

DISTRICT GROUND WATER INFORMATION BOOKLET



HOSHANGABAD DISTRICT MADHYA PRADESH



Ministry of Water Resources
Central Ground Water Board
North Central Region
Government of India

2013

HOSHANGABAD DISTRICT AT A GLANCE

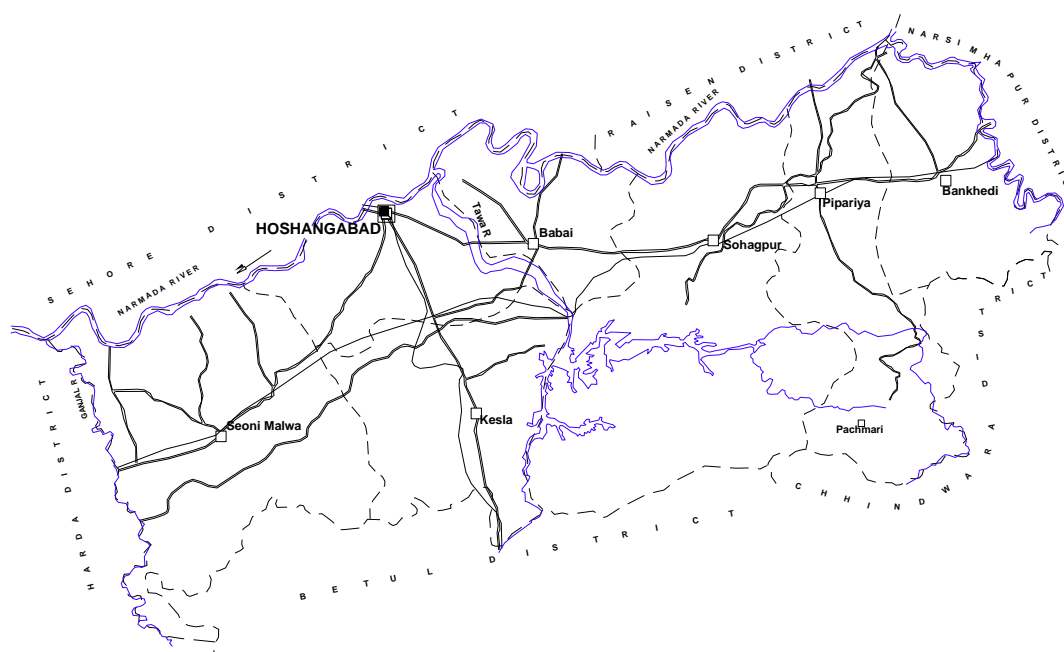
S. No.	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i) Geographical area	6704 Sq.Km.
	ii) Administrative Divisions (As on 2013) Number of Tehsils	8 (Babai, Bankhedi, Hoshangabad, Itarsi, Pipria, Seonimalwa, Dolaria and Sohagpur)
	Number of Blocks	7 (Babai, Bankhedi, Hoshangabad, Kesla, Pipria, Seonimalwa and Sohagpur)
	Number of Panchayats	391 Village Panchayats, 07 Block Panchayats and 14 Revenue Zonal Panchayats.
	Number of Villages	975
	iii) Population (As per 2011 census)	1,240,975
	iv) Normal Rainfall (mm)	1225.9 mm
2.	GEOMORPHOLOGY	
	i) Major Physiographic Units	(1) Satpura range in the south, (2) Alluvial plain in the middle and (3) Badland topography zone confined to the vicinity of Narmada river
	ii) Major Drainage	Narmada river and its tributaries, namely, Tawa river, Denwa river, Morand river, Banjal river, Ajnal river, Ganjal river and Keolari, Hather and Indra Nadi.
3.	LAND USE (Sq. Km.)	
	i) Forest area:	2561
	ii) Net area sown:	3009
	iii) Cultivable area:	3150
4.	MAJOR SOIL TYPES	
	Soil Type	Black soils and ferruginous red lateritic soils, Sandy clay loam, sandy loam and clay loam (area lying west of Ganjal river).
	Taxonomy	(Ustocherpts/ Ustorthents/ Haplustalfs/Haplusterts as per pedological taxonomy)

5.	PRINCIPAL CROPS		
		1.Wheat	
		2.Soyabean	
		3.Gram	
		4.Paddy	
		5.Tuar	
6.	IRRIGATION BY DIFFERENT SOURCES		
		Number	Area (Sq. Km.)
	Dugwells	23495	535
	Tube wells/Bore wells	4853	523
	Tanks/Ponds	9	11
	Canals (Tawa Canal Command)	6	1474
	Other Sources		163
	Net Irrigated Area		2703
7.	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2013)		
	No. of Dug Wells	18	
	No. of Piezometers	1	
8	PREDOMINANT GEOLOGICAL FORMATIONS		
		Alluvium and Soil Cap, older alluvium & laterite; Basaltic lava flows, dykes, sills & intertrapean beds;	
		Gondwanas (Sandstones, arenaceous mudstones, clays/shales, sandstones, Bagra conglomerates, Talchir Boulder bed, limestones and marls);	
		Vindhyan (Lower Bhandar) sandstones & quartzites, Archaean Granite, gneiss etc.	
9	HYDROGEOLOGY		
	Major Water Bearing Formation	Alluvium	
	Pre-monsoon depth to water level during 2012	4.14 to 17.50 m.bgl	
	Post-monsoon depth to water level during 2012	1.24 to 13.47 m.bgl	
	Long Term water level trend in 10 years (2003-2012) in m/yr	Rise 0.2 to 0.22 (Pre-monsoon)	
		Fall 0.06 to 0.13 (Pre-monsoon)	

10.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2013)	
	No of wells drilled (EW,OW,PZ,SH, Total)	EW 87and OW 43 Pz 4 , SH 1
	Depth Range (m)	24.23 to 330.31 m.bgl
	Discharge (litres per second)	10 to 55 lps.
	Storativity (S)	1.95×10^{-4} to 1.83×10^{-2}
	Transmissivity (m^2 /day)	50.8 to 5.1×10^3
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit (eg EC, F, As, Fe)	High Nitrate (> 45 mg/l) recorded EC: 440-2710 NO ₃ : 1.3-122 F: 0.11-1
	Type of Water	Calcium Bicarbonate type
12	DYNAMIC GROUND WATER RESOURCES (2009) in MCM	
	Annual Replenishable Ground Water Resources	2018.88 MCM
	Net Annual Ground Water Draft	356.17 MCM
	Projected Demand for Domestic and Industrial uses upto 2025	41.76 MCM
	Stage of Ground Water Development	19 %
13.	AWARENESS AND TRAINING ACTIVITY	
	Water Management Training Programmes Organised	One
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
	Number of Critical Blocks	Nil
	Number of Blocks notified	Nil

1.0 INTRODUCTION

Hoshangabad district has predominantly an agricultural based economy. It is situated in the eastern part of Madhya Pradesh. Prior to 1998-99 District Harda was a part of Hoshangabad District. After the division of the district, the present area of the district is 6704 Sq. Km. It is surrounded by Sehore and Raisen districts in the North, Narsinghpur district in the east, Chhindwara district in the south west, Betul district in the south and Harda district in the west. Hoshangabad district lies between north latitudes 22° 15' and 23° 00' and east longitudes 77° 15' and 78° 42' in part of survey of India toposheet Nos, 55F & 55J. Hoshangabad is the district headquarter and Itarsi, Sohagpur, Piparia, Pachmarhi and Bankheri are some of the major towns. Itarsi is a very important railway Junction lying on Delhi-Chennai, Delhi-Bangalore and Patna-Mumbai railway routes. National Highway No. 69 and State Highway No. 21 and 22 pass through the district. The villages in the district are approachable by fair weather motorable tract.



The district is divided into eight Tehsils namely Babai, Bankhedi, Hoshangabad, Itarsi, Piparia, Seonimalwa, Sohagpur and Dolaria and seven development Blocks, namely Bankhedi Block, Piparia Block, Sohagpur Block, Babai Block, Hoshangabad Block, Kesla Block (Itarsi Tehsil) and Seoni Malwa Block. (Fig-1). The total population of the district is 1,240,975 as per Census 2011.

DRAINAGE

The entire district is drained by Narmada River and its tributaries. Thus the area falls in the Narmada Basin. The river Narmada flows along the northern boundary of the district. The river Narmada originates from the Amarkantak plateau and after flowing through Hoshangabad, Mandla, Jabalpur from the north-eastern part. The Tawa river is the major tributary of the Narmada river and flows from south to north west before merging into the Narmada river. Denwa river originates from south-eastern part of the Hoshangabad district and flows district and flows from east

to west direction before joining the Tawa river (south of Rainpur) where Tawa dam has been constructed. The important nalas are Keolari, Hather and Indra Nadi. The rivers draining the area in the western part are Morand, Banjal and Ajnal. The Morand river joins the Ganjal river near Chhidgaon and flows towards Narmada river.

IRRIGATION

Tawa dam is a major irrigation system in the district. About 60% of the total area of Hoshangabad district is irrigated by Tawa canal system. The Tawa dam is constructed about 823 m. down stream of the confluence of Tawa and Denwa rivers at east longitude 77° 58'30" and north latitude 22° 33' 40". It has a Catchment area of 5982.90 Sq. Km. with 20055 ha area under submergence. The left Bank Canal starts from Ranipur and runs parallel to Narmada river course along the limits of the foot hill pediments of Satpura. This canal takes off directly from the reservoir with a head discharge of 103.06 cumecs. The first 6.44 km length is lined with thick concrete. The Handia branch canal with a head discharge of 29.9 cumecs takes off from the main canal at 92 km point. The right bank canal is taken through a tunnel from Kamthi and runs parallel more or less to the course of Narmada river. The distributary system has been planned along the drainage divide. Due to topographic difference between the right and left bank canal has been taken through 6 km long tunnel. Bagra branch canal and Piparia branch canals take off on either side of the pickup weir. The Bagra canal is 60 km long. The total length of distributaries and minors on the right bank is 450 km.

Many minor irrigation Schemes are also operating in the district, amongst which Dokrikhera Tank Project in Bankheri block is prominent. Dokrikhera Tank Project has a gross command area 9104 ha and culturable command area 7625 ha. The area irrigated by canals, tubewells, dugwells and tanks are tabulated below in Table 1.

Table-1 : Irrigation by Different sources

S. No.	Source	Hoshangabad District Total	
		Number	Area (In sq.km)
1	Canals	6	1474
2	Tubewells	4,853	523
3	Dugwells	23,495	535
4	Tanks	9	11
5	Other sources	-	163
6	Net area irrigated	-	2703

CROPPING PATTERN

District is very rich in the field of agriculture due to good sources of irrigation and fertile alluvial soil. Wheat and gram are the main crops grown during Rabi season. Soyabean, Mustard, Til and Groundnut are the main oilseeds produced here. The farmers have started the production of Sunflowers.

CGWB ACTIVITIES

Preliminary hydrogeological studies in parts of Hoshangabad district were carried out by the erstwhile ground water wing of geological survey of India in co-ordination with the erstwhile exploratory tube wells organization from 1953 to 1963 (P.G. Adyalkar, 1975). A comprehensive hydrogeological study of the alluvial area of

the district was carried out by Central Ground Water Board, during the Narmada Project period from 1971 to 1978. During the above mentioned studies, besides hydrogeological, hydrological and hydrometeorological studies, extensive exploratory drilling was also carried out covering the entire Narmada upland alluvial valley. Systematic hydrogeological survey has been carried out by Shri K. Srinivasan, Junior Geologist of the GSI in the western part of the district in 1969-90 and by Shri A. K. Jain, Asstt. Hydrogeologist of Central Ground Water Board in the southern part of the district in 1984-85. Reappraisal of hydrogeological conditions in parts of the Tawa common area of the district was taken up by Shri A. K. Mishra, Jr. Hydrogeologist of the Central Ground Water Board in the year 1984-85 to study and define the extent and causes of water logging and by Shri A. K. Budhaliya, Scientist B, Km. Anu Radha Bhatia, AHG, Seraj Khan, AHG and R. M. Verma AHG during AAP 1991-92 to assess the Scenario of ground water regime and the extent of water logging, its causes and suggesting remedial measures.

2.0 RAINFALL & CLIMATE

The climate of Hoshangabad district is characterized by a hot summer and general dryness except during the south west monsoon season. The year may be divided into four seasons. The cold season, December to February is followed by the hot season from March to about the middle of June. The period from the middle of June to September is the southwest monsoon season. October and November form the post monsoon or transition period.

The normal rainfall of Hoshangabad district is 1225.9 mm. It receives maximum rainfall during southwest monsoon period. About 92.8% of the annual rainfall received during monsoon seasons and only 7.2 % of the annual rainfalls take place during October to May period. Rainfall forms the sole source of natural recharge to ground water regime and the rain water is available mainly during the southwest monsoon period only. The maximum rainfall received in district at Pachmarhi i.e. 2122 mm and minimum at Hoshangabad i.e. 1302.3 mm.

The normal maximum temperature received during the month of May is 42.1°C and minimum during the month of January is 11.7°C. The normal annual means maximum and minimum temperature of Hoshangabad district is 32.8°C and 19.8°C respectively. During the southwest monsoon season the relative humidity generally exceeds 91% (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 33%. 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 7.7 km/hr observed during the month of June and is minimum 2.9 km/hr during the month of December. The average normal annual wind velocity of Hoshangabad district is 5.0 km/hr.

3.0 GEOMORPHOLOGY & SOIL TYPES

The study area is bounded by Satpura ranges in south and by Narmada river in the north. The area slopes north west toward the Narmada river. The slope is generally steep at the foothills of Satpura but moderate to gentle towards Narmada river. The land surface attains a maximum altitude of 1352 m above mean sea level at

Dhupgarh ($77^{\circ} 22'30''$: $22^{\circ} 27' 00''$), near Pachmarhi and minimum altitude of 270 m above mean sea level at confluence of Ganjal river with the Narmada ($77^{\circ} 12'30''$: $22^{\circ} 33' 30''$).

The area may be divided into three zones on the basis of the Physiography (1) the Satpura range in the south, (2) An alluvial plain in the middle and (3) Badland topography zone confined to the vicinity of Narmada river. The maximum width of the valley between Satpura and Narmada river is about 30 kms.

The famous adamgarh hill, which stands out in the valley portion near Hoshangabad, is known from history stone age. Another hill, which stands out in the valley portion is near Chautalia village close to Narmada river. A large number of north westerly flowing tributaries originating from the Satpura join the Narmada along the left bank.

Soils of the area are characterized by black grey, red and yellow colours, often mixed with red and black alluvium and ferruginous red ravel or lateritic soils. These soils are commonly known as black soils. About 15% of the area is covered by sandy loam soils immediately on the high bank of Tawa river. Remaining part is occupied by clay loam with big pockets of sandy clay loam and sandy loam. The permeability of the soil is low when the clay contains montorillonite. They swell intensively when wet and shrink with deep cracks when dry. Intake of water is very rapid till the cracks disappear after complete wetting.

The soils have been classified as Ustocherpts/Ustorthents/Haplustalfs/Haplusterts as per pedological taxonomy.

The rocks occurring in the district range in age from Palaeoproterozoic to Quaternary. The Mahakoshal Group of rocks mainly comprise quartzite, slate and phyllites. The rocks of Vindhyan Supergroup comprise Bhander Group. Bhander group consists of Lower Bhander sandstone which is fine to coarse grained and at places, pebbly and quartzitic.

The Gondwana sequence belonging to the Gondwana basin of Central India, comprises of Talchir, Barakar, Motur, Bijori, Panchmari, Denwa, Bagra and Jabalpur Formations. The Talchir formation comprises tillite, diamictite, fine to medium grained sandstone and grey to olive green shales. The Barakar Formation is dominantly made up of coarse grained feldspathic sandstone, grey shales and carbonaceous shale. Motur Formation overlies Barakar Formation with a gradational contact. It comprises coarse grained sandstone with pebbly interbands, variegated shales and clay. The Bijori Formation is exposed as a broad band of olive and buff coloured clays and shales, alternating with massive sandstone. The Pachmarhi Formation consists of thick beds of coarse to granular, white arenite or quartzwacke, separated by lenses or thin layers of conglomerate and thin red clay bands. The Denwa Formation consists mainly of alternating bands of sandstone and red to variegated calcareous clay. The Bagra formation comprises of conglomerate, variegated shales and subordinate limestone bands.

The youngest Gondwana sequence is represented by Jabalpur Formation. It consists mainly of massive sandstone alternating with white clays. Lenses of conglomerate are common. Discontinuous patchy exposures of Lameta Group are seen east of Barapura, Gotabari and Tangna. The basaltic lava flows of Deccan trap are well exposed in the southern and southwestern part of the district. These flows, grouped under Satpura Group are mainly of Aa type and non-porphyrific to porphyritic to mega-porphyrific in nature. The thickness of individual flows varies from 15m to 47m. The Satpura Group comprises of 18 to 21 basaltic flows which are further classified in 5 Formations. Numerous dykes and sills, mostly of doleritic composition intrude the Gondwana rocks and basaltic flows.

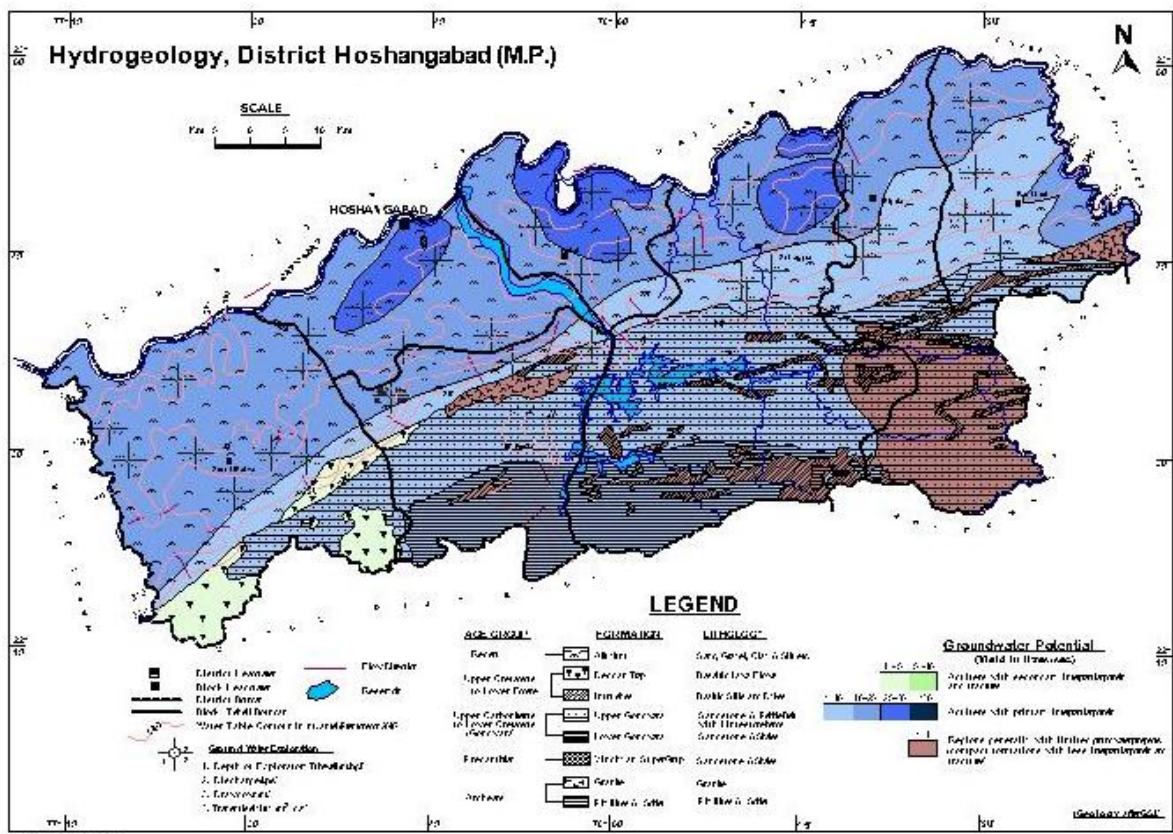
The dykes range in the length from few hundred meters to few kilometres, with width ranging from few meters to few hundred meters. Most of the dykes trend in NE-SW direction. Quaternary Narmada alluvial deposits occupy a major part of the district have been sub divided into seven litho-stratigraphic formations viz. Surajkund Formation, Beneta Formation, Hirdepur Formation, Bauras Formation and Ramgarh Formation, on the basis of lithological characters, degree of oxidation, calcification of the sediments, erosional unconformities, soil stratigraphy, morpho-stratigraphy and presence of volcanic ash.

4.0 GROUND WATER SCENARIO

4.1 HYDROGEOLOGY

Aquifer System And Aquifer Parameters

The water bearing properties of different hydrogeological units occurring in Hoshangabad District are described below. Hydrogeology of the district is shown in Plate-II.



Northern part of Hoshangabad district, adjoining the Narmada river is covered with alluvium, which makes for more than 50% of the entire district. Deccan traps occur as lava flows in the west central part of the district. The southern part of the district is hilly and occupied by rocks belonging to Gondwanas. The Archaeans are exposed south of Itarsi around Kesla railway station between the rocks of Gondwana in the form of inliers in very small patches and no ground water structure exist in them for hydrogeological studies. In general ground water occurs in phreatic condition.

Vindhyan

Upper Vindhyan represented by lower Bhandar sandstone are exposed south of Hoshangabad in Adamgarh quarry and at the confluence of Hather nala and river Narmada, north of Misrod and Dhamasa village near Chautalai village. These sandstones are medium grained, hard, compact, red light pink in colour and dip 12° due N. top of sandstone is buff coloured and fine grained and traversed by two sets of joints, one parallel to the strike and another at right angles to it. The rocks have poor groundwater potential as they form hills in the district. The Vindhyan sandstone serves as a good building stone.

Gondwanas

Lower Gondwanas are well exposed in the Satpura region of the district on the sides of upper Denwa valley in the southern base of Pachmarhi hills, and at the confluence of the Anjan river and at Pathapani due north of Fatehpur (55J/10). The lower Gondwana are divided into the Talchirs (pebbles and boulders and green clays

shales and sandstones) and the Damuda series (white to fawn coloured coarse grained sandstones, micaceous flagstones, grits, conglomerates, shales and carbonaceous shales). Damuda series of the lower Gondwana is overlain by the rocks of the Mahadeva (coarse grained red to buff coloured Pachmarhi sandstones with thin intercalations of pebbles, red Denwa clays containing calcitic nodules, with a few bands of white to yellow sandstones and Bagra conglomerates and pebble beds with occasional bands of calcareous sandstones variegated clays, limestones and dolomites) and Jabalpur series (soft, fine grained, occasionally pebbly sandstones with thin subordinate beds of conglomerate, earthy hematite, coal, carbonaceous red clays, shales and chert) of Upper Gondwana system. Gondwana rocks are criss-crossed by dykes/sills in the southern part of the district.

In the Gondwana occupying the southern part of the district, the aquifers are formed by fractured/weathered occurring below alluvium from confined/semi confined aquifer which are not very productive. In the exploratory tubewells, drilled by central ground water board during Narmada Project, water bearing zones in the Gondwana were encountered at Pathrai (Nibhora), Taron, Mahuakhera, Sohagpur Manegaon, Pathrota, Guraria and Kalkuhi. The Pachmarhi sandstone especially in Pachmarhi, though hard and massive, form potential zones wherever fractured and jointed. The transmissivity of Gondwana aquifer in general varies from 249 to 449 m²/day.

Deccan Trap

Deccan Trap basaltic lava flows, are exposed in the southern part of the district and also criss-cross the Gondwana formations as dykes and are also encountered as basement rock below alluvium around Powarkhera and Itarsi. The phreatic aquifer in weathered/vesicular basalt are tapped by dugwells, which in general does not yield a good discharge.

Alluvium

The alluvial aquifer system in the district is the most extensive. Two to three granular zones and at places more number of potential granular zones comprising of fine to medium to coarse grained sand, gravel and pebbles and laterite are encountered in alluvium. The top phreatic aquifer range in thickness from 2 to 10m and is encountered in the depth range of 4 to 20 mbgl. The phreatic aquifer intercalations of clay and silt, and at places also of coarse sand or gravel.

It appears that all the alluvial aquifer zones constitute a single aquifer system. The unconfined aquifer along the southern fringe adjacent to Gondwana, passes laterally to the north into a number of aquifer zones separated by thick clay zones. The deeper aquifers are of semi-confined to confined nature with varying potentiometric heads. The yield of alluvial aquifers ranges from 180 to 3000 litres per minute.

All the aquifers are principally recharged by a lateral low from the south and also by direct vertical percolation rain/irrigation water/seepage from tanks/canals.

Hot Spring

A hot water spring occurs in the area at Anthoni (55J/5) (west of road from Pipariya to Pachmarhi). The temperature of Anthoni spring water is 41°C. A borehole

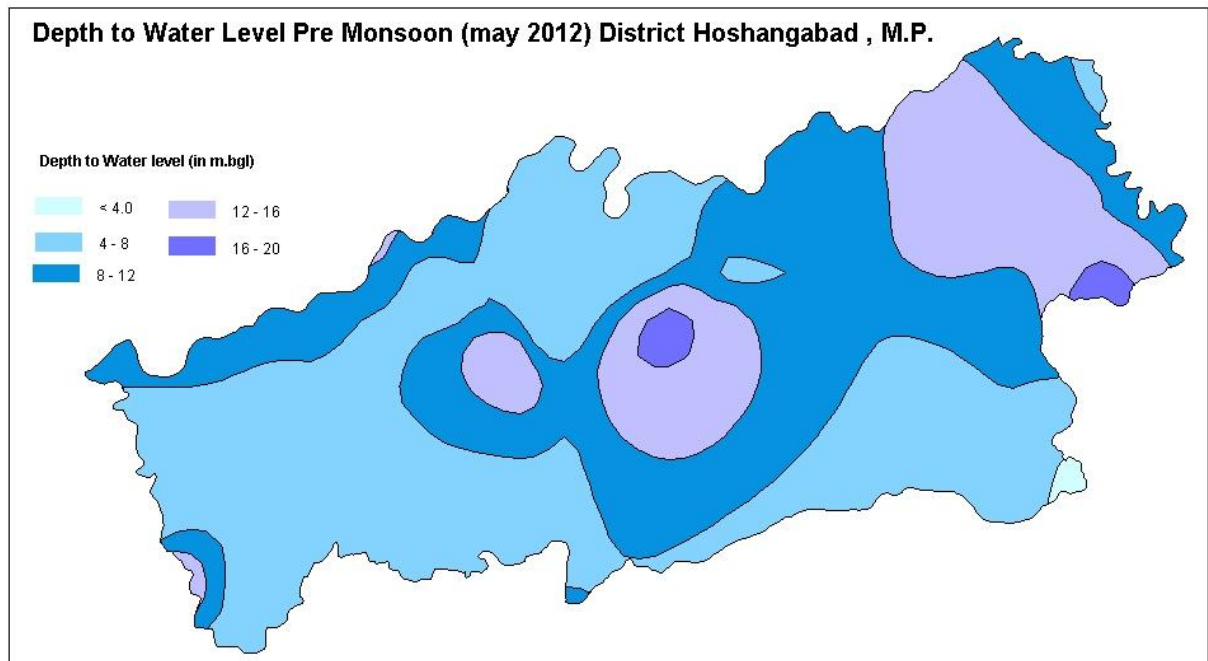
has been drilled by Geological Survey of India, Geothermal Division,, Nagpur down to a depth of 250 mbgl near the spring. The lithology encountered in the borehole is Gondwana sandstone intruded the borehole is 54°C and free flow discharge is about 30 lpm from top of casing pipe 0.6 mbgl. The water smells of sulphur and occurrence of methane gas during drilling is reported by G.S.I. staff.

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 18 National Hydrograph Monitoring wells and 1 Peizometers in Hoshangabad district.

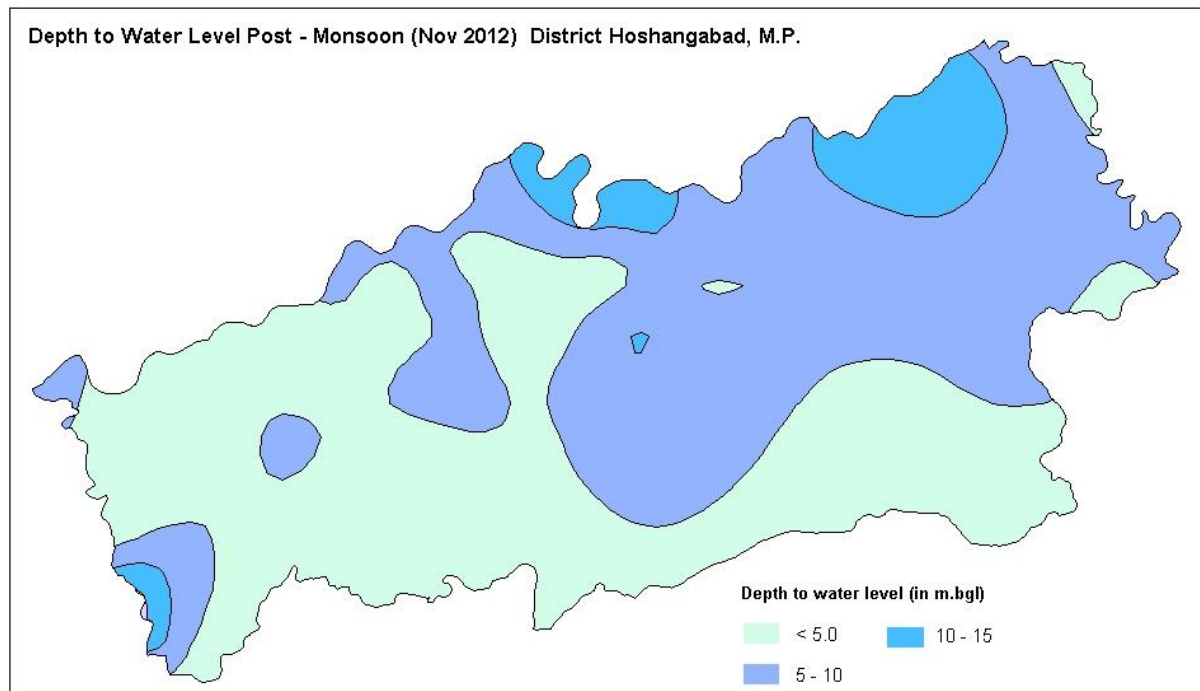
Pre-monsoon Depth to Water Level (May-2012)

In general depth to water level in the area ranges from 4.14 to 17.50 m below ground level. It is observed that the major part of the district was covered by the water levels varying between 4 to 12m bgl during the period



Post-monsoon Depth to water level (November-2012)

In general, during post-monsoon period, depth of water levels in the district ranges between 1.24 and 13.47 m below ground level. It is observed that the major part of the district was covered by the water levels varying between 5 to 10 m bgl during the period



4.2 Ground Water Resources HOSHANGABAD

Hoshangabad district is characterized by alluvial formations, Gondwana , Achaean and Deccan trap basaltic lava flow. Dynamic ground water resources of the district have been estimated for base year -2008/09 on block-wise basis. Out of 6,70,400 ha of geographical area, 5,58,352 ha (84 %) is ground water recharge worthy area and 1,12,048 ha (16 %) is hilly area. There are six number of assessment units (block) in the district which fall under command (43 %) and non-command (57 %- Bankhedi, Pipariya and Kesla) sub units. All blocks of the district are categorized as safe blocks, Bankhedi block is with highest stage of ground water development of 61 %. The net ground water availability in the district 2,01,888 ham and ground water draft for all uses is 35,617ham, making stage of ground water development 18 % (14 % in 2003/04) 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 1,64,889 ham at 50 % stage of ground water development's safe limits in the district.

Table: Ground Water Resources of Hoshangabad District, M.P.

S. No	District/ Assessment Unit	Sub-unit Command/ Non- Command/	Net Annual Ground water Availabili ty (ham)	Existing Gross Ground water Draft for Irrigation (ham)	Existing Gross Ground water Draft for Domestic & Industria l 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
	Hoshangabad									
1	Babai	Command	37886	2214	288	2502	415	35257	7	Safe
		Non-Command								
		Block Total	37886	2214	288	2502	415	35257	7	Safe
2	Bankhedhi	Command								
		Non-Command	23581	14043	279	14323	500	9038	61	Safe
		Block Total	23581	14043	279	14323	500	9038	61	Safe
3	Hoshangabad	Command	39773	2966	405	3371	612	36195	8	Safe
		Non-Command								
		Block Total	39773	2966	405	3371	612	36195	8	Safe
4	Kesla	Command	6584	107	26	133	76	6401	2	Safe
		Non-Command	13242	2829	509	3338	672	9741	25	Safe
		Block Total	19825	2936	535	3471	748	16142	18	Safe
5	Pipariya	Command	4141	319	37	356	49	3773	9	Safe
		Non-Command	16415	4860	334	5194	430	11124	32	Safe
		Block Total	20555	5179	371	5550	479	14897	27	Safe
6	Seoni Malwa	Command	30957	724	203	927	328	29905	3	Safe
		Non-Command	15470	2009	236	2245	382	13079	15	Safe
		Block Total	46427	2733	438	3172	709	42984	7	Safe
7	Sohagpur	Command	8424	377	86	464	162	7884	6	Safe
		Non-Command	5416	2374	391	2765	551	2491	51	Safe
		Block Total	13840	2752	477	3229	713	10375	23	Safe
	District Total		201888	32823	2794	35617	4176	164889	18	Safe

4.3 Ground Water quality

Quality of ground water is fresh to saline with EC ranging from 440 to 2710 mmhos/cm at 25° C, nitrate from 1.3 to 122 mg/l and fluoride from 0.11 to 1 mg/l.