DISTRICT GROUND WATER INFORMATION BOOKLET

ASHOKNAGAR DISTRICT

MADHYA PRADESH

Ministry of Water Resources

Central Ground Water Board

North Central Region

BHOPAL

2013

ASOKNAGAR DISTRICT AT A GLANCE

S.No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geographical area (sq. km)	4,673.94 km^2.
	ii) Administrative Divisions (As on 2013) Number of Tehsil/Blocks Number of Villages	 5/4 907
	iii) **Population (Census 2011)** • Rural • Urban **a.) Male** • Rural • Urban **b.) Female** • Rural • Urban	845071 691387 153684 443837 363411 80426 401234 327976 73258
	iv**) Normal Rainfall (mm)** **Normal Rainy days (number)**	927.1 38
2.	**GEOMORPHOLOGY**	
	i) Major Physiographic Units ii) Major Drainag	Alluvial plain, Intermundane valley, Residual hills, Denudation hill, Deccan plateau, Linear ridge, Plateau, Pediment & Lineament Sindh, Betwa, Kethan & Orr
3.	**LAND USE (000Ha)**	
	i) Geogrophical Area ii) Cultivated Area iii.) Forest Area iv.) Land under non –Agriculture use v.) Permanent Pastures vi.) Cultivable wasteland vii.) Barren and un cultivable land viii.) Current fallows ix.) Other fallows	467.4 307.1 52.8 27.6 12.5 25.4 36.2 2.3 3.5
4.	**MAJOR SOIL TYPES**	Black Cotton & Sandy Loam
5.	**AGRICULTURE LAND USE** Area (000Ha) i) Net sown area ii) Area sown more than once iii.) Gross cropped area	307.1 68.3 375.4
5.	**IRRIGATION** Area (‘000Ha) i) Net Irrigated area ii) Gross Irrigated area iii.) Rainfed area	 115.6 115.6 191.5

6.	**IRRIGATION BY DIFFERENT SOURCES**	**No of Structures**	**Area ('000Ha)**
	Dugwells	7245	18365
	Tube wells/Bore wells	4679	48175
	Tanks/Ponds	28	2670
	Canals	22	10641
	Other Sources	-	29268
	Pumpsets	14959	-
7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB(As on 31.3.2013)**		
	No. of Dug Wells No. of Piezometers	10 05	
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Bundelkhand Granite, Vindhyan Sandstone & Shale, Deccan Trap	
9.	**HYDROGEOLOGY**		
	Major Water Bearing Formation	Weathered fractured & jointed Deccan Trap, Vindhyan Sandstone & Shales & Bundelkhand Granite	
	(Pre-monsoon) Depth to water level during 2012 **(Post-monsoon)** Depth to water level during 2012	 2.34 to 17.40- m b.g.l. 2.95- to 20.68- m b.g.l.	
	Long Term water level trend in 10 years (2003-2012) in m/yr	0.01to 0.05 Rise 0.07to 0.14 fall	
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31.3.2013)**		
	No of wells drilled (EW,OW,PZ,SH, DW Total)	14 ,18, Nil, Nil, Nil	
	No. of PZ (Contractual)	5	
11.	**GROUND WATER QUALITY**		
	Presence of Chemical constituents (eg EC, F, NO_3) Type of Water for Irrigation	EC: 563 to 1569 µS/cm^2 at 25 ^{0}C. F ranges: 0.03 to 0.43 mg/l NO_3 ranges: 11 to 192 mg/l C_2S_1 & C_3S_1 Class	
12	**DYNAMIC GROUND WATER RESOURCES (As on 2009) in MCM**		
	  Annual Replenishable Ground Water Resources Net Annual Ground Water Draft Projected Demand for Domestic and Industrial Uses upto 2035 Stage of Ground Water Development	 404.23 168.86 25.78 42%	
13	**MASS AWARENESS & TRINING PROGRAMME**	Nil	

1.0 INTRODUCTION

1.1 Administrative Divisions:

Ashoknagar district was previously a part of Guna district. It is situated in the northeastern part of the Madhya Pradesh and covers an area of about 4,673.94 sq km. Ashoknagar is located on the northern part of Madhya Pradesh between Sindh and the Betwa. It comes under the northern part of Malwa plateau, though main part of its district lies in the Bundelkhand Plateau. Geographically, the district is situated between the latitude 24.34 N and longitude 77.43 E. and falling in Survey of India toposheet nos 54 G, H & L. It is bounded in the North by Shivpuri district and east by Uttar Pradesh, in the south by the Rajgarh & in the west by the Guna district .The eastern and western boundaries of the District are well defined by the rivers (Fig. 1). The Betwa flows along the eastern boundary separating it from Sagar District and Lalitpur District of Uttar Pradesh. The Sindh is the main river flowing along the western boundary.

Ashoknagar district is divided into 5 tehsils and 4 blocks. It has 907 villages. Total population of the district is 845071 (As per census 2011) and density of the population is 147 persons per sq. km.

1.2 Basin & Sub basins

The district lies in the Yamuna drainage system. Sindh, Betwa, Kethan & Orr are the main rivers in the district. Sindh river forms the western boundary & river Betwa forms the eastern boundary of the district. The general flow direction of all the rivers is towards north with low gradient

1.3 Hydrology & Irrigation

The gross irrigated area by all sources is 701.31 Sq. Kms. The Irrigation by different sources is given in Table - 1

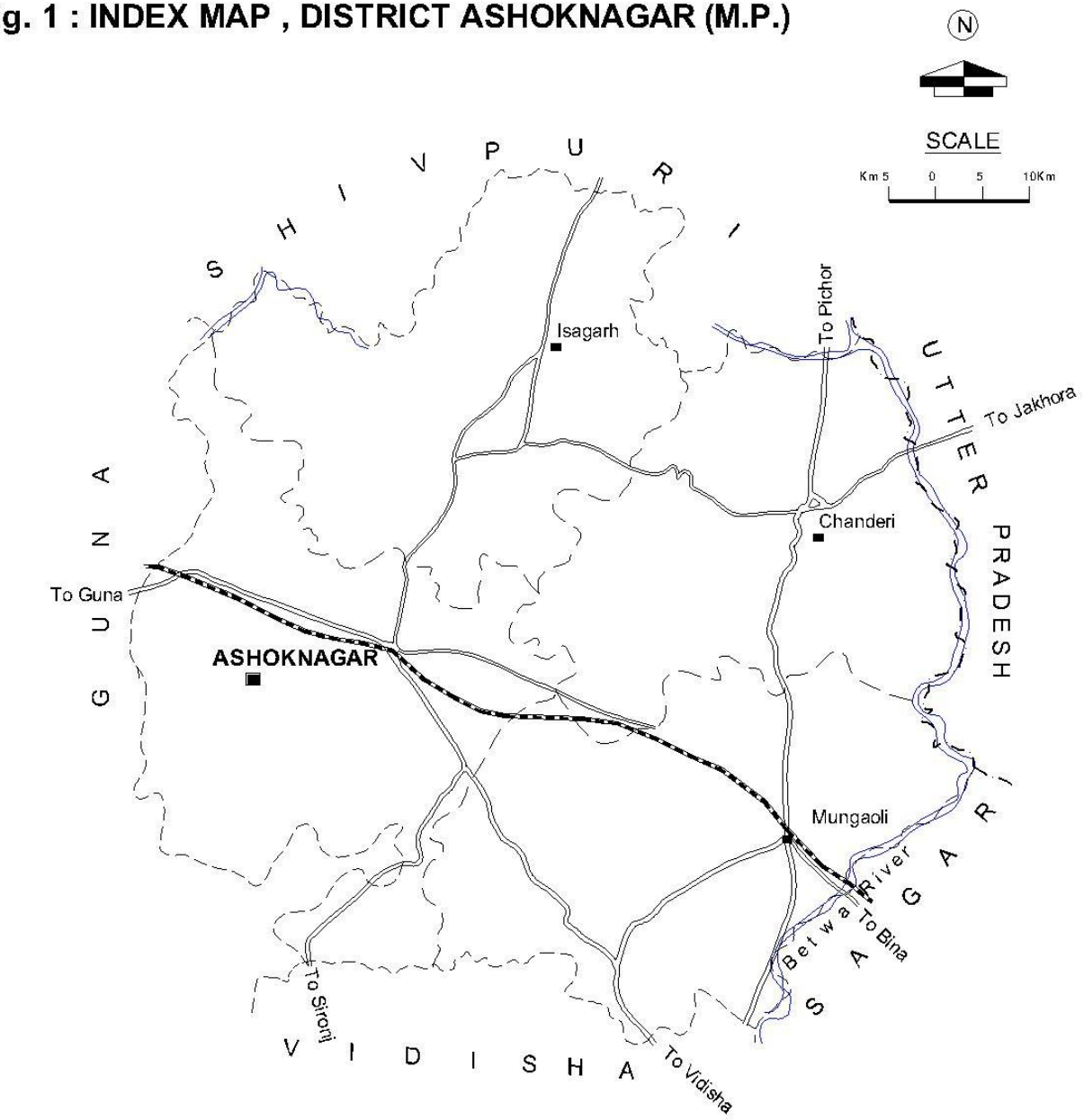
Table - 1 Irrigation by different sources

IRRIGATION BY DIFFERENT SOURCES	No. of Structures	Area ('000Ha)
Dug wells	7245	18365
Tube wells/Bore wells	4679	48175
Tanks/Ponds	28	2670
Canals	22	10641
Other Sources	-	29268
Pumpset	14959	

1.4 Previous work

Systematic Hydrogeological studies was carried out by CGWB under Annual Action Plan of 1990 – 91 & after the systematic Hydrogeological surveys the Ground Water management studies were carried out in the entire district under AAP 2000 - 2001.The ground water exploration in the district was carried out under Annual Action Plan 2002-03 & 2003-04.

Fig. 1 : INDEX MAP , DISTRICT ASHOKNAGAR (M.P.)



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2.0 CLIMATE & RAINFALL

The climate of Ashoknagar district characterized by a hot summer and general dryness except during the southwestern monsoon. A year may be divided into four seasons. Cold season December to February followed by the hot season from March to about middle of June. The period from Middle of June to September is the southwestern monsoon season. October & November forms the post monsoon or transition period. The nearest observatory is Guna, hence meteorological data of Guna observatory is used except rainfall data.

The normal rainfall of the district is 927.1 mm. District receives maximum rainfall during southwest monsoon period i.e. June to September. About 91.5% of the annual rain fall predicates during the monsoon season. Only 8.5% of the annual rain fall takes place between October to may period. Thus surplus water for ground water recharge is available during the period from June to September.

During the southwest monsoon season the relative humidity generally exceeds 90% (August month). In the rest of the period is dry. The driest period is summer season, when relative humidity is less than 27%. April is the driest month of the year.

Normal maximum temperature during the month of May is 41.3^0C and minimum during January month is 7.7^0C. Normal mean maximum & minimum temperature of Asoknagar is 32.5^0C & 17.7^0C respectively.

Wind velocity is higher during the pre monsoon period as compared to the post monsoon period. The maximum wind velocity is 14.3 km/h during the month of June and minimum is 4.3 km/h during the month of November. Average normal annual wind velocity of Asoknagar district is 8.1 km/h.

3.0 GEOMORPHOLOGY & SOIL TYPE

3.1 Geomorphology

District has an undulating topography inter spread mostly by low residual hills except in east & north & west, which are flat topped. The river Betwa crosses the eastern off shoot of Vindhyan hills with low scarps before entering the district. The valley portion of Betwa River in the district starts from Mungawali on Deccan trap lava flows, which is overlain by black cotton soil. Further down Betwa river passes through rugged sandstone of Vindhyan formation.

The eastern offshoot of Vindhyan range which runs south to east passes through Isagarh & Chanderi forms the second Physiographic region.

The Sindh valley and wider parts of Malwa plateau lies at general elevation of 460 m above MSL and mostly has an undulating topography. Sindh valley occupies central & western strips of the district covers Ashoknagar, Mungawali & Isagarh blocks.

3.2 Soil

In this region, the main classes of soil are black, brown and bhatori (stony) soil. The volcanic, clay-like soil of the region owes its black colour to the high

iron content of the basalt from which it is formed. The soil requires less irrigation because of its high capacity for moisture retention. The other two soil types are lighter and have a higher proportion of sand .

4.0. GENERAL GEOLOGY.

The geological Succession of the area has been worked out as follow

Recent		Alluvial and Black Cotton soil
Sub Recent		Ferrugineous Laterite
	Decan Trap	**FLOW I**
	(Locally Known as Malwa Trap)	Massive and Porphyritic Basalt
Early Eocene to		**Intertrappeans**
Upper Cretaceous		Red clay and calcareous Chert
		FLOW II
		Massive porphyritic Basalt
		Dykes and Sills of Doleritic
		Intrusive into Vindhyan
		sandstone
	Upper	Upper Bhander Sandstone
	Vindhyan	Sirboo Shale
Purana &		Lower Bhander Sandstone
(Pre- Cambrian)		Bhander limestone
		Gangarh Shale
		Upper Rewa Sand stone

Base is not seen

UPPER. REWA SANDSTONE

This is the oldest formation exposed in the area. It consists of cream to grey coloured sandstone and is generally quartzitic. It is usually coarse grained. Frequent shale intercalations and iron staining are peculiar to this sandstone, at some places nodules of brown iron-stone and found arranged parallel to the bedding. This formation is compared of massive coarse grained sandstone strata alternating with current bedded flags. The thickness of this sandstone varies between 3.05 m. and 6-10 m. Well-developed joints were Observed in -this sandstone along which it breaks into large cubical blocks. The sedimentary structures in this sandstone include cross-bedding and ripple marks.

GANURGARH. SHALE

The Ganurgarh Shale rests directly on the Upper Rewa Sandstone. It is deep red in colour for the most part of it although at places the colour changes to brown and grey. This shale is usually earthy and slightly micaceous and brittle. The thickness of it varies from 2.54 cm. to 3.8 cm. At places, this shale shows cross-joints and alaty cleavage. Sometimes it becomes more ferruginous also. Towards the top this shale is intercalated with pink coloured limestone and other calcareous materials.

BHANDER. LIMESTONE

Limestone was seen along the nalla flowing west into the Kunu river and south west of Magarda to occur in beds 2.5 cm. to 15.5 cm. thick. The dominant colour of this

limestone is yellowish-brown although it varies from pink to brown with distance. This limestone is associated with silica shaly materials and is therefore impure. At places this limestone is concreationary in nature. Towards the top it becomes sandy with yellow and brown argillaceous bands.

LOWER BHANDER_SANDSTONE

The lower Bhander sandstone of the area forms a conspicuous horizon and has been observed in a few locality. In most places of the Bhander limestone is directly overlain by the Sirbu Shale. Where Iower Bhander Sandstone occurs, the Upper portion of the Bhander Limestone becomes arenaecous and gradually passes into a bed of sandstone whose thickness never exceeds 7.5 cm. to 10 cm. The colour of this sandstone is usually reddish to dirty white. Ripple marks occur frequently in this sandstone. This sandstone is practically horizontally bedded with slight dip of 5° to the North West. This sandstone strikes NNE. Towards the top the sandstone gradually, becomes shaly and passes into the Sirboo Shale.

SIRBU SHALE

This shale is exposed at the base of the Sandur hills, on the east bank of the Kunu river and also along the course of the latter for a distance of one fourth kilometre or less. Its thickness varies from a few centimetres to about 30 m. It is generally olive-green in colour although sometimes it changes to dark brown and grey. It is aluminous, earthy, slightly micaceous and brittle. When unprotected by the sandstone talus it weathers into steep precipitous faces. At places, it contains intercalations of thin bands of sandstone. At the top this shale passes into grey and pinkish purple, ripple marked sandstone blotched with brown. There are places where surface of the Sirbu Shale was been to be concealed by the debris from the overlying upper Bhander Sandstone.

UPPER BHANDER SANDSTONE

Upper Bhander Sandstone lies conformably above the Sirbu Shale. It is quite extensive and thick as compared to the other sandstones of the area. The usual colour of this sandstone is deep red with white specks or paler tints. Variation in colour from red to brown and chacolate colours is also noticeable. It is very fine grained, massive and hard. In the total thickness of this sandstone, proportion of shale intercalations increases with the depth. Its dip varies between 9° and 15° and strikes N25°E. Ripple marks occur in profusion through out the entire thickness of this sandstone. These ripples are a symmetric type consisting of long parallel ridges and troughs trending north-west with insignificant curvature. Few sets of vertical joints are usually seen. The joint directions are N30°E - S30°W and N15°W - S15$_0$E.

Deccan Trap

Two simple and horizontal flows of basalt separated by a prominent red clay and elsewhere by unfossiliferous limestone, were worked out. Both the flows are massive and porphyritic type except that the second flow is vesicular and amygdular at places. Beyond the area of inter trappean the following are the criteria by which the individual flows of basalt were demarcated.

i. Red bole horizon.
ii. Presence of thick weathered zones at the top of the dividual flows,
iii. High vesicularity indicating the top of the flows and
iv. The petrography of the rock types.

LATERITE

Laterite occurs as small and detached capping on isolated hill tops. The thickness ofthe laterite profile varies from 1 m. to 7 m. It is highly ferruginous and cavernous. The major area of such laterite formation is the north-eastern part of the area near Dongasro, Madhopur, Bhedra and UmriVillages. At places, the laterite was seen to rest directly on the Vindhyan.sandstone and shale.

INTRUSIVES

The Vindhyan rocks are intruded by a number of dolerite dykes which vary in width from 10 am to 150 m. They extend in a north and north-easterly direction and are tracable for distances upto 2 to 3 km. At places, these dykes bifurcate and branch out into smaller ones.Near their contacts with the country rock, there is little change in the sandstone and shale, except for slight baking in the latter, although chilling effect in the dyke rock, at its contact with the Vindhyan country has been observed. Xenoliths of sandstone and shale were also seen to occur in the dyke rock at some of the places near their contact.

Sills

The dykes mentioned above have given rise, to sills along the horizontal bedding planes of Vindhyan sandstone and shale. The thickness of these sills vary from 0.5 m. to 1 m.and the length ranges from 20 to 25 m. Although they show nearly parallel upper and lower margins for quite some distance, they thin out and become lenticular still further away.

Intertrappean

The intertrappean of the area consists of calcareous chert, limestone and redbole. Thebreak between the erruptions of the two lavaflows of the area is represented by redbole. After the erruption of the 1st flow and its solidification its surface might have been reddened due to the oxidation and the heat of the lava flowed over it.

III STRUCTURE

Faults: The area investigated is highly disturbed.The disturbance is evidenced by the presence of normal faults with throws ranging from 0.25 km. to 0.50 km. They are more or less parallel with strikes to NNE and have broken-up the tract into faulted blocks. One of the faults is within the Vindhyans and has no effect on the Deccan Trap from which it can be said that this fault has taken place before the erruption of the lava flows, hence it is pre-trap in age. The other faults have affected the Deccan Trap formation, the evidences for which are (i)slicken sides on basalts, and (ii) sillicification in them. Therefore it can be said that the movement, has taken place only after the basalt flows came into being. The parallel strike direction of both the pre-trap fault and the post trap faults indicate that the later movements have followed the pre-trappean line of weakness.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

District is characterized by variety of geological formations representing vast period of geological time. The distribution of the Geological formation is shown in Fig – 2

4.1.1 Alluvium

Alluvium of Quaternary age occurs as a narrow belt along the major rivers like Sindh, Betwa, Kethan & Orr. It comprises pebble beds, gravel, silt & sand.

In the area occupied by alluvium, the ground water occurs under water table condition. The granular portion of this formation such as sand & gravel forms good aquifers, but the thickness is shallow. The yield of the wells in this formation ranges from 2 to 7 lps

4.1.2 Deccan Trap

Deccan trap basalts of Malwa Group of Cretaceous to Paleozoic age occupy major part of the district. Intertrappean of lacustrine or fluviatile origin occur in the top part of the each lava flow. Deccan trap consists of number of basaltic lava flows.

Water bearing capacities in Deccan trap formation differ from flow to flow. weathered basaltic layer is extensive, a continues aquifer can be traced to some distance, however due to low permeability of the weathered basalt the aquifer sustain limited ground water withdrawal. The groundwater at deeper levels occurs under semi confined to confined conditions in vesicular, jointed & fractured basalts. Unit draft of the wells varies from 0.001 to 0.008 m cm/year for dug wells & 0.005 – 0.017 m cm/yr

4.1.3 Vindhyan Formation

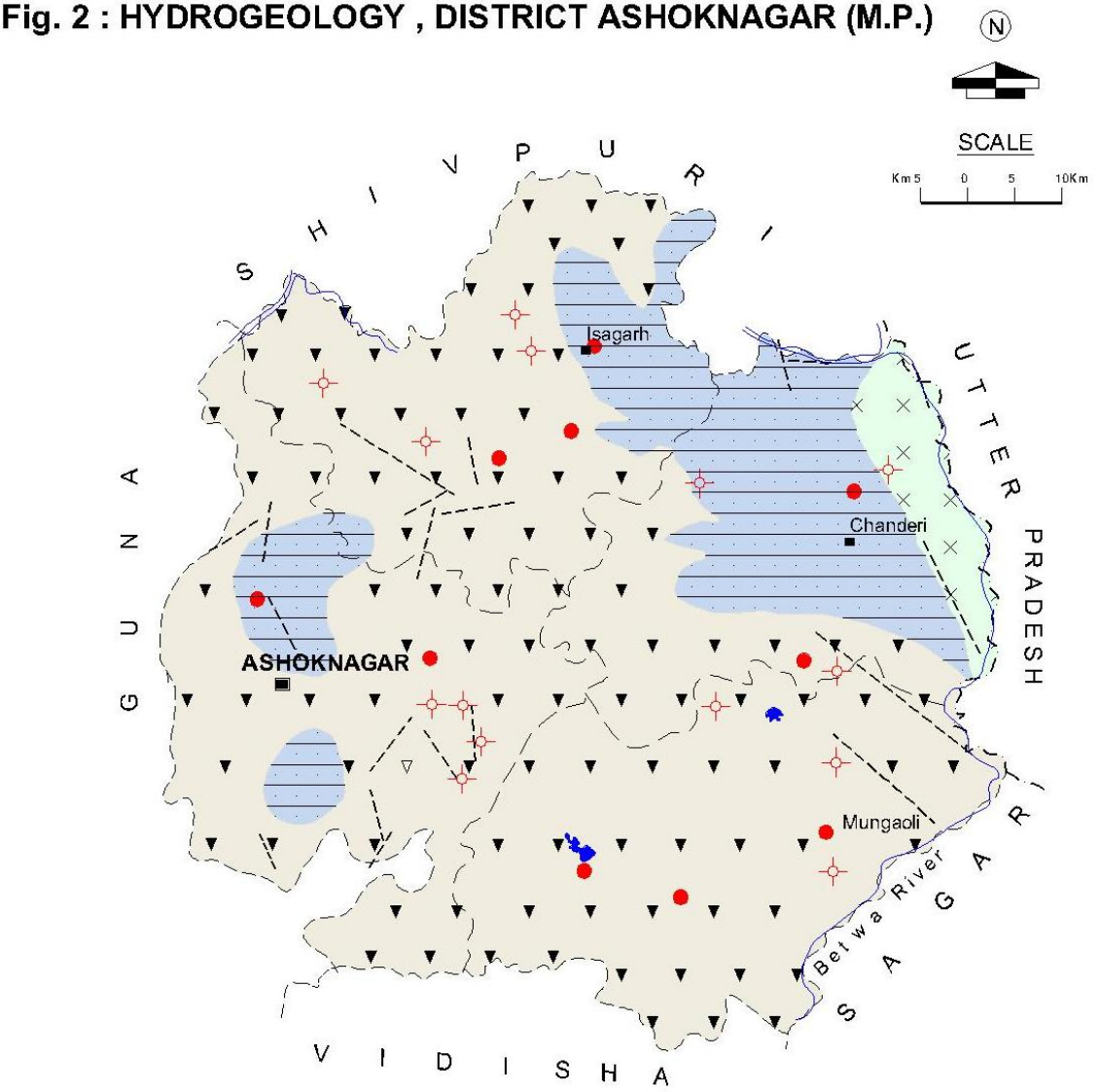
The Sandstone intercalated with Shale beds are exposed in the northeastern parts of the district (Isagarh & Chanderi blocks). The rocks are hard & compact, but at places and at different depth it is fractured & jointed and forming potential aquifer at deeper levels. The ground water occurs under semi confined to confined conditions and are being exploited through bore wells. The yield of these bore wells is fairly good ranging between 1.0 to 4.9 lps. The depth to water level during pre monsoon period ranges from 3.70 to 22.10 m.bgl. with seasonal fluctuation of 0.07 to 9.98 m

4.1.4 Archeans

The Archeans rocks are represented by the Bundelkhand Granites in the district and occurring in northeastern portion of the Chanderi block. The intensity of the weathering is varying from place to place. The intensity of the weathering is high and formation of the deep residum or mantle overlying the hard granite in the low lying, intermountain & depressions. The weathered mantle of the granite forms sometimes-good aquifers at a shallow depth, where ground water occurs under water table condition. The yield of this formation ranges from less than one to 3 lps.

Under the Ground water Exploration Programme CGWB has constructed the exploratory wells & observation wells of 96 to 201.30 m deep. The depth to water levels in these wells varies from 8.25 to 51.40 m bgl and discharge of the wells ranges from 0.5 to 11.5 lps with a draw down of 28.00m.

Fig. 2 : HYDROGEOLOGY , DISTRICT ASHOKNAGAR (M.P.)



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4.2 Depth to Water Level

To monitor the change in ground water levels in the district, Central ground Water board is regularly monitoring 10 dug wells & 5 piezometerrs four times in a year.

4.2.1 Pre - Monsoon Depth to Water Levels

The premonsoon depth to water levels (DTW) map is presented as figure 3. The DTW ranges from 2.34 to 17.40 mbgl. However, in major part the DTW ranges between 4 and 16 mbgl. Deeper water levels of more than 16 mbgl is observed in northern part.

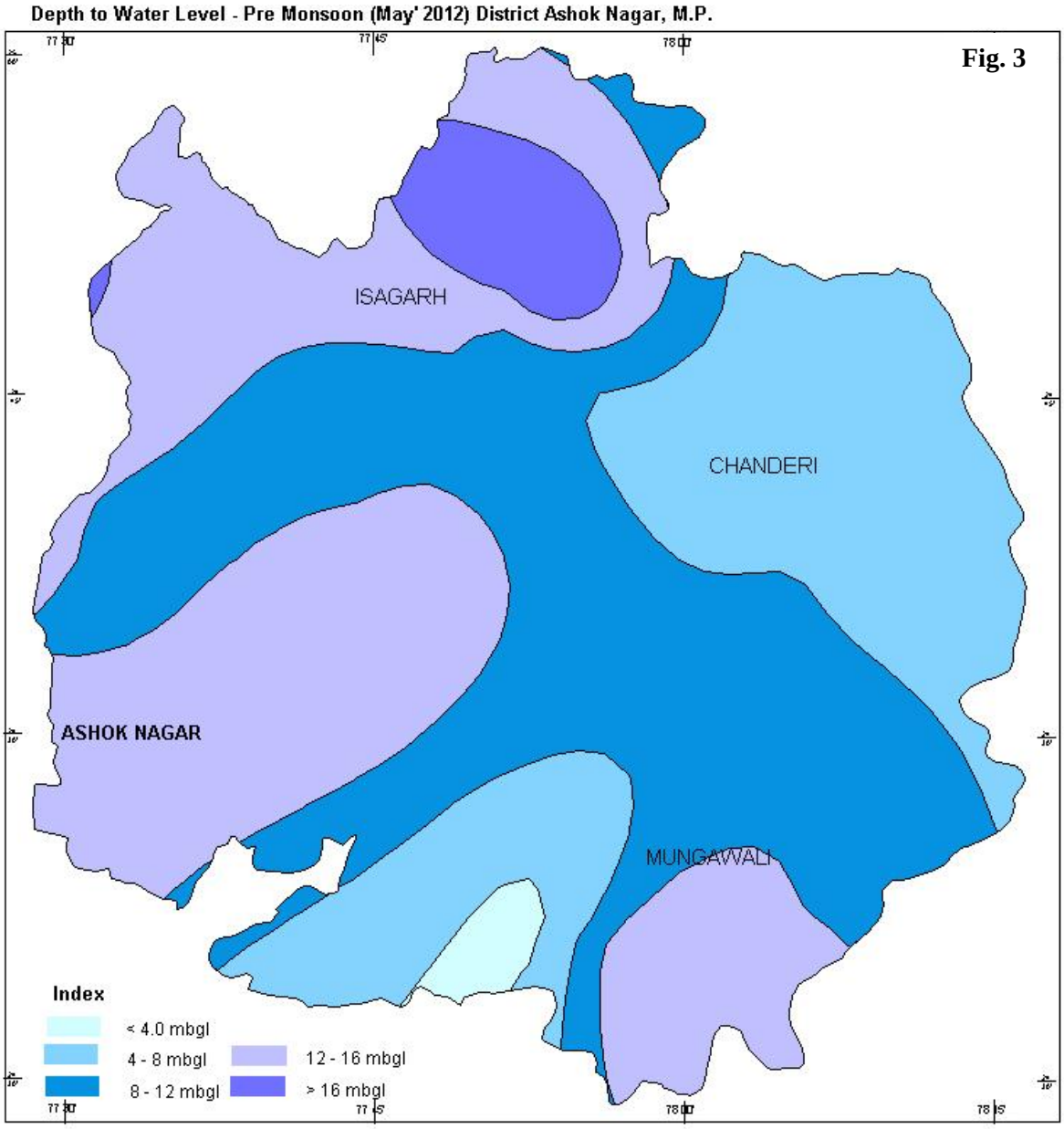

Fig. 3

4.2.2 Post - Monsoon Water Levels

The postmonsoon depth to water levels (DTW) map is presented as figure 4. The DTW ranges from 2.95 to 20.68 mbgl. In general shallow water levels of less than 5 mbgl are observed in eastern part and deeper water levels are observed in western part. In major part the DTW ranges between 5 and 10 mbgl. Deeper water levels of more than 15 mbgl is observed in isolated patches in southern and western part.

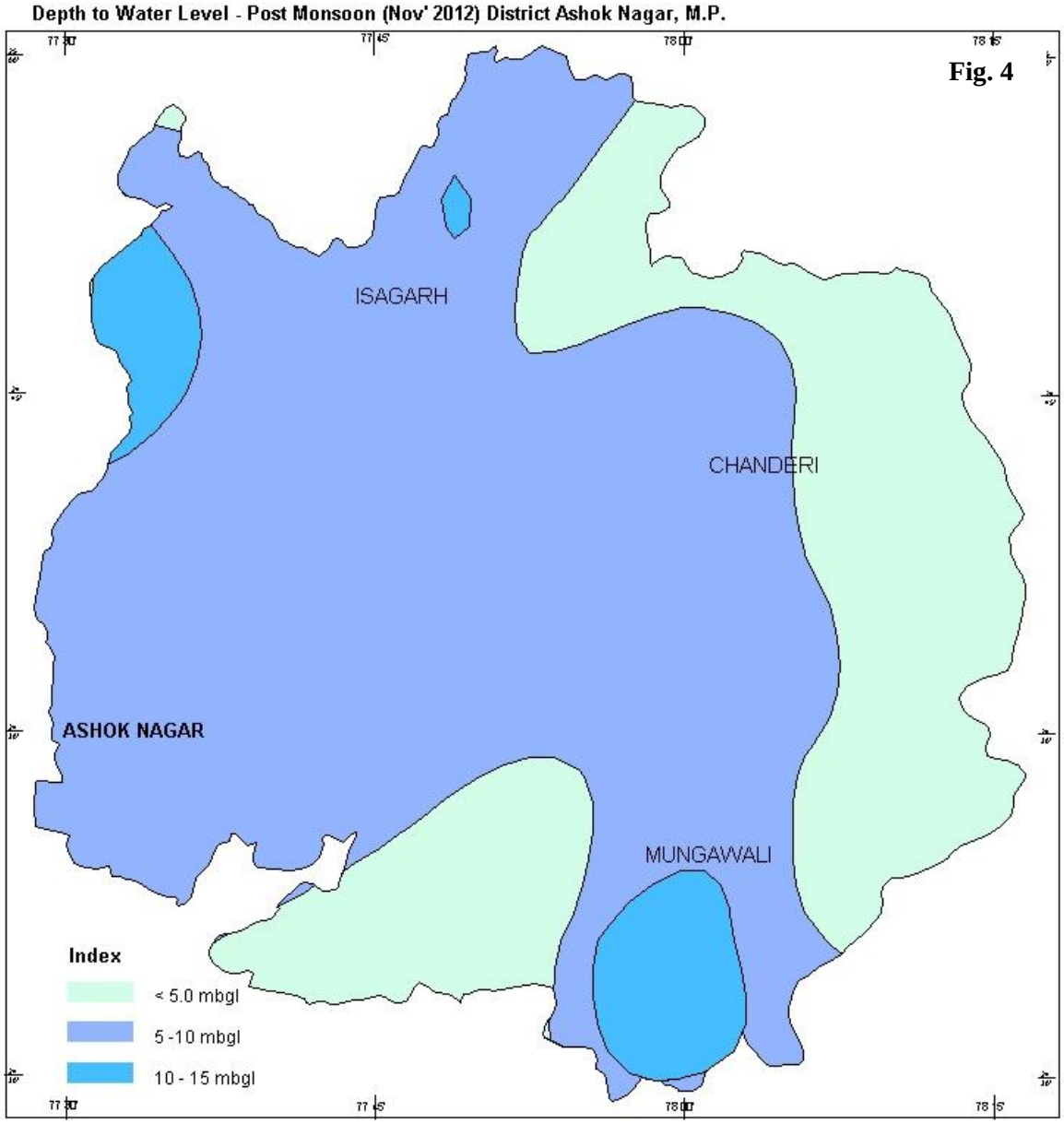

Fig. 4

4.3 Ground Water Exploration

Under the ground water Exploration programme of CGWB 37 wells has been constructed in the district. 14 exploratory wells, 18 observation wells & 5 Piezometers have been constructed.

4.4 Ground Water Resources

Block wise Groundwater Resources has been calculated for the base year 2011 on the basis of GEC'97. Over all ground water development of the district is 48% and all the blocks of the district fall in safe category of ground water development.

Net Ground water availability is **404.23 MCM** existing ground water draft for all uses is **168.86 MCM** and allocation for the domestic and industrial use upto year '2033 are **25.78 MCM** respectively .The Ground Water Resources is given in Table-2

Table - 2 Block wise Ground Water Resources

S. No.	District/ 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 (%)
3	**Asoknagar**								
	Ashoknagar	Command	-	-	-	-	-	-	-
		Non-Command	12697	4574	519	5093	716	7406	40
		Block Total	**12697**	**4574**	**519**	**5093**	**716**	**7406**	**40**
	Chanderi	Command							
		Non-Command	7740	3869	336	4205	485	3385	54
		Block Total	**7740**	**3869**	**336**	**4205**	485	**3385**	**54**
	Ishagarh	Command							
		Non-Command	10301	3923	476	4399	607	5770	43
		Block Total	**10301**	**3923**	**476**	**4399**	**607**	**5770**	**43**
	Mungawali	Command	1769	64	43	107	46	1659	6
		Non-Command	7917	2644	438	3081	723	4550	39
		Block Total	**9686**	**2707**	**480**	**3188**	**769**	**6209**	**33**
		District Total	**40423**	**15075**	**1811**	**16886**	**2578**	**22771**	**42**

4.5 Ground Water Quality

Ground Water quality in Ashoknagar district is assessed by CGWB on the basis of water samples collected from ten numbers of hydrograph stations in the year 2011. Ground water is generally low to high saline as electric conductivity values vary between 563 to 1569 µS/cm^2 at 25°C. High EC of more than 1500 µS/cm^2 was found in dug wells of Chanderi (1569 µS/cm^2) and Bhadurpur (1564 µS/cm^2). Constituents like Fluoride, Sulphate, calcium and Magnesium were within the safe limit for drinking water as per BIS standards. Nitrate in the ground water varies from 11 to 192 mg/l. As per BIS recommendation nitrate more than 45mg/l was found in two villages namely Bahadurpur (122 mg/l) and Chanderi (192 mg/l). The total hardness of ground water is under safe limit or BIS standards.

4.5.1 Quality of water for Irrigation:-

High SAR is not good for irrigation as it lead to sodium hazards. Water samples falls in C_2S_1 and C_3S_1 classes of US Salinity classification. The ground water in the district is safe for irrigation purpose but proper drainage system is required where EC is high i.e. more than 1500 µS/cm^2.

4.5.2 Geogenic Problems

Fluoride in the district generally below 1.5 mg/liter, however, groundwater in the district is safe for drinking purpose. No arsenic has been detected in the district.