8,878.7 sq km. It is bounded by the Gambhir and Banas River Basins in its south-southwest; Ruparail and Sabi in its north; and the Shekhawati Basin in its west. Its eastern border is marked the Yamuna River Basin and Uttar Pradesh State.

River Banganga originates in the Aravali hills, near Arnasar and Bairath in Jaipur District. It flows towards the south up to the village of Ghat, then towards east through partly hilly and partly plain terrain. The total length of the river is approximately 240 km. The main tributaries are Gumti Nalla and Suri River, joining the river on its right bank, and Sanwan and Palasan Rivers meeting the river on its left bank. Alluvial deposits cover major part of the basin, while various hardrock formations outcrop in the upstream part of the basin, on both sides of the river, and as scattered and isolated hillocks in alluvial terrain.

Administrative Set-up:

Administrative, Banganga River Basin extends over parts of Alwar, Jaipur, Dausa, Sawai Madhopur and Bharatpur Districts. The total number of fully or partially covered administrative blocks in this basin is approximately 30 and within 2,473 towns and villages.

S. No.	District Name	Area (sq km)	% of Basin Area	Total Number of Blocks	Total Number of Towns and Villages
1	Alwar	2,332.6	26.5	7	594
2	Bharatpur	2,746.8	31.3	9	844
3	Dausa	2,131.8	24.3	5	621
4	Jaipur	1,325.4	15.1	5	101
5	Karauli	244.1	2.8	2	308
6	Sawai Madhopur	7.6	0.1	1	3
7	Sikar	0.4	0.1	1	2
TOTAL		8,788.7	100.0	30	2,473

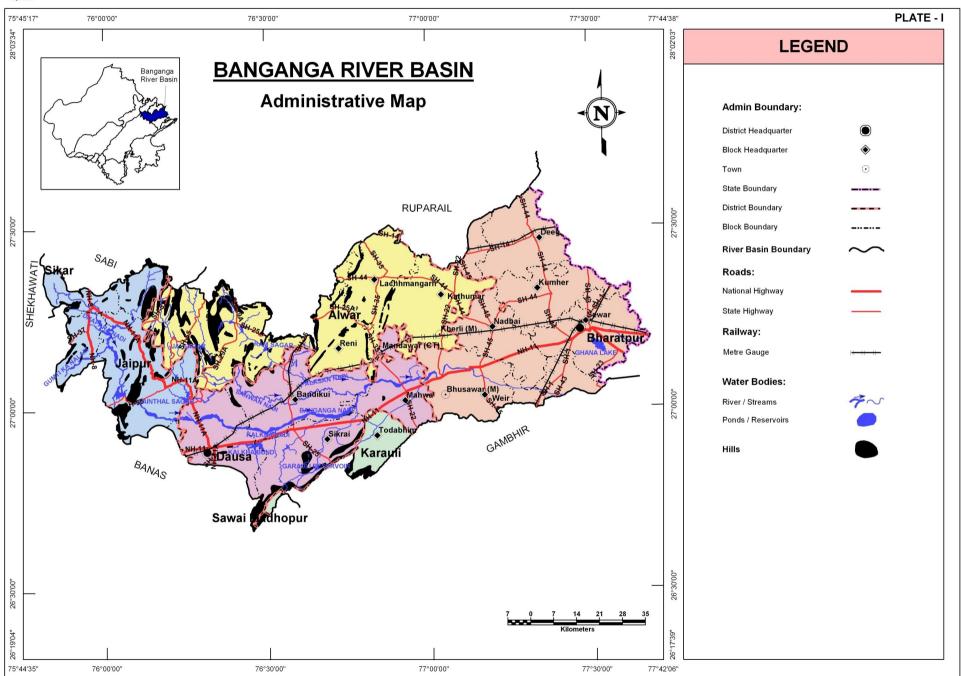
Climate:

Banganga basin's climate is sub-humid and receives fairly good rainfall during monsoon season. It is very cold from November to February while turns very hot from March to June. The mean annual rainfall over Banganga Basin was 596 mm, of which about 95% is received during the Monsoon months spreading from end of June to September. The transition months from September to November are very pleasant.















TOPOGRAPHY

BANGANGA RIVER BASIN

The western part of the Basin is marked by hilly terrain belonging to the Aravali range, with fairly flat valleys along the Banganga River and its tributaries. East of the Todabhim - Mandawar chain of hills, lies an extensive alluvial plain with gentle easterly slopes towards the Yamuna River in Uttar Pradesh. The northeastern part of the area is also rather flat, interspersed with moderately elevated hills.

Physiographically, the district can be divided into two distinct units, viz. Alluvial plain and Hilly areas. The Western part of the basin where the Banganga originates is largely hilly and further westwards and most of the eastern part is alluvial plain with gently undulating topography. The hills attain a maximum elevation of 727m in Jaipur district and topographically the minimum elevation of 160m is seen in Bharatpur district. The Banganga River is an east flowing river and after flowing through the basin it drains into Ghana Lake near Bharatpur city and thus forming an inland drainage system.

Table: District wise minimum and maximum elevation

District Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)				
Alwar	200	689				
Bharatpur	160	416				
Dausa	222	594				
Karauli	233	438				
Jaipur	322	727				
Sawai Madhopur	430	526				
Sikar	575	698				

RAINFALL

The rainfall in this basin is fairly good as compared to other parts of Rajasthan. The general distribution of rainfall across can be visualized from isohyets presented in the Plate – III where most of the central part of the basin received rainfall in the range of 500-800mm in year 2010, however reaching a maximum of 1039mm in Jamwa Ramgarh Block in Western hilly part of the basin.

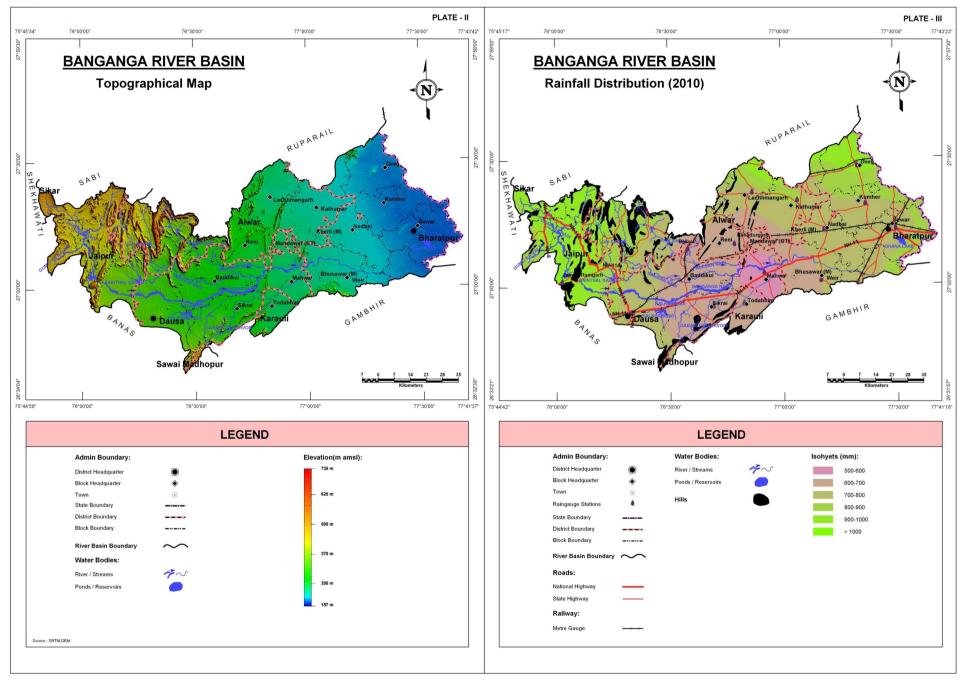
Table: District wise total annual rainfall (based on year 2010 meteorological station recordings (http://waterresources.rajasthan.gov.in)

Rain Gauge Station Location	Total Monsoon Rainfall (mm)	Total Non-Monsoon Rainfall (mm)	Total Annual Rainfall (mm)
Baswa	547	103	650
Bharatpur	684	70	754
Dausa	640	78	718
Deeg	869	58	927
Jamwa Ramgarh	950	89	1,039
Kathumbar	786	48	816
Laxmangarh	679	51	730
Kumbher	722	48	770
Mahuwa	424	117	541
Nadbai	708	53	761
Sikrai	550	110	660
Todabhim	555	73	628
Weir	595	114	709
Bahadurgarh	798	18	816















GEOLOGY

BANGANGA RIVER BASIN

The rocks ranging in age between Archaean Granites and Gneisses to Quaternary alluvium are found in the basin.

Pre-Delhi Group: This group is largely represented by pink to grey granites and gneisses. These are compact, jointed and foliated in nature. Weathering in these rocks has been noticed to various depths. Delhi Super Group of rocks un-conformably (Eparchean unconformity) overlay the Pre-Delhi Group of rocks.

Delhi Super Group: This Super Group is divided into two Groups i.e., Alwar and Ajabgarh Groups separated by Kushalgarh limestone and Hornstone breccia formation. The Alwars are predominantly arenaceous whereas the Ajabgarhs are argillaceous in nature appearing as long linear ridges prominently appearing distinctly above the surrounding alluvial tract.

Quaternary Alluvium: River deposited alluvium constituted of sand, silt clay and kankar constitutes the Quaternary Alluvium. At places, wind-blown sand mixes with alluvial sediments as top layer and also often occurs as stabilized sand dunes.

Super Group	Group	Formation						
	Quaternary	Alluvium and wind-blown sand comprised of sand, silt, gravel and talus, clay and kankar.						
	Ajabgarh	Argillaceous meta sediments, consisting of phyllities, quartzites, amphibolities (and soapstone), impure						
Delhi		dolomitic limestone, Kushalgarh limestone and (tectonic) hornstone breccia.						
Delili	Alwar	Arenaceous meta sediments, consisting of quartzites, conglomerates, gritty quartzites interbedded						
		with phyllite, quartz sericite schist, etc.						
X	UNCONFORMITY							
	Bhi	lwara and Aravali (pre-Delhi), Granites, Granitic Gneisses (Archean)						

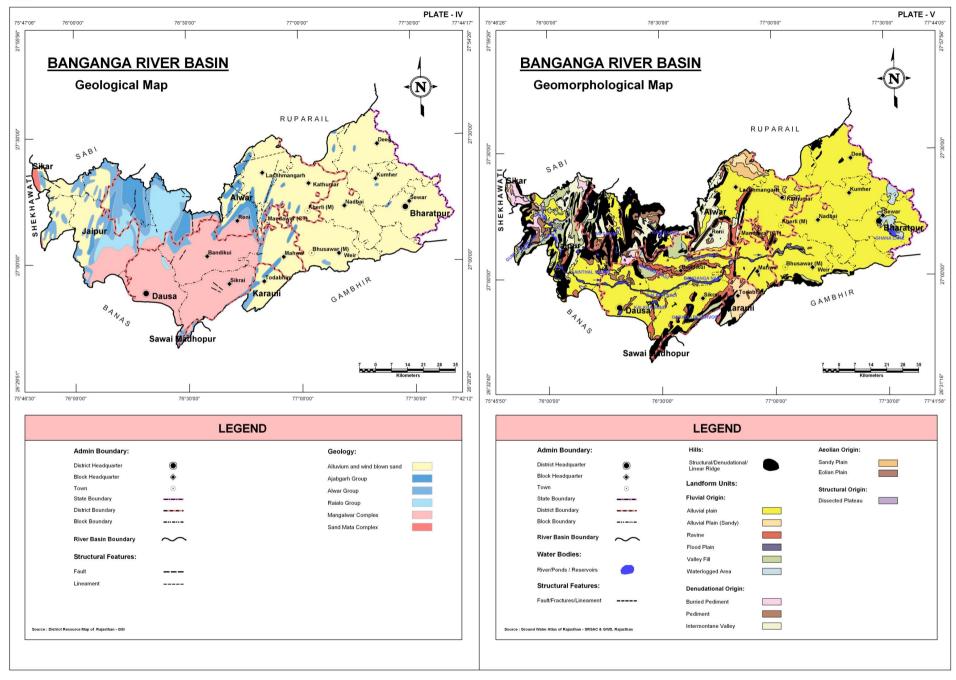
GEOMORPHOLOGY

Origin	Landform Unit	Description
Aeolian	Eolian Plain	Formed by eolian activity, with sand dunes of varying height, size, 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.
	Sandy Plain	Formed of aeolian activity, wind-blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt & clay.
Denudational	Pediment	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss-crossed by fractures & faults.
	Intermontane Valley	Depression between mountains, generally broad & linear, filled with colluvial deposits.
	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.
Fluvial	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.
	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.
	Water logged/ Wetland	Area submerged in water or area having very shallow water table. So that it submerges in water during rainy season.
Hills	Structural Hill	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.
Structural	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys.















AQUIFERS

BANGANGA RIVER BASIN

The structural lineaments and general strike of ridges is parallel to the Great (strike-slip) Boundary Fault, of NE-SW to NNE-SSW alignment of the Aravali ranges. In the immediate vicinity of these ridges there is, generally, a coarse grained belt (talus, fault debris) having favorable ground water prospects.

In the Delhi rocks, mainly the quartzites, as well as in the pre-Delhi rocks, ground water occurs in the weathered zones of granites and gneisses and in secondary openings, and these comprise the only, rather poor, exploitable aquifers.

Aquifer in Potential Zone	Area (sq km)	Description of the unit/Occurrence
Younger Alluvium	1,254.7	Alluvium generally comprising gravel, sand, silt, sandy and silty clay, clay and clay kankar. Gravel generally occurs as regular bed over the bedrock, although it may also be present in dispersed form or as thin lenses embedded in sand horizons. The
Older Alluvium	4,972.6	maximum thickness of alluvium is about 225m at Bahaj of Bharatpur district. Sandy clay, sand and kankar generally form the water table aquifer, which is normally tapped by dug wells.
Quartzite	1,667.0	Groundwater occurs in weathered and fractured zones of quartzite. The yield of dug well in Quartzite ranges between 40.00 to 75.00 cum/day, whereas in tube well varies from 0.40 to 9.00cum/hr and upto the maximum yield of 27.00cum/hr at Boronda of Dausa District.
Schist	136.4	Here also water occurs in weathered and fractured zones. The yield of dug wells in this formation varies from 3.80 to 43.40m³/day whereas in tube wells, the discharge varies from 11.00m³/hr to 25.00m³/hr.
Phyllite	73.7	Average yield of dug well in this formation is 40.00m³/day and the discharge of the tube well is about 18.00m³/hr.
Granite	49.0	Very limited in occurrence, and wherever the rock is fractured or jointed, fresh groundwater is generally found.
Gneiss	105.1	The yield of dugwell in Gneiss varies from 35.00 to 45.00cum/day while in Piezometer constructed at Baswa, District Dausa, the discharge observed as 6.75cum/hr.
Non Potential Zone (Hills)	530.3	Areas occupied by hills
Total	8,788.7	

LOCATION OF GROUNDWATER MONITORING WELLS

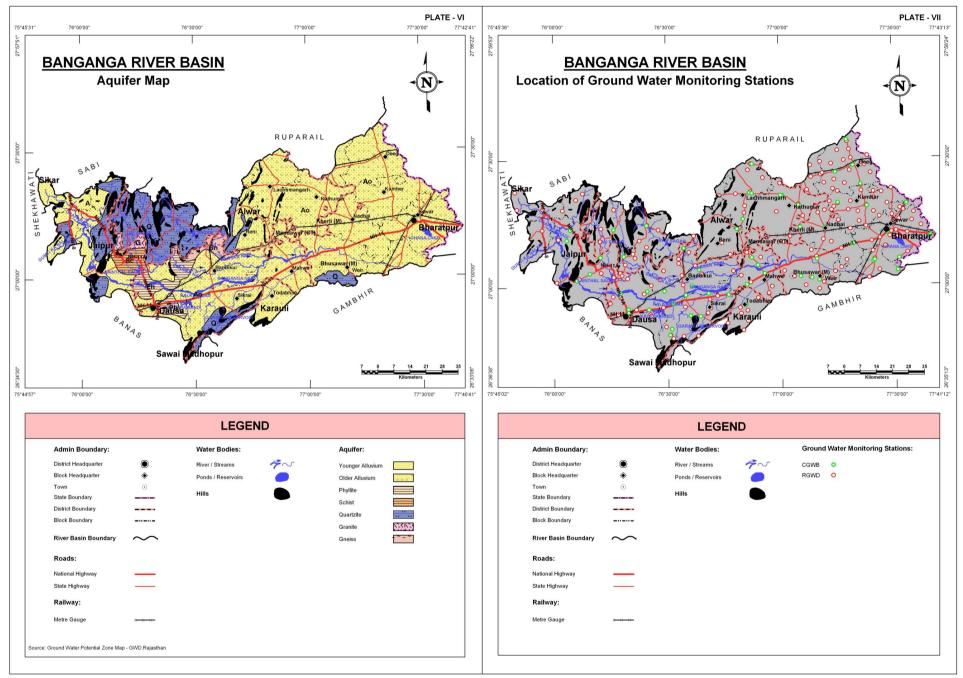
The basin has large number of groundwater monitoring stations (260) in the basin owned by RGWD (202) and CGWB (58). Benchmarking and optimization studies recommend that for optimal monitoring of the aquifers in the basin, 52 additional wells for water level monitoring and 160 additional wells for water quality monitoring be added to existing network

District Name		ng Ground nitoring Sta		Recommended Additional Ground Water Monitoring Stations						
	CGWB	RGWD	Total	Water Level	Water quality					
Alwar	11	27	38	30	52					
Bharatpur	25	95	120	-	36					
Dausa	21	54	75	11	60					
Jaipur	-	18	18	11	3					
Karauli	1	8	9	-	9					
Sawai Madhopur	-	-	-	-	-					
Grand Total	58	202	260	52	160					















LOCATION OF EXPLORATORY WELLS

BANGANGA RIVER BASIN

260 exploratory wells are present in the basin drilled in the past by RGWD (202) and CGWB (58) which form the basis for aquifer delineation and three dimensional visualization of the same.

District Name	Exp	loratory \	Wells
District Name	CGWB	RGWD	Total
Alwar	11	27	38
Bharatpur	25	95	120
Dausa	21	54	75
Jaipur	-	18	18
Karauli	1	8	9
Sawai Madhopur	-	-	-
Grand Total	58	202	260

DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The general depth to water level in the basin ranges from 10 to 30 meters all over the alluvial areas except for the locations north of Bandikui, Karauli and Amber where deeper water levels of around 30 to 50m have been observed.

Table: District wise area covered in each water level depth range

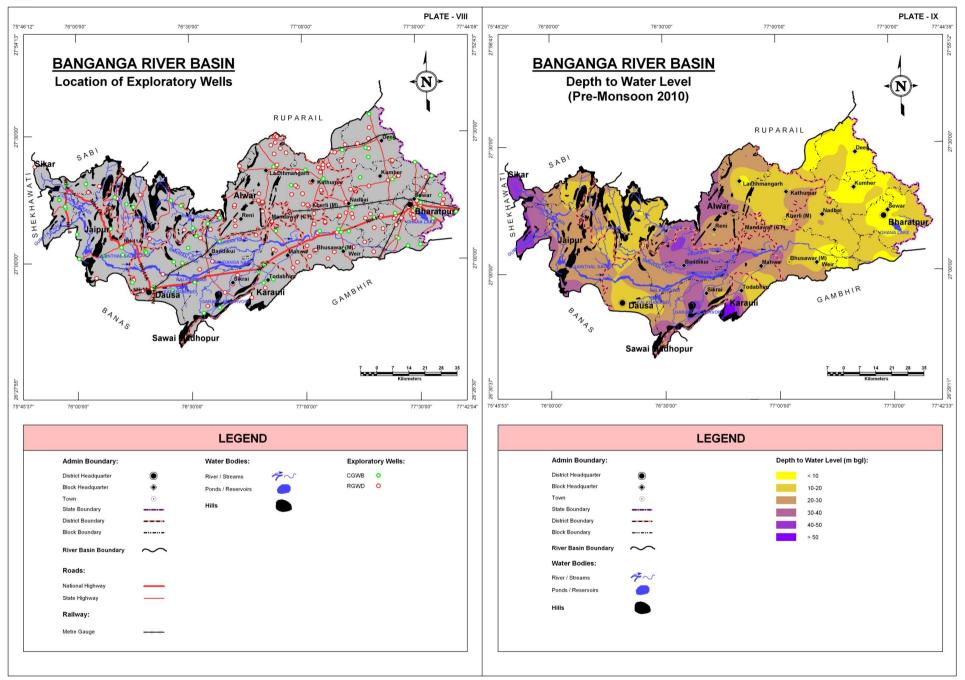
Depth to water level			Distric	t wise are	ea (sq km)*		Total Area	
(m bgl) Pre Monsoon - 2010	Alwar	Bharatpur	Dausa	Jaipur	Karauli	Sawai Madhopur	Sikar	(sq km)	
< 10	19.8	1,056.8	-	-	-	-	-	1,076.6	
10-20	1,010.1	1,382.4	339.8	169.8	77.3	-	-	2,979.3	
20-30	808.3	289.0	1,007.2	645.4	70.0	-	-	2,819.8	
30-40	240.7	18.7	648.2	242.9	34.2	-	-	1,184.7	
40-50	0.1	-	32.9	118.9	22.2	-	0.4	174.4	
> 50	-	-	-	-	21.2	-	-	21.2	
Total	2,079.0	2,746.8	2,028.1	1,176.9	224.9	-	0.4	8,256.0	

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















WATER TABLE ELEVATION (PRE MONSOON – 2010)

BANGANGA RIVER BASIN

Very high variation in groundwater elevation has been observed in the basin which ranges from 160m amsl to more than 460m amsl. In the hilly areas in the western part the water table is not only high but also has a steeper gradient. The general groundwater flow direction is towards eastwards. Further in the east where groundwater occurs in alluvial sand, the flow gradients are relatively flatter. In far eastern part, the water table intersects ground and water logging is observed near Ghana Lake.

	District wise Area (sq km) per water table elevation range (m)														Total Area														
District Name	160-	170-	180-	190-	200-	210-	220-	230-	240-	250-	260-	270-	280-	290-	300-	310-	320-	330-	340-	350-	360-	370-	380-	390-	400-	410-	420-	430-	(sq km)
	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	460	
Alwar	-	-	90	191.8	314.3	336	149.6	137.6	138.6	18.3	15.7	22	32.9	25	52.2	41.9	42.1	44.3	48.9	34.9	43.1	50.1	50.4	48.7	67.1	51.1	30.6	2	2,079.0
Bharatpur	383.9	1,033.40	685.4	413.9	165.5	64.7	-	-	-	-	-	-	-	-	•	-	-	•	-	-	-	-	-	-	-	-	-	-	2,746.8
Dausa	-	-	-	18	118.3	140.1	122.7	162.7	401.5	163.7	129.7	125.4	115.8	147.5	281.7	101	0	•	-	-	-	-	-	-	-	-	-	-	2,028.1
Jaipur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3	36	140.8	89.1	64.4	73.2	62.6	51.9	52.6	102.1	98.3	134.7	111.5	158.5	1,176.9
Karauli	-	-	-	0.5	33	30.9	75.8	67.9	0	0	0.2	0.1	11.2	5.3	-	-			-	-	-	-	-	-	-	-		-	224.9
Sawai Madhopur	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-			-	-	-	-	-	-	-	-		-	-
Sikar	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-			-	0.4	-	-	-	-	-	-		-	-
Total	383.9	1,033.40	775.4	624.2	631	571.6	348.1	368.2	540	181.9	145.6	147.5	159.9	177.8	335.1	179	182.9	133.3	113.4	108.5	105.7	102	103	150.8	165.4	185.9	142	160.5	8,256.0

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

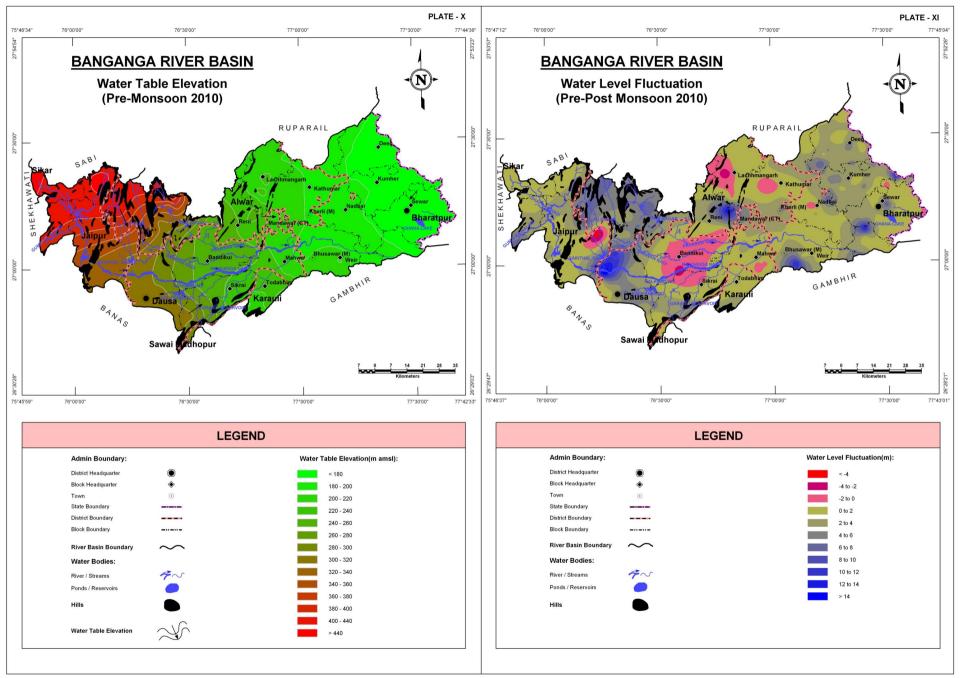
The red shaded areas in the Plate XI indicate the areas that showed negative fluctuation i.e., water table has gone down in Post-Monsoon period as compared to Pre-Monsoon water levels. This map is very significant as it indicates the general recharge situation post monsoon season of the year. Except for few pockets around Bandikui, Lakshmangarh and North of Jamwa Ramgarh, the water table has generally risen.

District Name			Di	strict wise	area cove	rage (sq k	m) within	fluctuation	range			Total Area
District Name	-6 to -4m	-4 to -2m	-2 to 0m	0 to 2m	2 to 4m	4 to 6m	6 to 8m	8 to 10m	10 to 12m	12 to 14m	14 to 16m	(sq km)
Alwar	-	15.3	206.3	671.2	521.7	465.6	161.4	23.2	10.6	3.6	-	2,079.0
Bharatpur	-	-	22.3	1,190.0	1,180.6	250.9	62.5	26.6	13.3	0.6	-	2,746.8
Dausa	-	14.6	422.2	786.2	457.0	199.8	43.1	35.9	44.6	18.4	6.1	2,028.1
Jaipur	6.1	18.2	37.9	659.3	331.2	75.1	36.5	12.4	0.1	-	-	1,176.9
Karauli	-	-	-	182.7	40.4	1.8	-	-	-	-	-	224.9
Sawai Madhopur	-	-	-	-	-	-	-	-	-	-	-	-
Sikar	-	-	-	0.4	-	-	-	-	-	-	-	0.4
Total	6.1	48.2	688.8	3,489.7	2,531.0	993.2	303.5	98.1	68.7	22.6	6.1	8,256.0















ELECTRICAL CONDUCTIVITY DISTRIBUTION

BANGANGA RIVER BASIN

The electrical conductivity of ground water ranges from less than 2000 μ S/cm to more than 30,000 μ S/cm in the basin. The areas marked in red colour are high salinity areas with EC values more than 4000 μ S/cm. Such area are largely found in eastern part of the areas and in alluvial aquifers, as seen around Bharatpur, Nadbai, Kumber, Deeg, Lakshmangarh, and in Dausa. The fresh water areas are found within and around hardrock areas. Rest of the areas has generally higher salt content in groundwater. The analysis is based on average of EC values observed during Pre-Monsoon between years 2005-09.

Electrical Conductivity Ranges		District wise area coverage (sq km)									Total Avea				
(μS/cm at 25°C)	Alw	ar	Bhara	tpur	Dau	sa	Jaip	ur	Kar	auli	Sawai	Madhopur	Si	kar	Total Area
(Ave. of years 2005-09)	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	(sq km)
< 2000	1,217.7	58.6	184.6	6.7	1,315.8	64.9	1,087.7	92.4	190.9	84.9	-	0.0	0.4	100.0	3,997.0
2000-4000	669.0	32.2	1,267.7	46.2	667.8	32.9	89.0	7.6	34.0	15.1	-	0.0	1	0.0	2,727.5
> 4000	192.3	9.3	1,294.5	47.1	44.5	2.2	0.2	0.0	-	0.0	-	0.0	-	0.0	1,531.5
Total	2,079.0	100.0	2,746.8	100.0	2,028.1	100.0	1,176.9	100.0	224.9	100.0	-	0.0	0.4	100.0	8,256.0

CHLORIDE DISTRIBUTION

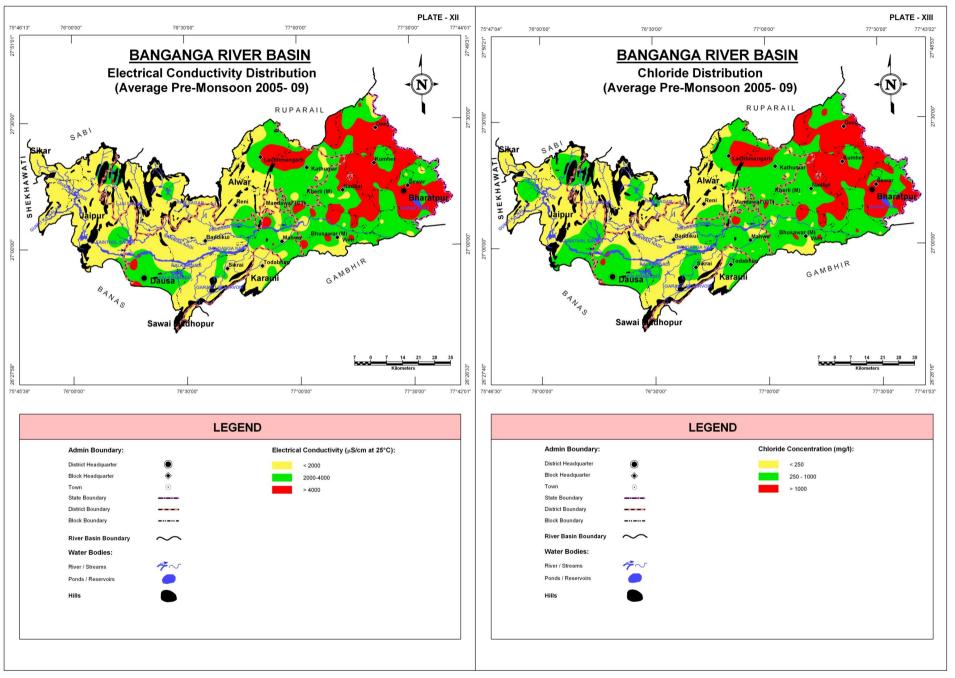
The chloride distribution also follows the same pattern of distribution as that of Electrical conductivity. The analysis is based on average of Chloride values observed during Pre-Monsoon between years 2005-09. High chloride concentration in groundwater is found in the eastern part around Bharatpur, Nadbai, Deeg, Kumher, Kathumar, Lakshmangarh and a small patch around Dausa. Bharatpur district has largest area under high salinity, whereas Dausa, Alwar and Jaipur districts have large areas with freshwater.

Chloride Concentration		District wise area coverage (sq km)										Total Area			
Ranges (mg/l)	Alv	Alwar		Bharatpur		Dausa		Jaipur		rauli	Sawai Madhopur		Sikar		
(Ave. of years 2005-09)	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	(sq km)
< 250	1,217.7	58.6	184.6	6.7	1,315.8	64.9	1,087.7	92.4	190.9	84.9	-	0.0	0.4	100.0	3,997.0
250-1000	669.0	32.2	1,267.7	46.2	667.8	32.9	89.0	7.6	34.0	15.1	-	0.0	-	0.0	2,727.5
> 1000	192.3	9.3	1,294.5	47.1	44.5	2.2	0.2	0.0	-	0.0	-	0.0	-	0.0	1,531.5
Total	2,079.0	100.0	2,746.8	100.0	2,028.1	100.0	1,176.9	100.0	224.9	100.0	-	0.0	0.4	100.0	8,256.0















FLUORIDE DISTRIBUTION

BANGANGA RIVER BASIN

High fluoride pockets are seen to the west of Deeg, around Kherli – Mahwa – Weir and to the east of Dausa. In these areas, the concentration is more than 3 mg/l. The general concentration of Fluoride in most of the area is below 1.5 mg/l and some areas between 1.5 to 3 mg/l in between.

Fluoride Concentration		District wise area coverage (sq km)								Total Area					
Ranges (mg/l)	Alw	/ar	Bhara	tpur	Dau	sa	Jaip	ur	Kar	auli	Sawai	Madhopur	Si	kar	(sq km)
(Ave. of years 2005-09)	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	(SQ KIII)
< 1.5	1,217.7	58.6	184.6	6.7	1,315.8	64.9	1,087.7	92.4	190.9	84.9		0.0	0.4	100.0	3,997.0
1.5-3.0	669.0	32.2	1,267.7	46.2	667.8	32.9	89.0	7.6	34.0	15.1		0.0	1	0.0	2,727.5
> 3	192.3	9.3	1,294.5	47.1	44.5	2.2	0.2	0.0	-	0.0		0.0	1	0.0	1,531.5
Total	2,079.0	100.0	2,746.8	100.0	2,028.1	100.0	1,176.9	100.0	224.9	100.0		0.0	0.4	100.0	8,256.0

NITRATE DISTRIBUTION

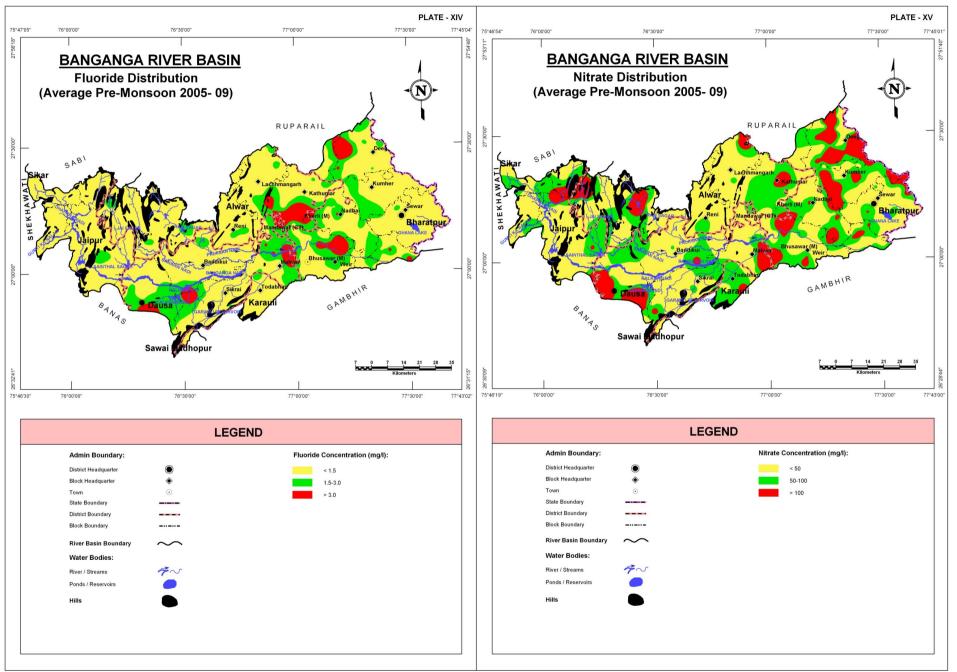
High nitrate concentration in groundwater renders it unsuitable for agriculture purposes. Plate XV shows distribution of Nitrate in groundwater. There are some pockets around Dausa, Rajgarh, Kathumar – Kherli – Bhusawar region that around Deeg have high Nitrate concentration whereas rest of the area has relatively low Nitrate i.e., under 50 mg/l to upto 100 mg/l.

Nitrata Dangas (mg/l)					D	istrict wis	e area cov	erage (sc	km)						Total Area
Nitrate Ranges (mg/l) (Ave. of years 2005-09)	Alwa	Alwar		Bharatpur		Dausa		Jaipur		auli	Sawai Madhopur		Sikar		
(Ave. 01 years 2005-09)	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	(sq km)
<50	1,302.6	62.7	1,294.1	47.1	1,265.4	62.4	759.2	64.5	54.7	24.3	1	0.0	0.4	100.0	4,676.4
50-100	583.4	28.1	883.8	32.2	527.9	26.0	344.8	29.3	157.9	70.2	1	0.0	-	0.0	2,497.9
>100	192.9	9.3	568.8	20.7	234.8	11.6	72.9	6.2	12.3	5.5	1	0.0	-	0.0	1,081.7
Total	2,079.0	100.0	2,746.8	100.0	2,028.1	100.0	1,176.9	100.0	224.9	100.0	•	0.0	0.4	100.0	8,256.0















DEPTH TO BEDROCK

BANGANGA RIVER BASIN

The entire area of the Banganga river basin is underlined by the hard rocks at different depths. The major rocks types occurring in the area are Limestone, Shale as sedimentary rocks and Slate, Schist, Phyllite, Quartzite and Gneiss as Metamorphic rocks type. These rocks are overlain by alluvial deposits of sand, clay, silt, kankar, gravels and admixture of all. The depth to bed rock defines the sub surface topography of the occurrence of hard rock beneath alluvial deposits and fractured bedrock. Plate – XVI presents the sub-surface occurrence of bedrock in meters below ground level. It is apparent that the bedrock is at deeper levels in eastern part of the river basin which gradually occurs at shallow depths towards west where even it appears in the form of high hills. The depth to bedrock in the basin varies from less than 20 m bgl in the west and southwest to more than 279 m bgl in the east.

Depth To Bedrock		District Area coverage (sq km)							
(m bgl)	Alwar	Bharatpur	Dausa	Jaipur	Karauli	Sawai Madhopur	Sikar	(sq km)	
20-40	-	-	111.0	37.3	16.8	-		165.1	
40-60	404.4	-	1,238.3	1,102.0	81.5	-	0.4	2,826.7	
60-80	752.4	1,128.9	594.0	37.6	126.6	-	-	2,639.4	
80-100	817.1	1,560.6	84.8	-	-	-		2,462.6	
100-120	105.0	57.3	-	-	1	-	-	162.3	
Total	2,079.0	2,746.8	2,028.1	1,176.9	224.9	-	0.4	8,256.0	

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.

Alluvial areas

Except for hardrock exposure areas, this aquifer is present all over the basin with thicknesses varying from very high (reaching 70m) in eastern part in Sewar-Kumher-Dig region to a general less than 30 meter in rest of the basin area. Significant thickness of 30-50m can also be noticed around Weir and Lachhmangarh-Kathumar region.

Hardrock areas

Weathered, fractured and jointed rock formations form the phreatic aquifer in the areas where hardrocks are exposed or are very shallow. These aquifers are largely found in the western part of the basin in the region between Viratnagar, Jamwa Ramgarh, Dausa, Bandikui and Reni. The weathered zone reaches a thickness of more than 40m. In addition to this large region of aquifers formed in weathered and fractured zone, isolated pockets of such unconfined aquifers are found in east of Dausa, Lalsot-Todabhim region and south of Weir where the pocket east of Dausa has shown the presence of >30m of weathered/fractured zone while other two areas have upto 20m of weathered zone.

Alluvial areas:

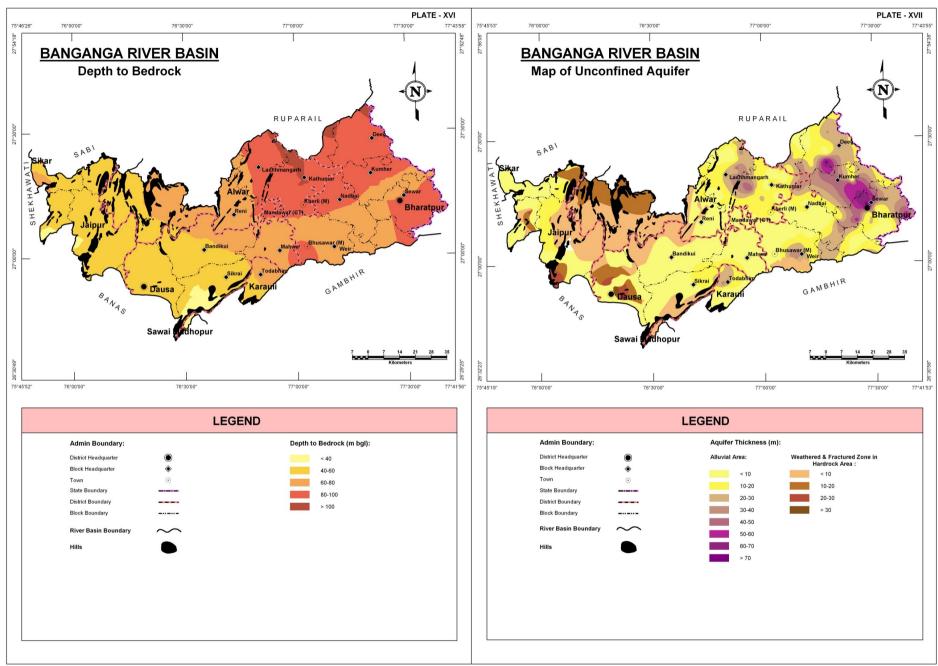
Unconfined aquifer		District area coverage (sq km)										
Thickness (m)	Alwar	Bharatpur	Dausa	Jaipur	Karauli	S. Madhopur	Sikar	(sq km)				
< 10	1,086.6	780.5	1,718.1	852.4	116.7	-	0.4	4,554.7				
10-20	707.2	671.1	257.5	287.8	57.7	-	-	1,981.3				
20-30	177.2	663.8	44.4	25.4	48.3	-	-	959.1				
30-40	95.0	297.5	8.1	-	2.2	-	-	402.8				
40-50	12.8	178.5	-	-	-	-	-	191.3				
50-60	-	107.8	-	-	-	-	-	107.8				
60-70	-	44.4	-	-	-	-	-	44.4				
70-80	-	3.3	-	-	-	-	-	3.3				
Total	2,079.0	2,746.8	2,028.1	1,165.6	224.9	-	0.4	8,244.7				

Hardrock areas:

Unconfined aquifer		District area coverage (sq km)										
Thickness (m)	Alwar	Bharatpur	Dausa	Jaipur	Karauli	S. Madhopur	Sikar	(sq km)				
< 10	556.36	72.65	329.04	343.87	16.90	-	-	1,318.8				
10-20	252.38	0.60	114.86	100.20	-	-	-	468.0				
20-30	-	-	38.96	25.38	-	-	-	64.3				
30-40	-	-	8.08	-	-	-	-	8.1				
Total	808.7	73.3	490.9	469.5	16.9	-	-	1,859.3				













CONFINED AQUIFERS

BANGANGA RIVER BASIN

First Confined Aquifer

Thick and regionally persistent clay formations separate the unconfined aquifer with the next sandy formation below the unconfined layer of aquifer, forms the first semi-confined to confined aquifer (Plate XVIII) in the region. This aquifer is not found in the western part of the area and largely restricted in occurrence to the eastern part of the hilly region (Bandikui, Reni, Lachhmngarh) attaining greater thicknesses eastwards. The thickness of this aquifer in general, is in the range of <10 to 20 meters in most of the area however with pockets around Sewer, Bharatpur, Nadbai, west of Mahwa and north of Kathumar show a thickness of upto 30 meters. Near Uchain (south of Bharatpur), very high thickness has been noticed.

Aquifer Thickness			Total Area					
(m)	Alwar	Bharatpur	Dausa	Jaipur	Karauli	Sawai Madhopur	Sikar	(sq km)
< 10	858.72	1,515.57	932.00	-	131.89	-	-	2,316.8
10-20	293.42	701.44	268.64	-	75.45	-	-	287.9
20-30	87.03	244.84	20.56	1	0.66	-	-	190.2
30-40	31.07	72.32	-	-	-	-	-	145.1
40-50	0.20	49.40	-	-	-	-	-	103.0
50-60	-	34.74	-	-	-	-	-	95.0
60-70	-	25.67	-	1	-	-	-	69.6
70-80	-	19.04	-	-	-	-	-	42.2
80-90	-	8.94	-	-	-	-	-	25.5
90-100	-	1.57	-	-	-	-	-	3,275.3
Total	421.34	2,667.91	185.89	-	0.12	-	-	2,316.8

Second Confined Aquifer

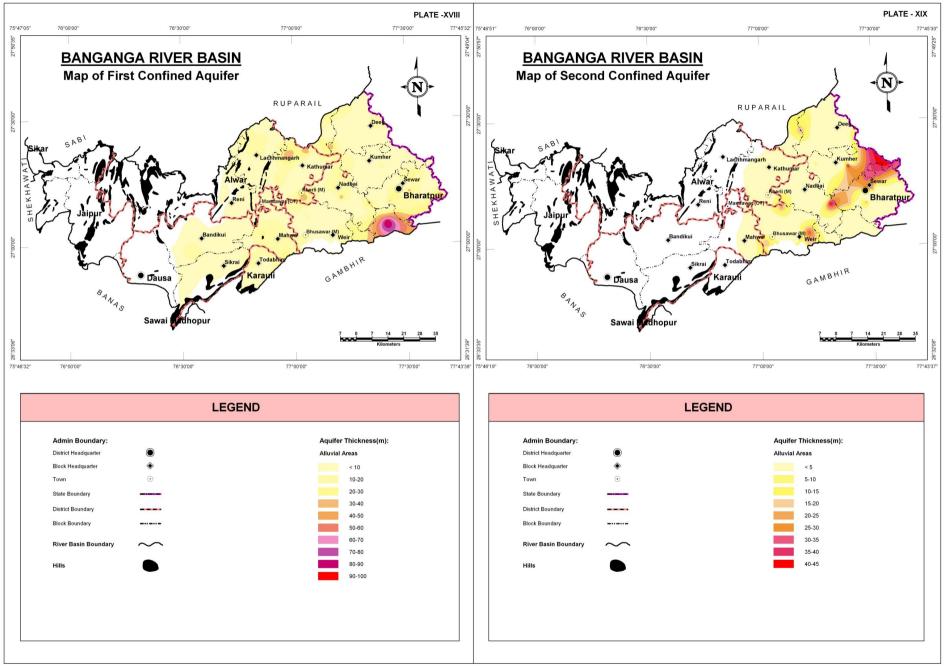
The third aquifer of the region i.e., second confined aquifer, occurs further below the 1st confined aquifer, separated by a clayey horizon. This aquifer is also very limited in spatial distribution and occurs only in the far eastern part of the region and largely absent in the central and western part. The general thickness of this is in the range of 10 meters, however in the region of Weir, Uchain, Bharatpur and further northeast, it attains higher thicknesses reaching more than 45m.

Aquifer Thickness			Total Area					
(m)	Alwar	Bharatpur	Dausa	Jaipur	Karauli	Sawai Madhopur	Sikar	(sq km)
< 5	404.51	1,749.19	162.93	-	0.12	-	-	2,316.8
5-10	11.30	258.96	17.59	-	-	-	-	287.9
10-15	3.71	181.14	5.37	-	-	-	-	190.2
15-20	1.81	143.29	-	-	-	-	-	145.1
20-25	-	103.01	-	-	-	-	-	103.0
25-30	-	95.04	-	-	-	-	-	95.0
30-35	-	69.56	-	-	-	-	-	69.6
35-40	-	42.21	-	-	-	-	-	42.2
> 45	-	25.50	-	-	-	-	-	25.5
Total	421.34	2,667.91	185.89	-	0.12	-	-	3,275.3















CROSS SECTIONS

BANGANGA RIVER BASIN

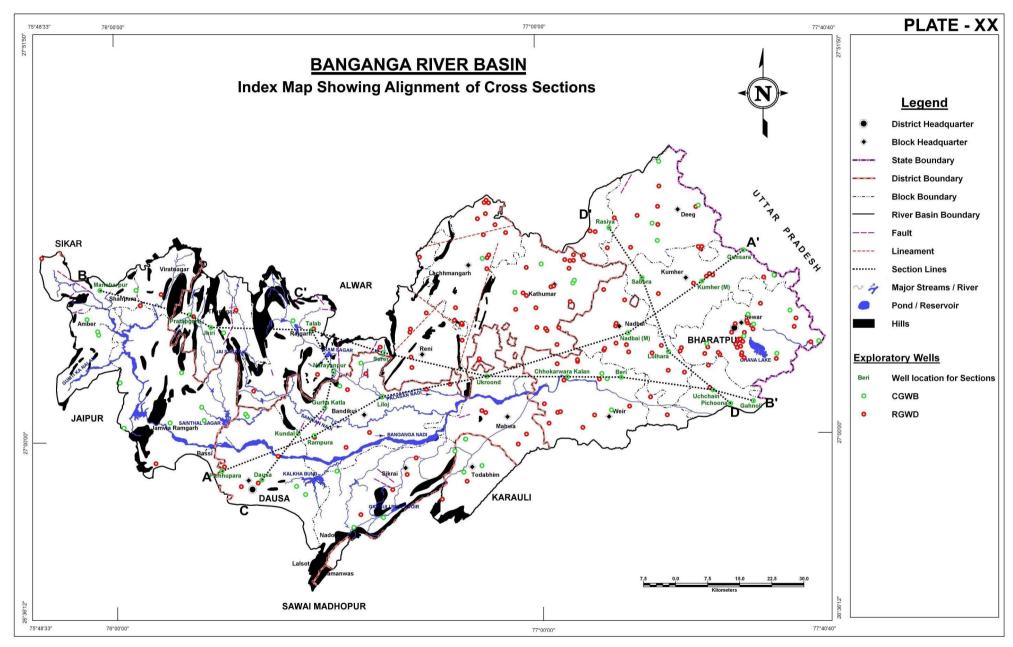
Four different hydrogeologic cross sections have been prepared to better understand sub-surface lighologic distribution. This has been overlaid with water table elevation of pre-monsoon 2010 and structural faults. The alignment of the cross sections is shown in Plate XX and corresponding sections are presented in Plates XXI through XXIV. The broad orientation of the sections is as given below:

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















CROSS SECTIONS

BANGANGA RIVER BASIN

Section A-A':

This section is the longest of the sections plotted in the area and trends in SW-NE direction, cutting across the basin (Plate XXI). The section depicts the disposition of different layers of sand and clay along with weathered and fractured zones in limestone, schist, phyllite and quartzite. The south western part of the river basin is predominantly hard rock with aquifer formed within quartzite and schist. Due to availability of lithologs of limited depths the continuity of the same is not observed as moved towards north east. However, few deep lithologs in the NE part have shown the presence of schist and quartzite. In the rest of the area, sand is predominating while there are some lenses of clay. The water level varies from 174 m amsl to 323 m amsl following the surface topography as observed from the 2010 pre monsoon season.

Section B-B':

The B-B' section is another long section trending SW-NE (Plate XXII). The section depicting sand and clay layers of alluvium aquifers underlined by thick zone of weathered and fractured schist, quartzite and granite. In the central part of the section is pre dominated by granite and quartzite. The alternate sequence of clay and sand is forming the major aquifer system in these areas. In some of the wells towards the NE of the cross section quartzites are encountered with limited thickness of weathered and fractured zone. Limited depth of the wells and their lithologs information below it is not available. However, from the cross section it is apparent that occurrence of hard rock aquifer in form of weathered and fractured quartzite is occurring below the alluvium.

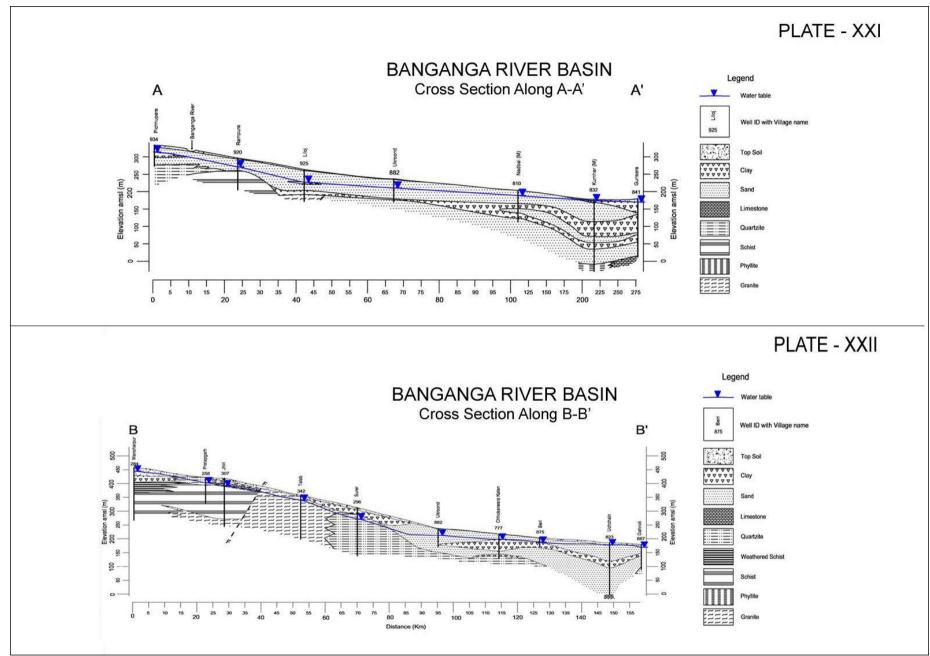
Thickness of alluvium in North eastern part more than 150 m and decreases to around 100 m in the central part of the river basin. It is observed from pre monsoon 2010 data the Ground water level varies from 173 m amsl to 460 m amsl from SW – NE of the section.

There is a major fault indication observed in south western part of the basin in between phyllite, limestone and schist.















CROSS SECTIONS

BANGANGA RIVER BASIN

Section C-C':

The C-C' section has been selected across the basin trending SW – NE in the western part of the basin. The northern part of the section is characterized by the hard rock formation of Granite. The weathered and fractured portions of quartzite are most suitable aquifer zones. Cross section (Plate XXIII) depicts, that in southern part, alluvium is forming the major aquifer system underlain by weathered schist, which is saturated with water.

In this section the thickness of alluvium ranges from 50 to 80 m however the hard rock aquifer are explored limited to the thickness of 30 m.

The water level varies from 267 m amsl to 322 m amsl as per the data of pre monsoon 2010.

Section D-D':

This section is selected in the central part of the basin which depicts mainly the alternating layers of clay and sand with hard rock being encountered in some of the wells. As all the wells have not been drilled till basement the limited information available has been interpolated for preparation of the sections. Thickness of alluvium in this area ranges from 100 m to more than 150 m (Plate XXIV). In the eastern part of the area quartzite is encountered in the well.

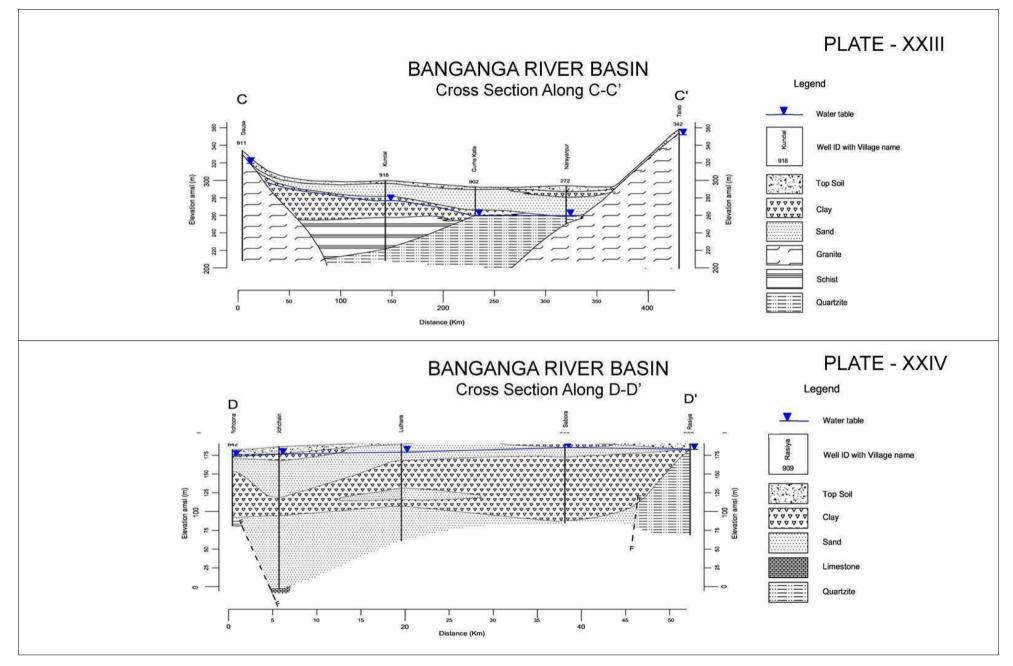
It is observed from pre monsoon 2010 data the ground water level varies from 177 m amsl to 183 m amsl. In this area alluvium acts as semi confined aquifer due to continuous and thick impermeable layer of clay mixed with kankar overlying on it and encountered in all the wells in the area.

A fault zone appears to pass through this section as indicated.















3D MODEL OF AQUIFERS

BANGANGA RIVER BASIN

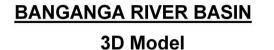
A 3D model depicting the various litho-stratigraphic units in the entire river basin is presented in Plate XXV. The model reveals that beneath the first sandy unconfined aquifer, there are two persistent clay horizons (1st largely persistent all over the alluvium to the east of hilly area whereas the 2nd one largely confined to far eastern part of the basin only) in the region separating three sandy aquifers. The second sandy aquifer is found only in the eastern part of the basin within alluvium whereas the third sandy aquifer is present only to a limited extent in the eastern part of alluvial terrain.

The depth of hard rock is shallow in the western part as compared to the eastern part of the basin. Granite Gneiss is the basement rock occurring in the western part of the basin which is not been encountered in eastern part. The small discontinuous patches depicted in 3D model below the second sandy aquifer are indicative of occurrence of limestone, quartzite, phyllite, slate and schist etc. as reported in data of GWD and CGWB. In absence of continuity of the similar formation in adjacent well data they are occurring as small patches. However, the quartzite, below the second sandy layer is appearing as almost continuous layer in the model.

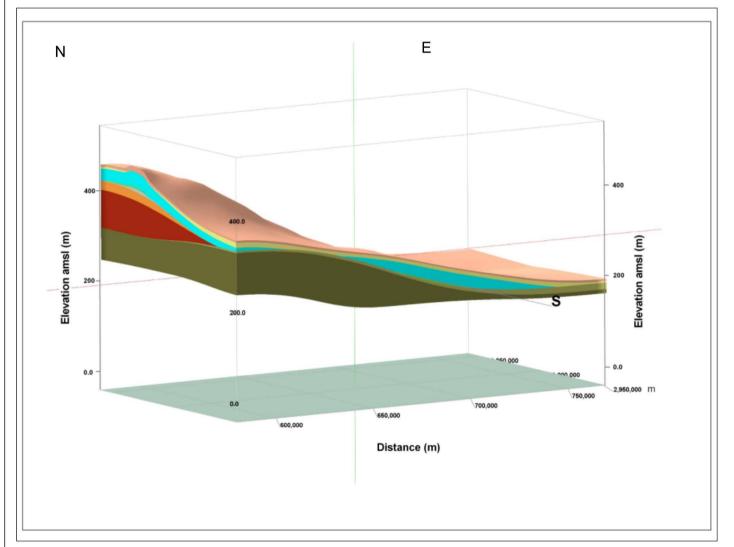


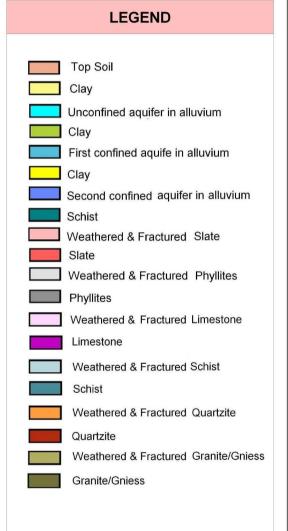






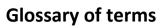












S. No.	Technical Terms	Definition
	40111550	A saturated geological formation which has good permeability to
1	AQUIFER	supply sufficient quantity of water to a Tube well, well or spring.
2	ARID CLIMATE	Climate characterized by high evaporation and low precipitation.
3	ARTIFICIAL RECHARGE	Addition of water 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	рН	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.
20	SEMI-CONFINED	Aquifer overlain and/or underlain by a relatively thin semi-pervious
26	AQUIFER	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.

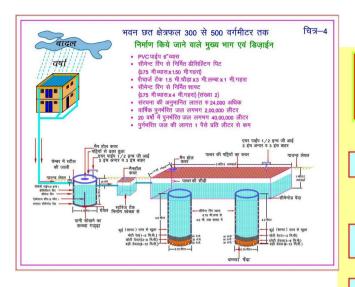
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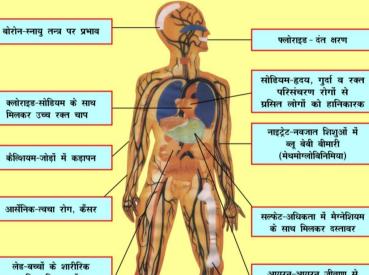
S. No.	Technical Terms	Definition
		It is defined as the rate of flow through an aquifer of unit width and
29	TRANSMISSIBILITY	total saturation depth under unit hydraulic gradient. It is equal to
		product of full saturation depth of aquifer and its coefficient of
		permeability.
30	UNCONFINED AQUIFER	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
22	WATER CONCERVATION	water and air.
32	WATER RESOURCES	Optimal use and proper storage of water. Availability of surface and ground water.
33	WATER RESOURCES WATER RESOURCES	
34	MANAGEMENT	Planned development, distribution and use of water resources.
	IVIANAGEIVIENT	Water table is the upper surface of the zone of saturation at
35	WATER TABLE	atmospheric pressure.
36	ZONE OF SATURATION	The ground in which all pores are completely filled with water.
30	ELECTRICAL	Flow of free ions in the water at 25C mu/cm.
37	CONDUCTIVITY	riow of free ions in the water at 25c mayem.
		A Vertical Projection showing sub-surface formations encountered in
38	CROSS SECTION	a specific plane.
		A structure showing all three dimensions i.e. length, width and
39	3-D PICTURE	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	TODOCDADUV	Details of drainage lines and physical features of land surface on a
45	TOPOGRAPHY	map.
46	GEOLOGY	The science related with the Earth.
47	GEOMORPHOLOGY	The description and interpretation of land forms.
		Monitoring of Ground Water level from the selected
48	PRE MONSOON SURVEY	DKW/Piezometer before Monsoon (carried out between 15th May
		to 15th June)
	POST-MONSOON	Monitoring of Ground Water level from the selected
49	SURVEY	DKW/Piezometer after Monsoon (carried out between 15th
	0021	October to 15th November)
50	PIEZOMETER	A non-pumping small diameter bore hole used for monitoring of
	_	static water level.
51	GROUND WATER	Change in static water level below ground level.
	FLUCTUATION	
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	Dug wells selected on grid basis for monitoring of state water level.
55	STATION EOLIAN DEPOSITS	Wind blown cand dangeits
22	EOLIAN DEPOSITS	Wind-blown sand deposits

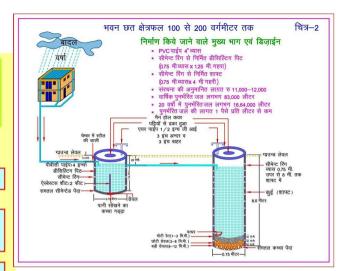


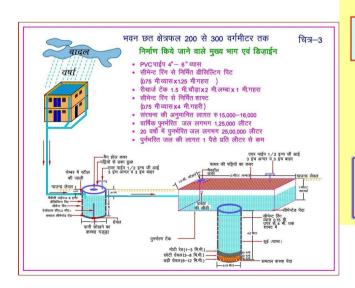




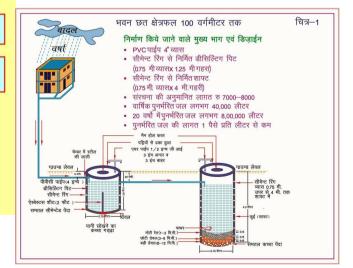
भूजल में घुले मुख्य तत्वों की अधिकता का मानव शरीर पर दुष्प्रभाव















S No	Myths	Facts
1	What is Ground Water an underground lake a net work of underground rivers	Water which occurs below the land in geological formations/rocks is Ground water
2	a bowl filled with water 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



Rolta India Limited

Central & Registered Office

Rolta Tower A, Rolta Technology Park, MIDC, Andheri (East), Mumbai - 400 093

Tel: +91 (22) 2926 6666, 3087 6543 Fax: +91 (22) 2836 5992 Email: indsales@rolta.com

www.rolta.com