

GROUND WATER BROCHURE OF CHITRAKUT DISTRICT, U.P.

(AAP:2012-13)

By
A.K. Budhaliya
Scientist 'D'

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CHITRAKUT DISTRICT AT GLANCE

1. GENERAL INFORMATION

(i)	Geographical Area (Sq km)	: 3388.97
(ii)	Administrative Division	:
	Number of Tehsil / Blocks	2/5
	Number of Panchayat / Villages	567
(iii)	Population (As on 2001 Census)	:
	Male	42,8410
	Female	373550
	Total	801960
	Schedule Caste	210400
	Schedule Tribe	20
	Population Density (Person/Sq.Km.)	236.64
(iv)	Average Annual Rainfall (mm)	: 980.1

2. GEOMORPHOLOGY

Major Physiographic Units	: 2 (southern pediplain & northern pediplains region)
Major Drainages	: Yamuna, Baghain & Paisuni & its tributaries

3. LAND USE (Hectare)

(i)	Forest Area	: 59731
(ii)	Net Area Sown	: 171227
(iii)	Gross Sown Area	: 182237

4. MAJOR SOIL TYPES

: 3 (Alfisols – Hilly Soil
(ii) Vertisols - Black soil
(iii) Entisols-Alluvial soil

5. AREA UNDER PRINCIPAL CROPS (Hectares)

: Rabi – 118515
Kharif – 63549

6. IRRIGATION BY DIFFERENT SOURCES

(i)	By Canals	: Length 611 Km Irrigated Area 3953 ha
(ii)	State Govt. Tubewell	: 4 Irrigated Area 93 ha
(iii)	Private Tubewell	: 6727 Irrigated Area 21968 ha
(iv)	Net Irrigated Area	: 38466 ha

(v)	Gross Irrigated Area	:	39826 ha
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF C.G.W.B. (As on 31-3-2012)		
(i)	No. of Dug Wells	:	10
(ii)	No. of Piezometers	:	Nil
8.	PREDOMINANT GEOLOGICAL FORMATIONS	:	Alluvium Vindhyan Bundelkhand Gneissic Complex
9.	HYDROGEOLOGY		
	Major Water Bearing Formation	:	Sand of various grades clay, silt, gravel Kaimur & Rewa sandstones & Shales, Tirohan limestone
	(Pre-monsoon Depth to Water Level During 2012)	:	8.60 to 22.90 mbgl
	(Post- monsoon Depth to Water Level During 2012)	:	2.92 to 15.43 mbgl
	Longterm Water Level Trend in 10 Years (2003-2012) in m/yr	:	Rise in 2 wells Min 0.05 m/year Max 0.08 m/year Full in 8 wells Min 0.11 m/year Max 1.67 m/year
10	GROUND WATER EXPLORATION BY C.G.W.B. (As on 31-3-2012)		
	No. of Wells Drilled	:	56
	Depth Range (m)	:	34.10 to 251.55
	Discharge (litres per minute)	:	Meager to 2000
11	GROUND WATER QUALITY		
	Electrical conductivity (EC microsiemens/cm) at 25 ⁰ C	:	388 – 1043
	Chloride (Cl)	:	14 – 78 (mg/l)
	Nitrate (NO ₃)	:	8.7 – 37 (mg/l)
12	DYNAMIC GROUND WATER RESOURCES (as on 31-03-2009) – in HAM		
	Annual Ground Water Recharge	:	26396.44
	Net Ground Water Availability	:	23983.72
	Existing Gross Ground Water Draft	:	17302.65
	Net Ground Availability for Future Use	:	5734.88
	State of Ground Water Development	:	72.14%

13	AWARENESS AND TRAINING ACTIVITY	: One (WMTP)
14	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	: Technical guidance rendered to State Govt. as when required.
15	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	: Nil
	Number of Critical Blocks	: 1 (Chitrakut – Dham Karvi)
	Number of Semi Critical Blocks	: 1 (Ramnagar)
	Number of Blocks Notified	: Nil
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	: Critical Block – Chitrakut Dham Karvi with stage of Ground Water Development 97.08 Water level declining trend in Chitrakoot Dham (Karvi) & Ramnagar blocks

GROUND WATER BROCHURE OF CHITRAKUT DISTRICT, U.P.

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1.0 INTRODUCTION

Chitrakut district covers an area of 3388.97 sq.km. which is located in southern part of U.P. the district is bounded on the north by the districts of Fatehpur & Allahabad, on the east, south-east & south by the state of Madhya Pradesh and on the west by the tehsils of Naraini & Baberu of Banda (its parent district). The river Yamuna forms the natural boundary of the district on its northern side whereas the river Baghain forms the western & north-western boundary.

Administratively, the district Chitrakut has been carved out as a separate district on 13th May, 1997 from Banda district which has been divided into two tehsils, Karvi & Mau with headquarters of the district at Karvi and further sub divided into 5 blocks namely (Plate I) vis a vis Pahari, Karvi (Chitrakut), Manikpur, Ramnagar and Mau. There are 650 villages in the district out of which 551 villages are habitated.

The total population of the district is 801960 as per 2001 census out of which 428410 (53.42%) are male and 373550 (46.58%) are female. Total population of scheduled caste is 210400 (26.23%). Population density is 225 persons/sq.km. The decennial population growth is 12.8%.

Topographically, as well geographically, the district consists of an elevated plateau called 'Patra'. The general slope of the district area is from south-west to north-east. The drainage pattern of Chitrakut district is mainly controlled by three rivers viz-Yamuna, Baghain and Paisuni.

Ground Water is the main source of irrigation in the district as 89.72% of net sown area is irrigated through water resources (district statistical information) (year 2008-09) by means of shallow/deep tube wells & dug wells and rest 10.28% area is irrigated through surface water resources by means of canals. The reported area is 338797 ha, out of which net sown area is 171227 (44.02%). The total forest area is 26599 ha (7.84%). The maximum

utilization of land for cultivation is in Pahari (66.68%) block and minimum is in Ram Nagar block (37.79%). The area sown more than once is 11010 ha and total gross sown area is 182237 ha. Rabi & Kharif are main crops. The most important crop is wheat, paddy followed by gram, Jawar & Arhar.

The hard rock terrain of Chitrakut district was geologically mapped & studied by Medicot (1859), Mallet (1869) & Auden (1933). The hydrogeological investigations in drought effected area was carried out by Sh. M.L. Shrivastava (CGWB) in 1973. Systematic hydrogeological survey in the district were carried out during the year 1976 by Sh. S.C. Bhattacharya, CGWB. Reappraisal hydrogeological survey in the district were carried out by the officers of CGWB during the year 1990-91, 1997-98. Ground Water Management study was carried out by Sh. T.K. Pant, Scientist 'B', CGWB during the year 2011-12.

2.0 RAINFALL & CLIMATE

The annual normal rainfall (1950-80) of the district is 980.1 mm. The maximum rainfall occurs during monsoon period is June to September having normal value of 876.8 mm. which is 89.46% of the annual rainfall. August is the wettest month having the normal rainfall of 366.7 mm. followed by July with normal rainfall of 265.3 mm. The average 20 years data reveals that the average rainfall varies between 939.5 mm (Mau) and 1059.2 mm. (Karvi). Average number of rainy days is 47.1.

The climate of the district is sub-tropical. The monthly precipitation index (P.E.) i.e. 46.058. The hottest month is May with average mean temperature 35.3°C. The coldest month is January with average mean temperature 16.55°C. The average annual humidity is 56.29%. The normal annual wind speed is 2.29 km/hr.

3.0 GEOMORPHOLOGY & SOIL TYPES

Topographically as well as geographically, Chitrakut istt. largely consists of an elevated plateau called 'Patra' and also characterised by diverse fertile erosional plains & valleys. The general slope of the district area is from south-west to north-east. The maximum elevation is 200 mamsl near Manikpur and minimum elevation is 80 mamsl in the northern

plain area of the district. Geomorphology has an influence on the ground water regime of the area. Geomorphologically, Chitrakut district has two district region namely : (I) Southern pediplain and (II) Northern pediplain region.

(I) Southern pediplain region is characterised by the occurrence of Vindhyan systems & Bundelkhand granite gneiss. having weathered mantle of Colluvial & alluvial materials. This region is comprises of various geomorphic units such as pediments/inselberg complex, shallow pediplains & residual hills.

(II) Northern pediplain region includes other geomorphic units viz. moderately weathered pediplain & deeply burried plain.

Chitrakut district has various geological formations ranging right from the Archean, Vindhyan to Recent, obviously have undergone diversified pedogenesis. There are three types of soils namely

(I) Alfisols (Hilly Soil), (II) Vertisols (Blacksoil) and (III) Entisols (Alluvial soil). In general alfisols found found in Kaimur plateau having shrubby Jungles and land is not fertile. The vertisols occupies the parts of Mau, Ram Nagar, Pahari and Karwi blocks and one more fertile soil occupying the flood plains of the main rivers in the district. These soils are alkaline in nature and fertile.

4.0 GROUND WATER SCENARIO

4.1 Geology:

Geologically the district is mainly occupied by the units of Vindhyan system comprising of Tirohan dotomite/lime stone and Kaimur Sandstones of Kaimur Group with isolated out crops of Bundelkhand granite. A generalised geological set up in the district area is as under.

Age/Period	Formation	Group	Lithology
Quaternary	Alluvial deposit	Newer alluvium older alluvium	Sand, silt, clay, Gravels, kankar etc.
Puranas	Vindhyan	1. Kaimur Group 2. Rewa Group 3. Semri Group Upper Glouconitic limestone	Kaimur Sandstone Shale, Sandstone Tirohan lime stone dolomite Sand stone, pallet
-----Unconformity-----			
Archean	Bundelkhand Genesis Complex		Bundelkhand granite gneiss.

Archean group is mainly represented by the occurrence of Bundelkhand granite gneissic complex in the south & south-western part of the district. The coarse to medium grained granites are well exposed as extensive out crop in and around Sitapur Mafi, Laxman Pahar, Bharatcup, Dugwan, Marfa & South of Karwi block.

The major part of the district is occupied by semi-consolidated sedimentary formations which is mainly represented by sandstones, shales and Tirohan limestone/dolomite of the Vindhyan Super Group, Kaimur sandstones in central part, south & south-eastern & eastern part of the district are occurring in the form of extensive out crops with flat top & very steep escarpments in Manikpur block. The Tirohan limestones of the Semri Group are exposed beneath overlying Kaimur sand stone in south & southern parts of Karwi & Manikpur blocks. The Rewa shales are exposed in small patches at the extrem south-eastern boundary of the district. As the ground water potential within the sandstones & overlying alluvial deposit in the district is limited but the cavernous limestone occurring beneath the sandstones are expected to contain sizable quantities of ground water.

The quaternary group of sediments represented by unconsolidated alluvium occurs north of the Kaimur & Rewa hillocks & Bundelkhand complex hills to the vicinity of Yamuna river in north-west & west of Pansini & Baghain rivers. The thickness of alluvium gradually increases towards the north almost uniformly.

4.2 Sub Surface Geology:

About 40% of the total geographical area in the Chitrakut district is covered with unconsolidated sediments rest 60% occupied by the hard rocks of Vindhyan system. The thickness of granular zones in unconsolidated (alluvial) has a tendency to increase towards north ranging in depth from 40 to 120m. To study the sub-surface geology and lay out of aquifers, lithological logs of exploratory bore wells CGWB has constructed nearly 50 exploratory well mainly in the Kaimur & Rewa sedimentary formations and Bundelkhand granitic Chitrakut district which is given in Annexure-I

Two to three & more water bearing fractures may encountered within 100 m. depth & beyond this depth fractures are found to be less developed. On an average 2 to 6 sets of potential fractured zone are encountered in the depth range of 34 to 160 mbgl yields of borewells in these rocks range from 230 to 970 lpm. In alluvial areas the granular zones encountered at different depth range of 40 to 70 m. and the depth and thickness of these

granular zones vary laterally. The tube wells explored in alluvial areas expected to yield nearly 160 to 2000 lpm.

4.3 Occurrence & Movement of Ground Water:

The occurrence & movement in hard rocks depends largely on extent of fracturing, size of fractures, openness, continuity and nature of their interconnection. Ground water moves in hard rocks through crevices, joints & fissures and fractures within them.

To study the movement of ground water over the district, water table contour map drawn wells & NHS wells with respect to MSL. A perusal of this contour shows that ground water has a dominant north-easterly movement in the district, while it slopes towards north to NNE and in eastern part, it slopes north-eastern in general. The gradient of ground water is observed around 0.75 m/km. in the north & north-eastern parts. The average hydraulic gradient in the district is nearly 2.0 m/km.

4.4 Depth to Water Level:

Central Ground Water Board as well as state Ground Water Department have established number of permanent hydrograph stations in Chitrakut district to monitor the water level behaviour in space & time. All these wells are periodically measured. Based on the available data depth to water level map has been prepared (Plate II). A perusal of the map indicate that the water level in the district varies between 8.60 to 20.90 mbgl during pre-monsoon period. Deepest water level occurs in the eastern part in the Mau block.

The post monsoon water level data of the same stations show that water level varies between 2.92 to 15.43 mbgl (Plate III). During this period shallowest water level less than 5 metres occur in the southern part of the district in Manikpur block.

4.5 Seasonal & Long term Fluctuations

The Water level data of National hydrograph stations in the year 2012 reveals that during pre monsoon period depth to water level varies between 8.60 to 22.90 mbgl and during post monsoon period it varies between 2.92 to 15.43 mbgl. Seasonal fluctuation varies between 1.15 to 10.38 metres. The data of 2012 of NHS is given below in Table-1.

Seasonal Fluctuation in the Year 2012

Sl. No.	Name of GWMN Station	Pre Monsoon (mbgl)	Post monsoon (mbgl)	Fluctuation (m)
1	Bhaunri	11.35	6.57	4.78
2	Chakra Jafar	18.80	12.27	6.53
3	Chiwalaha	22.90	12.52	10.38
4	Deval	15.40	14.02	1.38
5	Harisonpura	17.68	15.43	2.25
6	Jorwara	8.60	5.33	3.27
7	Karwi	9.85	6.17	3.68
8	Manikpur	9.95	2.92	7.03
9	Mau	18.35	13.52	4.83
10	Raipura	11.55	10.40	1.15

For long term water level trends, the existing hydrograph data of CGWB was analysed from the year 2003 to 2012. Out of 5 blocks, only one block Manikpur is showing rising trend of 0.08 metres during pre monsoon period and other 04 blocks are showing falling trend between 0.11 (Karwi block) to 1.67 m/year (Pahan block) and during post monsoon period except Manikpur block all the blocks are showing falling trend between 0.18 to 0.97 m/year. Details are given in Table 2.

4.6 Ground Water Resource:

To facilitate the ground water development the ground water resources have been estimated by CGWB considering the norms of ground water estimation committee in consultation with state Ground Water Development which are as follows:

Table-2

District		Name of GWMN Station	Data points	Rice (m/year)	Fall (m/year)	Data points	Rice (m/year)	Fall (m/year)
Chitrakut	1	Karwi	8		0.54	9		0.36
	2	Mau	10		0.66	9		0.25
	3	Manikpur	10	0.08		9	0.01	
	4	Raipura (K)	10		0.11	9		0.20
	5	Pahra Ka purwa	7	0.05		6	0.15	
	6	Harison pura (K)	9		0.34	9		0.30
	7	Pokhri purwa	7		1.82	5		
	8	Chiwalaha (Mau)	9		0.84	9		0.59
	9	Bhaunri (Pahra)	10		0.81	9		0.57
	10	Jorwara (Mau)	10		0.30	9		0.18
	11	Chakrajafar (Pahra)	9		1.67	9		0.86
	12	Pausaunja	8		0.36	5		
	13	Deval (Karaun)	9		0.29	8		0.33
	14	Prasidhpur	8		0.52	6		0.97
	15	Rani Purbhatt	7		0.60	3		

Table-3

**Dynamic Ground Water Resources of Chitrakut District
As on 31.03.2009**

Sl. No.	Assessment Units- blocks	Annual Ground Water recharge (ham)	Net 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 (%)	Category of block
1	Karwi	4500.14	4050.13	3931.84	128.83	97.08	Critical
2	Manikpur	7289.07	6560.16	3804.30	2370.24	57.99	Safe
3	Mau	4538.39	4311.47	3070.48	915.20	71.22	Safe
4	Pahari	6119.43	5507.49	3931.84	1586.19	71.39	Safe
5	Ram Nagar	3949.41	3554.47	2564.19	734.42	72.14	Semi critical
	Total	26396.44	23983.72	17302.65	5734.88	72.14	

Categorisation of blocks has been shown in Plate-IV

4.7 Ground Water Quality:

Ground water in phreatic aquifers, in general, is colourless, odourless and slightly alkaline in nature. The specific electrical conductance ranges from 388 to 1043 $\mu\text{s/cm}$ at 25°C.

It is observed that the ground water is suitable for drinking and domestic uses in respect of all constituents. The value of nitrate ranges from 8.7 to 37 mg/l. Fluoride and nitrate are within the permissible limit of 1.5 mg/l & 45 mg/l respectively.

4.8 Status of Ground Water Development:

Overall status of ground water development in Chitrakut is 72.14%. Maximum development is in Karwi block (97.08%) which falls under the category of critical block. Stage of development in Ram Nagar block is 72.14% falling in semi-critical block. Rest of three blocks falls in safe category.

5.0 GROUND WATER MANAGEMENT STRATEGY

Based upon the studies carried out it is observed that water level is declining very fast in the district and it is strongly recommended that exploitation of ground water through private and state shallow tube wells be stopped in the critical block Karwi and semi critical block Ram Nagar of the district. The declining water level have caused adverse effect on ecological balance as minor drainage ways which used to have water are now almost dry. This obviously is the result of massive ground water exploitation for irrigation as well as for other need in these two blocks. Dug wells have become defunct due to lowering of water level. It is therefore suggested that piezometers should be constructed down to 40 to 50 metres depth to monitor water levels where either dug wells are defunct or water level has gone very deep. Exploitation of deeper aquifers be made in systematic manner which are capable of yielding good water at moderate draw down at selected hydrogeological favourable & feasible locations.

Rain water harvesting techniques be adopted in the areas where the depth to water level is more than 8 metres. In rural areas rain water harvesting through Gully plug, Gabbion

structures, Percolation tanks, Check dam/cement plug/Nala bund, recharge shaft, Dug well recharge and sub-surface ground water dams/sub surface dykes can be taken up. In these areas rain water harvesting be taken up considering water shed as a unit in ridge to valley concept. In addition to above techniques surface spreading technique, may be applied in plain areas.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS:

There is no water logged area exist in the district. In the Karwi block the stage of ground water development is 97.08% and in the Ram Nagar block the stage of development is 72.14%. At some locations in the blocks of Mau, Pahari and Karwi blocks water level has gone below 15 mbgl during pre monsoon period. This is due to heavy withdrawal of ground water resulting in declining trend in last decade.

7.0 AWARENESS & TRAINING ACTIVITY

7.1 Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB.

WMTP- one at Karwi (Chitrakut Dham) in the year 2012

7.2 Participation in Exhibition, Mela, Fair etc

Nil

7.3 Presentation Lectures Delivered in Public Forum

Nil

8.0 AREA NOTIFIED BY CGBW/SGWA

Nil

9.0 RECOMMENDATIONS

Keeping in view, the present hydrogeological set up it is strongly recommended that further ground water development in the blocks Chitrakut Dham Karwi & Ram Nagar must be cut down and stress on conjunctive use of water for irrigation should be given. Due to erratic and uneven distribution of monsoon rain the district suffers with drought especially in the south and eastern part which is occupied by hard rock terrain formations. So, conservation of water resources especially ground water through artificial recharge schemes are very much warranted in the water shed development projects. The structures, such as sub-surface dykes, percolation tanks, checkdam, gully plugs contour bunding and dug well recharge can be undertaken at various stages as per the local requirement. At certain places roof top rain water harvesting scheme such as Karwi city, Chitrakut Dham, Manikpur town and Mau town having recharge shaft arrangement may also be useful. This type of work can be extended to other parts of the district gradually in a long term basis. The streams & nalas in the southern & south-eastern parts which are seasonal as well as perennial should be selected for sub-surface dyke cum check dam which will enhance the ground water level & yield of wells.

**HYDROGEOLOGICAL DATA OF SHALLOW & DEEP BORE WELLS CONSTRUCTED BY CGWB, CHITRAKUT
DISTRICT, (HARD ROCK TERRAIN)**

Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
1	Lalpur 26°14'15" 81°06'00"	EW	34.10 LST		13.0	230				Vindhyans Lime stone			
2	Mau 26°16'10" 81°22'15"	EW	50.35 SST	29.6 50.3		970				Vindhyans			Over burden 29.4 m
3	Lodhwara 25°15'36" 80°55'28"	EW	151 Granite	17, 20, 87, 90		180				Fract. Granite			Over burden 11.30m
4	Ashoh 63C/15 C3	EW	221							Granite			over burden 13.6
5	Khoh 63C/16 D4	EW	150.80	10.13		55				Vindhyans			Abonded
6	Golla Mandi 25°13'28" 80°55'23"	EW	49.0			230	16.65	25.26		Weathered sand			Basement not found
7	Sitapur 63C16 B2	EW	81.55 SST	41.4 62.4		1700				Vindhyans			over burden 33.68 m
8	Tarahuwan 25°11'30" 81°54'40"	EW	114.35 SST	56, 84, 96		920				Vindhyans			over burden 31.00 m
9	Danri I Danri II Danri III	EW	86.85 SST 99.05			1130 454				Vindhyans Vindhyans Vindhyans			Abond. poor yield surface soil

Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
	63C/16 C3		SST 88.25 ST										9.55 m abandoned - mech brealed down surface soil 10.70m
10	Dadri I 25°04'48" 80°54'04" Dadri 25°04'48.5" 80°54'04"	EW OW	125 SST 87	63, 66, 81, 84, 90, 93 71, 74, 80, 83	55 56.10	491 204				Vindhyan Vindhyan			over burden 7.75 m over burden 6.00m
11	Kihunian 25°00'50" 81°04'30"	EW	150.95 SST	104	5.00	50				Vindhyan			Abond. Overburden 7.25 m
12	Tikaria 25°01'10" 81°02'15"	EW	74.00 SST	41.1	3.40	125				Vindhyan			Overburden 3.35m
13	Karri Forest 25°12'57" 80°55'27"	EW	200 Granite	48-51 121-125 153-155	11.08					Granite			Overburden 52.00m (WAPCOS)
14	Malin Ka Purwa 25°22'10" 81°02'05"	EW	68.60 SST	25.9 62.0	6.27	2000				Vindhyan			Overburden 1.25 m
15	Kalighati 25°06'19"	EW	105 SST	47, 50 51, 53	25.50	450				Vindhyan			Overburden 7.5 m

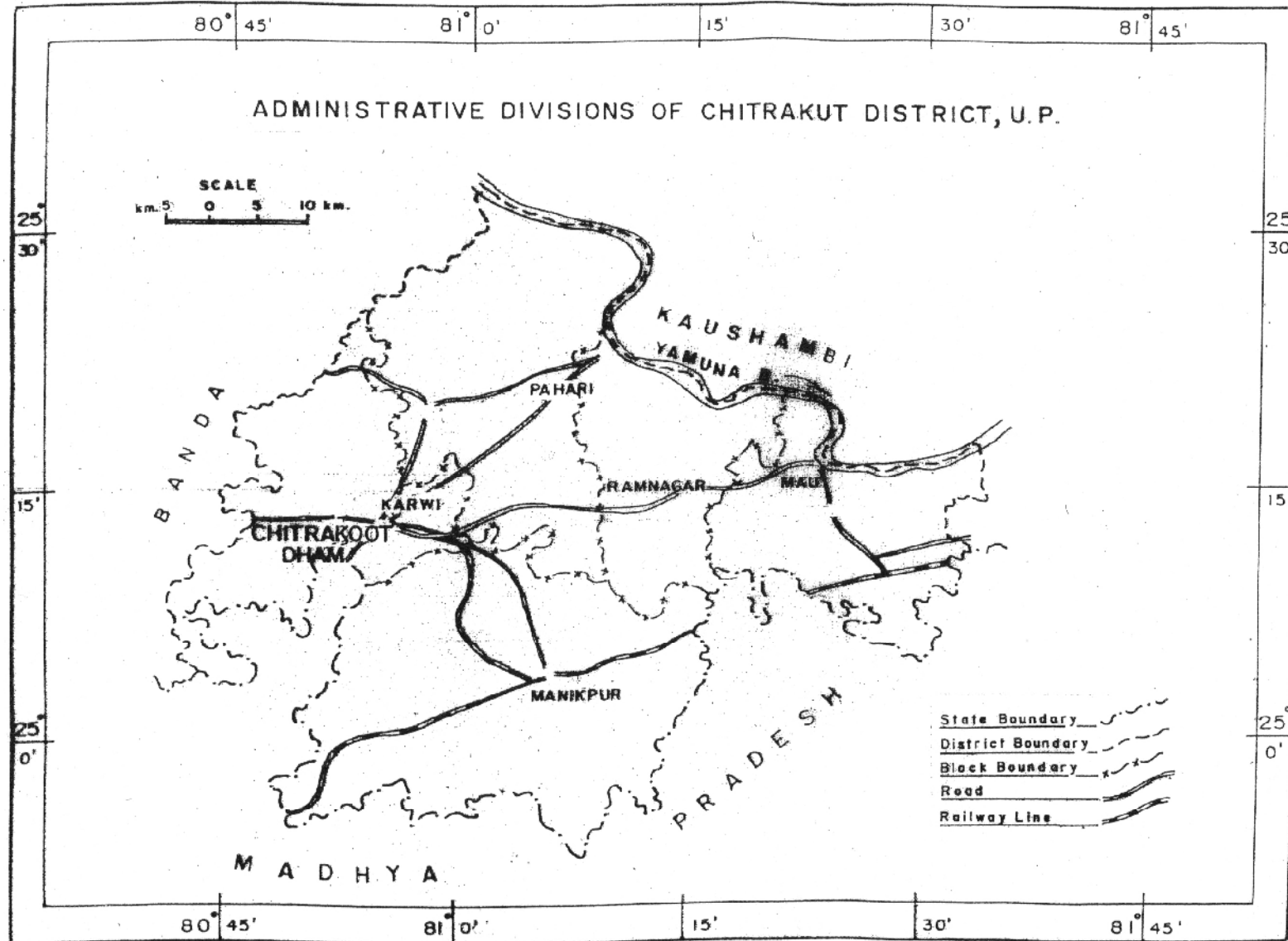
Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
	81°49'56" Kalighati 25°06'19" 81°49'56"	OW	105	54, 56 20, 23 53, 56 63, 66	29.0	960				Vindhyan			Overburden 6.5 m
16	Saryan 25°08'25" 81°04'55"	EW	62.45 SST	22.8, 25.8 38, 41.2 50.2, 59.4	6.50	926				Vindhyan			Overburden Surface soil 9.37 m
17	Baika Purwa 25°06'40" 81°05'10"	EW	68.55 SST	16.7, 25.8 28.9, 39.6 44.2, 47.2 56.3, 62.4	7.50	1866				Vindhyan			Surface soil
18	Garhi Manikpur 63E/4 B2	EW	153.95	-	-	-				Vindhyan			Abond.
19	Gaurala 25°03'56" 81°07'60"	EW	157.00 SST	29, 32 84, 87 142, 145	12.0	120				Fract SST & Quartz Vindhyan			Overburden 9.0 m
20	Sarhat 63E/4 B3	EW	150.90 SST	29.32	-	65				Vindhyan	-		-
21	Chiria Khurd 63E/4 A3	EW	87.85 SST	19, 26 31.9, 65.5	-	450				Vindhyan	-		-
22	Unchadih 63E/4 C3	EW	103 SST	7.70 10.75	3.00	60				Vindhyan	-		Overburden 3.20 m
23	Bargarh 63E/4 C2	EW	150.00 SST	101	3.60	726				Vindhyan	-		-
24	Guiya Khurd	EW	154.00	10, 13	2.69	252				Vindhyan			Overburden

Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
	25°06'40" 81°58'10" Guiya Khurd	OW	SST 136.00 SST	105, 108 10.3, 13.8 105, 108	2.82	406				Vindhyan \fract sst & Quartz			4.00 m Overburden 5.50 m
25	Semra 63E/8 C2	EW	144.75 SST	44, 44.3		60				Vindhyan			-
26	Kotwamafi 63E/8 B1	EW	99.05 SST	13.5, 18.65 47, 47.2	-	750				Vindhyan			
27	Kolmajra 63E/8 C2	EW	141.75 SST	23.26	-	400				Vindhyan			-
28	Manikpur 25°03'45" 81°06'00"	EW	251.55 SST		9.15	62				Vindhyan			Abond, shale at 181.85 m
29	Rampur Kalayan ganj 25°01'47.5" 81°03'47.9"	EW	154.00	13.00	3.75	20				Vindhyan			
30	Maraiyan 25°08'00" 80°57'28" Maraiyan 25°08'00" 80°57'28"	EW OW	74.80 SST 74.80 SST	68.7 74.8 65.65 74.80		237 330	0.26	560.10	7.28×10 ⁻³	Vindhyan Vindhyan			Overburden 12.70 m
31	Nagar 24°59'28" 81°04'35"	EW	200 SST	Nil	-					Vindhyan			Overburden 10.00 (WAPCOS)

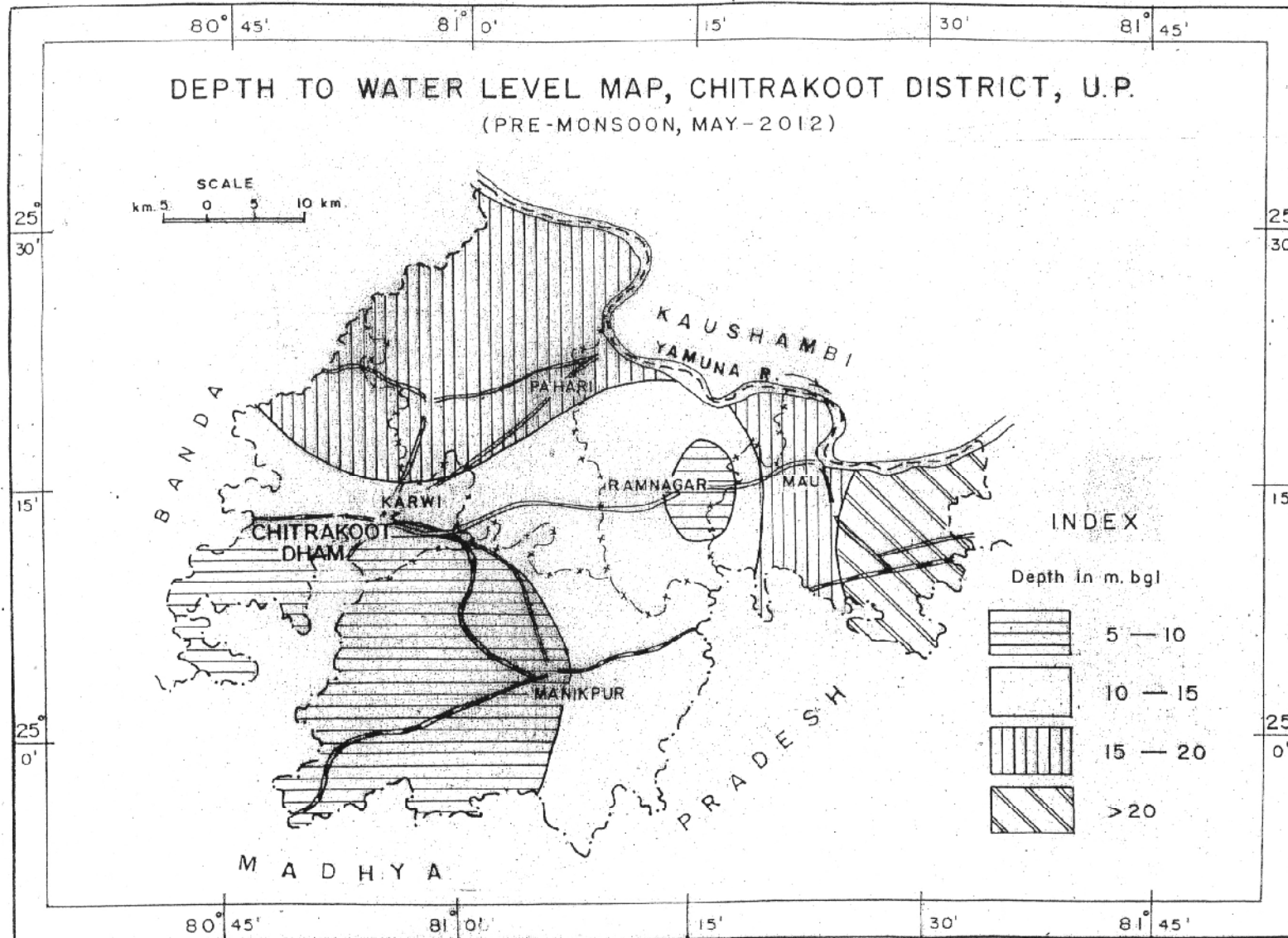
Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
32	Barahmafi 25°01'45" 81°01'43"	EW	200 SST	10 – 11 170	8.38	Nil				Vindhyans			WAPCOS Overburden 3.0 m
33	Churai Kesarwa 63E/4 B3	EW	200 SST	9 – 12 76 – 82	14.50	220	62.69			Vindhyans Shale & SST			WAPCOS Overburden 10.45 m
34	Nandappa 25°05'13" 81°07'41"	EW	200 SST	10 – 17	5.27	72				Vindhyans SST & Shale			WAPCOS Overburden 8.65 m
35	Chulichak 25°03'30" 81°02'19.3" 63E-4 A3	EW	200 SST	101 152	19.09	1				Vindhyans SST & Shale			WAPCOS Overburden 3.00 m
36	Manikpur Forest R.H. 25°04'14" 81°05'52"	EW	200 SST	98, 166	15.30	Nil				Vindhyans Sandstone			Overburden 3.00 m WAPCOS
37	Karvi Police line 63C/16 C1	EW	141.25 SST	56 – 61.50 Cavity zone	12.20	440	1.77	77		Vindhyans wealth SST			WAPCOS Overburden 42.00 m
38	Bharatkup 25°11'57" 80°46'54"	EW	154 Granite	14, 93	10.10	100				Granite			Weathered Overburden 11.80 m
39	Kalchiha	EW	150 – 55	minute fract.	13.0	10				Vindhyans Sandstone			Overburden 5.62 m
40	Simardha 25°08'39"	EW	62.00	46 – 50 50 – 53	7.17	528	0.73	1388		Vindhyans Sandstone			WAPCOS Overburden

Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
	81°03'22"			53 – 55						& Shale			11.30 m
41	Agraundha 25°10'44.9" 81°06'11.7"	EW	50.00 SST	10.80 33.4	4.25	628	5.36			Highly wealth argillaceous			Overburden 22.35 m
	Agraundha 25°10'45" 81°06'11.7"	Pz	56.50	4.60, 7.70 26, 38 47, 56	3.00	600				SST --do--			--do--
42	Pathraudi 25°13'25" 80°49'09"	EW	200 Granite	41, 70 125, 148	14.30	1				Granite			WAPCOS Overburden 20.00 m
43	Dugwan 63C/12 C2	EW	200 Granite	70 – 75 129 – 131 164 – 166 174 – 196	12.17	60				Granite			WAPCOS Overburden 17.00 m
44	Jhari 25°03'14" 81°05'00"	EW	150 SST	25	9.00	30				Vindhyan			Overburden 1.05 m
45	Kapri 63E/3 C3 25°14'30" 81°09'25"	EW	53.80	48.70 53.80	6.08	700 LPM	4.05	900.89	6.87×10 ⁻⁵	SST			
46	Jamira 63E/8 C1	EW											
47	Bahilpurwa 25°08'13.5" 80°59'45.2"	EW	97 SST	30, 36, 49	17.0	700				Vindhyan argillaceous friable SST			Overburden 5.70

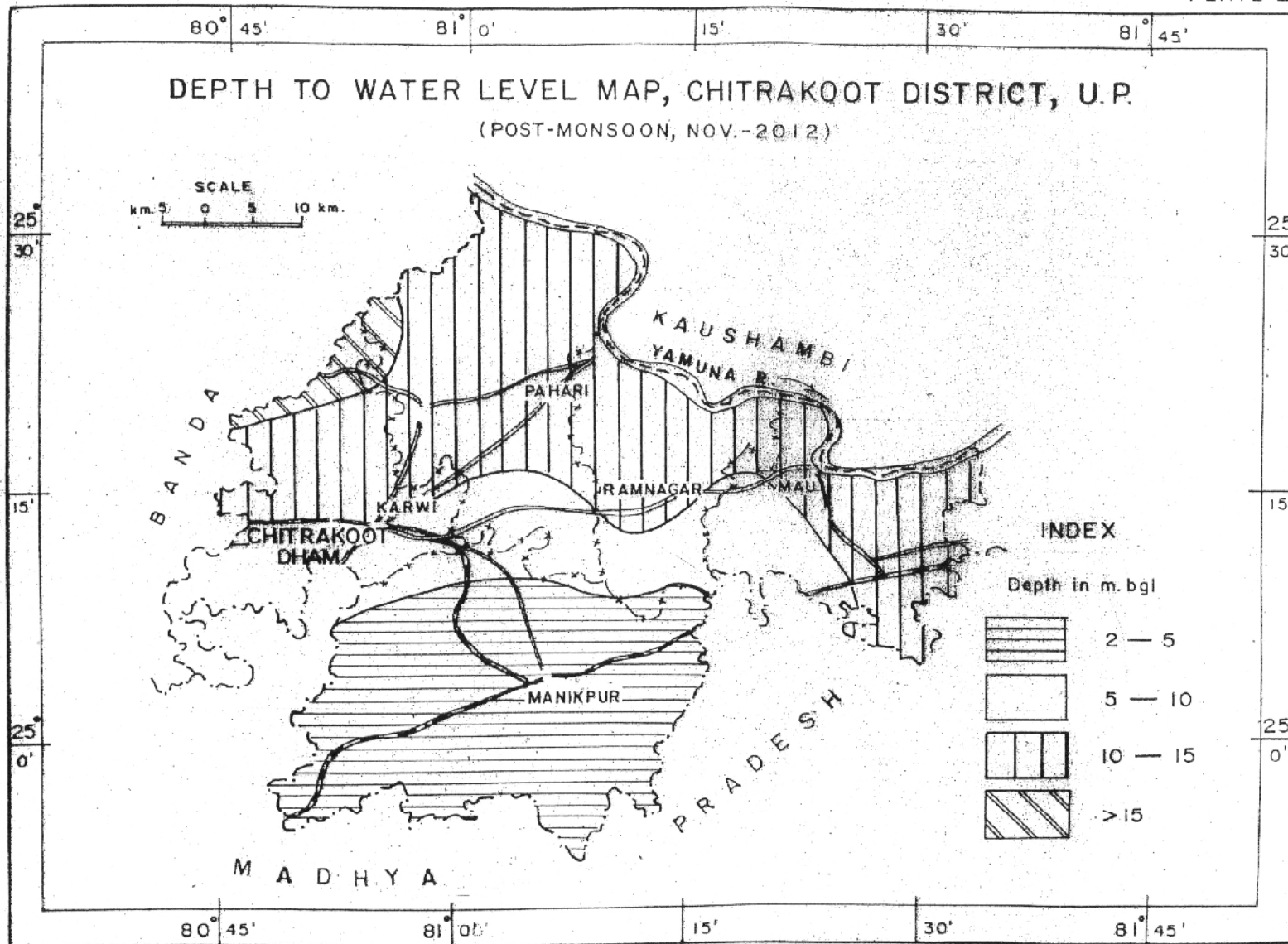
Sl. No.	Location/ Latitude/ Longitude Toposheet	Type of well	Drilled Depth/ Bedrock (mbgl)	Fracture zones (mbgl)	Water Level (mbgl)	Yield (lpm)	Draw Down (m)	Transmissivity 'T' (m ² /day)	Storativity 'S'	Geology	Electrical conductivity (micro mhos/cm at 25°C)	Chloride (mg/l)	Remarks
48	Payasi Purwa 24 ⁰ 08'21" 81 ⁰ 11'54"	EW	154 SST	35, 38	14.47	68				Vindhyan			Overburden 7.00 m
49	Kota Kandila 63E/4 C3 25 ⁰ 08'30" 81 ⁰ 15'00"	EW	75.20	25.5	11.50	51 lpm				SST			
50	Bhaunri 63E/4 A1	EW	19.75 LST	-	4.40	454				Vindhyan			Abandoned due to mechanical breakdown
	Bhaunri	EW	56.35 LST	12.15, 21	3.40	1130				--do--			--do--



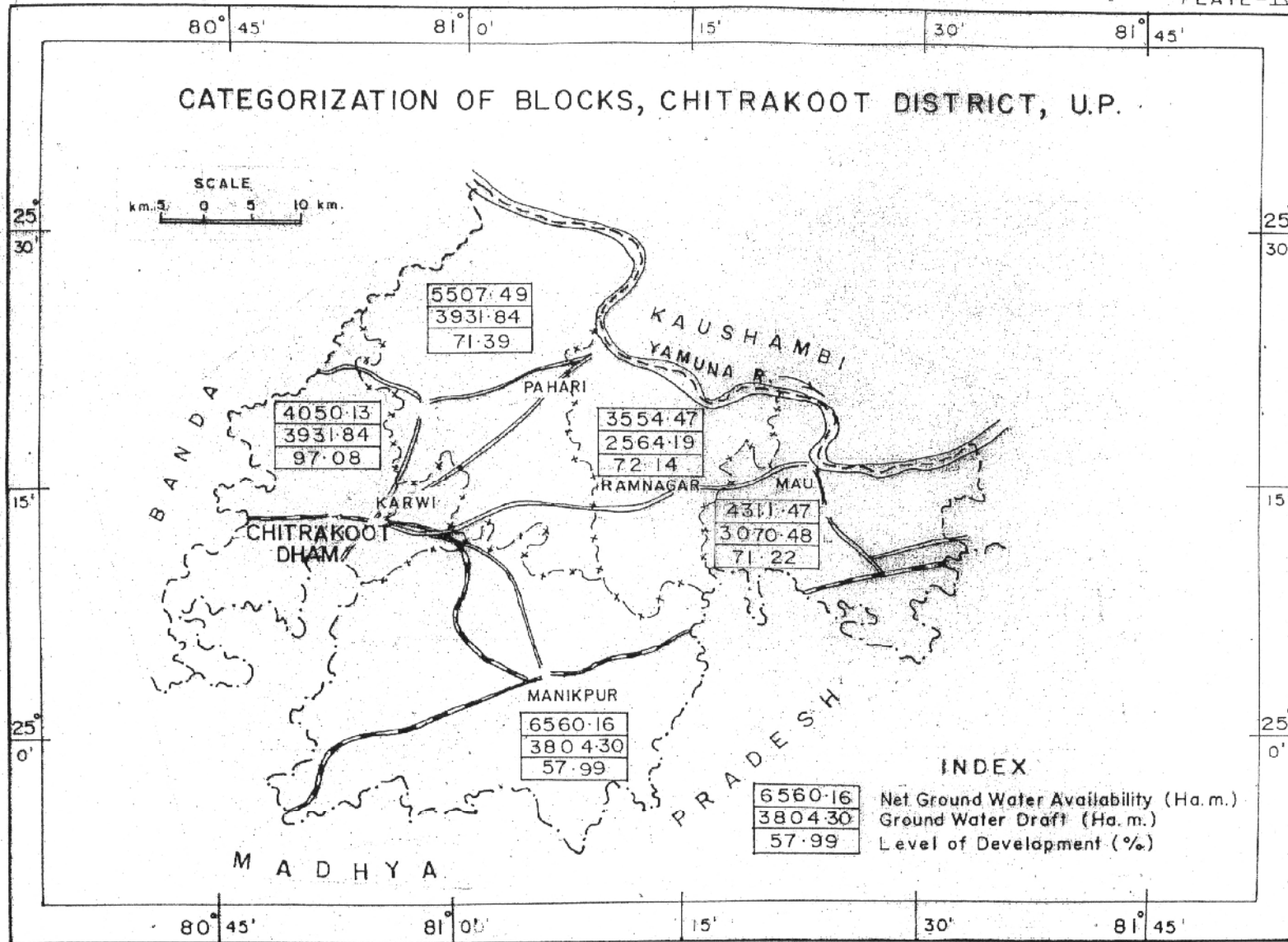
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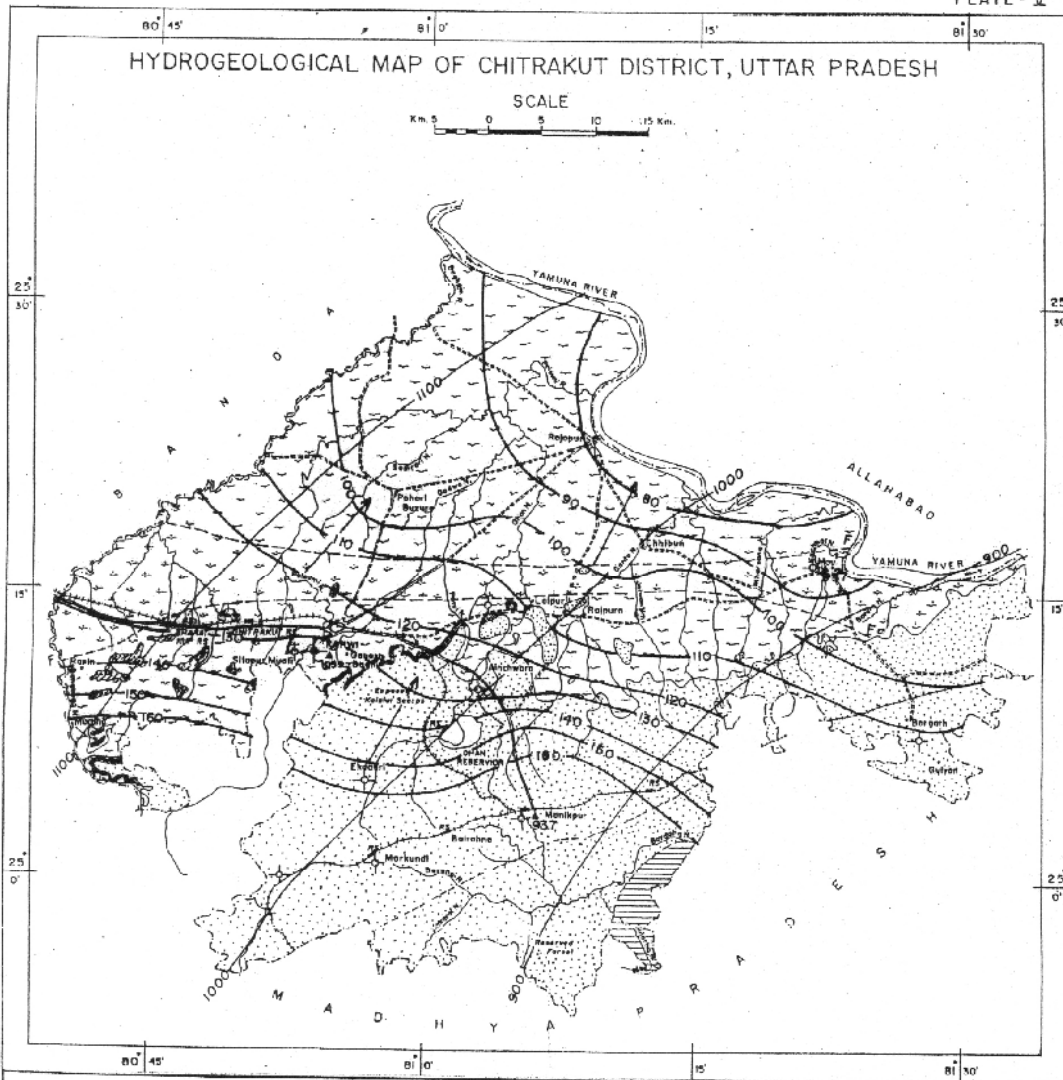
CGWB, N.R. Drg. No. 4991/14, 4993/14



CGWB, N.R. Drg.No.4991/14(N.Chandra) Drg.No.4994/14



CGWB, N.R. Drg. No. 4991/14 (N.Chondra) Drg. No. 4995



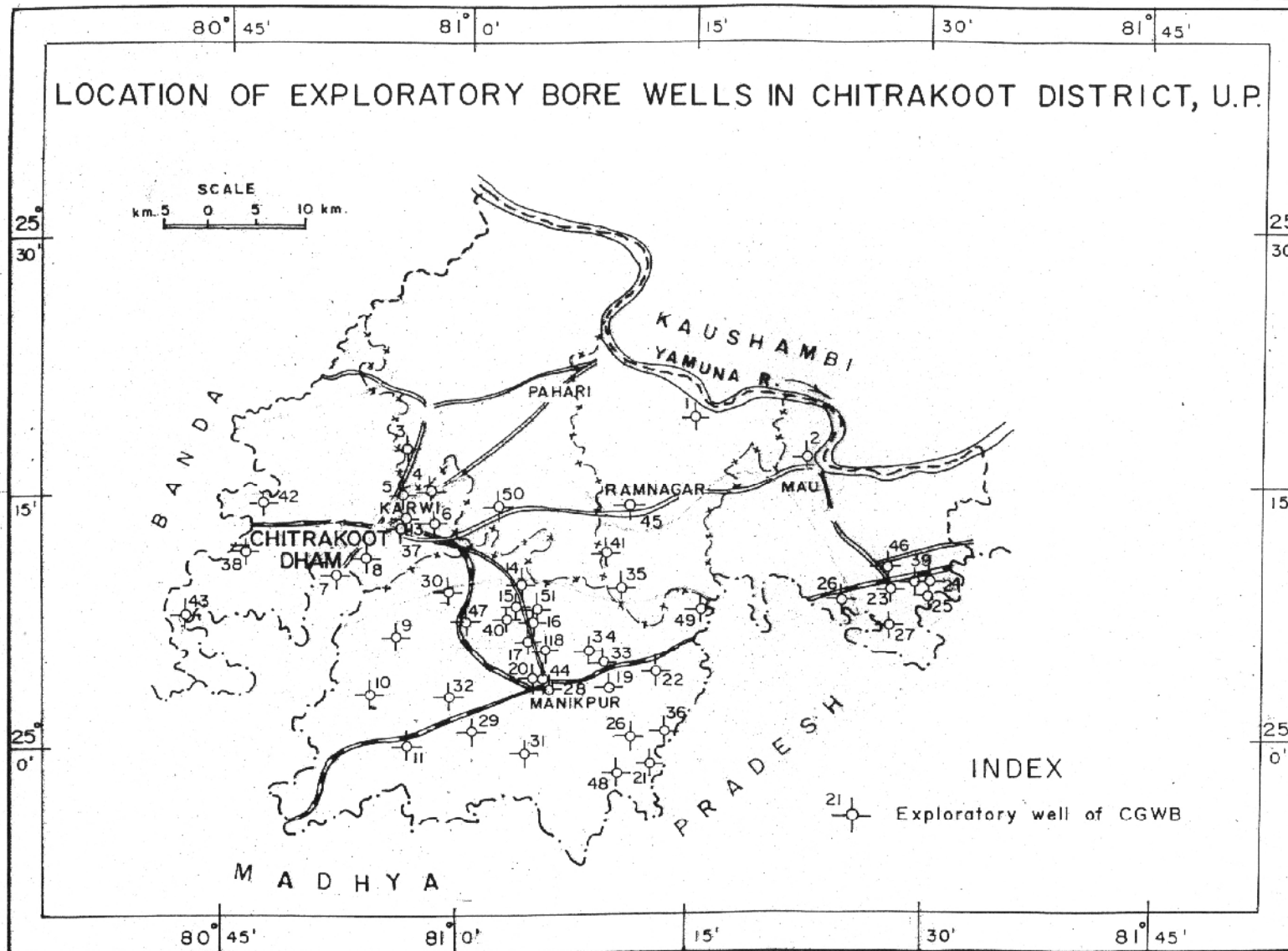
LEGEND

AGE GROUP		LITHOLOGY	HYDROGEOLOGICAL CONDITIONS	GROUND WATER POTENTIAL
Unconsolidated Formation	Quaternary	Alluvium, thickness may vary 0 to 50 m.	Cavity well, dug-cum-bore	Limited to moderate yield prospects below 150 lpm.
	Vindhyan-	Alluvium	Thin discontinuous patches forming shallow aquifers, freeflow at places	Yield may vary 100 to 120 lpm.
Consolidated Formation	i) Kaimur sandstone	Sandstone	FISSURED FORMATION	
	ii) Rewa	Shale	Ground water restricted to residuum and fracture zone having secondary porosity	Limited to moderate yield prospects below 3000 lpm.
	iii) Tirahan	Limestone highly cavernous		
		Glauconitic sandstone		
		Palaeo limestone		
Archaean		Bundelkhand granite		

SURFACE HYDROLOGY	GROUND WATER HYDROLOGY	GEOLOGICAL STRUCTURE
River	Water table contour in m.	Fault
Braided channel	Direction of ground water flow	
	Exploratory wells by CGWB	

TOPOGRAPHY	METEOROLOGY
Residual soil and hill	Rain gauge station (Annual average rainfall in m.m.)
	Isohyetal contour with value in m.m.

C.G.W.B., NR, (N.C. Pandey) Drg. No. 1504/2004, 4996/14



CGWB, N.R. Drg. No. 4991/14 (N. Chandra) Drg. No. 4997/14