DISTRICT AT A GLANCE

MANDLA DISTRICT

MADHYA PRADESH

Ministry of Water Resources

Central Ground Water Board

North Central Region

BHOPAL

2013

MANDLA DISTRICT AT A GLANCE

S.No.	Items	Statistics	
1.	General Information		
	i) Geographical area	7544 km^2	
	ii) Administrative Divisions (As on 2006) Number of Tehsil/Blocks Number of Villages	 6/9 1239	
	iii) Population (Census 2011)	10,53,522	
	iv) Normal Rainfall (mm)	1427.7	
2.	Geomorphology		
	1.Major Physiographic Units:	i. Niwas Plateau in northcentral ii. Southern hilly tract iii. Bichhia-Dongaria plateau iv. Plains of Bamhni-Mandla v. Plains of Nainpur-Pindarai vi. Michal range	
	2.Major Drainage: Narmada Bain Godavari Basin	 Narmada, Burner, Banjar, Balai & Gour rivers Wainganga River	
3.	**Land Use ('000ha)**		
	i) Forest area:	593.2	
	ii) Net area sown:	214.3	
	iii) Cultivable area:	277.9	
4.	Major Soil Types	Black cotton soil	
5.	**Principal Crops**	Wheat, Soyabean, Maize	
6.	Irrigation By Different Sources	No.	Area irrigated ('000Ha)
	Dugwells	3180	2.9
	Tube wells/Bore wells	19	0
	Tanks/Ponds	3	0.18
	Canals	67	15.9
	Other Sources	539	1.6
	Net Irrigated Area	-	20.4
	Gross Irrigated Area	-	20.4
7.	Number 0f Ground Water Monitoring Wells of CGWB (As on 31.3.2013)		
	No. of Dug Wells No. of Piezometers	27 2	
8	Predominant Geological Formations	Alluvium, Laterite, Deccan Trap basalts and Lameta formation, Archaeans (Granites, Granites Gneisses	
9	**Hydrogeology** Major Water Bearing Formation	Alluvium sand & Gravels, Weathered/vesicular basalt, flow contacts and fractured basasalt, Lameta Sandstone Weathered & fractures Granites	

	Pre-monsoon depth to water level during 2012 Post-monsoon depth to water level during 2012 Long Term water level trend in 10 years (2003-2012) in cm/yr	1.90-10.70 m bgl 0.10 – 5.05 m bgl 1.34 to 13.69 (fall)
10.	**Ground Water Exploration By CGWB (As on 31.3.2013)**	
	No of wells drilled (EW, OW, PZ, SH, Total)	EW-38,OW-23,Pz-19
	Depth Range (m)	
	Discharge (liters per second)	
	Specific Capacity lpm/m	
	Transmissivity (m^2 /day)	
11.	Ground Water Quality	
	Presence of Chemical constituents more than permissible limit (e.g. EC, F, As, Fe)	EC-406-1780, Nitrate-11-143 Flouride-0.02-2.81
	Type of Water	Alkaline
12	Dynamic Ground Water Resources (20009) in ham	
	Net Annual Ground Water Availability	53779
	Existing Gross Ground Water Draft	8205
	Projected Demand for Domestic and Industrial Uses upto next 25 years	3104
	Stage of Ground Water Development	15%
13	Awareness and Training Activity	
	Mass Awareness Programmes Organised	1
	Water Management Training Programmes	Nil
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	All blocks are come under Safe category
	Number of Critical Blocks	
	Number of Notified Blocks	
16	Major Groundwater Problems and Issues	Deterioration of Groundwater quality

1.0 INTRODUCTION

The Mandla district lies in the Southeast part of the state of Madhya Pradesh spanning over an area of about 7544 km^2. Mandla district is situated in the south eastern part of Madhya Pradesh and cover an area of 7544 sq km falling in survey of India degree sheet no 64A, B, E and F, 55 N between north latitudes $22^0$12’: 23^0 22’’ 02’ and longitude $79^0$59’23” : $81^0 44^i 22^{ii}$E. It is bounded by Jabalpur on the north west, Dindori and Seoni district in south west and Kawardha district and Chhatisgarh state on the south east. Mandla is well connected with all parts of country by Rail and roads. It lies on Jabalpur-Balaghat narrow gauge railway line. One State highway SH 37 (Jabalpur – Raipur) passes through Mandla town. The geogenic problem of high concentration of fluoride in ground water widely affect the quality life of the people of region. As per 2011 census, the population of Mandla district is about 1053522 . The district is primarily a tribal district. The district is divided into 6 tehsil and 9 blocks. There are one city (Mandla), three town (Mandla,Nainpur,Bamhni) and 1239 villages.

DRAINAGE: The district falls under two major drainage basins - the Narmada in the north and the Godawari in the south. It shows a typical dendritic drainage pattern of river network. The general slop of the Narmada valley is towards west. The Narmada river & its tributaries drain in northern and northwestern part of area. The Wainganga river flowing southerly and its tributaries drain the south western part They have broad, flat, shallow valleys with low imperceptible gradients, because their channels have reached the base level of erosion. Vertical erosion has ceased and lateral erosion is taking place.

Fig 1

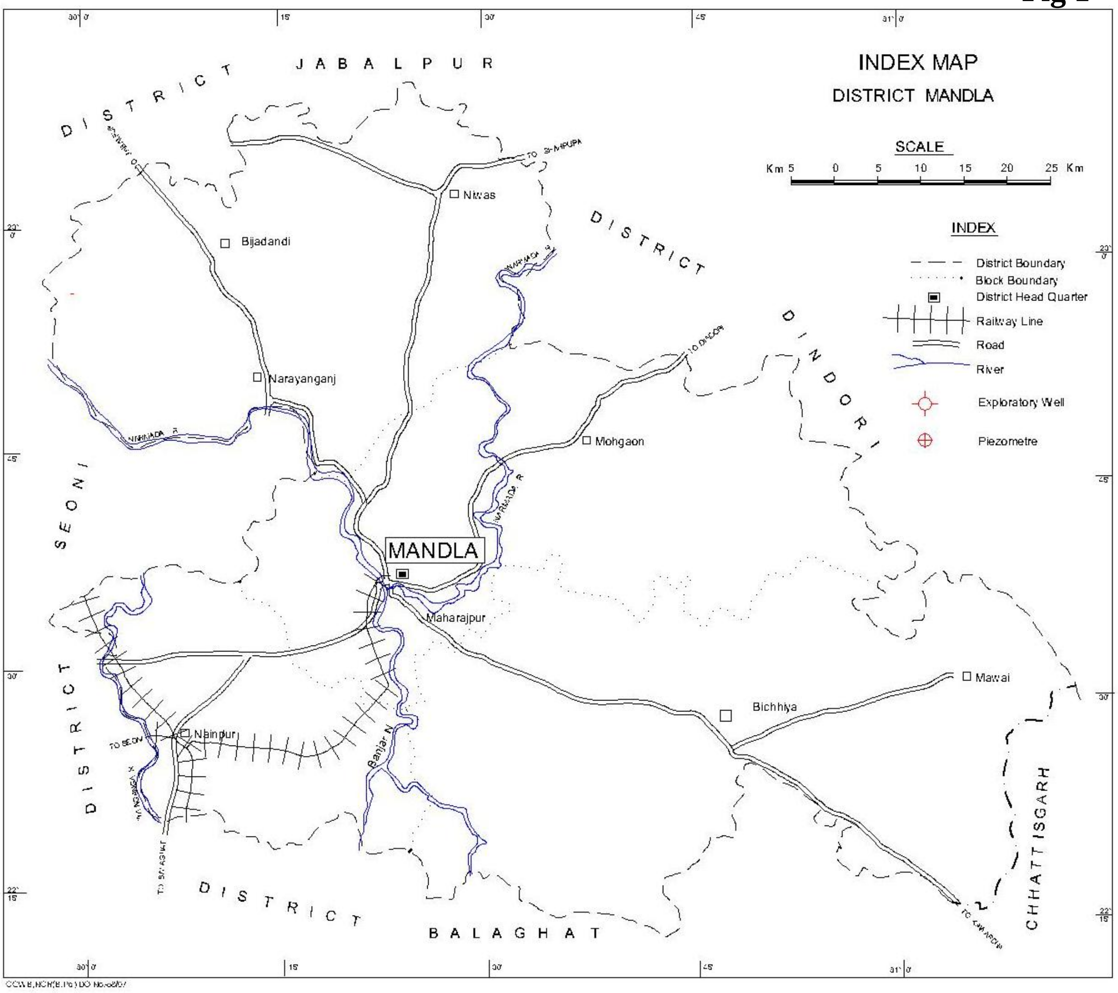

Table-1: Drainage of the Mandla district

River/ Stream	Catchment area		Length km	Gradient	Nature	Bed formation
	Km^2	% Of total				
Narmada	3130	35.90	150	1000	Perennial	Basalt/Sand
(i) Banjar	1520.0	31.07	62	1 in 3650	Ephemeral	Granite/Sand
Surpan				1 in 3650	Perennial	Basalt
(ii) Burhner	2708.0	17.44	129	1 in 1000	Perennial	Basalt
(iii) Balai	412.0	4.73	41	1 in 500	Ephemeral	Basalt
(iv) Bijra				1 in 250	Ephemeral	Basalt
(v) Hingra			-	1 in 300	Perennial	Basalt
Newari			32	1 in 350	Ephemeral	Basalt
(vi) Gaur	217.0	2.49				
Godawari Basin						
Wainganga	730.0	8.36	35	1 in 600	Perennial	Archaean
Halen				1 in 1250	Perennial	Archaean
Thanwar				1 in 250	Perennial	Basalt
Chaknamla				1 in 250	Ephemeral	Basalt

Physiography:

Mandla district is hilly and forested (Satpura hill range) and highly undulating with narrow strip of cultivated plains in the valley portion of river and nala. The plateau is in the northern part formed by basalt and east west trending hill in the southern part. The highest elevation 934 m amsl in the northern part and lowest elevation in around 400 m amsl in northwestern part of area.

Soil:

The soils in the area are generally of clayey loam types with sandy loam soil in some areas. In the northern and central parts of the District, the undulating plateau with mounds are covered with slightly deep soil, well drained, fine to fine loamy soils on gentle slopes marked by moderate erosion. The southern hilly region is covered by very shallow loamy soils, some what excessively drained. The soils developed on moderately steep slopes are marked by severe erosion. The soils have been classified as Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts, as per pedological taxonom

Climate and Rainfall:

Climate of the district is tropical with moderate winter and severe summers and well distributed rainfall received from southwest monsoon. However due to higher general elevation and abundance of forests, summer temperature do not rise as much as in other areas. The normal annual rainfall of Mandla district is 1427.7 mm.

CGWB ACTIVITES

A. Systematic Hydrogeological in parts of Mandla district

(1) Reconnaissance Hydrogeological surveys in parts of Narmada Basin, Mandla district (AAP 1972-73) -Sh. M.A.Haseeb Jr.HG
(2) Systematic Hydrogeological surveys in parts of Narmada Basin, Mandla district (64A/4)(AAP 1976-77) -Sh. K.R.Shrinivasan & Shri M.S.Akramula

(3) Reappraisal Hydrogeological Surveys in parts of Narmada Basin, Mandla district (AAP 1988-89) -Sh.A.K.Budhauliya.Jr.HG, Seraj Khan Astt.HG, M.L.Parmar Astt.H.G & Sh.Nandan Barger, Astt.H.G

B. Reappraisal Hydrogeological Surveys (GWMS) of Mandla District

1. Reappraisal Hydrogeological Surveys in parts of Narmada Basin, Mandla district (AAP 1998-99) -Sh.A.K.Jain .Jr.HG
2. District Groundwater development & management studies in parts of Narmada Basin, Mandla district (AAP 2003-04) –(64A4, 8,12 &64B/1,2,3,5,6,7,8,9,10,11) Sh.Devendra Joshi.Astt.HG
3. District Groundwater development & management studies in parts of Narmada Basin, Mandla district (AAP 2004-05) Sh.Devendra Joshi.Astt.HG

C. Ground Water Exploration from 2005 – 2008

D. Source Finding in Problematic villages 1989-90, Sh.A.K.Budhauliya.Jr.HG & Seraj Khan Astt.HG

2.0 GEOLOGY

Geology:

The area is underlain by various geological formations ranging in age from Archaean to recent. The general geological succession occurring in the Mandla region is given in table 1.

Table 1: Geological succession of Mandla region

Formation	Age	Litho- characteristic
Alluvium	Recent	Sand , gravels and clay
Laterite	Pleistocene	Compact, ferruginous and weathered product of Deccan trap
Deccan trap	Cretaceous to Eocene	Basaltic lava flows
Lameta bed	Lr.Cretaceous	Limestone & sandstone
Archean	Precambrian	Granite & Gneiness

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Archean: The oldest rock is the area belongs to the Archean that comprises granite Gneisses and schist. These rocks occur the southwestern part of Mandla area. Granite rock is generally well-jointed and fractured upto depth to 10 to 150 mbgl.

Lameta Bed: This group of rocks is formed of sedimentary laid prior to the eruption of lava flows to the Deccan traps. It is unconformable overlies the granite gneisses and is mainly exposed below Deccan trap in the central and eastern part of Mandla area Its contact with Deccan trap slops from east (510 m amsl) to west (430m amsl). In the eastern part due to step faults this contact goes upto 680 m amsl. These rocks occur as small pockets bordering the great mass of lava flow along its northern boundary. The rocks comprise limestone and sandstone and occur over a area of about 90 sq km. The rock are fine to medium grained and compact in nature and form thickness in the range of 1 to 6 m thickness

Deccan traps: Deccan trap are the most extensive geological formation of the Mandla district. They are differentiated into a succession of basaltic flows as interflow zone of red/green below of varying thickness. The 500 m thick lava sequence of Mandla area has been divided into four formations on the basis of litho characters, type of flow and their long distance continuity. All the formation exhibits thickening in the centre, thinning out in the marginal area.

Characteristic of basaltic flows:

Basaltic lava flows of Narmada basin of Mandla area mainly of two types

1. Simple flow and 2. Compound flow

The simple flows are characterized by 1-7 m thick vesicular and amygdular and 20-70 cm thick lower vesicular zone. The compound flows comprise number of flow unity and show large variation in thickness and aerial extent as well as thinning and pinching units. These units exhibit pahohoe character such as chilled and ropy surface basalt zones of pipe amygdular, vesicle cylinder etc.

Intertrappean Bed: Intertrappean beds mark definite Stratigraphic horizons in the lava sequence and have been used to divide the lava sequence into four formations. Episodic nature of volcanism is also evident from the presence of fairly persistent intertrappean beds these bed form 1-10 thick sedimentary sequence consisting of limestone, chart clay. It is exposed all along the valley of Narmada and Banjar River. Along Chalked to Malpur, Bamhni banjar to Mugdare and exhibit thickening in the centre area. it also shown a gradient of 1:200 toward WSW. the limestone of this bed shows development of nodules at places.

Infratrapean bed: The lava pile is underlain by 2-3 m thick sequence of sedimentary rocks which are fairly persistent as to area and have been correlated with the lameta bed of Jabalpur are it comprise hard sandstone occurs along Ganghi, Chechile along chakar nala near Nainpur.

Structure: The Deccan lava pile of Mandla area is bounded by Narmada - Son lineament to the north and Tapti lineament to the south. The reactivation of these lineaments during upper cetaceans period result into **formation of a rift basin.** The initial volcanism, which follows the deposition of lameta formation, was sub aqueous in nature as evident from the presence of Pillow lava in many parts of the area and gradient of lava pile suggest easterly source.

Intrusive: A few thin ENE-WSW trending basaltic dykes interlude the lava sequence. These dykes are confined to the marginal area along major ENE-WSW trending faults. A porphyritic dyke has been observed is Burner river section Jhingartola in the southern part of area and abets 2-3 km length of dyke in the area below chairaidongri Bamhni

3.0 HYDROGEOLOGY

There are 4 distinct water bearing formation in the area which are as follows :

(i) Alluvium

(ii) Basaltic lava flows (Deccan trap)

(iii)Inter trappean/infra trappean bed

(iv)Granite

The nature and extent of aquifer and its continuity shows wide variation as the formation exhibits four separate episode of tectonic activity with development of fairly persistent intertrapean bed.

Alluvium : Alluvium covers nearly 8 % of the study area along Narmada Bank. The ground water is alluvium generally occurs under unconfined condition at shallow depth (upto 22 mbgl). Alluvium comprises clay, silt and gravel/pebbles and fine to medium grain. Granular zone occurs at 16.0 to 18.0 m bmgl. The nature of gravel and fine sand exhibits its origin from grainitic terrain.

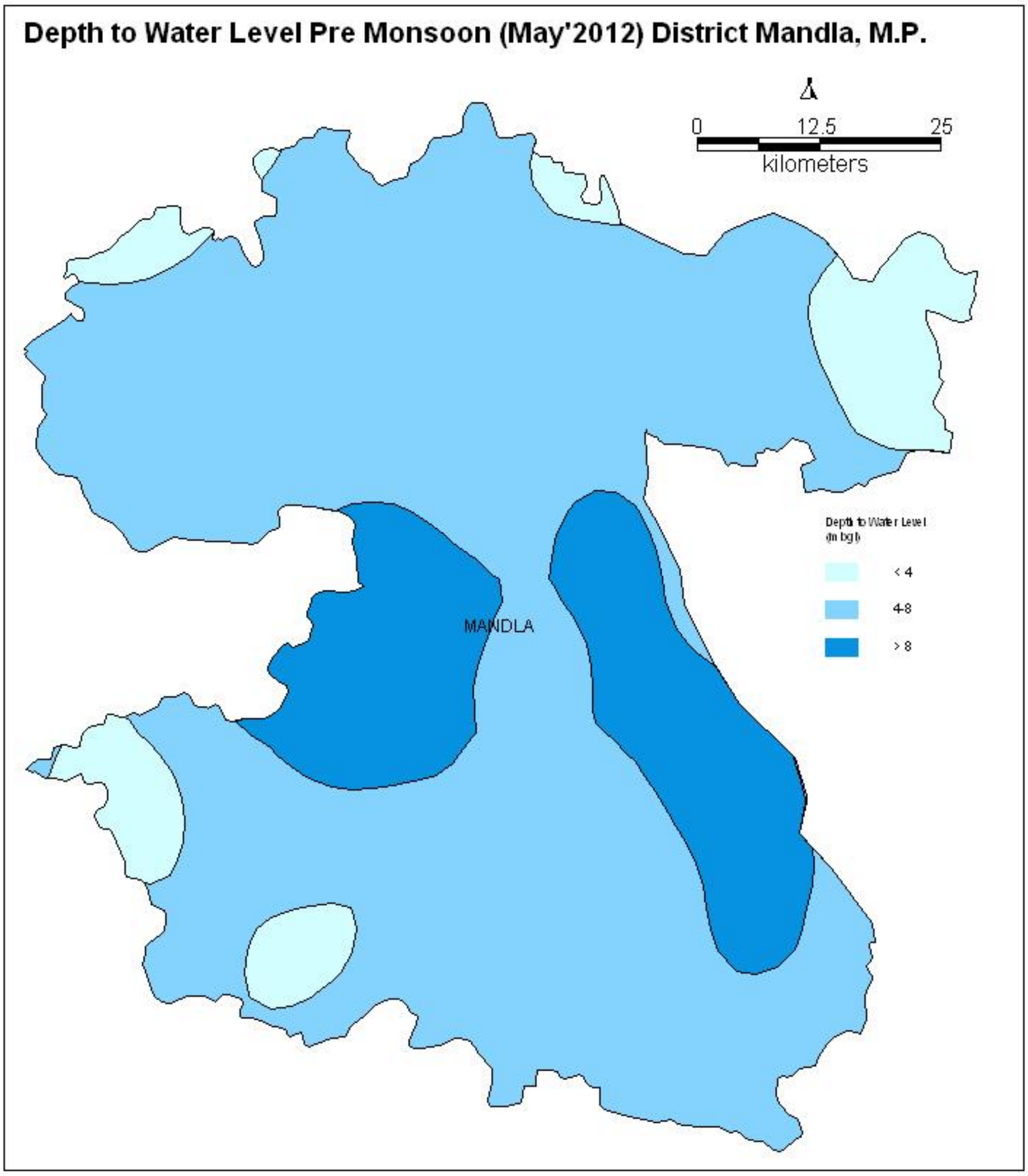
Deccan traps: Basaltic lava flows is the main water bearing formation of the area and covers about 92% of total area. Each individual basaltic flows shows lot of variation in lithological and structure features, which influence occurrence, movement and recharge of ground water in the area. These laterally and vertically variation in characteristic in basaltic flow give rise to varying degree of ground water productivity. Degree of weathering and topographic setting plays major role in respect of productivity of wells. In basaltic ground water occurs in weathered months joints fractured and other similar zone of weakness. The basaltic flow unit shows vertical variability in permeability.The inter flow zone between two basaltic at depth act as conduits for ground water flows. Ground water is basalt occurs under confined to semi confined and unconfined conditions.

3.1 Water Levels

Ground water levels form a very important parameter of the ground water system. The groundwater balance expresses itself in the change in water levels; hence a continuous record is important and useful. CGWB has 27 National Hydrograph Monitoring wells and 2 Peizometers in Shahdol district.

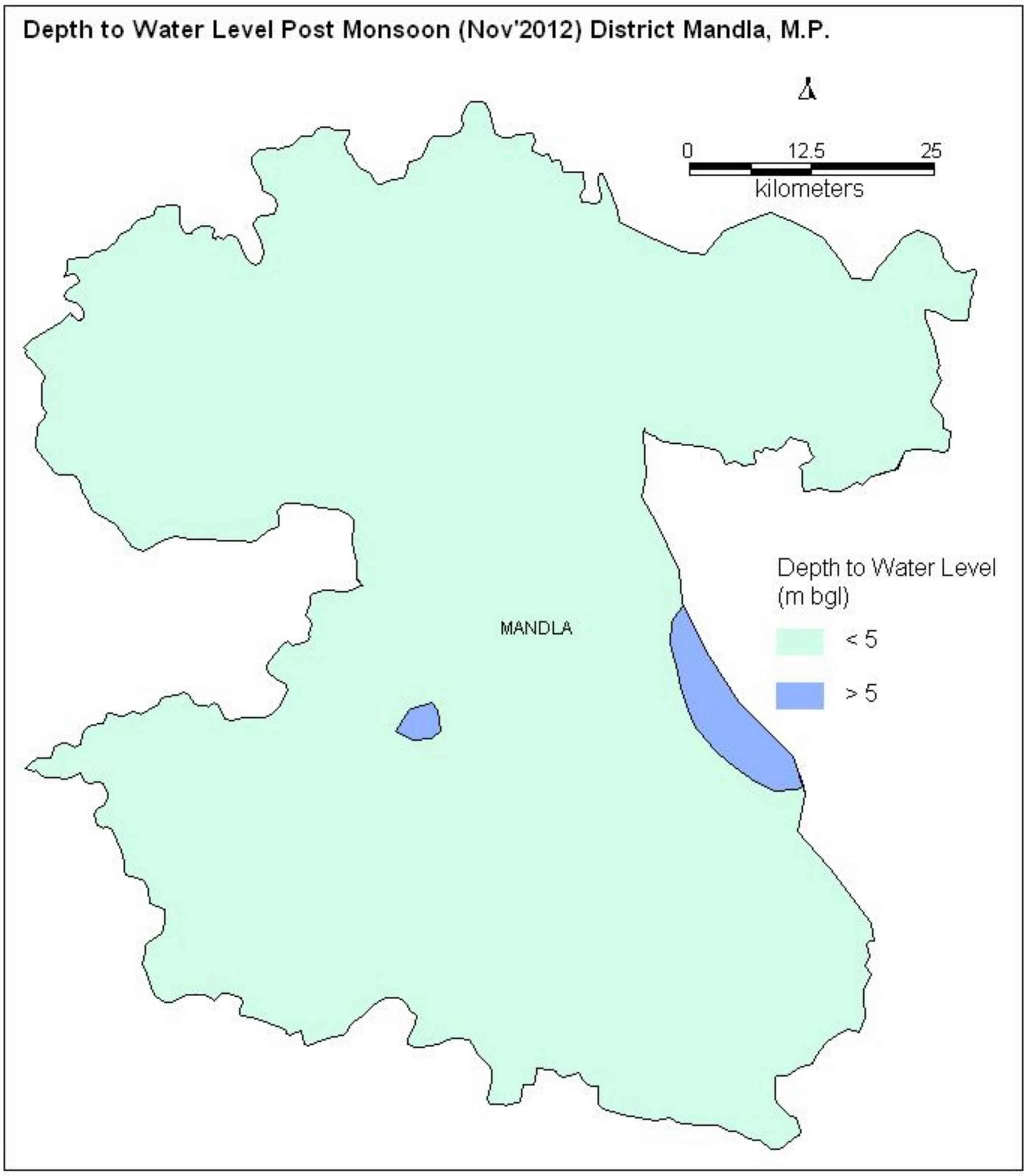
Pre Monsoon Depth to Water Level (May-2012)

In general depth to water level in the area ranges from 1.90 to 10.70 m below ground level. However, in major part the depth to water level is between 4 and 8 mbgl.



Post Monsoon Depth to water level (November-2012)

In general, during post-monsoon period, depth of water levels in the district ranges between 0.10 and 5.05 m below ground level.



Long Term Trend Analysis

To study change in ground water regime of the area during pre and post monsoon periods over 10 years (2003 to 2012), water level data of 27 Hydrograph Monitoring Wells, have been used which indicate declining trend with an average decline of water level from 1.34 cm/year to 13.69 cm/year

3.2 Ground Water Resources

Mandla district is underlain by Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year -2008/09 on block-wise basis. There are nine assessment units (block) in the district which fall under non-command (95 %) and command (5.%- Mandla and Nainpur) sub units. All blocks of the district are categorized as safe blocks, and highest stage of ground water development is computed as 40.3 % for Mohgaon Block. The net ground water availability in the district is 53779 ham and ground water draft for all uses is 8205ham, making Stage of Ground water development 15% as a whole for district. After making allocation for future domestic and industrial supply for next 25 years, balance available ground water for future irrigation would be 44,658 ham at 50 % stage of ground water development's safe limits in the district.

DYNAMIC GROUND WATER RESOURCES (As on March, 2009)

S. No.	Assessment Unit	Sub-unit Command/ Non-Command/	Net Annual Ground water Availability (ham)	Existing Gross Ground water Draft for Irrigation (ham)	Existing Gross Ground water Draft for Domestic & Industrial water Supply (ham)	Existing Gross Ground water Draft for All uses (ham)	Provision for domestic, and industrial requirement supply to next 25 year (2033) (ham)	Net Ground water Availability for future irrigation d development (ham)	Stage of Ground water Development (%)	Category
	Bichhiya	Command								
		Non-Command	9087	1191	332	1523	469	7428	17	Safe
		Block Total	**9087**	**1191**	**332**	**1523**	**469**	**7428**	**17**	Safe
	Bijadnndi	Command								
		Non-Command	5040	166	153	319	215	4660	6	Safe
		Block Total	**5040**	**166**	**153**	**319**	**215**	**4660**	**6**	Safe
	Ghughri	Command								
		Non-Command	6995	170	193	363	278	6547	5	Safe
		Block Total	**6995**	**170**	**193**	**363**	**278**	**6547**	**5**	Safe
	Mandla	Command	1294	63	91	154	145	1086	12	Safe
		Non-Command	4099	733	410	1144	651	2716	28	Safe
		Block Total	**5393**	**797**	**502**	**1298**	**795**	**3802**	**24**	Safe
	Mawai	Command								
		Non-Command	11452	802	194	996	266	10384	9	Safe
		Block Total	**11452**	**802**	**194**	**996**	**266**	**10384**	**9**	Safe
	Mohgaon	Command								
		Non-Command	2562	875	158	1033	217	1471	40	Safe
		Block Total	**2562**	**875**	**158**	**1033**	**217**	**1471**	**40**	Safe
	Nainpur	Command	2749	78	145	224	173	2498	8	Safe
		Non-Command	4033	771	195	966	259	3002	24	Safe
		Block Total	**6782**	**850**	**340**	**1189**	**432**	**5500**	**18**	Safe
	Narayanganj	Command								
		Non-Command	2999	624	169	792	224	2151	26	Safe
		Block Total	**2999**	**624**	**169**	**792**	**224**	**2151**	**26**	Safe
	Niwas	Command								
		Non-Command	3467	543	150	693	209	2716	20	Safe
		Block Total	**3467**	**543**	**150**	**693**	**209**	**2716**	**20**	Safe
		District Total	**53779**	**6016**	**2189**	**8205**	**3104**	**44658**	**15**	

3.2 Hydrochemistry:

The Electrical conductance ranges from 406 to 1780 micro mhos per cm at 25°C. The nitrate ranges from 11 mg/l to 143 mg/l. The concentration of Fluoride is high in parts of the district mainly in Mandla and Ghughri blocks.

4.6 Ground Water Quality

In order of determine the Chemical Quality of ground water to assess the suitability for agriculture and drinking purposes, a total number of 19 water samples from phreatic aquifer were collected .

DISTRICT AT A GLANCE

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BHOPAL

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SHAHDOL DISTRICT PROFILE

S. N.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geogeaphical area	5841Sq. Km
	ii) Administrative Divisions (As on 2013) Number of Tehsils	4 (Beohari, Jaisinghnagar, Sohagpur, Jaitpur)
	Number of Blocks	5 (Beohari, Jaisinghnagar, Sohagpur,Gohparu, Burhar)
	Number of Panchayats	4 Nagar Panchayats (Beohari,Jaisinghnagar, Khand and Burhar) 391 Village Panchayats.
	Number of Villages	852
	iii) Population (As per 2011 census)	10,64,989 persons
	iv) Normal Rainfall (mm)	11.31.4 mm
2.	**GEOMORPHOLOGY**	
	ii) Major Physiographic Units	1. High Lands of Maikal mountain range 2. The Hills of Eastern Plateau, 3. Low Lands of Rivers/ Upper Son Valley
	ii) Major Drainage	Ganga Basin (Son River and its tributaries Tipan, Chandas, Bakan and Banas)
3.	**LAND USE (sq km)**	
	i) Forest area:	2278.85
	ii) Net area sown:	1728.00
	iii) Cultivable area:	2313.00
4.	**MAJOR SOIL TYPES**	
		Clayey loam and sandy loam soil. (Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts as per pedological

		taxonomy)
5.	**AREA UNDER PRINCIPAL CROPS (Sq.Km.)**	
		Paddy (1087), Jowar (22.8), Maize (116.8), Tuar (77.3), Urad (60.33), Soyabeen (16.7), Other Pulses (15.9), Til (54.2), Alsi (33), Wheat (241), Gram (42.5), Mustard (44.34) and Vegetables (17.84)

6.	**IRRIGATION BY DIFFERENT SOURCES**		
		Number of Structures	**Area (sq km)**
	Dugwells	2470	37.98
	Tube wells/Bore wells	513	13
	Tanks/Ponds	457	24
	Canals	76	44
	Other Sources		89.0
	Gross Irrigated Area		208

7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2013)**	
	No. of Dug Wells No. of Piezometers	19 4
8.	PREDOMINANT GEOLOGICAL FORMATIONS	
		Archaean granite gneisses/ quartzite/ schist, Vindhyan Sandstone/Shale, Gondwana Sandstone/Shale, Lameta Sandstone/Limestone, Deccan Trap basaltic lava flows and older dolerite dykes/ sills and Recent laterite and alluvium
9.	HYDROGEOLOGY	
	Major Water Bearing Formations	Gondwana Sandstone , Lametas underlying Deccan Trap
	Pre-monsoon depth to water level (2012) Post-monsoon depth to water level (2012)	3.03 to 13.57 m.bgl 1.66 to 17.86 m.bgl
	Long Term water level trend in 10 years (2003-2012) in m/yr	Rise 0.08 to 0.19 Fall 0.56-0.88 m.bgl
10.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2013)	
	No of wells drilled (EW,OW,PZ,SH, Total)	16EW,07 OW and 4 Pz Total -27
	Depth Range (m)	88.85 to 303 m.bgl
	Discharge (litres per second)	meagre to 10 lps.

11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit (eg EC, F, As,Fe)	EC-175-1440, Nitrate-.1-34, Fluoride – 0.05-0.69 in phreatic aquifer
	Type of Water	Calcium Bicarbonate type
12.	DYNAMIC GROUND WATER RESOURCES (2011) in MCM	
	Net Ground Water Availability	644.69 MCM
	Gross Annual Ground Water Draft	42.33 MCM
	Projected Demand for Domestic and Industrial uses upto 2035	26.79 MCM
	Stage of Ground Water Development	7 %
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes Organised Date Place No. of Participants	Nil
	Water Management Training Programmes Organised Date Place No. of Participants	Nil
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	All blocks are under Safe category
	Number of Critical Blocks	
	Number of Blocks notified	
16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	
		i. Dewatering of Coal Mines leading to decline in groundwater level ii. Under-utilisation of groundwater resources for irrigation

4 INTRODUCTION

Shahdol district is predominantly a tribal district, situated in the eastern part of Madhya Pradesh. Prior to 1998-99, district Umaria and district Anuppur were parts of Shahdol district. A new district Umaria was formed out of district Shahdol, in the year 1998-99 and a new district Anuppur was formed out of district Shahdol in the year 2003. Because of the division of the district on 15-8-2003, the area of the district at present remains 5841Sq. Kms. It is surrounded by Koriya district (Chhatisgarh State) and Sidhi district in the East, Bilaspur district (Chhatisgarh State), Anuppur and Mandla districts in the South, Satna and Sidhi districts in the North and Umaria district in the West. This district is situated between 23°00' N and 24°18'N latitude and 81°00' E to 82°00' E longitude, extending 100 Kms. from East to West and 141 Kms. from North to South. It is covered in Survey of India Degree sheet Nos. 63H and 64E. Shahdol is the district headquarter and Sohagpur, Beohari, and Jaisinghnagar are some of the major towns. Shahdol is located on the Bilaspur-Katni Section of the South-Eastern Railways.The district is divided into four Tehsils and five development Blocks (Plate-I).

Table - 1 : Administrative Divisions, District Shahdol, M.P.

Tehsils	Block	Area Sq.Km.	Municipalities	Nagar Panchayats
Beohari	Beohari	1110	-	Beohari
Jaisinghnagar	Jaisinghnagar	1639	-	Jaisinghnagar
				Khand
Sohagpur	Sohagpur	810	Shahdol	-
	Gohparu	935		
Jaitpur	Burhar	1347	Dhanpuri	Burhar
	District Total	**5841**		

DRAINAGE

The entire district is drained by Son River and its tributaries. Thus the area falls in the Ganga Basin. The river Son flows due north till the northern extent of the district, marking the western boundary of the district Shahdol with Umaria District. Thereafter, the river Son flows due east and marks the northern boundary of Shahdol district with Satna district.The important tributaries of the Son river are the Kunak nadi and the Chuwadi nadi. The river son draining the south eastern parts of the district through its important tributaries like Tipan, Chandas and Bakan flow in the north-west direction with a dendritic pattern, draining the central plains of the district.

Another important tributary of the Son River is the Banas river, flowing along the eastern boundary of the district, marking the boundary of the district Shahdol with Sidhi District. The north-western part of the district is drained by the Banas river and its tributaries namely the Jhanapar river, Kormar nadi, the Rampa nadi, and the Odari Nadi. Banas River confluences with the Son River at the northernmost tip of Shahdol District.

IRRIGATION

Bansagar is a multipurpose river valley project on Son River situated in Ganga Basin in Madhya Pradesh, envisaging both irrigation and hydroelectric power generation. The Bansagar Dam across Son River is constructed at village Deolond in Shahdol district on Rewa – Shahdol road. However, irrigation through this Project will benefit only a small area in the north of the District. Shahdol district still has poor irrigation facility. Only 9% of the total crop gets irrigation facility. Tribals of the district prefer the cultivation in the old traditional method and depend mainly on rain. The area irrigated by canals, tubewells, dugwells and tanks are tabulated below in Table 2.

	IRRIGATION BY DIFFERENT SOURCES		
		Number of Structures	**Area (sq km)**
	Dugwells	2470	37.98
	Tube wells/Bore wells	513	13
	Tanks/Ponds	457	24
	Canals	76	44
	Other Sources		89.0
	Gross Irrigated Area		208

CROPPING PATTERN

District is very backward in the field of agriculture. The size of the fields is very small and the tribals are mainly marginal farmers. The yearly yield of the products from the fields is not enough for their home use. Paddy, Kodo, Kutko and Maize are the crops of the district. Til, Mustard and Groundnut are the main oilseeds produced here. The farmers have started the production of Sunflowers and Soyabean. In the central and southern part of the district, paddy is the main crop grown during Kharif season and in the north-west, wheat is the main crop grown during Rabi season.

CGWB ACTIVITES

Central Ground Water Board has carried out extensive field work in the district of Shahdol to provide scientific base to understand the dynamic system of ground water in the region. Systematic hydrogeological surveys were carried out in the district during the year 1987-88 by Sh. R.N. Sharma and Sh.A.K.Budhauliya, then Junior Hydrogeologists and Sh. A.K.Jain, Sh. M.L.Parmar, Sh. M.V.Gopal and Sh. I.Javid Ali, then Assistant Hydrogeologists.

Detailed hydrogeological work was carried out in the District under Technology Mission Programme for drinking water during the period 1988 to 1991 by Sh. R.N. Sharma, then Junior Hydrogeologist and Sh. I.Javid Ali, Sh. A.Srinivas and Sh. R.M.Verma, then Assistant Hydrogeologists.

Re-appraisal Hydrogeological Surveys of the area was carried out by Shri A.K.Jain, Junior Hydrogeologist during year 1998-99. CGWB had carried out regular Groundwater Exploration in the district during the period 1988-93 and a total of 16exploratory wells were drilled at various places in different geological formations of the district.

5 RAINFALL & CLIMATE

Shahdol district experiences a temperate climate characterized by a hot summer, well-distributed rainfall during the south-west monsoon season and mild winter. The winter season commences from December and lasts till the end of February followed by the summer from March to middle of June. The south-west monsoon or rainy season continues from middle of June to September when south west monsoon is active while October and November months constitute post- monsoon or retreating monsoon season. The climate of Shahdol District, as calculated by Thornthwaite Precipitation Effectiveness Method, is humid climate with forest type vegetation.

The month of May is the hottest month with mean daily maximum temperature at 41.4^0C and mean daily minimum temperature at 26.5^0C. With the onset of south-west monsoon during June, there is an appreciable drop in day temperature, while at the end of the September or in early October, there is slight increase in day temperature but nights become progressively cooler. January is generally the coolest month with the mean daily maximum temperature at 25.6^0C and the mean daily minimum temperature at 8.4^0C. The average daily maximum temperature is about 41.4^0C and minimum temperature is about 26.5^0C. During the southwest monsoon season the relative humidity generally exceeds 88% (August month). In rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 38%. April is the driest month of the year. The wind velocity is higher during the pre-monsoon period as compared to post monsoon period. The maximum wind velocity of 6.8 km/hr is observed during the month of June and minimum 2.3 km/hr during the month of December. The average normal annual wind velocity of Shahdol district is 4.3 km/hr.

The normal rainfall of Shahdol district is 1131.4 mm .

As per rainfall statistics, frequency of occurrence of Normal drought in the area is 25 % and that of Mild drought is also 25 % while occurence of severe droughts in the area is only 5 % i.e. on an average there is a possibility of occurrence of a normal or mild drought once in every seven years, while that of severe draughts is once in every 20 years. The area does not experience any most severe drought.

5.1 GENERAL GEOLOGICAL FEATURES

3.1 General Geological Succession

The stratigraphic sequence of various geological units with their respective rock types are described below.

AGE	LITHOSTRATIGRAPHIC UNIT	LITHOLOGY
Recent to sub recent	Alluvium, Laterite	Sandy loam, silty sand, coarse medium laterite
Cretaceous to Eocene	Deccan Trap	Basaltic lava flows and older dolerite dykes and sills.
Upper Cretaceous	Lameta	Sandstone, siliceous limestone, marl and Shales.
Lower Cretaceous	Chandia (Gondwana Supergroup)	White clays and medium grained sandstone
Late Norian to Rhaetic	Parsora (Gondwana Supergroup)	Coarse-grained sandstone variegated shale and lilac coloured clays.
Upper Permain to Larnic	Tihki Pali (Gondwana Supergroup)	Coarse grained sandstone grey shale, red shale, red green and mottled clay with thin coal bands
Late Permain	Barakar	Sand stone, Shales and Coal seams
Upper Carboniferous to Lower Permain	Talchir	Tillite, sandstone and green shale
Pre - Cambrian	Lower Vindhyan (Semri series)	Porcellanite shales sandstone basal conglomerates
	Bijawar	Quartzes, Gneisses
Algonkian	Archaean	Granite, Gneisses, Schists etc.

3.2 Geomorphology And Soil Types

The District is located in the north-eastern part of the Deccan Plateau. It lies at the trijunction of Maikal Ranges of the Satpura Mountain, the foot of the Kaimur Range of the Vindhyan Mountain. In between these hill ranges lies the narrow valley of the Son and its tributaries.

Physiographically, structural landforms, represented by plateau and low lying plains with average altitude of 450m to 500m above MSL, are developed in northern, northeastern and northwestern and central parts of the district. In the southern part of the District, hills and highlands of Maikal Range and high to medium level (500m to 990m) plateau and flat topped, step like terraces are developed. Fluvial Land Forms represented by flood plains are present along the western boundary of the district. The maximum elevation of the area is 1123m above mean sea level at Singingarh Hill (23°03'40" : 81°27'37") in Satpura hills, in southern part of the district.

Soil

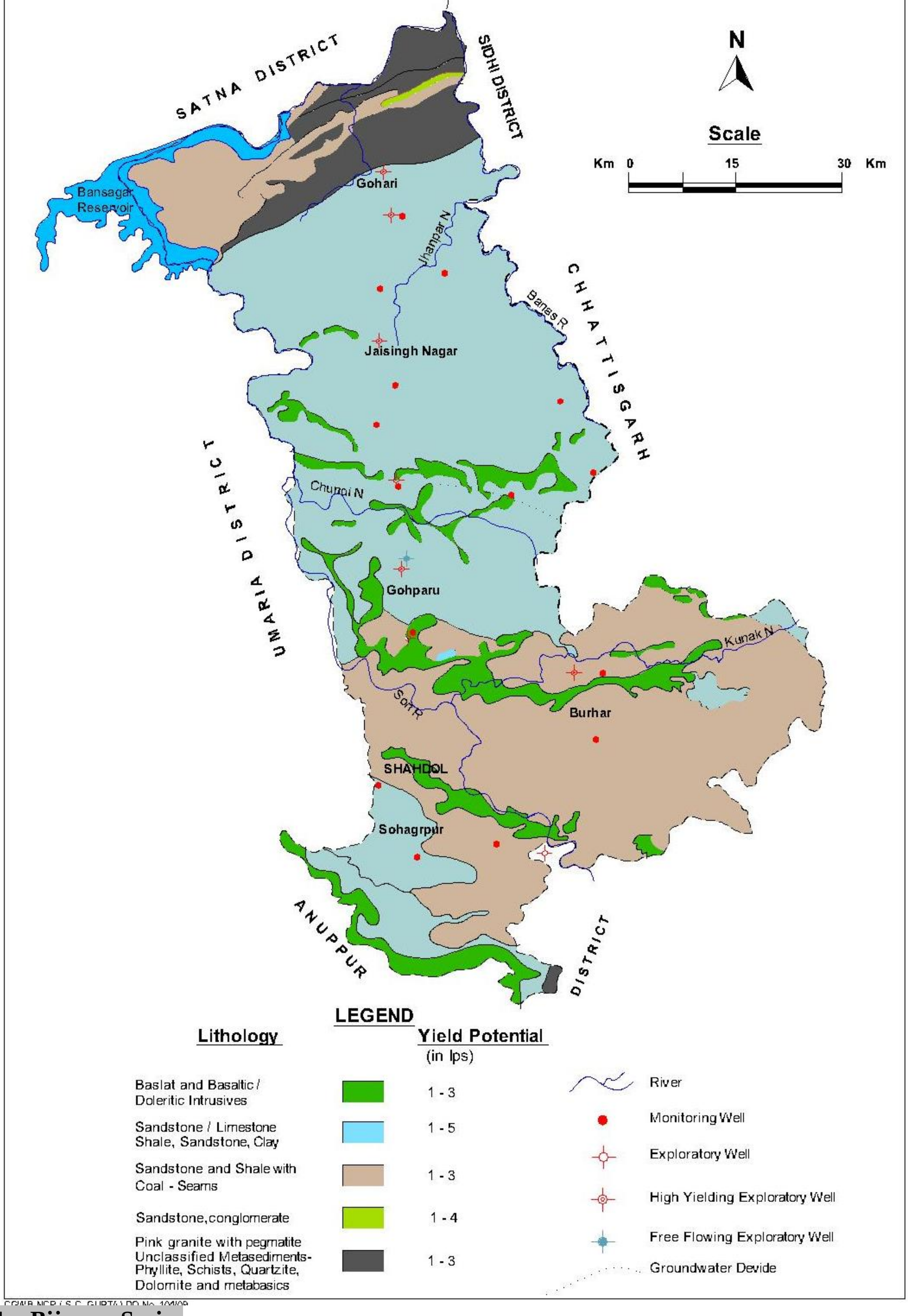
The soils in the area are generally of clayey loam types with sandy loam soil in some areas. In the northern and central parts of the District, the undulating plateau with mounds are covered with slightly deep soil, well drained, fine to fine loamy soils on gentle slopes marked by moderate erosion. The southern hilly region is covered by very shallow loamy soils, some what excessively drained. The soils developed on moderately steep slopes are marked by severe erosion. The soils have been classified as Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts, as per pedological taxonomy.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology, Aquifer System And Aquifer Parameters

The water bearing properties of different hydrogeological units occurring in Shahdol District are described below. Hydrogeology of the district is shown in Fig-2.

Fig. 2 : Hydrogeology, Shahdol District (M.P.)



4.1.1 Bijawar Series

This consists of Quartzites, Gneisses and Schists, which are moderately weathered and jointed. Weathering in quatrizites has gone as high as 10 m. These rocks out crop in the area of Beohari block. Groundwater occurs in the secondary porosity, developed in the weathered, sheared, fractured portion of these rocks. The dug wells yield as high as 40,000 litres per day to as low as 400 litres per day. The wells dry up in summer. The premonsoon water level in wells go as deep as 12m and rise up during post monsoon to as high as 1.60m bgl.

4.1.2 Lower Vindhyan

Semri series of rocks represent Lower Vindhyans in the district. They also support development of ground water through open wells. Porcellanite shales layer and its stratification allow some percentage of water to percolate downward and move along the planes of bedding and water gets pooled up in weathered zones/disintegrated crushed zones, along the contact planes. Semi weathered yellowish shale from undulating topography. The Vindhyans have also developed aquifer with the groundwater flow gradient of 1 in 200 in the NE direction, almost in the dip direction of the shales (600N).

The dugwells in Vindhyans aquifer vary in depth range from 16.6-20mbgl. The depth to water level in the wells during pre monsoon ranges between 4.80 to 15m bgl.

4.1.3 Gondwanas

The Gondwana group of rocks, that bears the coal deposit, is also a fine groundwater repository in this district. The felspathic medium to coarse grained sandstone, bears groundwater in the interconnected primary pores is the formation as well as the contact planes between shales and sandstone. Groundwater is also mined out along with the coal in almost all the coal fields of the district. Groundwater occurs in both unconfined conditions in the Gondwana formations of the district.

Due to excessive pumpage of groundwater from the underneath coal mines, there has been excessive lowering of water levels in the phreatic groundwater regime overlying the coal field areas. Gondwana formation particularly the upper part of the Barakar sandstone supports development of phreatic aquifers which extends from few meters below ground level to 25 m below land surface.

The fluctuation of groundwater level is between 3-5m.

4.1.4 Lametas

These are sedimentary deposits resting over Gondwana formations (some times resting over the Granites directly). Generally, these are compact and impervious rocks (siliceous limestone). However, at places the nodular limestone and poorly consolidated sandstone have allowed the development of ground water in confined and unconfined system.

Since the Lametas are generally thickly forested, population and habitation is been rather sparse. However, there are quite a few number of dug wells that are used for drinking purpose by the tribal population. It is found that about 80% of the dug wells are within the depth range of 8 m to 16 m bgl. with a diameter of 3-4 m. The pre -monsoon depth of water level goes as deep as 17m to 20 m and rise up to as high as 12-16 m . The yield of the well is between 50,000 litres per day to 75,000 litrer per day.

4.1.5 Deccan Traps

Many basaltic / doleritic dykes and sills (equivalent to Deccan Traps) cut across Gondwana and Lameta formations. These dykes and sills are spread near the surface or spread over the paleo-topography surface in limited area as basaltic flows and form hills wherever exposed. These are weathered, vesicular, jointed and fractured similar to Deccan Trap basalts without the layering feature of basaltic flows. These exhibit scope of groundwater development because of the development of secondary porosity. The yield is limited and vary according to the degree of weathering, weathered mantle, presence of fractures and joints etc. However, on drilling a borehole piercing the thin dolerite/ basalt near the base of these hills (dyke/ sills), where the dolerite/ basalt flow pinches, good yields are obtained from the underlying Gondwana and Lameta formations.

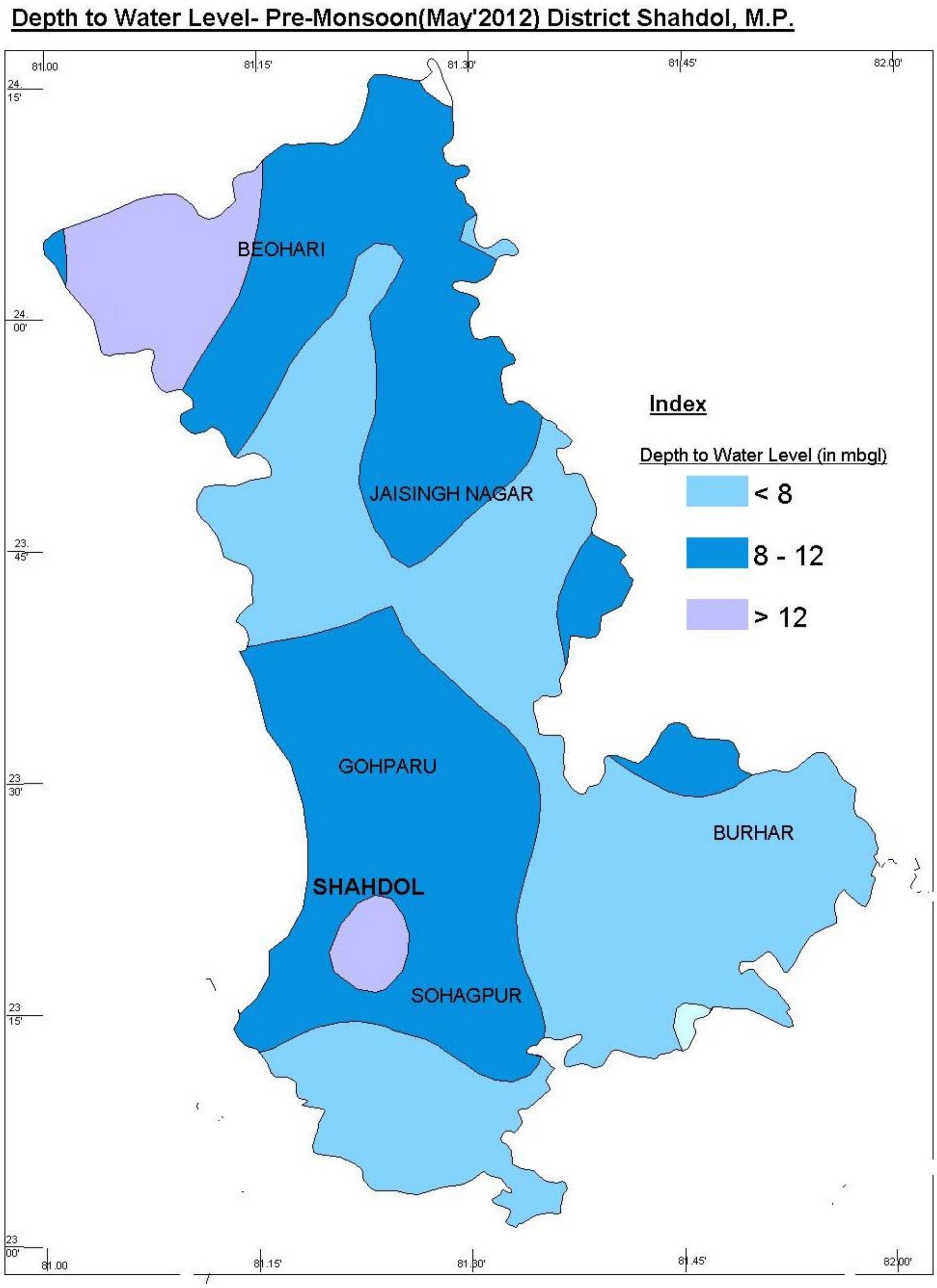
The wells in the basaltic flows of Deccan Traps vary in depth between the range of 6-9 m bgl. With a diameter of 2m to 3m . The wells go dry during summer. The yield varies between post monsoon and premonsoon from 1,30.000 litres per day to 70,000 litres per day.

4.2 Water Levels

Ground water levels form a very important parameter of the ground water system. The groundwater balance expresses itself in the change in water levels; hence a continuous record is important and useful. CGWB has 19 National Hydrograph Monitoring wells and 4 Peizometers in Shahdol district.

Pre Monsoon Depth to Water Level (May-2012)

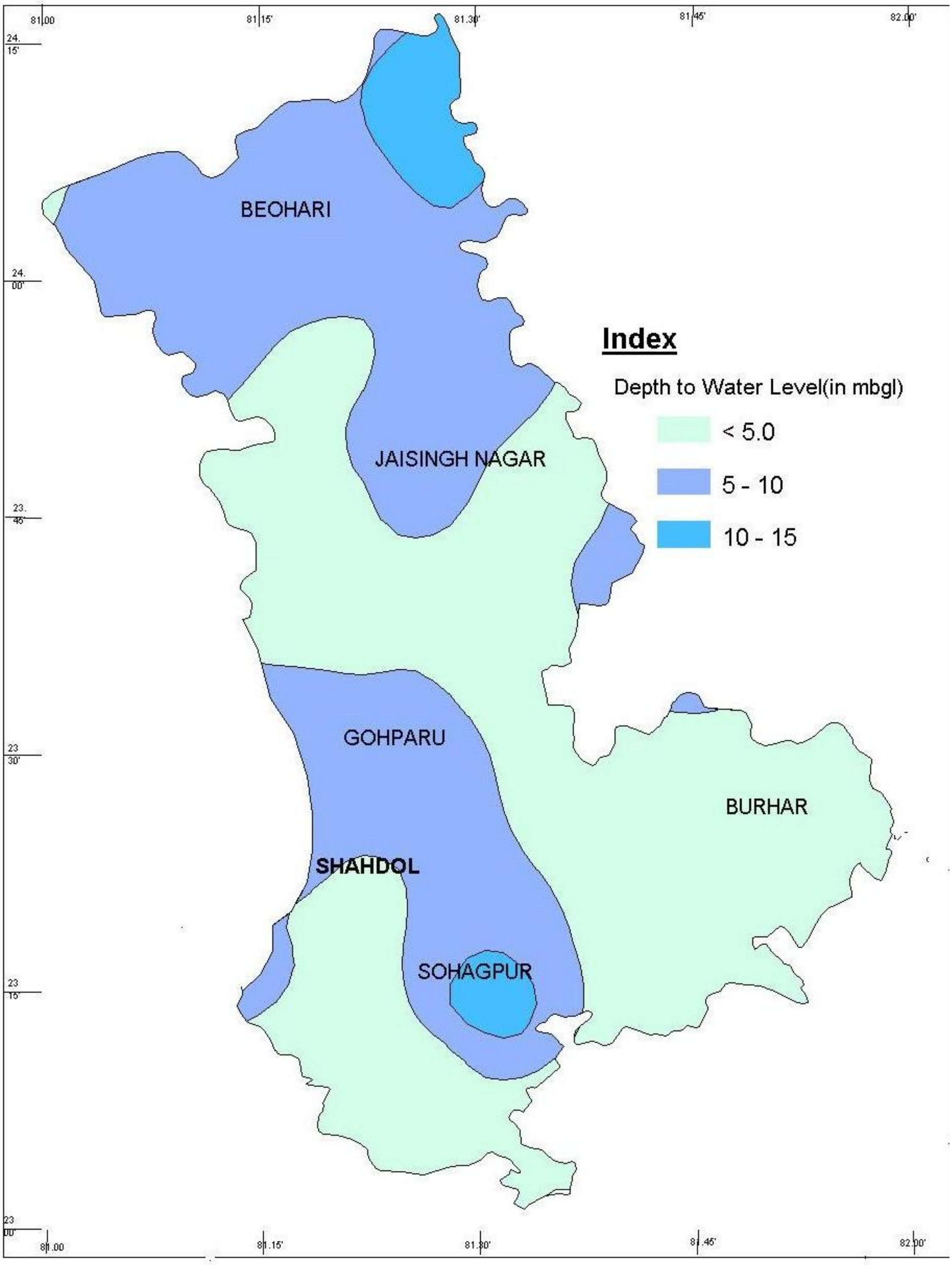
In general depth to water level in the area ranges from 3.03 to 13.75 m below ground level. Shallow water level of less than 8 m has been recorded in the north-central& south-eastern part of the district. Depth to water level between 8to 12 m bgl. is occurring in northern &western part of the district. Depth to water level >12 m. bgl. is recorded in isolated patches in north-western part of the district.



Post Monsoon Depth to water level (November-2012)

In general, during post-monsoon period, depth of water levels in the district ranges between 1.66 and 17.86 m below ground level. Shallow water level of less than 5 m is occurring in major part of the district. Depth to water level between 5 to 10m bgl. is observed in northern & south- westrern part of the district. Depth to water level between 10-15 m. bgl. is recorded in isolated patches in north-eastern& southern part of the district.

Depth to Water Level Post - Monsoon(Nov' 2012) District Shahdol, M.P.



4.3 Change in Ground Water Levels

Long Term Trend Analysis

To study change in ground water regime of the area during pre and post monsoon periods over 10 years (2003 to 2012), water level data of 18 Hydrograph Monitoring Wells, have been used which indicate rising trend with an average rise of water level from 0.08 m/year to 0.19m/year& the rate of decline ranges from 0.56 m/year to 0.88m/year.

Long term decline in water levels is perhaps due to increased dependency on ground water resources for various uses and continuous withdrawal of it at various places.

4.4 Ground Water Exploration

Groundwater Exploration through deep drilling was carried out by deploying four direct rotary rigs to drill through semi consolidated Gondwana sediments. Central Ground Water Board carried out exploratory drilling programme in the area between 1990 and 1994 and during this period 16 exploratory wells and 7 observation wells were constructed. 4 number of piezometers were drilled in Shahdol district under Hydrology Project for water level monitoring purpose. The details of piezometers are given in table 4.

Exploration revealed occurrence of potential aquifer within Lameta formation.The Gondwana formations – the clay and mudstone facies of Tihiki stage overlying the arenaceous facies of Pali beds have an aquifer system of moderate to high yield potential in Beohari Block. The yields range from 6 to 10 lps with average drowdown of 12 to 15 m over static water level (which vary from 6 to 7.5 m.bgl). However exploratory well at Bhejari site was abandoned due to insignificant yield. The Upper Barakar Sandstone of Gondwana Super Group has a positive piezometric head and at many places, auto-flowing condition occur, e.g. in Churmura (Shallow), Churmura (Deep) and Gohparu exploratory tubewells.

The Upper Barakar Sandstone are devoid of coal seams while Middle and Lower Barakars have a number of coal seams occuring at different depths, from surface exposures to 150 m.bgl. The well at Gohparu was auto flowing, but its yield was meagre. Well at Churmura confirmed a three aquifer system, out of the middle aquifer (80 – 160 m.bgl) and third aquifer (deeper 210 – 240 mbgl) showed auto-flowing condition with piezometric head of 3.3 m agl and 5 m agl respectively with free flow discharge of 3 lps. At Bijha site, very shallow water level of 0.19 m bgl was recorded with a discharge of 3.4 lps.

Table 5. : Hydrogeological Details of Piezometers drilled in Shahdol district.

S.N	Name of site	Depth (m)	Aquifer zones	SWL mbmp	Yield (lpm)	E.C. (µS/cm)	Aquifer
1	Burhar-D 23°13'30" 81°31'28"	58.15	12.6-17.8 50.0-52.0	22.0	4.2	365	Barakar Sandstone
2	Burhar-S 23°13'30" 81°31'28	30.69	12.6-17.8	9.8	4.2	570	Barakar Sandstone
3	Jaisinghnagar-D 23°40'42" 81°23'48"	46.48	32.0-35.0	1.58	1.25	166	Upper Gondwana Sandstone
4	Shahdol-D 23°17'55" 81°21'35"	61.77	37.5-38.5 46.0-50.1	9.75	0.5	466	Gondwana Sandstone

4.5 Ground Water Resources

The groundwater resources of the District are under-developed and under-utilised. 513 tubewells and 2470dugwells facilitate to irrigate an area of 50.98 sq.km. of agricultural land as against 2714.12 sq.km cultivable area and 2313 sq.km of net sown area in the district. The net groundwater availability of the district is 644.69 MCM while gross annual groundwater draft in the district is only 42.33 MCM. The stage of ground water development of the district is only 7%. Shahdol comes under safe category from ground water development point of view.

Net Groundwater Availability for future irrigation development is 568.82 MCM. There is ample scope for development of groundwater for irrigation, industrial and domestic purposes.

Block wise ground water resources are given in Table-5

Table 5: Ground Water Resources of Shahdol district, M.P as on march- 2011.

Assessment Unit/ District	Command/ non-Command/ Block Total	Net Annual Ground water Availability (%)	Existing Gross Ground water Draft for Irrigation	Existing Gross Ground water Draft for Domestic & Industrial water Supply	Existing Gross Ground water Draft for All uses	Allocation for domestic & industrial requirement supply upto next 25 years (2035)	Net Ground water Availability for future irrigation	Stage of Ground water Development
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Sohagpur	Command	0	0	0	0	0	0	0
	Non-Command	80.17	4.32	5.74	10.06	15.03	60.81	13
	Total	**80.17**	**4.32**	**5.74**	**10.06**	**15.03**	**60.81**	**13**
Jaisingh nagar	Command	0	0	0	0	0	0	0
	Non-Command	191.53	8.46	4.12	12.58	12.28	170.79	7
	Total	**191.53**	**8.46**	**4.12**	**12.58**	**12.28**	**170.79**	**7**
Beohari	Command	0	0	0	0	0	0	0
	Non-Command	85.90	7.94	3.90	11.85	10.44	67.52	14
	Total	**85.90**	**7.94**	**3.90**	**11.85**	**10.44**	**67.52**	**14**
Burhar	Command	0	0	0	0	0	0	0
	Non-Command	165.76	1.18	3.10	4.28	7.88	156.70	3
	Total	**165.76**	**1.18**	**3.10**	**4.28**	**7.88**	**156.70**	**3**
Gohparu	Command	0	0	0	0	0	0	0
	Non-Command	121.34	1.14	2.41	3.55	7.20	113.00	3
	Total	**121.34**	**1.14**	**2.41**	**3.55**	**7.20**	**113.00**	**3**
	District Total	**644.69**	**23.05**	**19.28**	**42.33**	**52.82**	**568.82**	**7**

4.7 Ground Water Quality

In order of determine the Chemical Quality of ground water to assess the suitability for agriculture and drinking purposes, a total number of 19 water samples from phreatic aquifer were collected .

Quality of Ground Water for Drinking Purpose

The quality of ground water in district is being assessed by the analysis of groundwater samples from 19 number of hydrograph stations collected during May,2011 .The analysis of water samples for year 2011 indicate that The electrical conductivity (EC) values indicative of total dissolved solids in groundwater were found to be in the range of 175and 1440 µs/cm at 25^0C.

Temporary Hardness of water can be removed by boiling. However, shallow ground water is vulnerable to contamination from different sources. Nitrate concentration ranges between to 34ppm.The study of analyzed data shows that Shahdol district does not have any problem of fluoride since all the wells have fluoride less than 1.5 ppm of BIS (1990) permissible limit and ranges between 0.05-0.69ppm. In general, groundwater in phreatic aquifer is fresh and fall in classification of good category for drinking purpose.

Quality of Ground Water for Irrigation Purposes

The chemical quality of groundwater is an important factor to be considered in evaluating its suitability for irrigation purpose. The parameters such as EC, Sodium Absorption Ratio (SAR), percent sodium (% Na) and Residual Sodium Carbonate (RSC) are used to classify the water quality for irrigation purpose. US Salinity Laboratory suggested a diagram of classifying waters for irrigation purposes in 1954. It is clear that more than 82% groundwater samples from the district fall under C_2-S_1 class (medium salinity and low sodium) which means that these waters can be used for all type of crops on soils of low to high permeability, without causing problem of salinity. The groundwaters representing the wells of Singhpur, Gohparu and Beohari are grouped under C_3-S_1 (high salinity and low sodium) class, indicating that groundwater from these areas can be used for irrigation purposes on well drained soils or used for salt tolerant crops like groundnut, safflower etc.

5.0 GROUND WATER MANAGEMENT STRATEGY

Shahdol district has been identified as drought prone area. Drought has been recognised as a hydrological phenomena which occurs in certain frequency of incidence and cause misery and economic crises practically every alternate third year. Therefore, a scientific study of its cause and effects and pooling these experiences for the most optimum utilisation of the limited water resources should be the first task of the district’s development authorities. Groundwater development and management is an important measure for drought mitigation.

5.1 Ground Water Development for Rural Water Supply

Practically, the entire district of Shahdol has been suffering from the problem of drinking water. The problems get more pronounced during the year of deficient rainfall. Though the State Public Heath Engineering Department with its division at Shahdol, which is entrusted the task of providing drinking water supply to urban and rural population, has made considerable progress in providing drinking water facilities in problem villages under accelerated Rural water supply Scheme, much work is to be done through concrete and concerned plan of action to tackle the problem on short term and long term. Water is being supplied through dugwells, tubewells, hand pumps. At places mine discharge water and water from surface water sources is also being supplied. Detailed hydrogeoligical surveys for proper source of drinking water supply is to be investigated in villages which have no source of drinking water, in villages where tube wells failed and villages where yield dwindle in the summer affected due to coal mining activities and villages where piped water supply schemes are to be strengthened and in villages which are partially covered.

5.2 Problem related with Deforestation and Soil Erosion

Due to improper and unscientific management as well as exploitation of forest to yield high revenue, there has been a regular degradation in forest quality and its coverage during the pre independence period. Deforestation has been also caused by large scale mining of coal through open cast system and rehabilitation and construction of residential colony surrounding mine area.

In Shahdol district there has been tremendous depletion of the forest cover in the recent past due to heavy human interference. After Independence, survey and demarcation was carried out but the ecological degradation could not be controlled due to natural influence of unfavorable geological formation and human interference. Poverty and ignorance of local Adivasis, regular fire incidence and periodical droughts have also contributed to devastation of vegetation resulting in retrogression of forest. Regression in ecology and degradation in vegetation cover has done a great damage to soil and moisture conservation in the district, there is an urgent need to reverse this process by a proper a forestation program with latest management technique and innovations.

Soil erosion in general occurs when rains are heavy and flow of water through the field occurs with high velocity . This erosion by water is accelerated due to defective method of cultivation, burning or destruction of forest for shift cultivation, excessive grazing by animals, inadequate precipitation etc. As a result. Vegetation cover is reduced and soils are exposed to erosion. Thereby fissures and gullies are formed within cultivated areas through which rain water flows and carries away the fertile soil. There is thus a need for a scientific approach for implementing soil conservation measures. To begin with the task of reviving unproductive land into productive land, proper and improved technology of plantation vis-a-vis protection of land against varieties of erosion can lead to a successful programme of afforestation in this district. Vast tract of waste land needs reclamation. The moisture retention capacity of the degraded land has to be restored by suitable engineering skill and schemes. Groundwater development plays an important role in forest development

5.2.1 Problems related with the Dewatering of Phreatic Aquifer Due to Mining of Coal

Sohagpur coal field is the main coal mining area of the district. There are 71 village which fall in the various coal fields of the district. These are identified for the problem of depletion in the general water table and decline in the tube well discharge. Gondwana formation particularly the upper part of Barakar Sandstone support development of phreatic aquifers which extends from few metres below ground level to 25 m below land surface. Underground and opencast excavations behave as large sinks and create hydraulic gradient towards the mine. Mine water is pumped out for trouble free mining operations. Continuous withdrawal of water from Coal mines for their mining activities is causing adverse impact on ground water regime of the area which ultimately results in declining water levels, drying up of wells, dwindling of their discharge and some times land subsidence. As per Central Mine and Design Institute, Bilaspur, in Sohagpur Coalfield area daily 29,890 cubic metre water is being pumped for trouble free mining operations. Out of 29,890 cubic metre water per day, 9,869 cubic metre is used for domestic water supply, 2,667 cubic metre is used for mine industry and balance 21,223 cubic metre water per day goes as discharge runoff. These figures indicate that such a huge quantity of important ground water resource go as waste.

Strict water management practices should be adopted for the coal-mining belt. Abandoned mines can be treated as a big rainwater harvesting and artificial recharge structure. Hence, priority needs to be given for mine water harvesting and sustainable development. In post-mining, the abandoned mine voids should be backfilled to serve as huge groundwater reservoirs and recharge structures. In open cast mines, the permeability of the reclaimed area is usually higher than the in-situ and allows to infiltrate up to 40% of rainfall. These areas can be the major water pockets for future development. Thus, with proper water management, by mining out one resource 'Coal', another valuable resource 'Water' may be generated. Coal mining can an eco-friendly engineering activity by adopting groundwater resource management.

6.0 RECOMMENDATIONS

Based on the hydrogeological studies the following recommendations are made for proper development and utilization of the available groundwater resources and management of ground water resources.

Shahdol comes under safe category from ground water development point of view. Net Groundwater Availability for future irrigation development is 64469 ham. There is ample scope for development of groundwater for irrigation, industrial and domestic purposes.

Groundwater development should be carried out in the district in a planned manner for agricultural development, industries and afforestation. Groundwater development and management is also an important measure for drought mitigation.

Detailed hydrogeoligical surveys for proper source of drinking water supply is to be investigated in villages which have no source of drinking water, in villages where tube wells failed and villages where yield dwindles in the summer as also in villages affected due to coal mining activities and villages where piped water supply schemes are to be strengthened and in villages which are partially covered.

The areas, where tubewells are to be constructed, should be geophysically surveyed since there recommendations are based on the hydrogeological surveys on regional scale and furnished a broader picture of hydrogeological conditions in the district.

These areas are recommended for dugwells having depth of 12-15 mbgl and 8-10 m diameter. Horizontal boring is recommended in the dugwells constructed in valley portions to enhance the yields of the wells.

In some watershed areas, where deforestation has occurred and soils are exposed to erosion, watershed management may be adopted by constructing gully plugs, contour bunding and artificial recharge structures after detailed micro level surveys, to increase retention of soil moisture, stop soil erosion and increase the ground water potential. Stop dams are recommended across the streams sections near villages, so that the stored water can be used for domestic purposes in the tribal pockets.

Strict water management practices should be adopted for the coal-mining belt. Mines can be treated as a big rainwater harvesting and artificial recharge structure. Hence, priority needs to be given for mine water harvesting and sustainable development.

In post-mining, the abandoned mine voids should be backfilled to serve as huge groundwater reservoirs and recharge structures.

In open cast mines, the permeability of the reclaimed area is usually higher than the in-situ formations and allows infiltration up to 40% of rainfall. These areas can be the major water pockets for future development. Thus, with proper water management, by mining out one resource ‘Coal’, another valuable resource ‘Water’ may be generated.

Coal mining can an eco-friendly engineering activity by adopting groundwater resource management.