DISTRICT GROUND WATER BROCHURE

BULANDSHAHAR DISTRICT

UTTAR PRADESH

(A.A.P.: 2012-13)

Prepared By:

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Scientist-'C'

Central Ground Water Board
Northern Region
Lucknow

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CONTENTS

DISTRICT AT A GLANCE

BULANDSHAHAR DISTRICT, UTTAR PRADESH

1.	**GENERAL INFORMATION**			
	i.	Geographical Area (Sq km)	:	4352
	ii.	Administrative Divisions (2007-08) Number of Tehsil/Block Number of Panchayat/Villages	:	Tehsils-7, Blocks-16, Nyaya Panchayat-154, Gram Sabha-889, Villages -1246
	iii.	Population (As on 2001 Census)	:	30,09,860 (Male – 16,02,191and Female-14,07,669)
	iv.	Average Annual Rainfall (mm)	:	696
2.	**GEOMORPHOLOGY**			
	Major physiographic units		:	Part of Central Ganga Alluvial Plain. 1. Younger alluvium (i) Younger Flood Plain (ii) Older Flood Plain 2. Older Alluvium occupies the entire upland area (i) Sandy soil/sandy ridges Central upland
	Major Drainages		:	Ganga River and Kali Nadi
3.	**LAND USE (Sq Km) (2010 –11)**			
	a)	Forest area	:	77.95
	b)	Net area sown	:	2987.14
	c)	Cultivable area	:	3026.21
4.	**MAJOR SOIL TYPES**		:	1. Bhur (Pure sand), 2. Matiar (clay) 3. Dumat or loam (sand mixed with clay in equal proportion – a good agricultural soil) 4. Kallor- the bad land patches where nothing grows. 5. Kemp- alluvial soil occurring in flood plain of rivers, yield good crop.
5.	**AREA UNDER PRINCIPAL CROPS (Sq.km) (Year: 2011-12)**		:	Rice-746.81 ,Wheat-1977.79 ,Barely-70.60, Millet-117.96, Maize-524.35 ,Arhar-107.95
6.	**IRRIGATION BY DIFFERENT SOURCES (Areas in Ha) - 2010-11**			
	Dugwells		:	2770 Ha

	Tubewells/Borewells	:	Public-3124 Ha, Govt.TW=466, Private-235090 Ha, Private TW & Pump set – 72661
	Canals	:	25575 Ha – 1879 km
	Other sources	:	Total – 266559 Ha
	Net Irrigated area	:	267000 Ha
	Gross irrigated area	:	521000 Ha
7.	**NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2013)** **No of Dug Wells** **No of Piezometers**	 : :	 7 03
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**		Alluvium deposits of Quaternary age brought by river system of Ganga and its tributaries. The thickness of unconsolidated sediments (including Quaternary alluvium) may range between 400 and 600 m as revealed by the study of ONGC data and CGWB drilling records Alluvium consists of clay, silt and various grades of sand with occasional pebbles at depths. The beds of kankar are also common. The sand is fine to medium grained being coarser towards Ganga river.
9.	**HYDROGEOLOGY And AQUIFER GROUP**		I Aquifer – Down to depth of 120 mbgl- Fresh- Semi-confined to confined. II Aquifer – Down to depth of 160-220 mbgl- Fresh- confined. III Aquifer –Down to depth of 240-450 mbgl - Quality not good- confined.
	Major Water bearing formation	:	Sand, Granular material
	Pre-monsoon Depth to water level during May' 2012		4.96 to 11.25 mbgl
	(Post-monsoon Depth to water level during Nov'2012	:	4.74 to 11.34 mbgl
	Long term water level trend in 10 years (2003-12) in m/year	:	**Pre-monsoon :** Fall 0.04 to 0.54m/year, Rise –0.01 m / year **Post-monsoon:** Fall 0.03 to 0.54 m/year, Rise- 0.03 m/year
10	**GROUND WATER EXPLORATION BY CGWB (As on 31-3-2013)**		
	No of wells drilled (EW, OW, PZ, SH, Total)	:	Exploratory Well-6, Observation Well-1, Piezometer-4
	Drilled- Depth Range (m)	:	EW- 260 to 454 mbgl
	Discharge	:	1280-2309 lpm

	Storativity (S)	:	-
	Transmissivity (m^2/day)		141 to 833
11.	**GROUND WATER QUALITY**		
	Presence of Chemical constituents more than permissible limit (e.g EC,F,As,Fe)	:	Nitrate (33% of water samples collected from unconfined shallow aquifers in 2011 have high concentration of No_3 (>45 mg/l)
	Type of water		Ground Water suitable for drinking and domestic uses.
12.	**DYNAMIC GROUND WATER RESOURCES (2009) – in MCM**		
	Annual Replenishable Ground Water Resources	:	1595.70 – Annual Ground Water Recharge
	Gross Annual Ground Water Draft	:	1119.38
	Projected Demand for Domestic industrial Uses upto 2025	:	81.67
	Stage of Ground Water Development	:	77.15 %
13.	**AWARENESS AND TRAINING ACTIVITY**		
	Mass Awareness Programmes organized		Nil
	Date		-
	Place		-
	No. of participants		-
	Water Management Training Programme organized	:	NIL
	Date		-
	Place		-
	No of participants		-
14.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**		
	Projects completed by CGWB (No & Amount spent)		NIL
	Projects under technical guidance of CGWB (Numbers)		NIL
15.	**GROUND WATER CONTROL AND REGULATION**		
	Number OF OE Blocks	:	Nil
	No of Critical Blocks	:	2(Gulauthi ,Khurja)
	No of blocks notified	:	NIL
16.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	:	Declining trend of water level observed in Gulauthi ,Khurja, Agauta, B.B. Nagar, Pahasu and Suikandarabad blocls.

1.0 Introduction :

The history of Bulandshahar begins before 1200 B.C. This region is nearer to the capital of Pandava-Indraprastha and Hastinapur. After the decline of Hastinapur, Ahar which is situated in the north east of the district became an important place for Pandavas. With passes of time the king Parme made a fort on this part of region and a king named Ahiboran laid the foundation of a tower called Boran (Bulandshahar). Since it was perched on a highland it came to be known as highest city which was translated into local language as Bulandshahar.

Bulandshahar district is located in the western part of U.P. state and lies between $28^{o}3'45"$ and $28^{o}42'30"$ north latitudes and $77^{o}38'$ to $78^{o}30'$ east longitudes falling in survey of India toposheet numbers 53H/10, 11, 14, 15, 16 and 53L/2, 3, 4, 7, 8. The district is 237.44 meters above mean sea level.

The river Ganga in the east separates this district from J.P. Nagar and Budaun district. In the west of the district is Gautam Buddha Nagar and in the north is Ghaziabad. In south there is border of Aligarh district.

The geographical area of the district is 4352 Sq.Km which is about 1.48% of the total area of U.P. The urban area of the district is 122.8 Sq.Km and rural areais 4230.2 Sq.Km. The nuclear atomic power plant is locatd at Narora town of the district. The national level satellite earth station is located near Sikandarabad town. Bulandshahar is an important grain producing agriculture district.

1.1 Administration:

Administratively the district is divided into seven Tehsils. There are sixteen development blocks, 154-Nyaya Panchyat, 889 Gram Sabha and total 1246 Villages in the district. The population of the district is 30,09,860 (2001 census) and density of population is 692 persons per sq.km. The average annual rainfall is 696 mm.

1.2 Drainage:

The district falls in the doab of Ganga and Yamuna rivers (Ganga basin and Yamuna basin). The district is drained by river Ganga, Kali nadi, Karwan nadi and Nim nadi. All these drainages flow in SE course in their regional pattern.

Ganga River – forms the eastern boundary of the district. It has developed a wide flood plain on the eastern bank. A variable width of flood plain is seen in the western bank. The flow of the river is south or SE.

Kali Nadi – enters the district near Gulaothi and flows in a southerly direction near Khurja. It becomes south easterly stream in Pahasu block. The river has a tortuous course and bends are numerous being at places succession of loops. It's banks are well defined and forms a narrow flood plain. It is a ephemeral river, which is fed by effluents of industrial units especially sugar mills.

Karwan Nadi – Between Kali nadi on the east and Mat Canal on the west, flows Karwan Nadi which originates in the NE of Dadri. Originally it was not well defined but was a chain of swamps and Jheels till the Irrigation Department Widened and deepened its channel and

created a drainage for the area between Ganga Canal and Mat Branch. Its banks are not well defined but channel is level and firm.

Nim Nadi – This river flows between Kali and Ganga in a southerly course. It originates in syare block in a series of Jheels. It runs in an irregular curve. Its banks are well defined and river bed is well entrenched.

1.3 Land Use and Cropping Pattern :

Block-wise land utilization of the district is given in the following table:

Table: Blockwise Land usage in the district Bulandshahar (in hectares) 2010-11

Block	Total area	Forest	Barren cult. waste	Present fallow land	Other fallow land	Barren & uncult. land	Land put to non-agri. use	Pastures	Area under bush, forest & garden
1	2	3	4	5	6	7	8	9	10
1. Sikandrabad	39499	47	612	425	132	1175	5872	554	11
2. Gulaothi	12199	14	168	268	28	106	1662	17	0
3. Lakhaothi	17293	195	181	221	42	232	1591	33	7
4. Bulandshahr	17816	15	328	196	69	312	2937	15	8
5. Shikarpur	26841	826	378	386	72	415	2641	47	96
6. Bhawan Bahadur Nagar	16172	0	67	87	34	91	1693	42	10
7. Syana	17692	8	132	163	29	92	2023	17	0
8. Jahangirabad	21999	437	172	113	43	132	2174	73	21
9. Khurja	34257	1236	221	445	63	586	3836	84	106
10. Araniya	25147	1654	250	188	46	447	2495	4	209
11. Pahasu	26424	9	113	331	42	151	1952	15	6
12. Unchagaon	21478	714	312	241	25	248	2956	3	22
13. Danpur	21527	45	311	236	122	342	1766	8	24
14. Dibai	23587	157	612	311	121	1233	3492	3	45
15. Anupshahr	27425	2433	318	112	134	279	3074	9	60
16. Agauta	15618	5	139	72	34	143	1592	29	2
Total District	**364974**	**7795**	**4314**	**3795**	**1036**	**5984**	**41756**	**953**	**627**

Block	Net area sown	Area sown more than once	Gross area sown				Net irrigated area	Gross irrigated area
			Total	Rabi	Kharif	Jayad		
1	11	12	13	14	15	16	18	19
1. Sikandrabad	30671	27530	58201	27100	29581	1519	30485	58200
2. Gulaothi	9936	6018	15954	6748	7976	1230	8246	15954
3. Lakhaothi	14791	6573	21364	9469	11363	532	12014	21364
4. Bulandshahr	13936	8685	22621	9654	10553	2414	10614	22621
5. Shikarpur	21980	16128	38108	17610	19491	1007	19180	38108
6. Bhawan Bahadur Nagar	14148	8008	22156	8642	12637	877	12140	22156

7. Syana	15228	8194	23422	8034	10795	4593	10659	23422
8. Jahangirabad	18834	15172	34006	14872	17765	1369	16811	34006
9. Khurja	27680	23491	51171	24702	24855	1614	27203	51171
10. Araniya	19854	17120	36974	17896	18012	1066	19664	36974
11. Pahasu	23805	19579	43384	21000	21164	1220	21013	43384
12. Unchagaon	16957	12434	29391	12307	14160	2924	13821	29391
13. Danpur	18673	18399	37072	18249	17857	966	17857	37072
14. Dibai	17613	13767	31380	14916	15281	1183	15281	31380
15. Anupshahr	21006	13826	34832	14646	19193	993	20135	34832
16. Agauta	13602	7568	21170	8943	11519	708	11436	21170
Total District	**298714**	**222492**	**521206**	**234788**	**262202**	**24215**	**266559**	**521205**

There is 2.1% of area under forests and maximum forest area is in Anupshahar block. Out of the total area, 298714 Ha is under cultivation and out of this 222492 Ha (74%) area is sown more than once. Gross area sown is 521206 Ha. Gross area sown during Rabi, Kharif and Jayad are 234788 Ha, 262202 and 24,215 Ha respectively.

There are two main harvesting seasons in a year known as Rabi (October to April) and Kharif (June to October). The main crops sown during Kharif are Paddy,Maize, Jwar and pulses while main rabi crops are Wheat, Barley, Pulses etc. Sugarcane is sown during both the crops.

The cropping pattern and, area covered by main crops are given in following table**:**

Table – Area (Ha) covered by main crops (2011-12)

Sl. No.	Crop	Area covered (Ha)
1.	Rice	74681
2.	Wheat	197779
3.	Barley	7060
4.	Maize	52435
5.	Millet	11796
6.	Jwar	101
7.	Pulses	15816

1.4 Irrigation Practices :

The irrigation in the district is done by means of minor irrigation structures such as Tubewells, Cavity Tubewells, occasionally dug wells and surface water irrigation system i.e, canals.

In the district, during 2010-11, 240984 Ha (90%) is irrigated by ground water and only 25575 Ha area constituting 10% of total irrigated area is irrigated by canals. The net irrigated area in the district is 267000 Ha, and Gross irrigated area is 521000 Ha.

The block-wise total area (hectare) irrigated by different sources in the district is given in the following table

Table: Blockwise total area (Hect.) irrigated by different sources in district Bulandshahar (Year:2011-12)

Block	Canals	Tubewell		Wells
		Public	Private	
1	2	3	4	5
1. Sikandrabad	3034	385	26501	565
2. Gulaothi	1170	288	6788	0
3. Lakhaothi	1062	110	10842	0
4. Bulandshahr	2600	114	7900	0
5. Shikarpur	205	33	18942	0
6. Bhawan Bahadur Nagar	45	187	11908	0
7. Syana	530	380	9743	6
8. Jahangirabad	54	167	16590	0
9. Khurja	2906	0	24297	0
10. Araniya	4007	0	15657	0
11. Pahasu	3059	470	17484	0
12. Unchagaon	1393	7	12421	0
13. Danpur	182	407	16674	594
14. Dibai	2728	257	11718	578
15. Anupshahr	2529	185	16394	1027
16. Agauta	71	134	11231	0
Total District	**25575**	**3124**	**235090**	**2770**

There is canal network in the district having length of 1879 Km. There are 466 Govt. tubewells.

The block-wise status of sources of irrigation in the district is as follows :

Table: Blockwise total area (Hect.) irrigated by different sources

Block	Canal length (km)	Govt. tubewell (No.)	Perma-nent wells (No.)	Pumpsets				Ground pumpset (No.)
				Electricity Run (No.)	Diesel Run (No.)	Other (No.)	Total (No.)	
1	2	3	4	5	6	7	8	9
1. Sikandrabad	223	62	0	2111	4794	40	6945	2
2. Gulaothi	69	2	0	1043	2154	52	3249	1
3. Lakhaothi	85	25	0	2222	1131	3	3356	0
4. Bulandshahr	131	16	0	1332	2664	3	3999	1
5. Shikarpur	136	42	0	3654	1723	17	5394	0
6. Bhawan Bahadur Nagar	72	35	0	2121	1499	3	3623	1
7. Syana	76	16	0	2442	801	11	3254	0
8. Jahangirabad	107	37	0	3169	1705	10	4884	0
9. Khurja	194	19	0	2559	4057	24	6640	1
10. Araniya	93	14	0	1237	4326	14	5577	0
11. Pahasu	173	39	0	1259	4109	28	5396	1
12. Unchagaon	77	26	0	2318	2535	9	4862	1
13. Danpur	118	61	0	1934	2214	4	4152	2
14. Dibai	121	11	0	1227	1521	8	2756	1
15. Anupshahr	119	38	0	2182	2734	2	4918	5
16. Agauta	85	23	0	2479	1117	43	3639	0
Total District	**1879**	**466**	**0**	**33289**	**39084**	**271**	**72644**	**16**

1.5 Studies carried out by Central Ground Water Board(C.G.W.B) :

Reappraisal Hydrogeological surveys were undertaken in the year 1989-90 by Sri Pradeep Kumar Scientist-B and District report was prepared in 1994.

Ground Water exploration has been undertaken to understand the aquifer disposition and hydrogeological details of the different aquifers.

The depth to water levels are being monitored four times in a year in the district (i.e, Jan, May, August & November) from permanent Ground water monitoring wells (dug wells), and few wells are being monitored every month, to understand the behavior of current water level and long-term trend of water level.

The ground water samples are collected in the month of May every year in the district to ascertain the chemical parameters/quality/pollution of ground water.

The dynamic ground water resources of the district as on 31.3.2009 have been calculated jointly by Central Ground Water Board, Northern Region and State Ground Water Department, U.P. and the report has been issued.

2. Rainfall & Climate:

The normal annual total rainfall is 696 mm. In the year 2011 the total average rainfall was only 258.35. The climate is sub-humid and is characterized by a cold winter, a hot summer and general dryness except during southwest monsoon season. About 90% of rainfall takes place from June to September. During monsoon surplus water is available for deep percolation to ground water.

May is generally the hottest month with the mean daily maximum temperature at about 41^{o}C, the mean daily minimum temperature at about 27^{o}C and maximum temperature reaches to 45^{o}C with the onset of the monsoon there is appreciable drop in temperature. January is generally the coldest month with mean daily maximum temperature at about 21^{o}C and mean daily minimum temperature at about 8^{o}C. The mean monthly minimum temperature is 18.4^{o}C and mean monthly maximum temperature is 31.5^{o}C.

During monsoon season the relative humidity is generally high and it decreases rapidly and by summer which is driest part. The mean monthly morning relative humidity is 65% and mean monthly evening relative humidity 45%.

Winds are generally light with some increase in speed in summer and monsoon seasons. The mean wind velocity is 6.3 k.m.ph.

The potential evapotranspiration is 1529.8 mm.

3. Physiography and Geomorphology :

3.1 Physiography –

Bulandshahar district forming a part of Ganga-Yamuna Doab, lies in the western part of U.P. Eastern boundary of the district being define by river Ganga. The district is almost a monotonous plain with occurrence of sand dunes, and sandy ridges, ravineous tracts and depressions close to river Ganga. At times, close to other minor rivers also, occurrence of minor sandy mounds can be seen. At places, close to river system, badland topography have developed which is due to differentiated erosions. Kankar-lenses and beds are seen exposed and forms mounds. The fertile and cultivated soil expanses are sometimes broken by barren expanses of flat lands which are user lands having kankar at shallow depth as well as having alkaline soils on the surface spread as white sheet.

The elevation of land surface varies from 207.4 mamsl at Gulaothi in the north to 193.8 ma msl in the south at the boundary of district with Aligarh district indicating an elevation difference of 13.6 m only. The general slope of the ara is about 0.29 m/km which is too gentle. The city of Bulandshahar, district headquarter, located in the western part of the district, is having an elevation of 222 ma msl.

Major part of the land surface lies within the upland surface between the valleys of two rivers-Ganga and Karwan Nadi. This upland surface is dissected by minor drainages namely Kali Nadi, Nim Nadi which run more or less parallel to each other in the district and have developed district valley floor.

In its regional aspect, the district can be divided into following tracts/units based on morphological consideration.

I. Khadar
II. Uplands

Ganga Khadar

The eastern most part of the district following and adjacent to Ganga river is a low flood plain of Ganga. The width of the tract is variable and the development of Khadar is most prominent on the east bank of Ganga. On the west bank, the development of Khadar is restricted and its boundary with the upland is madeup of bluffs and scraps as seen close to Anupshehar and Rajghat Narora.

Uplands

Beyond the western boundary of the district lies the upland plain which extends eastward as far as the Khadar of Ganga and consist of a wide and level plain broken only by various drainage lines and streams. The rise from low land to upland is seldom abrupt.

The upland can be further differentiated into two units –

(i) **Sandy Ridge** is a discontinuous one and is dominantly made up of sandy soil and appears in western most part of the district.

(ii) **Central Upland Plain** Beyond the sandy ridge and Mat branch canal stretches another level plain of loam and clay soil which extends right across the district to the cliffs of Ganga river.

3.2 Geomorphology:

The district of Bulandshahar can be divided into two broad geologic units namely –

I. Younger Alluvium
II. Older Alluvium

I. **Younger Alluvium**

The area occupied by younger alluvium can be delineated all along Ganga river and other tributary streams draining the district. The younger alluvium is confined.

The flood plain can be further differentiated into two geomorphic units –

(i) Flood Plain

(ii) Older Flood plain

(i) **Flood Plain**

The river channel and its adjacent area forming terraces which are subjected to periodic flooding, consisting of sand, silt and silty sand with minor clays, form the flood plain of river. This is a narrow zone along the river channel and gets flooded regularly during rainy season.

(ii) **Older Flood Plain**

Older Flood Plain of river Ganga, in local language, is termed as Khadar. This zone is characterized by presence of fluvial land forms such as meander scar, cut off menders, and palaces. The sediments are fine grained sand and silt with thin clay horizons. This zone can be separated from older alluvium by the presence of natural levee and an abrupt change in slope. Made up of terraces.

II. **Older Alluvium**

The older alluvium occupies the entire upland or interfluve area occurring between the major drainages i.e., Ganga river and Karwan nadi and Yamuna river in Gautam Buddha Nagar district. The soils are silty clayey and sandy in varying proportion.

Older alluvium can be differentiated into two broad units –

(i) **Sandy Soil/Sandy Ridges**

They occur close to drainage system and correspond to the Bhur of physiographic unit. Isolated sandy ridges/sand dunes are indicative of clearing drainage pattern.

(ii) **Central upland/Interfluve area**

The major geomorphic unit of the district occurring between river Ganga and Karwan Nadi.

3.3 Soil:

The development of soils in the district can be ascribed to different erosional and depositional agencies. Different morphological units have different types of soil. The soil ranges from pure sand to stiff clays and including all combination of the two extreme litho units. The pure sand is called **Bhur** and clay is called **Matiar** when the sand is mixed with clay in equal proportion, the soil may be termed as **Dumat or Loam –** a good agricultural soil. Several subdivisions of dumat is possible depending upon the contents of clay and sand. The word **Kallor** is used to denote the badland patches where nothing grows and may be ingested with **Reh** at places. Alluvial soils occurring in flood plain of rivers is called Kemp and yield good crops. Kankars associated with clay at times retard ground water movement.

Geological Frame Work:

The Bulandshahar district forms a part of Central Ganga alluvial plain. The area is underlain by alluvial deposits of Quaternary age. In the district, the thickness of unconsolidated sediments which include Quaternary alluvium also, may range between 400 and 600 m as revealed by CGWB drilling records and ONGC data. To the east of

Ganga, the thickness of Quaternary sediments are likely to be deeper in the range of 1000 m. In the southern adjacent district of Aligarh, the thickness of alluvial sediments including siwaliks and their equivalents have been found to range between 300 and 350 m.

The generalized tentative stratigraphic succession in Bulandshahar district is as follows –

Time Unit	Rock type		Thickness (m)
Recent to 0.01 my.	Sand, Clay Sequence	Alluvium	150
Holocene (<1 my)	Sand, Clay, Pebbles etc.	Lower portion of Fans	
----------DISCONFORMITY----------			
Pleistocene (1 my)	Conglomerate, Sand, Sandstone	Upper Siwalik	Missing
Pleistocene to Lower Miocene	Argillaceous sediments	Middle to lower Siwalik	Very thin
----------UNCONFORMITY----------			
Precambrian	Sand, Sandstone, Shale	Vindhyan	
Archaean	Granite		

The younger alluvium is present in the flood plain of river drainage in the district. Older alluvium is seen in uplands and below the younger alluvium in the flood plain.

Tectonic framework

The district of Bulandshahar lies to the south of Ramganga depression. Few major faults running in ENE-WSW direction and the other NE-SW direction have been defined by ONGC. Few lineaments running the NE-SW and WNW-ESE directions have also been delineated on the basis of the study of remote sensing data products.

4. Ground Water Scenario :

4.1 Hydrogeology:

Mode of occurrence of Ground Water –

Ground water occurs in the pore spaces of the unconsolidated alluvial sediments in the zone of saturation. The near surface sediments are dominantly sandy clays and clays which grade into sediments having varied proportions of sand and clays. These sediments occur as inter layered sequence and pockets. Kankar is generally present in clay in the form of lenses and layers as well as interspersed. These mixed sediments occur down to 20 m and support large number of dug wells. The depth of dug wells range between 6 to 20 m.

Below the top 4 to 10 m silty clays and clays, there occurs the sand formations which form a part of aquifer system. This aquifer is largely unconfined to semi-confined and supports a large number of cavity/shallow tube wells.

Depth to water level

Depth to water level(DWL) data collected from Ground Water Monitoring Wells in May' 2012 and Nov' 2012 have been utilized to prepare depth to water level contour maps.

Table: Water Level and Fluctuation (Pre & Post-monsoon) for the year 2012

Sl. No.	Ground Water monitoring well	Block	Pre-monsoon DWL (May' 12) (mbgl)	Post-monsoon DWL (Nov'12) (mbgl)	Fluctuation (m)
1	Bara Ferozpur	B.B.Nagar	11.25	11.34	-0.09
2	Batli	B.B.Nagar	7.08	7.30	-0.22
3	Daulatpur Khurd Pz	Arnia Khurd	-	8.16	-
4	Gulauthi	Gulauthi	8.77	8.92	-0.15
5	Jargawan	Dibai	6.12	7.00	-0.88
6	Khurja Pz	Khurja	5.88	6.08	-0.20
7	Lakhaothi Pz	Lakhnauti	5.80	5.45	0.35
8	Nandpur	Dibai	4.96	4.74	0.22
9	Sikandrabad 1	Sikandrabad	9.11	9.10	0.01
10	Ugrasan nagla	B.B.Nagar	6.48	-	-

A perusal of the table and depth to water level contour map for the period May'2012 reveal that water level varies from 4.96 mbgl as seen in Nandpur in Dibai Block to 11.25 mbgl at Bara Ferozpur in Syana block. Almost all the blocks, covering approximately 95% area of the district show DWL between 5 to 10 mbgl. Parts of Syana block show DWL between 10 to 12 mbgl.

A perusal of the table and depth to water level contour map for the period November' 2012 reveal water level varies from 4.74 mbgl in Nandpur in Dibai block to 11.34 m in Syana block. In almost all parts of the district water level varies from 5 to 10 mbgl.

Ground water flows from NNW to SSE following the general drainage pattern. River Ganga is effluent. Upper Ganga Canal contributes a substantial amount to ground water. Upper Ganga Canal more or less coincides with the ground water divide.

Seasonal Fluctuation :

Water Level/table fluctuates in response to recharge to the aquifer and withdrawal from the aquifer. The quantum of fluctuation is a direct function of the above. Recharge takes place mainly during rainy season. The minimum depth to water level in an area is expected sometime at the close of monsoon or in the middle of monsoon period depending upon the intensity and duration of rainfall as well as soil characteristics and maximum depth to water level is expected to be just before the rainfall. The part of the rainfall in the initial period goes towards meeting the soil moisture deficiency as well as to saturate the Evaportranspiration losses.

Since there was approximately 30% deficient monsoon rainfall in the district in 2012 therefore the recharge due to rainfall was also less which has resulted in deeper water level in Nov'12 than in May'12 in most of the wells.

Seasonal Fluctuation of Water Level

Seasonal fluctuation of water level has been determined from the Pre-monsoon (May'2012) and Post-monsoon (Nov'2012) water level data of Ground Water monitoring wells. The fluctuation varies from rise of 1 cm to fall of 88 cm.

Long term trend of water level

Table shows the long term Pre-monsoon(May) and Post-monsoon(Nov.) trend of water level of Ground Water monitoring wells for ten years period- 2003 to 2012.

Sl. No.	Location	Pre-monsoon		Post-monsoon	
		Rise(m/year)	Fall(m/year)	Rise(m/year)	Fall(m/year)
1	Anup sahar		0.54		
2	Gulauthi		0.15		0.29
3	Nandpur	0.01		0.03	
4	Batli		0.41		0.52
5	Ugrasan Nagla		0.18		0.17
6	Bara Ferozpur		0.33		0.54
7	Jargawan		0.04		0.15
8	Sikandarabad1		0.12		0.03

Pre-monsoon trend of water level

There is falling trend in all the wells during Pre-monsoon period except at Nandpur which shows a rise of 1 cm/year.. The range of decline is 4 cm/year at Jargawan to 54 cm/year at Anupsahar.

Table – DWL Trend during Pre-monsoon period (2003 to 2012)

Sl.No.	No. of wells analysed	No. of wells showing declining Trend	No. of wells showing decline of					
			0-10 cm/yr	10-20 cm/yr	20-30 cm/yr	30-40 cm/yr	40-50 cm/yr	50-60 cm/year
1.	8	7	1	3	0	1	1	1

Post-monsoon trend of water level

There is falling trend during Post-monsoon period in all the wells except in Nandpur where there is rise of 3 cm/year. The range of decline is 3 cm/year at Sikandarabad to 54 cm/year at Bara Firozpur.

Table – DWL Trend during Post-monsoon period (2003-2012)

Sl.No.	No. of wells analysed	No. of wells showing declining Trend	No. of wells showing decline of					
			0-10 cm/yr	10-20 cm/yr	20-30 cm/yr	30-40 cm/yr	40-50 cm/yr	50-60 cm/year
1.	7	6	1	2	1	0	0	2

Ground Water Exploration:

Central Ground Water Board has constructed six deep Tubewells at Gulaothi, Bulandshahar city (Yamuna Puram), Aurangabad , Daulat Khurd, Jahangirabad & Syana and four Piezometers at Khurja,-1,2,Lakhauti & Syana in the district to delineate the sub-surface lithology of the area. The hydrogeological details are shown in the table:

Hydrogeological Details based on Exploration Carried out by C.G.W.B in Bulandsahar District,U.P. as on 31.3.2013

Sl. No.	LOCATION/ LATITUDE/ LONGITUDE/ TOPOSHEET	TYPE OF WELL	DRILLED DEPTH/ BEDROCK (mbgl)	ZONES TAPPED (mbgl)	WATER LEVEL (mbgl)	YIELD (lpm)	DRAW DOWN (m)	TRANSMI-SSIVITY T (m^2/day)	GEOLOGY
1	**Gulaothi**	EW	450.00	218-224	7.85	-	-	-	ALLUVIUM
				229-232					
				259-271					
				282-288					
2	**Yamuna Puram**	EW	429.40	125-128		-	-	-	ALLUVIUM
	(Bulandshahar Town)			206-209					
				213-216					
				220-226					
				227-230					
				242-248					
3	**Aurangabad**	EW	454.00	69-75	4.81	2309	7.84	833	ALLUVIUM
	(Block: Lakhauti)			78-90					
				106-111					
				129-135					
				141-147					
4	**Daulatpur- Khurd (Block: Danpur)**	EW	450m	192-195 228-234 261-267 279-285 306-318	8.61	1280	7.98	141	ALLUVIUM
5	**Khurja-1**	PZ	300.01	38-44		-	-	-	ALLUVIUM
	28°14'30"			52-55					
	77°51'20"			82-98					
6	**Khurja-2**	PZ	33.00	20-29	-	-	-	-	ALLUVIUM
	28°14'30"								
	77°51'20"								
7	**Lakhauti**	PZ	114.00	60-66 87-90 108-111	3.67	-	-	-	ALLUVIUM

8	**Jahangirabad** 28°25'08" 78°6'12" (2009-10)	EW	Depth drilled-260m/ Well construct ed-256m	142-148 160-172 184-190 193-205 212-218 244-250					ALLUVIUM
9	**Syana** (2010-11)	EW	Well construct ed-235m	142-145 150-156 164-167 179-185 196-202 207-210 219-222 226-229					ALLUVIUM
10	**Syana** (2010-11)	OW	Well construct ed-232m	142-145 152-155 161-164 180-183 198-201 207-210 219-222 226-229					ALLUVIUM
11	**Syana** (2010-11)	PZ	Well construct ed-50m	43-49					ALLUVIUM

EW: Exploratory Well ; OW: Observation Well ; PZ : Piezometer

Aquifer Systems:

The regional subsurface disposition of aquifer system based on lithological logs and electrical logs is as follows:

I^{s}t Aquifer - down to depth of 120 mbgl - Fresh - Semi confined to confined
IInd Aquifer - 160-220 mbgl - Fresh - Confined
IIIrd Aquifer - 240-450 mbgl - Quality not good - Confined

Occurrence of a clay bed having variable thickness is seen in almost the entire district. The thickness of this clay bed varies from 2 to 3 m to as thick as 26 m. in the central part. The clays are generally silty in nature.

On the regional scale, I aquifer extends down to depth of 120 mbgl. The sand dominates in the north eastern part and clay starts dominantly in the southern part. The sediments are more a renaceous in the northern & eastern parts becoming argillaceous towards south. The aquifer in general behaves as semi-confined to confined. The sediments forming the aquifer are fine to medium grained. Occurrence of gravel has been reported from the central and northern part of the district.

The depth range of second aquifer varies from 160 to 220 mbgl. This aquifer is confined in nature and water is fresh.

The depth range of III aquifer varies rom 240 to 450 mbgl and is confined in nature but the quality of water is not good.

Hydrogeological characteristics of Aquifer System:

A perusal of hydrogeological data reveal that depth of Tubewells varies from 235 to 454 mbgl and they screen 13 to 48 m of saturated granular zones. The average yield varies from 1280 to 2309 lpm for economic drawdowns. Transmissivity varies from 141 to 833 m^2/day. The specific capacity of tubewells varies from 160 to 300 litre/minute/m of drawdown.

4.2 Ground Water Resources:

The dynamic ground water resources of the district as on 31.3.2009 is given in the following table:

DYNAMIC GROUND WATER RESOURCES OF BULANSHAHAR DISTRICT AS ON 31.03.2009

Sl.No.	Block	Annual Ground Water Recharge (Ham)	Net annual Ground water availability (Ham)	Existing Gross Ground Water Draft For All Uses (Ham)	Net Ground Water Availability For Future Irrigation Development (Ham)	Stage of Ground Water Development (in %)	Category of Block
1	AGAUTA	7917.26	7125.53	5574.46	1439.30	78.23	Semi-Critical
2	ANUP SHAHAR	12497.94	11248.15	7369.19	3768.36	65.51	Safe
3	ARNIA KHURD	12995.00	11695.50	7893.07	3670.70	67.49	Safe
4	B.B.NAGAR	6160.37	5544.33	5016.56	426.03	90.48	Semi-Critical
5	BULANDSHAHAR	9391.77	8452.59	6728.39	1556.72	79.60	Safe
6	DANPUR	8455.34	8032.57	6799.94	988.46	84.65	Safe
7	DEBAI	15628.83	14065.95	4192.71	9702.26	29.81	Safe
8	GULAOTHI	6052.91	5447.62	5266.96	92.58	96.68	Critical
9	JAHANGIRABAD	10930.09	10383.59	7745.71	2547.41	74.60	Safe
10	KHURJA	12306.80	11076.12	10597.06	105.14	95.67	Critical
11	LAKHAOTI	6556.24	5900.62	5195.35	598.78	88.05	Safe
12	PAHASU	11093.62	9984.26	9361.54	490.51	93.76	Semi-Critical
13	SHIKARPUR	10169.12	9660.66	8239.48	1324.68	85.29	Safe
14	SIKANDRABAD	14316.01	12884.41	11924.74	629.25	92.55	Semi-Critical
15	SIYANA	6544.10	5889.69	3973.24	1867.91	67.46	Safe
16	UNCHAGAON	8554.61	7699.15	6060.21	1567.36	78.71	Safe
	TOTAL	**159570.01**	**145090.74**	**111938.61**	**30775.45**	**77.15**	

The net annual ground water availability in the district ranges from 5447.62 Ham to 14066 Ham, minimum being in Gulaothi block and maximum being at Dibai block. Gross Ground Water Draft ranges from 3973.24 to 11924.74 Ham minimum in Siyana block and maximum in Sikandrabad block. Stage of Ground water development in the district is minimum in Dibai block (29.81%) and maximum in Gulaothi block (96.68%). Stage of ground water development of the district as a whole is 77.15%.

Gulaothi & Khurja blocks fall under Critical category and Agauta, B.B.Nagar , Pahasu & Sikandarbad blocks are Semi-critical. All other blocks fall in Safe category.

4.3 Ground Water Quality:

As per results of chemical analysis of water samples collected from shallow aquifer in 2011,Ground water, in general, is colourless, odourless and slightly alkaline in nature. The Electrical conductance(E.C.) ranges from 320 to 1560µS/cm at 25^{o}C.

It is observed that ground water is suitable for drinking and domestic uses in respect of all parameters except Nitrate. 33% of water samples have high concentration of NO_3 (>45 mg/l).The high content of NO_3 is due to return seepage from irrigated land, use of excess fertilizers and improper waste disposal.

4.4 Status of Ground Water Development:

Development of ground water in the district is mainly through dug wells, Hand Pumps – India Mark-II and Tubewells. The gross ground water draft for irrigation in the district as on 31.3.2009 is 1061MCM whereas the ground water draft for domestic and industrial use is 58 MCM. Hence the existing gross ground water draft for all uses in the district is 1119 MCM. Net Ground Water Availability for future irrigation development in the district is 308 MCM. A quantum of 81.67 MCM has been allocated for domestic and industrial requirement for year 2025. Net available ground water availability in the district is 1451 MCM. The stage of ground water development for the district is 77.15%.

Water Supply based on ground water sources

U.P. Jal Nigam is the government agency responsible for providing drinking water supplies to the urban and rural population in the district. The water requirements of the habitants are met with through surface water sources or through various mini water supply schemes or integrated water supply schemes utilizing the available ground water resources.

There are many shallow and deep tube wells through which water is supplied through pipe lines/taps in the urban areas of the district.

In the 17 urban areas and in the rural areas of the district there are 1175 no. of villages in which water is supplied by Tap/Hand Pump India Mark II(2011-12 data).

5 Ground Water Management Strategy:

5.1 Ground Water Development

In Dibai block, the level of development is 29.81%. In this block there is scope of ground water development with proper management and control.

In the blocks of high level of ground water development (>70%) covering major parts of the district it is necessary to exercise caution while planning further development of available ground water resources in the district.

In the areas of low ground water development the wells suitable for extraction of ground water, suitability of rigs, depth range and discharge in the district can be summarized as follows:-

Sl.No,	Wells feasible	Rig suitable	Depth of well (m)	Discharge (lpm)
1.	Dug well/Hand Pump	Manual/ Hand Boring set	20-40	50-100
2.	Shallow Tubewell	Rotary Rigs (Direct/Reverse)	50-100	1000-1500
3.	Deep Tubewell	Rotary Rig	100-220	2000-3000

5.2 Water Conservation & Artificial Recharge

In the areas where post-monsoon depth to water level is more than 8 mbgl and rate of decline during post-monsoon period is >50 cm/year, there is immediate need to adopt techniques of water conservation and aritificial recharge.

In such urban area, roof top rain water harvesting should be made mandatory for all government buildings, schools etc. Recharge Pits/shafts/trenches of suitable design are ideal structures for rain water harvesting in such areas.

In rural areas check dams, Cement Plug should be constructed as per local hydrogeological conditions to recharge the area. Revival, Renovation and Restoration of Ponds should be encouraged to arrest the decline of water level.

6. Ground Water Related Issues and Problems:

The trend analysis of historical ground water level data indicate fall both in Pre and Post-monsoon period in the major parts of the district. This will impact in:-

(i) further decline of ground water level
(ii) drying up of dug wells/shallow wells
(iii) decrease in yield of shallow wells, and
(iv) increased expenditure and power consumption for drawing water from progressively deeper depths.

Pollution of ground water due to industrial effluents is a major problem in the district. Excessive use of fertilizers and pesticides in agriculture, improper wastedisposal have resulted in high content of nitrate in the phreatic zone in the district.

7. Awareness & Training Activity:

Central Ground Water Board has not conducted any Mass Awareness Programme and Water Management Training programme in the district. In Gulaothi and Khurja blocks which fall in Critical category both these programmes should be done.

8. Areas Notified by Central Ground Water Authority:

Central Ground Water Authority has not notified any area/block in the district.

9. Recommendations:

As level of development in many blocks of the district is high, further development of ground water in these areas, especially in Gulaothi and Khurja blocks which fall in Critical category, should be done with extreme caution.

Artificial recharge technique should be adopted to arrest the decline of water level. In urban areas, roof top rain water harvesting, with structures such as Recharge pits/shafts/trenches of suitable design, should be made mandatory for all government buildings, schools etc. having large roof top area.

In rural areas, Check dams, Cement Plugs should be constructed as per local hydrogeological conditions to recharge the area. Revival, Renovation and Restoration of Ponds should be encouraged.

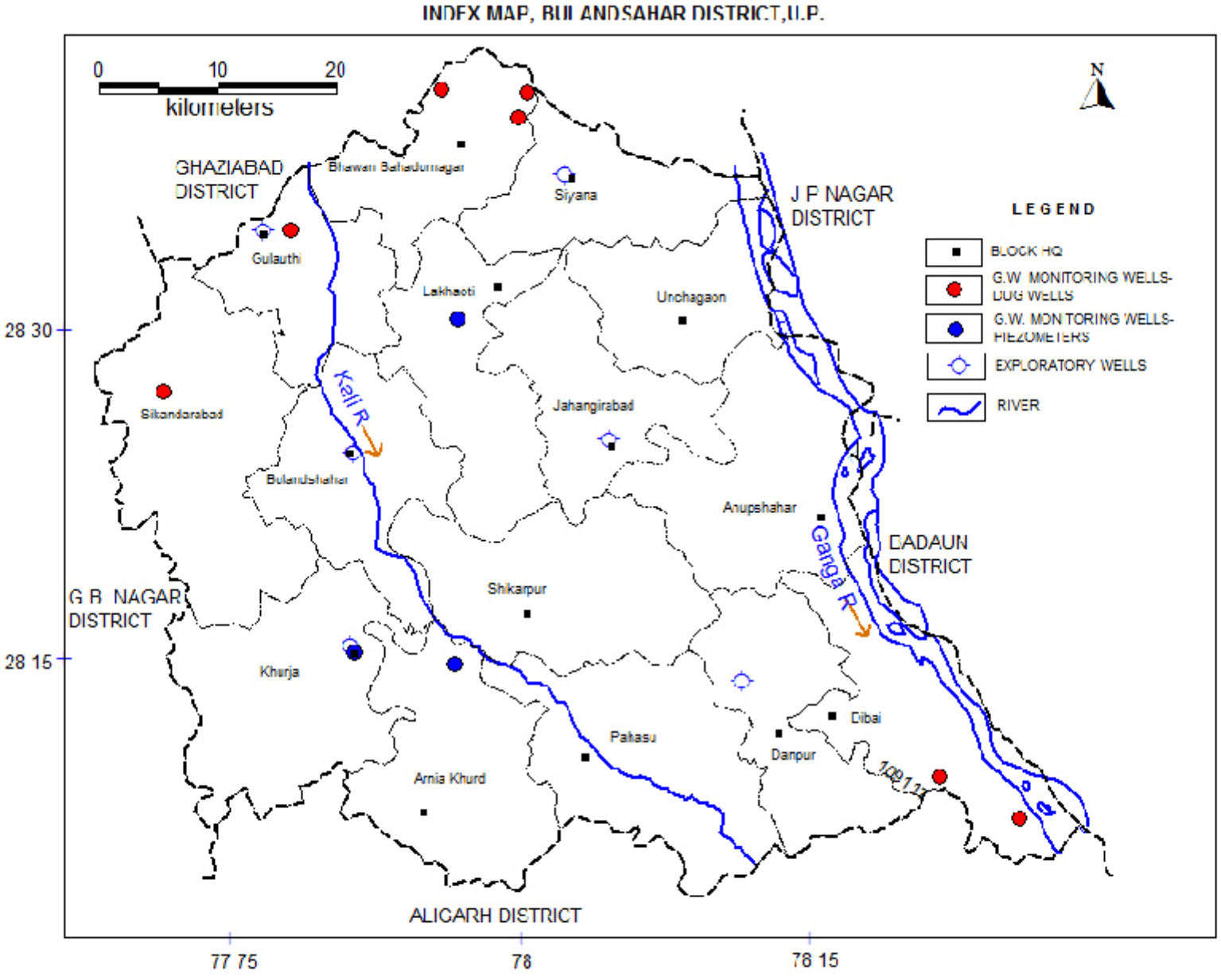
Further, operation and maintenance of artificial recharge structures are essential to make them efficient and priority may be given to this activity so as to make these structures effective.

Excessive use of fertilizers by the farmers should be discouraged.

References :

1. Statistical Data available in the website: www.upgov.nic.in.
2. Report on Hydrogeological frame work and Ground Water Resources Potential, Bulandshahar District, U.P., Jan' 1994.
3. Ground Water Year Book of U.P. -2011-12,Central Ground Water Board, Northern Region, Lucknow.

Plate-I


INDEX MAP, BULANDSAHAR DISTRICT,U.P.
0
10
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kilometers
N
GHAZIABAD DISTRICT
Bhawan BalharJunnagar
Siyana
J P NAGAR DISTRICT
LEGEND
BLOCK HQ
G.W. MONITORING WELLS-DUG WELLS
G.W. MONITORING WELLS-PIEZOMETERS
EXPLORATORY WELLS
RIVER
Gulauthi
Lakhaoti
Unchagaon
28 30
Kali R.
Sikandarabad
Jahangirabad
BulandShahar
Anupshahar
Ganga R.
BADAUN DISTRICT
G.B. NAGAR DISTRICT
Shikarpur
Khurja
28 15
Pahasu
Dibai
Danpur
Arnia Khurd
ALIGARH DISTRICT
77 75
78
78 15

Plate-II

DEPTH TO WATER LEVEL CONTOUR ZONES, BULANDSHAHAR DISTRICT, U.P., MAY'2012

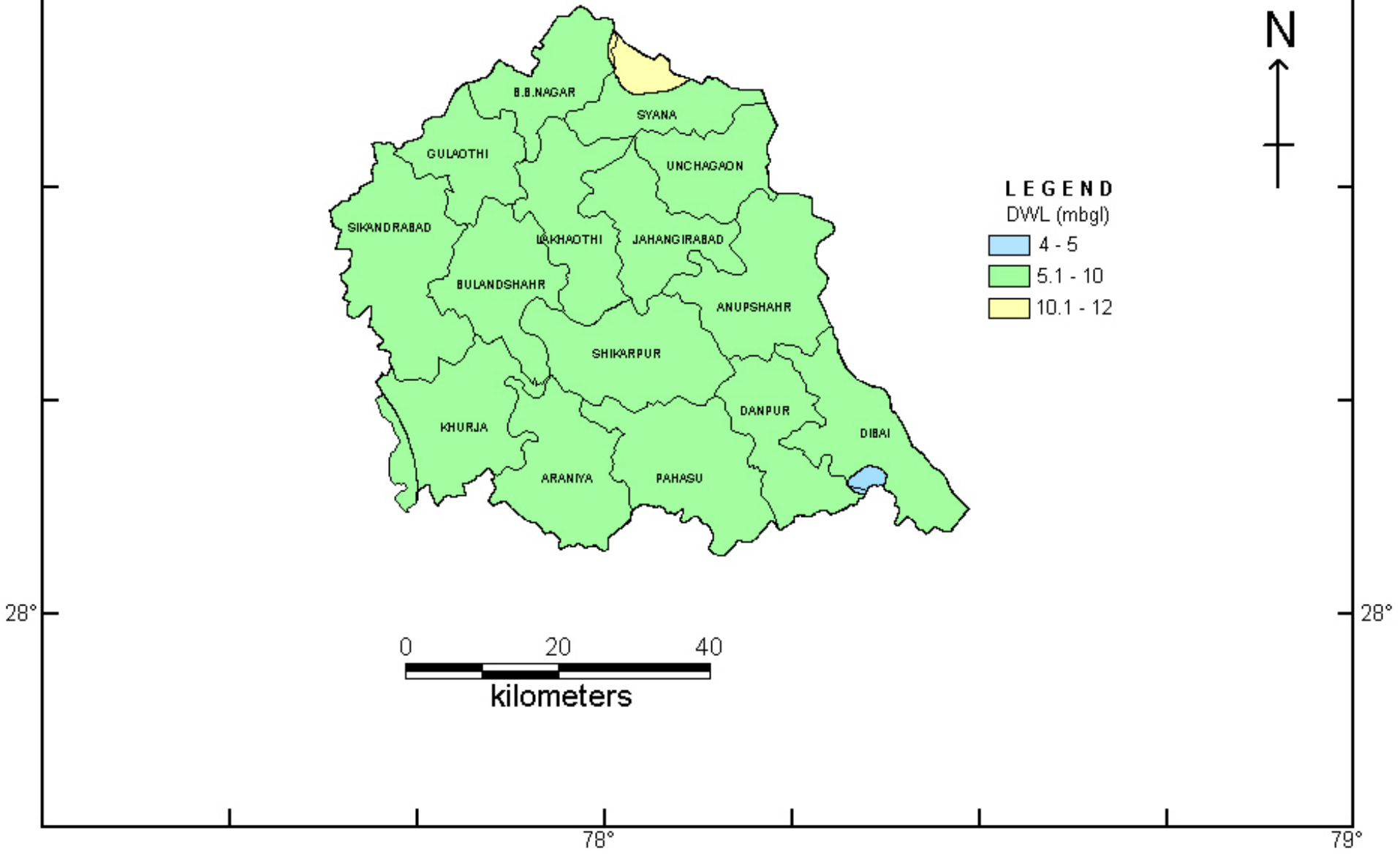


Plate-III

DEPTH TO WATER LEVEL CONTOUR ZONES,BULANDSHAHAR DISTRICT,U.P., NOVEMBER'2012

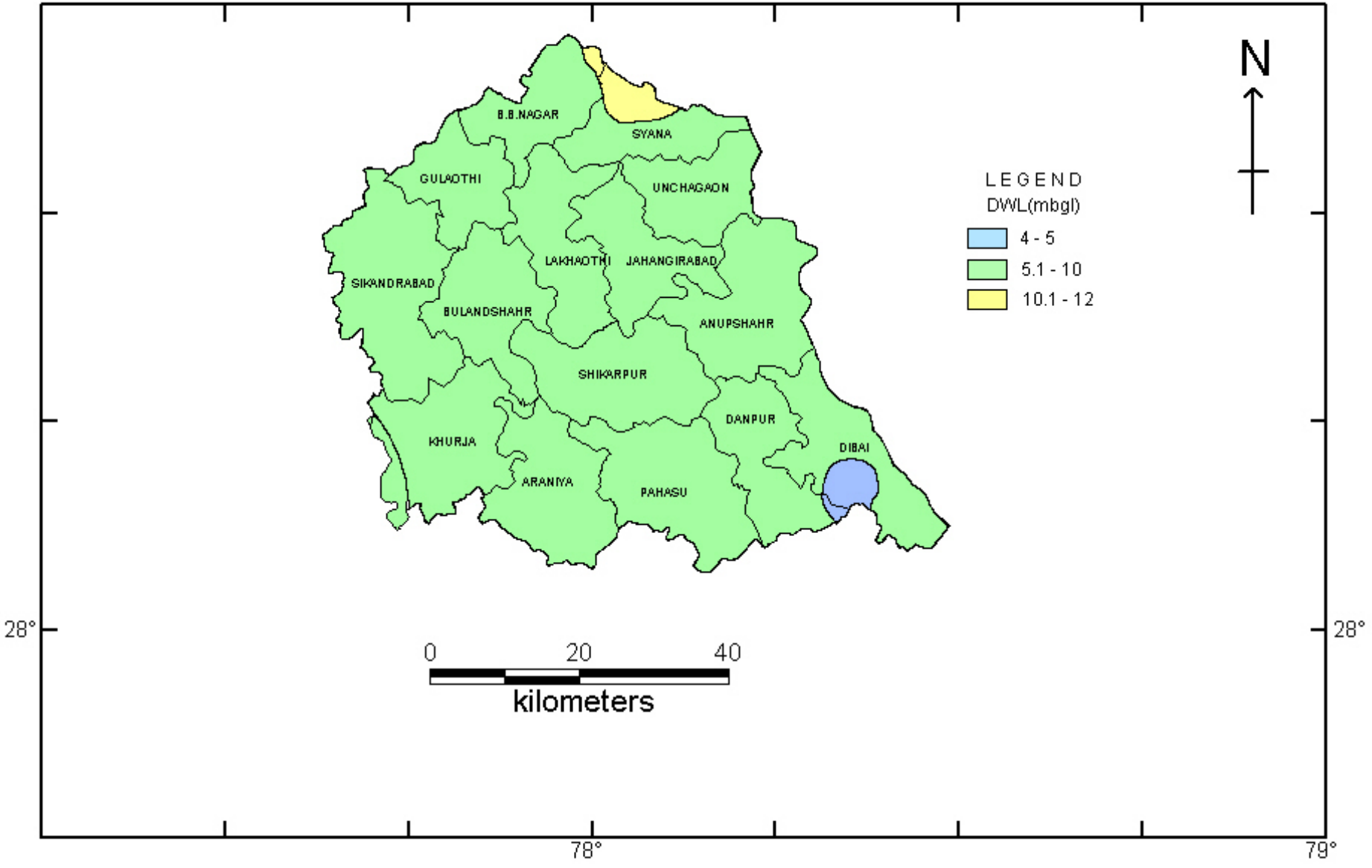


Plate-IV

GROUND WATER RESOURCES(2009), BULANDSHAHAR DISTRICT,U.P.

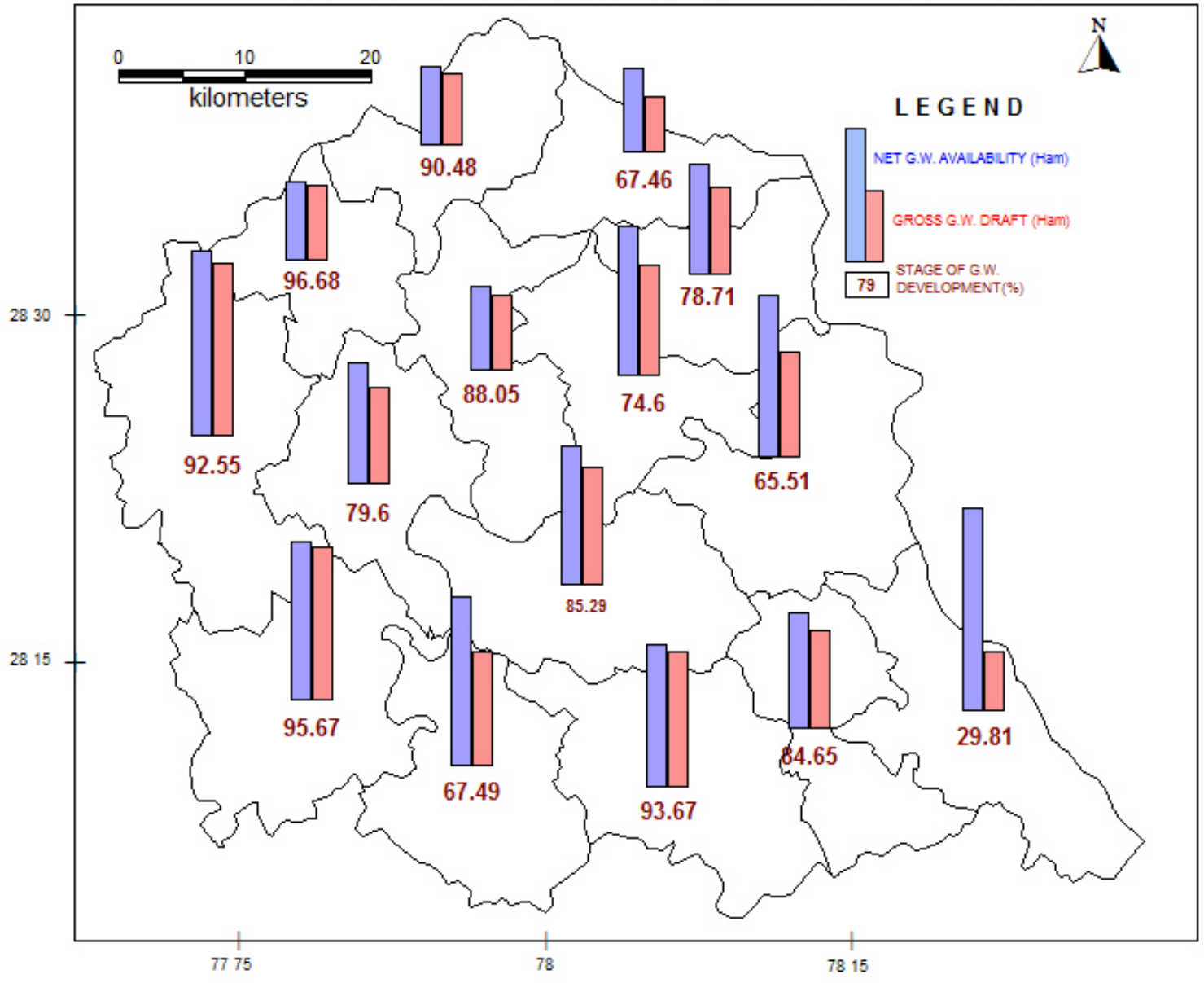
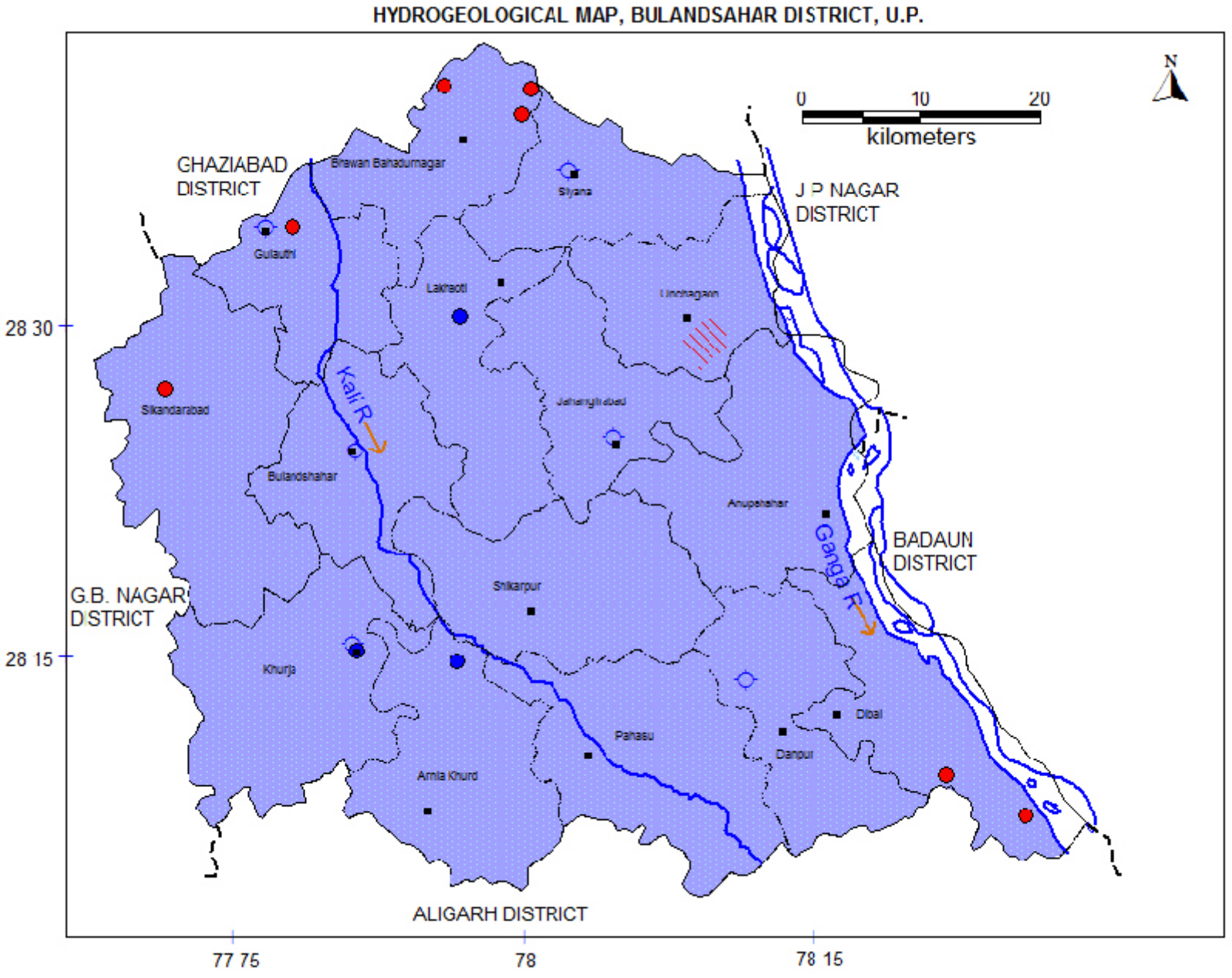
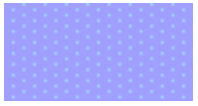


Plate-V


HYDROGEOLOGICAL MAP, BULANDSAHAR DISTRICT, U.P.
N
0
10
20
kilometers
GHAZIABAD DISTRICT
J P NAGAR DISTRICT
BADAUN DISTRICT
G.B. NAGAR DISTRICT
ALIGARH DISTRICT
Brawan Bahadurnagar
Siyana
Gulaothi
Lakhaoti
Unchagaon
Sikandarabad
Jahangirabad
Bulandshahar
Anupshahar
Shikarpur
Khurja
Dibai
Pahasu
Danpur
Amla Khurd
Kali R.
Ganga R.
28 30
28 15
77 75
78
78 15

BULANDSHAHAR DISTRICT

LEGEND, HYDROGEOLOGICAL MAP

	WELLS FEASIBLE	RIGS SUITABLE	DEPTH OF WELL (M)	DISCHARGE (LPM)	SUITABLE ARTIFICIAL RECHARGE STRUCTURES*
 Soft Rock Aquifer	Dug Wells / Hand Pump	Manual / Hand boring set	20 – 40	50 – 100	Recharge Shaft, Recharge Pit, Abandoned Hand-pumps / Tubewells, Roof Top Rain Water Harvesting Structures in urban areas.
	Shallow Tube Well	Rotary Rigs (Direct / Reverse)	50 - 100	1000 - 1500	
	Deep Tube Well	Rotary (Direct)	100 – 300**	2000 – 3000	
 Nitrate > Permissible limit (100 ppm)					

** Limited upto depth explored i.e. deeper prospects yet to be found.

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