केन्द्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,
Ministry of Jal Shakti
Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

VIDISHA DISTRICT
MADHYA PRADESH

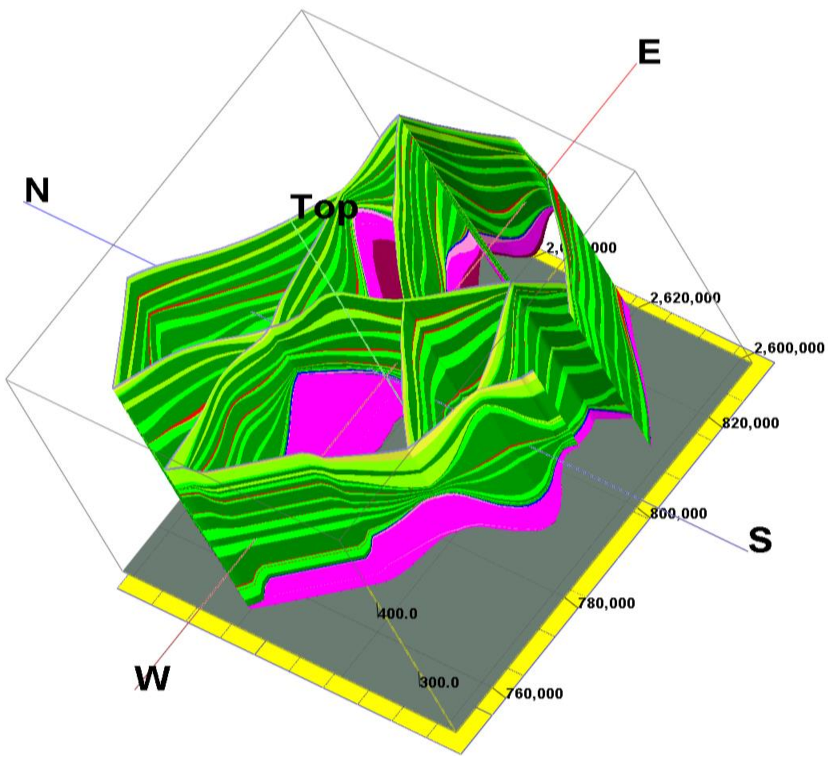
उत्तर मध्य क्षेत्र, भोपाल

North Central Region, Bhopal

जलभृत मानचित्रण और भूजल प्रबंधन योजना

विदिशा जिला, मध्य प्रदेश

AQUIFER MAPPING AND GROUND WATER MANAGEMENT PLAN OF VIDISHA DISTRICT,MADHYA PRADESH



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PREFACE

Aquifer mapping is as a multi-disciplinary scientific process, wherein a combination of geological, geophysical, Hydrogeological and geochemical studies is applied to characterize the quantity, quality and sustainability of ground water. Systematic aquifer mapping is a procedure to improve our understanding of the hydrogeological framework of aquifer system.

Under the project on National Aquifer Mapping (NAQUIM) in XII & XIII Plan to formulate sustainable aquifer management plan, Central Ground Water Board (CGWB), North Central Region, Bhopal has taken up Vidisha district to prepare the 3-Dimensional Model and 2-Dimensional Aquifer Maps for the entire district and formulate Block-wise Aquifer Management Plan.

Vidisha district occupies an area of 7371 sq. km out of which the ground water recharge worthy area is 6707.7 sq. km. and the rest is covered by hilly and forest area. The major rivers flowing through the area includes the Betwa River. The major part of the district is covered by the Deccan trap and Sandstone. As per the Dynamic Ground Water Resource Assessment Report (2020), the annual extractable ground water resource in the district 32665.13 MCM and ground water draft for all uses is 512.36 MCM, resulting the stage of groundwater extraction to be 60.74 % as a whole for district. The Vidisha district falls under safe but out of 7 blocks – 5 block falls under safe category and 2 block falls under semi critical category. After the implemented of project interventions in the report, the stage of extraction is expected to improve from 60.74 % to 57.65 % for the Vidisha district.

Vidisha district comprises of seven blocks namely Basoda, Gyaraspur, Kurwai, Lateri, Nateran, Sironj and Vidisha. Based on the available data and the earlier hydrogeological studies taken up in the district, an attempt has been made in this report to compile all relevant information, such as hydrogeological, agriculture, irrigation, land use, rainfall, chemical quality of water and other collateral data.

Before finalization of this report a three tier evaluation mechanism is adopted presentations were made at Regional level & State level Coordination Committee ,then the revised presentation were made before the Member and finally it was presented to National Level Expert Committee , after all corrections this report is prepared. Results of these comprehensive studies will contribute significantly to ground water sustainable management tools. It will not only enhance the long-term aquifer monitoring networks and but would also help in building the conceptual and quantitative regional ground-water-flow models for planners, policy makers and other stake holders.

I would like to place on record my appreciation of the untiring efforts of **Dr. Rakesh Singh, Scientist-'D'** for preparing the Aquifer maps and Management plan and compiling this informative report. I fondly hope that this report will serve as a valuable guide for sustainable development of Ground Water in the Vidisha district, Madhya Pradesh.

Rana Chatterjee
Regional Director

CONTENTS

Chapter-1

1.0 INTRODUCTION

Central Ground Water Board has pioneered extensive groundwater studies, in all the hydrogeological terrain of the country. It has remarkably brought out comprehensive regional picture of the aquifers in terms of their water quality and yield potential. To meet the challenges of growing ground water demand and sustainability of the resource, an effective aquifer based ground water management in the country, through adequate and precise information on aquifers in time and space at a scale as large as possible, is the most imperative and earnestly desired. The aquifer-mapping programme demands for a multi-disciplinary,multi-institutional, innovative and modern approach to arrive at a comprehensive aquifer data base under National Aquifer Mapping Programmed.

1.1 BACK GROUND OF AQUIFER MAPPING

'Aquifer mapping' is a holistic approach for aquifer-based groundwater management. It may not be construed as aquifer geometry mapping only. In a broader perspective it can be defined as understanding the aquifers, ascertaining and establishing their quantity and quality sustainability through multi-disciplinary scientific approach integrating the techniques of geology, remote sensing, hydrogeology, geophysics, borehole drilling, hydrochemistry, hydrology, hydrometeorology, mathematical modelling, agriculture and soil science, water treatment and remediation, economics and social and environmental sciences. Out of these the Geophysical technique will help as a strong tool to identify the aquifer geometry precisely.

1.2 SCOPE OF STUDY

At present a generalized picture of aquifer-dispositions and their characteristics are known from the existing hydrogeological and surface geophysical data, the borehole lithological and geophysical logs and the aquifer performance tests conducted by CGWB and other central and state agencies. But it is not enough to prepare aquifer maps because of the inadequate density of data vis-à-vis geological heterogeneities. The extrapolation and interpolation within the existing boreholes may not yield accurate information on aquifer disposition unless they are tied up further by close-grid geophysical measurements conducted in between. This has necessitated in asystematic mapping of aquifers. Further hydro-geological investigation either by geophysical technique or by exploration is proposed for the aquifer mapping. It is to provide adequate and precise subsurface information in terms of aquifer lithology and geometry leading to 3-dimensional aquifer dispositions. Also it is to establish the most appropriate technique or combination of techniques for identifying the aquifers in different hydrogeological terrains.

1.3 OBJECTIVES

The objective of applying the hydrogeological and geophysical techniques is to provide more adequate and more precise (reduced uncertainty and ambiguity) information on aquifers–shallow and deep including dry and saturated zones with their geometry at reasonable scale (1: 50,000) in the area. The tentative depth of the hydrogeological and geophysical exploration will be 200 m in hard rock area. However, the depth of exploration may vary depending on the geological conditions and requirements.

Additional exploratory wells shall be drilled for validations of aquifer parameter estimations where borehole data are not available.

The information thus generated through additional drilling of boreholes shall be used for refinement of hydrogeological data base in terms of aquifer characterization, yield capacity, chemical quality, selecting areas for artificial recharge and sustainability under varied future demand scenario leading to preparations of aquifer-management plans and recommendations to mitigate mining of aquifer.

1.4 APPROACH AND METHODOLOGY

National Aquifer Mapping Programme basically aims at characterizing the geometry, parameters, behavior of ground water levels and status of ground water development in various aquifer systems to facilitate Major Aquifers planning of their sustainable management. The major activities involved in this process include compilation of existing data, identification of data gaps and generation of data for filling data gaps and preparation of aquifer maps. The overall methodology of aquifer mapping is presented once the maps are prepared, plans for sustainable management of ground water resources in the aquifers mapped shall be formulated and implemented through participatory approach involving all stakeholders.

1.5 STUDY AREA

Vidisha district is lying in the central part of Madhya Pradesh. It is in Bhopal commissioners division and is well connected by roads and railway. National Highway 67, connecting Bhopal and Dewas passes through the district. There are 7 tehsils and 7 blocks in the district (Fig 1). The block headquarters are Vidisha, Gyarspur, Basoda, Nateran, Kurwai, Sironj, Lateri. Vidisha district with an area of 7371 km^2 lying between the North Latitudes 22°20' and 24°22' and East Longitudes 77°16' and 78°18'" and falls under the Survey of India toposheet No. 54H, 54L, 55E and 55 I. The district is encircled by Guna district in the North, Sagar and Raisen in the east, Raisen in the South and Bhopal in the west.
The district is sub divided into seven administrative blocks and seven tehsils. The administrative divisions are shown in fig-1 and details of administrative units and block-wise area are given in table 1 and table 2 respectively. There are 577gram panchayats and 1524 villages in the district. As per census 2011,the total population of the district is 14,58,875.

Table 1: Administrative Units of Vidisha district

Total Blocks	Area (sq km)
Total Geographical Area (sq km)	7371
Recharge worthy Area (sq km)	6707.7 (91%)
Hilly/Forest (sq km)	663.3

Table 2: Block-wise area of the district

Block	Total Geographical Area(Sq Km)	Total Recharge Area (Sq Km)
Basoda	1223	1088
Gyaraspur	872	841
Kurwai	831	810
Lateri	986	892
Nateran	1130	977
Sironj	1255	1037
Vidisha	1074	1062.7
DISTRICTTOTAL	**7371**	**6707.7**

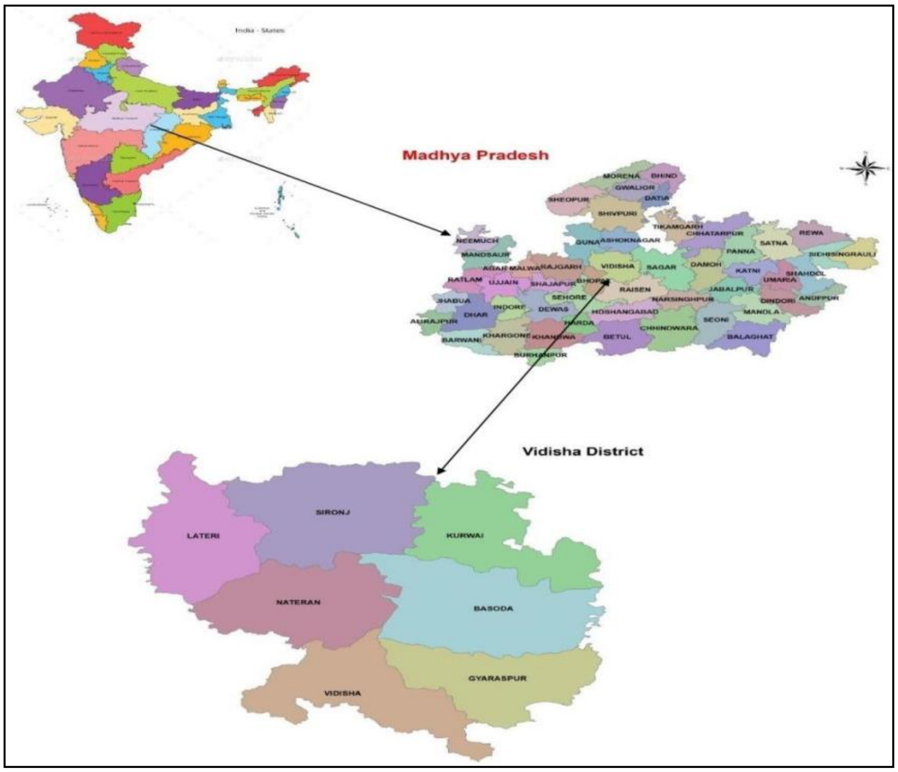

Fig 1: Location map of Vidisha district

1.6 CLIMATEAND RAINFALL

➢ RAINFALL

The normal rainfall of Vidisha districtis 1135.5mm.There is one distint rainy season when the statereceives rain through the south-west monsoon in the months of June to October. About 91.4% of rain is received during the monsoon period,only 8.6% of the annual rainfall takes place during October to May. The average number of rainy days are 54. The maximum rainfall is received at Kurwai (1191 mm) and minimum rainfall is received at Bareli (1150.3). Annual rainfall and average annual rainfall of previous five years are given in table 3 and table 4 respectively.

Table 3: Annual rainfall

S. no.	Year	Annual rainfall (mm)
1	2011	1373.84
2	2012	938.94
3	2013	1690.58
4	2014	994.43
5	2015	998.42
6	2016	1474.87
7	2017	835.49
8	2018	998.24
9	2019	1795.47
10	2020	1050.97

Table 4: Average Annual Rainfall of Previous Five Years (in mm)

S no.	Blocks	Yearwise rainfall (mm)			
		2011-12	**2012-13**	**2013-14**	**2014-15**
1	Vidisha	848	1350.4	1388.8	1469.3
2	Basoda	805	1272	994	2159.4
3	Gyaraspur	758	1086	908	1691.55
4	Nateran	804	1324	992	1486
5	Kurwai	942.4	1415	950.8	2037
6	Sironj	1016.6	1263	648	1225.6
7	Lateri	974	1070	1117	1579
	Average	**878.28**	**1254.34**	**999.8**	**1663.97**

(DIP,Vidisha)

- **TEMPERATURE**

The climate of Vidisha district characterized by a hot summer and general dryness except during the southwest 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 middle of June.The period from the middle of June to September is monsoon season. October and November form the post-monsoon or transition period.

The January is the coldest month of the year. The individual day temperature comes as low as 1 or2°C. From March onwards, the temperature starts rising and maximum temperature is observed during the month of May. On the arrival of monsoon the weather becomes pleasant. In October, on the retreating of monsoon the temperature rises lightly during the day time and nights become pleasant.

- **HUMIDITY AND WIND**

The driest part of the year is the summer season, when relative humidity is less than 39%. 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 11.2 km/hr observed during the month of June and is minimum 1.5 km/hr during the month of December. The average normal annual wind velocity of Vidisha districtis 5.3km/hr.

1.7 PHYSIOGRAPHY

Vidisha in Madhya Pradesh coordinates: 23.53°N latitude and 77.82°E longitude. It has an average elevation of 511 metres (1391 feet). Situated on the Eastern part of the fertile Malwa region, the Tropic of Cancer passes through the Southern part of the district. Vidisha is bounded by Raisen district in the South, Guna district in the North, Sagar district in the East. Owing to its proximity to the Bes and Betwa rivers, Vidisha was a prominent district for trade in erstwhile periods. With fertile black soil, rich vegetation and high mineral reserves, Vidisha is also very fertile. DEM map of district is represented by fig.2

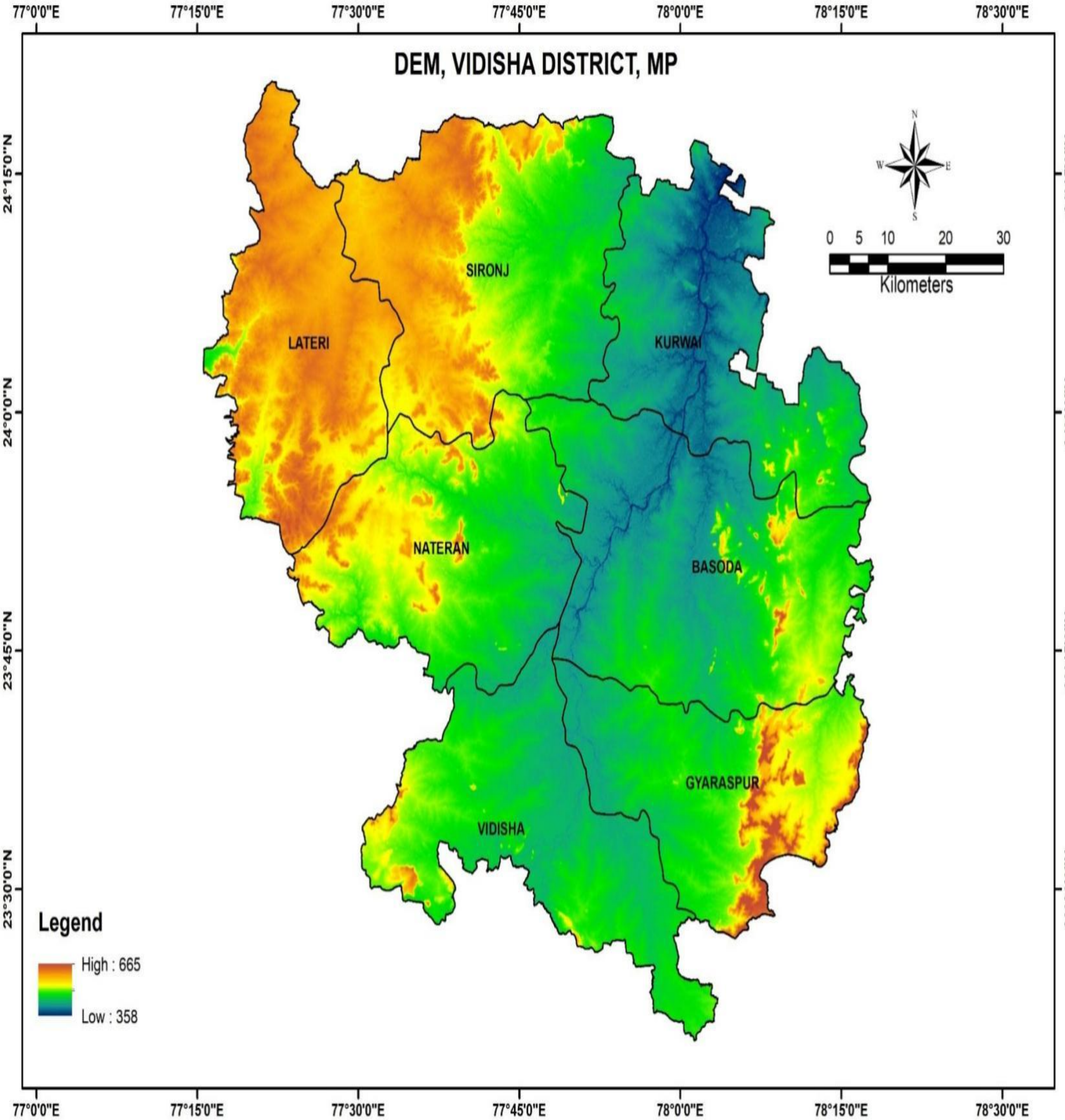

Fig 2: DEM map of Vidisha district

1.8 GEOMORPHOLOGY

Physiographically the district has been divided into three major units i.e. Malwa Plateau, Vindhyan Hill range and Alluvium plain. The district is formed by the valleys of major rivers like Betwa basin and Sindh River.

Most part of the district, measuring about more than 80% is located in the Betwa river basin, which is drained by its tributary like Bah nadi, Nion river, Keother nadi, Bina river and Kethan nadi. The presence of elevated ground on all the sub-basin marks the surface water divides. The interior area of the basin is marked by undulating topography with elevated plains with very few low altitude isolated hills. The ground elevations in the area vary between about383 m (Kurwai Block) in the northeast and about 550 m (Lateri Block) in the northwest part of district. Fig 3 represents the geomorphology of the district.

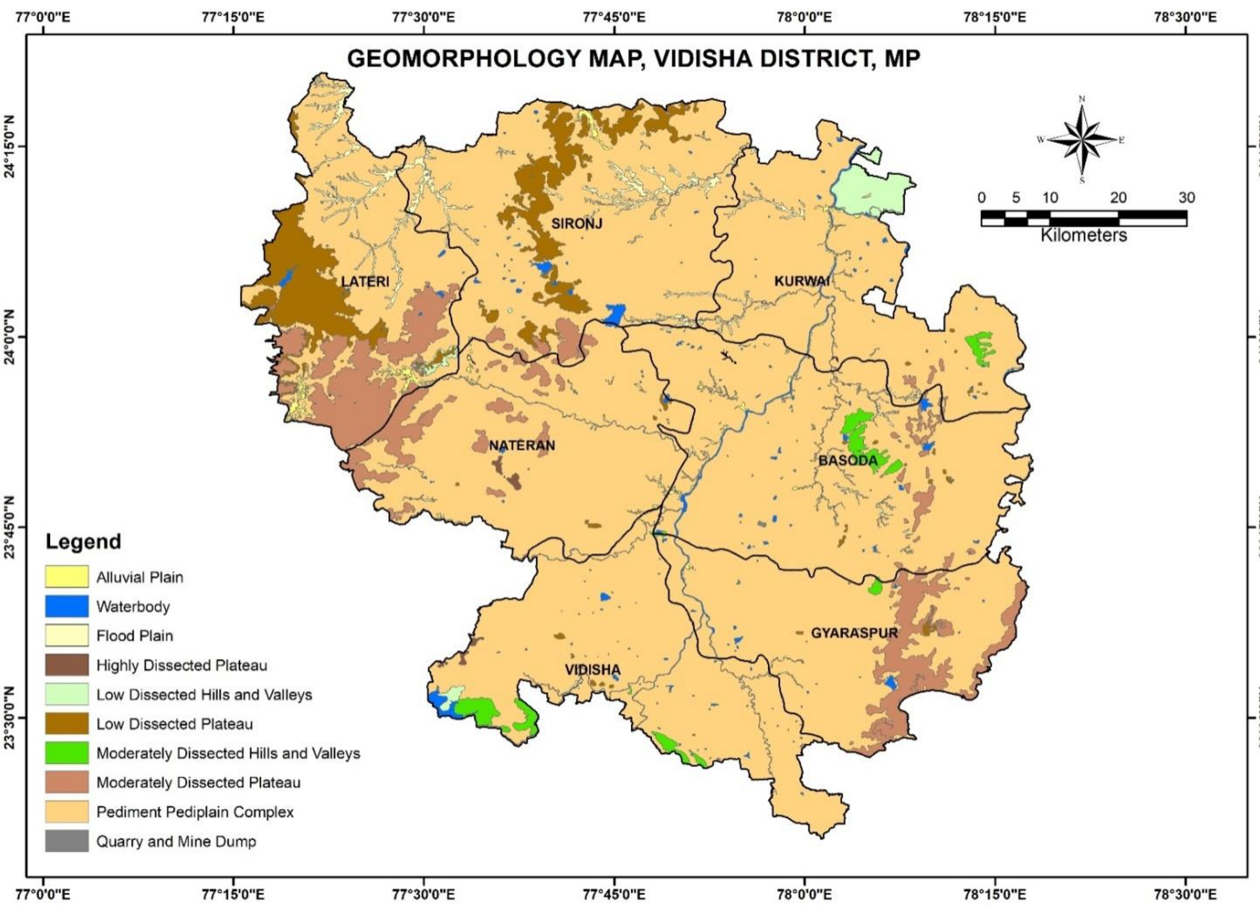

Fig 3: Geomorphology map of Vidisha district

1.9 SOILCOVER

The district is generally covered with black cotton soils covering almost three-fourths of the area. This part is occupied by Deccan basalts. The rest part has red yellow mixed soils derived from sandstone, shale. The alluvial soils are found Along the river courses. The higher elevations i.e. the hilly regions have a cover of murum which is made up of small rounded pieces of weathered trap.The Vindhyans and Bijawars have a thin cover of sandy loams,alluvium is derived from hills slopes by numerous streams and water courses.

The black soils cover70.8% area followed by red soil 11.8%, sandy loams 4.7% and sandy soil 3.5%. The dominant soil caps of the area represented by gently to very gently sloping. The soil of the region falls in dry sub-humid region, the dominant soil scapes of the area are represented bygentle to very gentle slope, shallow and moderately deep with the moisture index ranging from (-)03 to (-) 22. The clay content ranges between 63-65% decreasing abruptly to 54% in the sub-soil region. These are highly saturated soils and the exchange complex is dominantly saturated by divalent while the montmorillonite constitute the dominant clay material in the exchange complex (Fig 4).

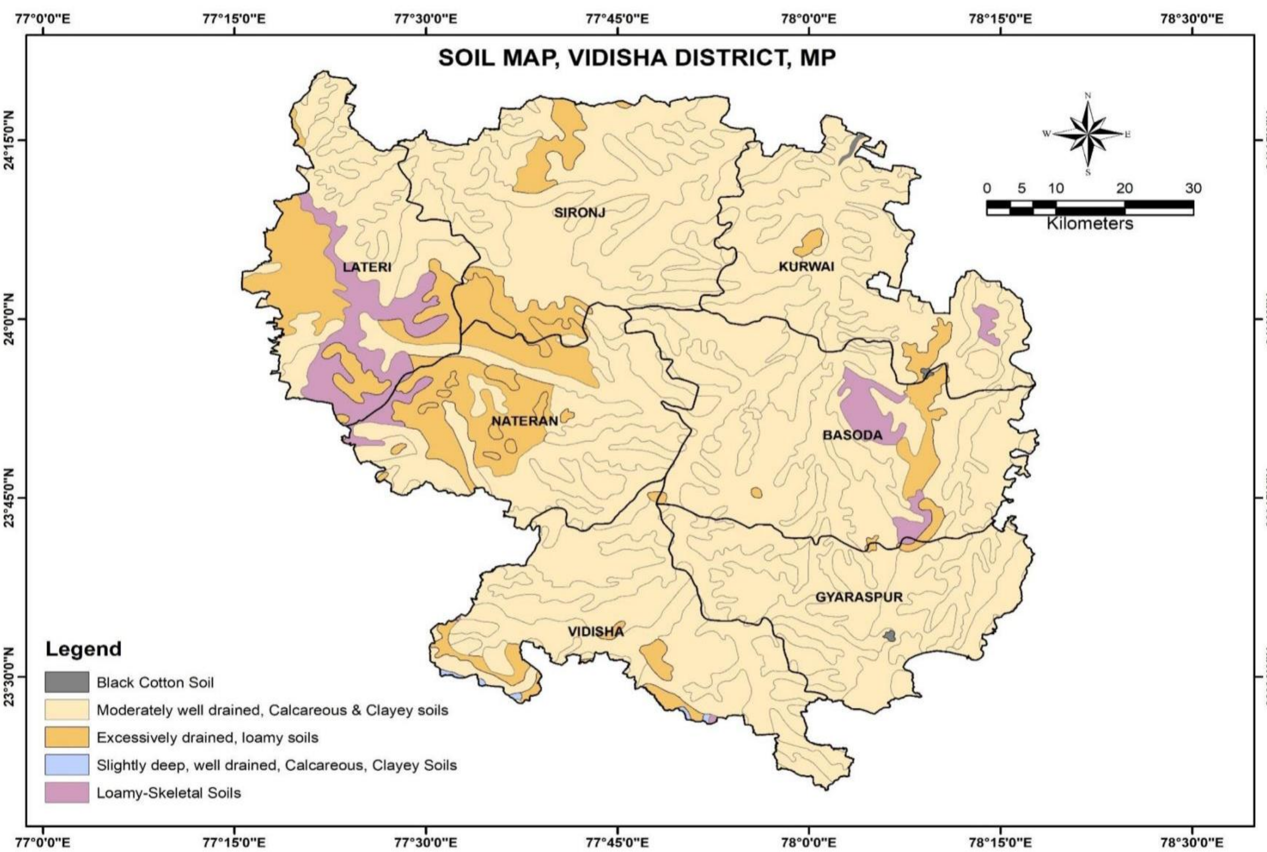

Fig 4: Soil map of Vidisha district

1.10 GEOLOGY

Most of the area of district is occupied by Deccan trap and remaining areas are covered by alluvium and Vindhyan formations. The generalized geological succession is given below in table 5 and the hydrogeological map of district is shown in fig 5.

Table 5: General geological succession of Vidisha district

Age	Formation		Lithology
Recent to Pleistocene	Alluvium		Clay with Kankar Sand and river alluvium
	Laterite		Small capping of lateritic on hills and Patches in river valley
Upper Cretaceous to Lower Eocene	DeccanTrap		Lava flows of basalt with red bole and Intertrappean beds
Upper Pre-cambrian to Lower Palaeozoic	Vindhyan system	Upper Bhander series	Upper Bhanders and stones Sirbushales at the base of scarps.
		Lower Bhander series	Lower Bhander sandstone but intercalated bands of shales known as Sanchishale, Bhander limestone and Ganurgarh shale

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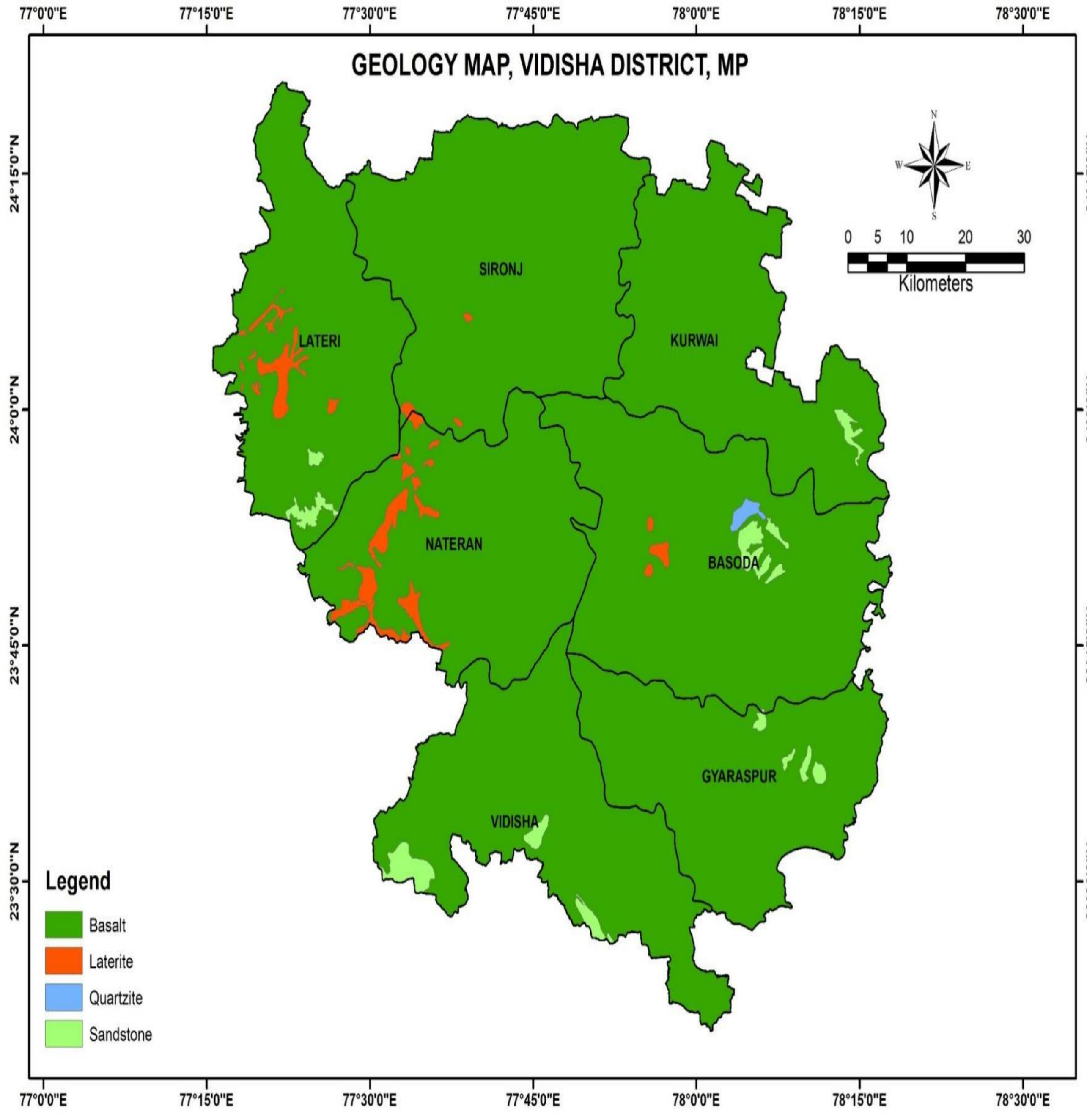


Fig 5: Geology of Vidisha district

1.11 DRAINAGE AND HYDROLOGY

The plain of the district is mainly drained by Betwa and its tributaries. The river Parvati also contributes draining though a very small area.

Betwa (Betrawati) is the main river of the district which takes birth from extreme south-west (23°02’N 77°20’E) corner of Vidisha district. After rising from the hills in Vidisha, it entersin Vidisha district (about 6 km away from Vidisha town towards south) and flows for about 96km in the district. The river traverses variety of landforms in Guna, Shivpuri, Tikamgarh (M.P),Jhansi, Hamirpur, Jalaun (U.P.) before submerging into the Yamuna. The important left bank tributaries are Kaliasot, Anjar, Ole Besh, Bah, Sahodara, Sagar, Kathan, Orr, Rechhan, Dabar,Nion,Parasari, Bina,Jamni,Dhasan and Birma join the river on its right bank.

The Sahodara nala on which the Ahmedpur rock shelters stands rise from the Reserve forest of Nasurabad in District Bhopal, south-east of Berasia. After flowing about 5 km in the hilly tract, it enters the plain and piles up a thin blanket of alluvium on both banks before the nala meets with the Betwa river.The total stretch of Betwa river in the district is about 50km (Fig 6).

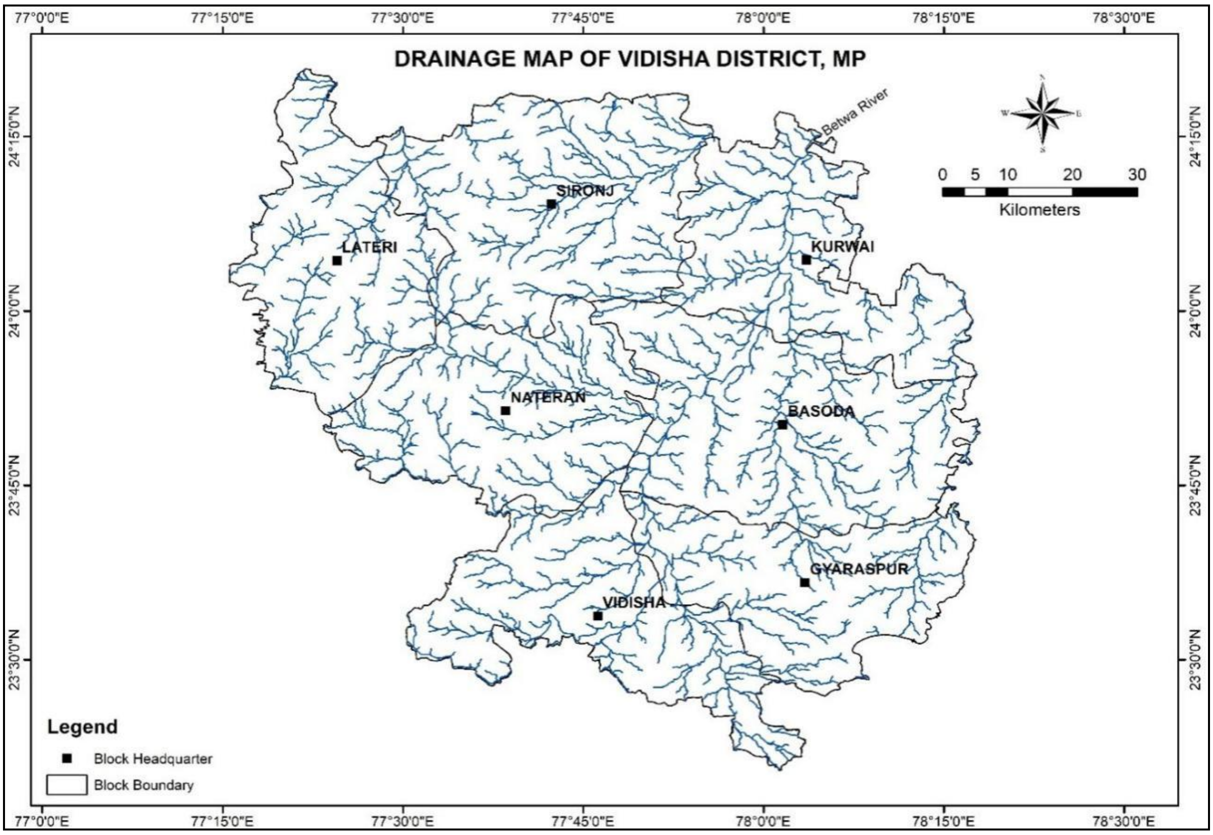


Fig 6: Drainage map of Vidisha district

1.12 LANDUSE, IRRIGATION AND CROPPING PATTERN

Out of total area, 537654 sq km is under cultivable area which is 72.94% of the total geographical area of the Vidisha district. Forest area is 14.87%, cultural wasteland is 3.73%,current fallow land is 0.40% and 8.06% is under other uses out of total geographical area (Fig 7).The block-wise land use pattern is given in Table 6.

Table 6: Land use pattern

Block	Geographical area	Cultivated area	Cultural wasteland	Current fallow	Forest land	Area under other uses
	Ha					
Vidisha	107400	88686	4341	132	5659	8582
Gyaraspur	87200	62560	1775	138	18171	4556
Basoda	122300	99816	3794	390	11019	7281
Nateran	113000	74871	5833	544	15266	16486
Kurwai	83150	70974	4668	262	166	7081
Sironj	125500	89867	4575	847	20817	9394
Lateri	98647	50890	2504	632	38568	6053
Total	**737197**	**537664**	**27490**	**2945**	**109665**	**59433**

Source:DIP,Vidisha

The area irrigated by borewells is 106300 ha (41.4% of the total irrigated area), by open-wells 42700 ha (16.6%), irrigated by canals was 39900 ha (15.5% of the total irrigated area) and by tanks 4800 ha (1.8%). The net area under irrigation is 255500 ha and the area under rain fed irrigation is 275900 ha. Table7

Table 7: Sources of irrigation

Irrigation	**Area('000ha)**		
Net irrigated area	255.5		
Gross irrigated area	255.5		
Rainfed area	275.9		
Sources of irrigation	**Number**	**Area**	**Percentage of total irrigated area**
Canals	11	39.9	**15.5**
Tanks	23	4.8	**1.8**
Openwells	11816	42.7	**16.6**
Borewells	16057	106.3	**41.4**
Liftirrigation schemes	NA	-	**-**
Micro-irrigation	NA	-	**-**
Other sources(reservoir)	03	61.90	**24.14**
Total irrigated area	-	255.50	**-**

Source:NICRA,Vidisha

Lateri block has the minimum irrigation potential whereas Kurwai has the maximum area under irrigation as compared to net sown area. The scarcity of power restricts the choice of irrigation source and hampers the agricultural operations. The block-wise area under irrigation is given below in Table 8:

Table 8: Area under irrigation

Block	**Irrigated area(ha)**		**Rainfed area(ha)**	
	Gross Irrigated area	**Net irrigated area**	**Partially irrigated/Protective region**	**Un-irrigated or totally rain fed**
Vidisha	122129	84227	16845	10107
Gyaraspur	69472	47912	9582	5749
Basoda	104436	72025	14405	8643
Nateran	78419	54082	10816	6490
Kurwai	91383	63023	12605	7563
Sironj	82105	56624	11325	6795
Lateri	50285	34679	6936	4161
Total	**598229**	**412572**	**82514**	**49509**

Source:DIP, Vidisha

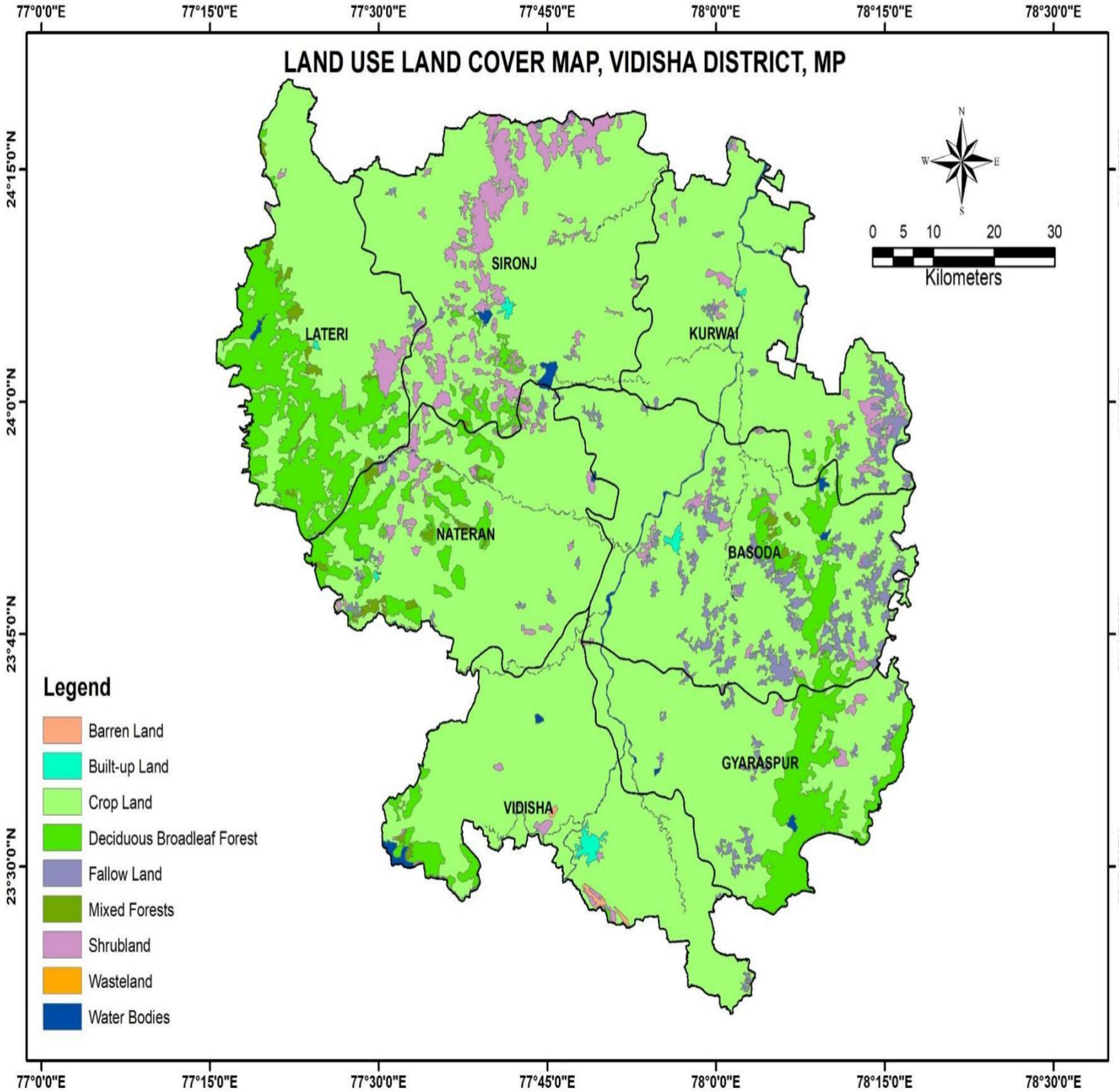


Fig:7 Land Use, Land Cover Map

1.13 AGRICULTURE

The district produces soybean, pigeon pea and maize in Kharif and wheat,gram and lentil in Rabi season. The Kharif area is 90%rain fed and Rabi area is 34% rainfed.

The principal crop grown during Kharif and Rabi season is given in table 9 below:

Table 9: Area covered under different crops

Block	Wheat	Maize	Sorghum	Grains	Chickpea	Pigeon pea	Total Pulses	Soybean	Total oilseeds
	Ha								
Vidisha	44606	349	55	45204	30614	137	39547	45211	45294
Gyaraspur	27096	275	48	27602	23657	158	35938	23987	24060
Basoda	27027	468	91	27884	39142	230	71113	22855	23002
Nateran	27537	777	434	28848	30521	524	42340	36623	36884
Kurwai	8122	367	130	8983	37397	18	69984	12667	13207
Sironj	24589	1442	1191	27251	38580	133	60149	24813	25348
Lateri	20948	1581	1012	23541	21269	50	25680	14189	14456
Total	**179925**	**5259**	**2961**	**189313**	**221180**	**1250**	**344751**	**180345**	**182251**

Source:DIP, Vidisha

Chapter-2

DATA COLLECTION AND GENERATION

2.1 HYDROGEOLOGY

Description of rocks and their water bearing properties

Vindhyan System

Vindhyan formations comprising of sandstone shales and breccias are exposed in the western and southeastern part of the district. The small patches of Vindhayans are exposed in the form of hills.A major part of Nateran, Gyarspur and Basoda blocks is occupied by Vindhyan formation and comprises of sandstone and shales. The sandstones are normally hard, Quartzitic, massive and compact. However, they are jointed at the surface level.

The Vindhyans are, in general, poor aquifers, however, these formations when subjected to weathering or jointing and fracturing gives rise to moderately yielding aquifers. The depth to water level in this formation varies from 4.0 m to 10.0 mbgl and seasonal water level fluctuation ranges from1to4.00meters.The yield of wells in this formation varies from 0.5 to 6 lps.

Deccan trap formations

Deccan trap formations occupy more than 60% of the total area of the district. The general flow is characteristic of lava flows in the area are the most of the flows are of 'Aa' type in nature being disposed in a three-fold system along a vertical column. Each flow normally consists of an upper fragmentary zone, a middle massive part and an impersistent thin layer of basalt clinkers. The fragmentary top zone presents a brecciate look. It is very often highly vesicular and amygdular.

The vesicles are generally sub- rounded to irregular in shape. The middle part comprises of massive basalt, which is aphanitic to highly porphyritic. Basalt clinker & horizon is impersistent and often absent. The thickness of this horizon where ever present varies between a few centimeters to about 0.50 m. This zone is analogous to top vesicular amygdular horizons in physical characters. Variation in thickness of different flows is also evident in the area.

Most of the flow contacts can be demarcated by the presence of a red bole horizon. About10-12 flows of Deccan trap can be identified in the district. In general the thickness of the individual flows range between 4 and 12m. However, the older flows seem to have more thickness comparedto the younger ones as indicated by flow numbers, 0 and 1. A major part of Lateri, Sironj, Kurwai, Nateran and basoda is covered by Basaltic rock formations.

The main aquifer systems in the formation are the weathered, vesicular flow contacts jointed, fractured zones etc. The ground water occurs mainly under phreatic conditions the red bole horizon generally confined conditions the red bole horizon generally act as semi-confining and confining layers in the deep aquifers. The yield of wells in this formation varies from 1to 5lps. Fig 8 represents hydrogeology map of the district.

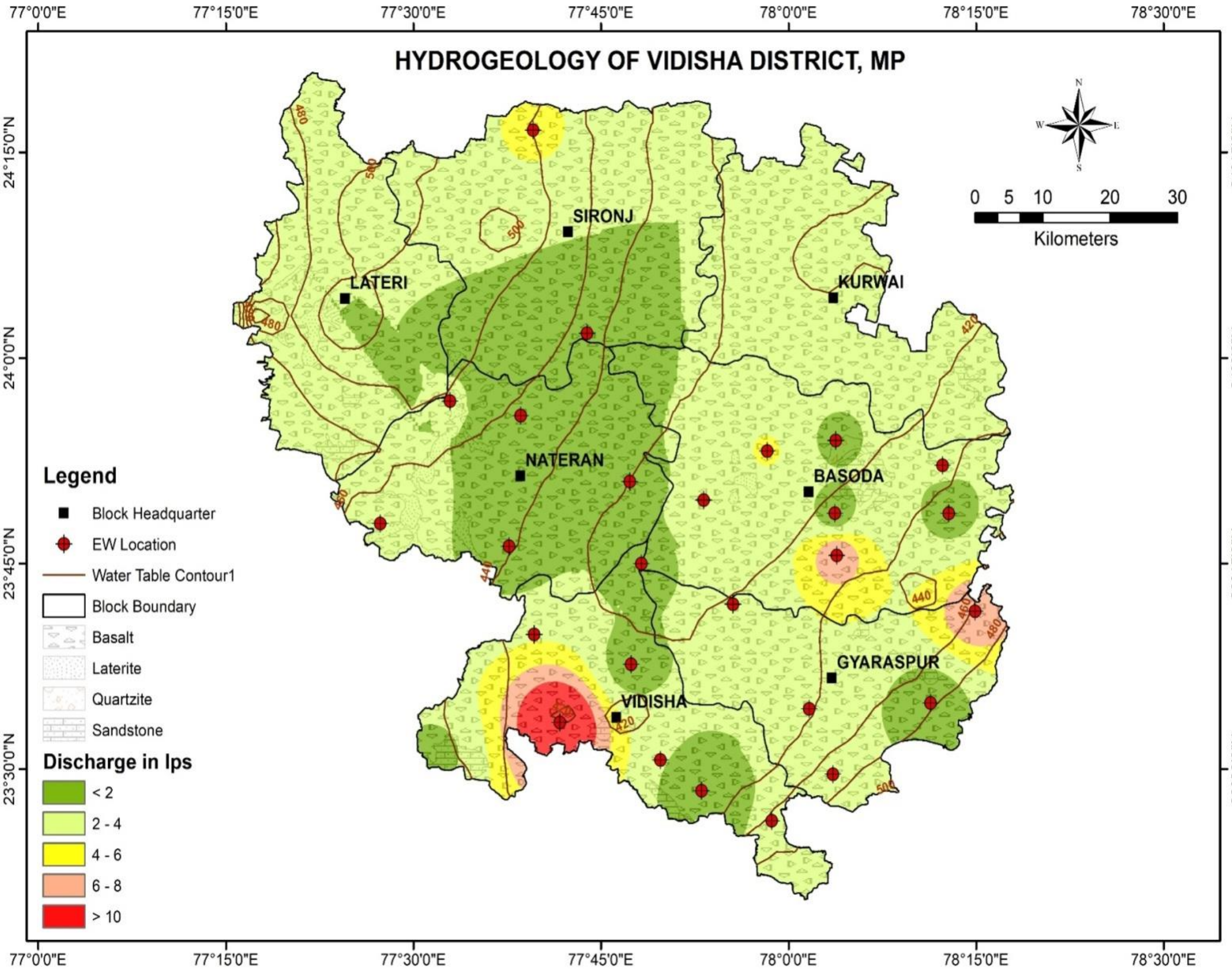


Fig 8: Hydrogeology map of Vidisha district

Alluvium

Recent to sub-recent alluvial formations of significant extension occur in the south eastern part of the district falling in Vidisha and Gyarspur block. The alluvial formation in this part occurs along the Betwa River. The other patches of alluvial formation, though insignificant in both aerial extension and thickness occur along the major rivers and streams flowing in the area. The alluvial formations comprises of Silt, Clay, Sand, Gravel and Pebbles Cobbles etc. with Kankar. The sandy gravelling zones when saturated form very good aquifers. The yield of the formation depends upon the ranges from 4 to10 lps.

2.2. GROUND WATER SCENARIO

(i) Water Levels

Water level data, including historical data are essential for not only to know the present ground water conditions but also for forecasting future trends in response to ground water reservoir operations. There are 35 monitoring wells in Vidisha district (fig 9), Using the water level data of NHS monitoring wells pre and post monsoon depth to water level maps are prepared.

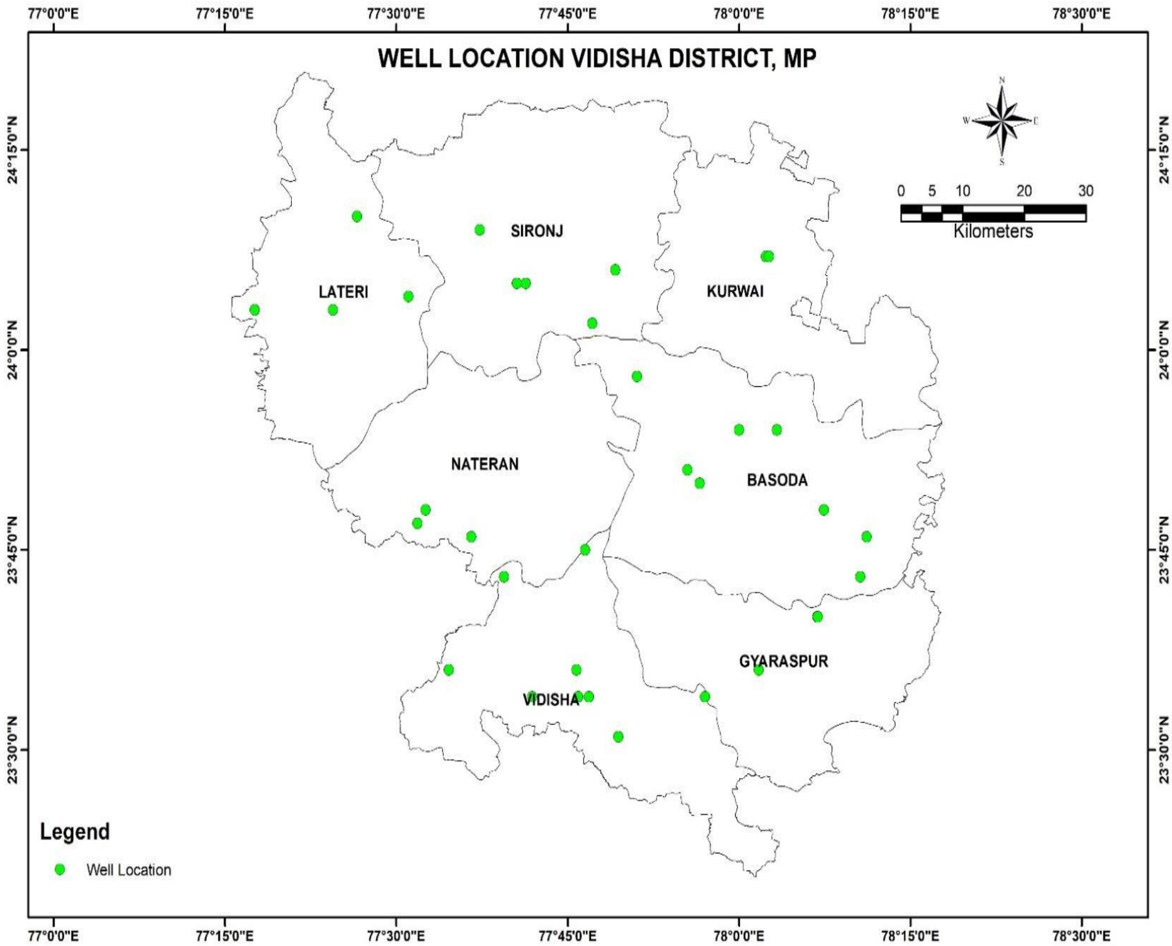


Fig 9: Monitoring well locations map

- **Pre Monsoon (May2021) :**

  Pre-Monsoon depth to water level in the year 2021range from 3.15 to 21.45 mbgl. Shallow water level (<2.00m) occur in the central part of the district (Refer Fig 10).

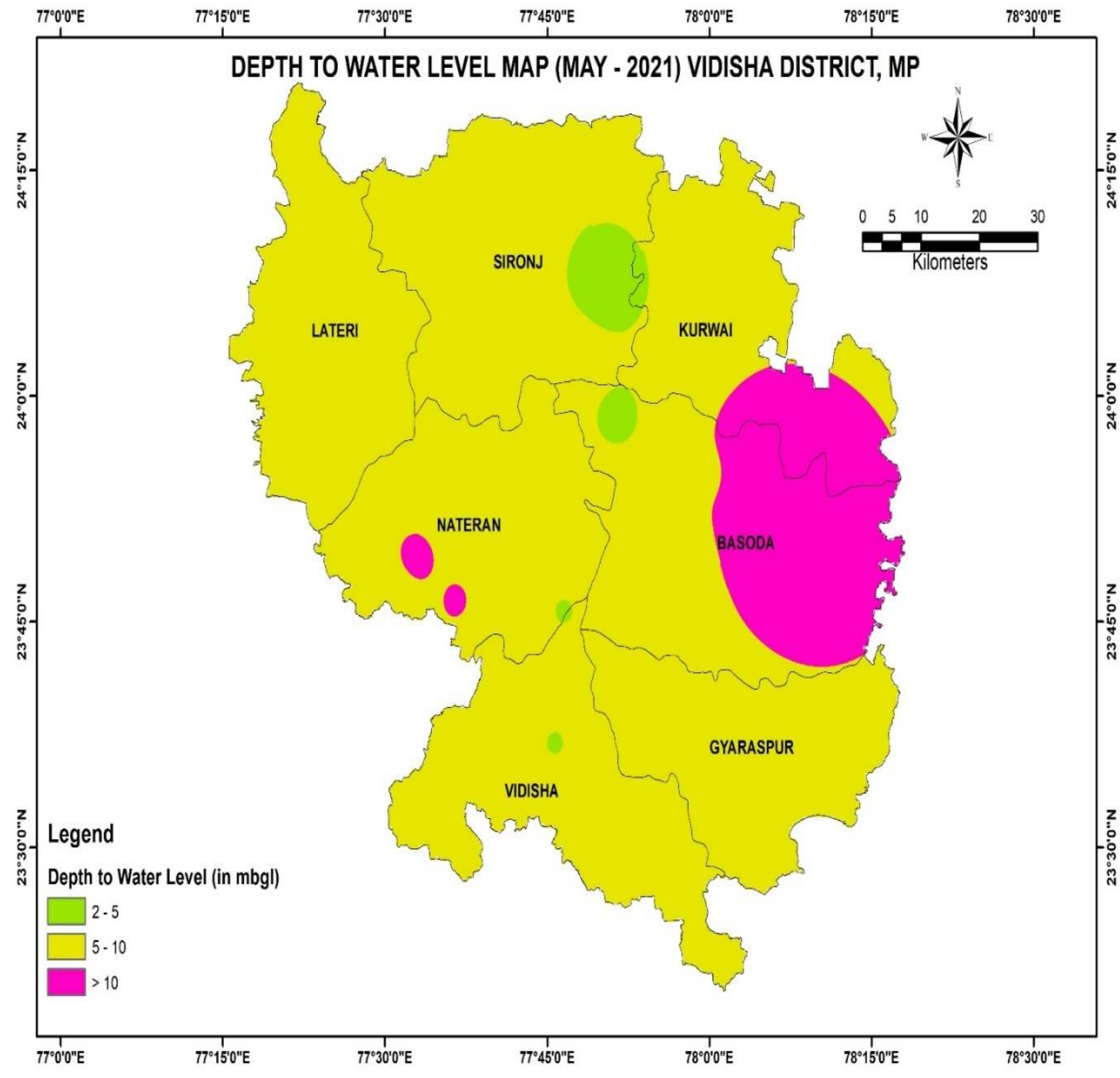


Fig 10: Pre-monsoon depth to water level map

- **Post Monsoon (November2021) :**

During post monsoon period, water level ranges from 1.23 to 14.7 mbgl. Shallow Water level (< 2 mbgl) occurs in central & northern parts while deep water levels (>10 mbgl) observed in Vidisha district (Refer Fig 11).

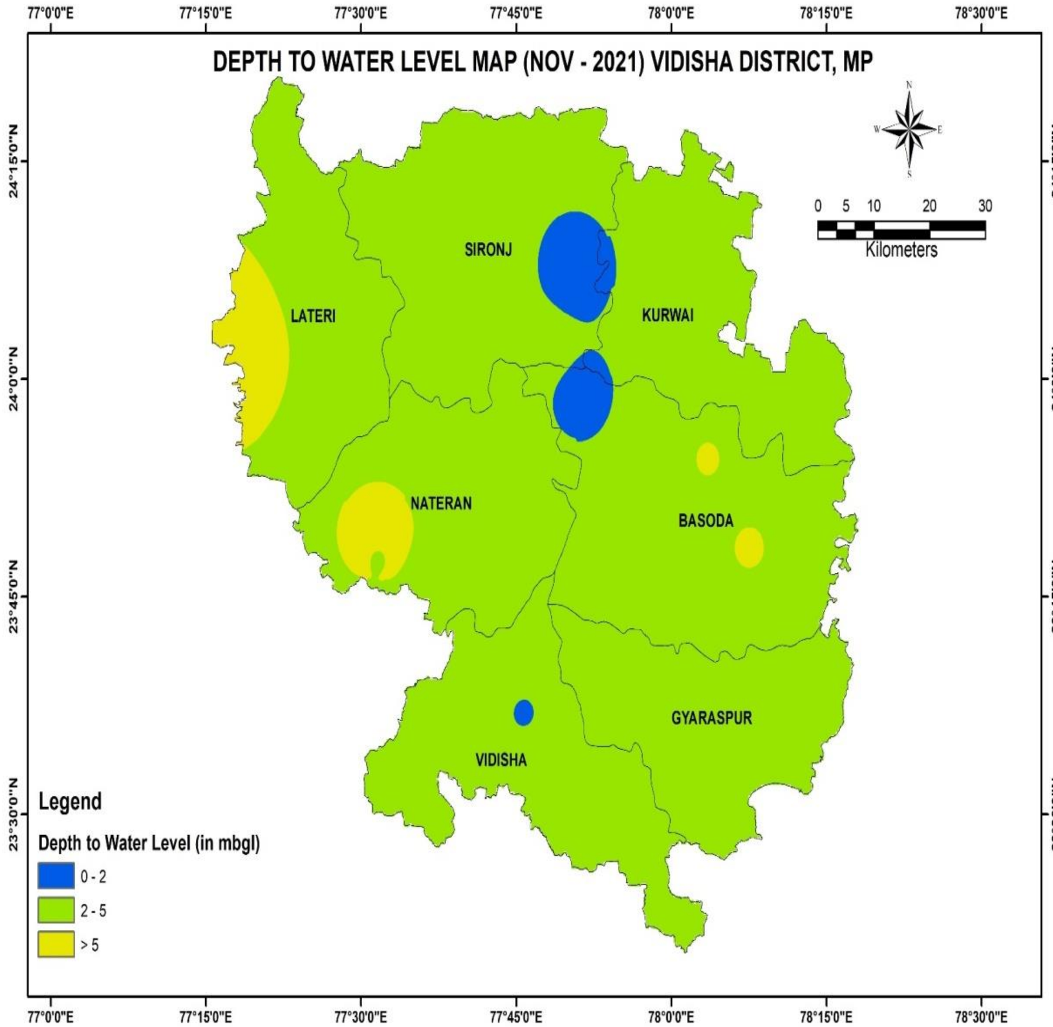


Fig 11:Post-monsoon depth to water level map

- **Pre and Post Monsoon Fluctuation 2021**

Pre and post monsoon fluctuation for 2021 is presented in Fig 12. The water level fluctuation map shows that in maxiumum area of the district water level fluctuation ranges from 2 – 5 m, in some portion (i.e. in Basoda block) water level fluctuation is more than 5 m and in some patches water level fluctuation between the ranges 0 – 2 m.

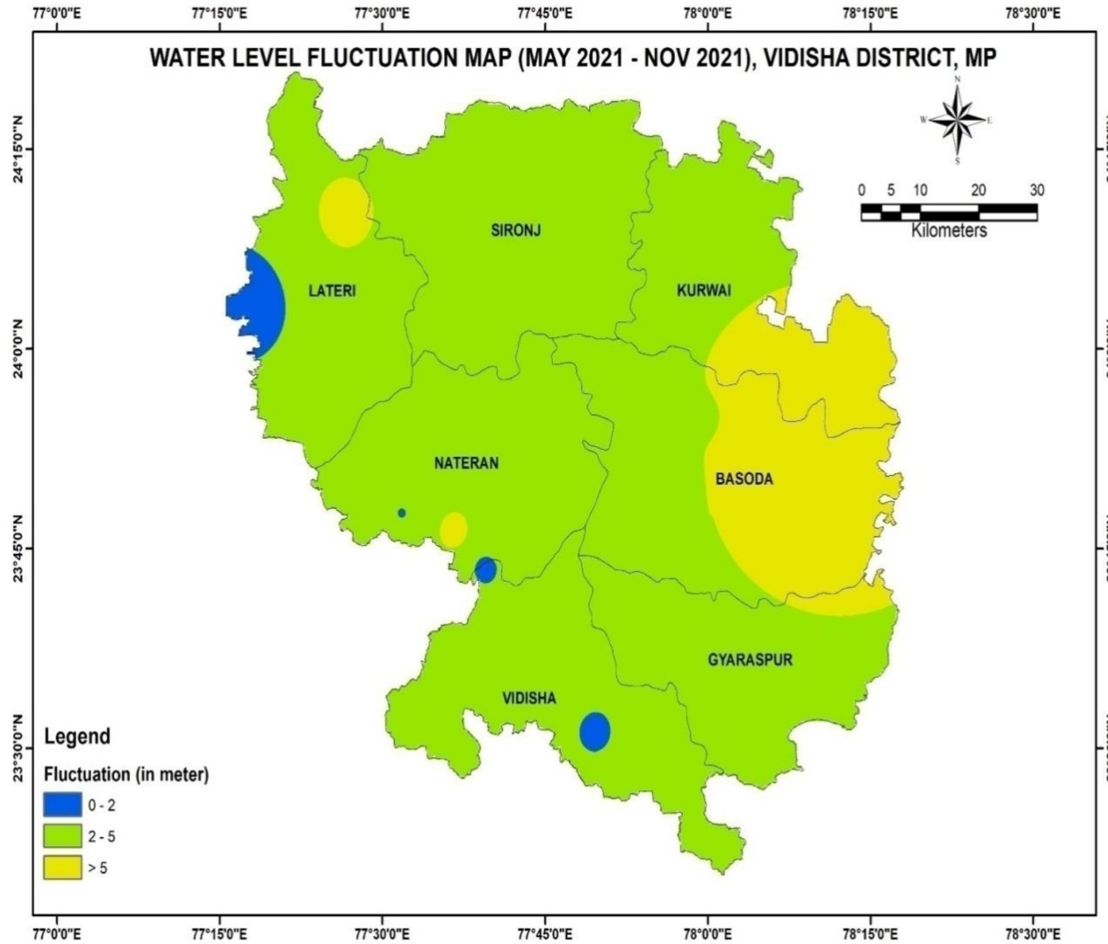


Fig 12: Fluctuation (Post-monsoon &Pre-monsoon 2021) Map

2.3 GROUNDWATER EXPLORATION:

27 exploration borewells have been drilled in Vidisha district through outsourcing by WAPCOS in 2021-22 (Refer Fig 13). On the basis of samples collected during drilling, lithologs have been prepared. The aquifer parameters are calculated on the basis of pumping tests. The salient details of the some of the drilled borewells and piezometers is given in Table 10.

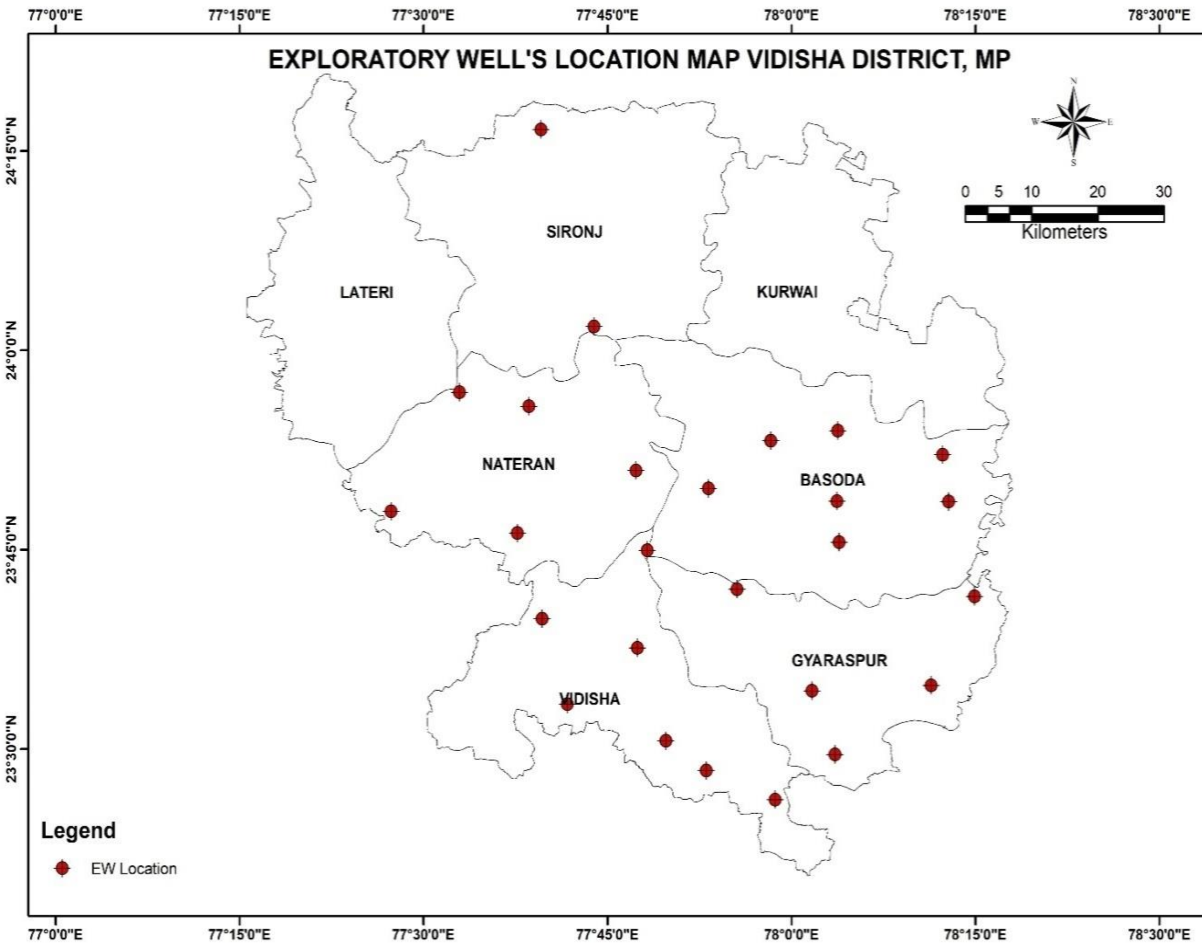


Fig 13: Exploratory Wells Location, Vidisha District

Table 10 – Exploratory Wells, Aquifer Trap and Discharge

S. No	Site	Block	Latitude	Longitude	Drilling depth (m)	Major Formation	Zone trapped(m)	Discharge (lps)
1	AgraJagir	Nateran	23.947335	77.548703	204.6	Basalt+Redbole	13.71-14.00,60.35-61.00	1.74
2	AhmedpurKasba	Vidisha	23.437	77.9777	204.6	Basalt+Redbole	51.20-52.00,114.10-114.70,129.00-129.50	1.74
3	Ambar	Gyaraspur	23.573197	78.027433	204	Basalt+Redbole	10.60-10.90, 99.30-99.60	
4	AtalUdyaan	Vidisha	23.5108	77.8291	207.5	Basalt+Redbole+Sst	10.50-10.70	Negligible
5	Barkheragambhir	Gyaraspur	23.49339	78.05907	203	Basalt	9.15-9.70	2.44
6	Barkhedajat	Nateran	23.92978	77.64293	203	Basalt+Carbonaceousclay	6.50-6.70,100.20-100.50	1.19
7	Bagaroda	Sironj			99	Basalt	78.20-78.50	6.71
8	Bhiakhedi	Nateran	23.7984	77.4559	204.6	Basalt+Redbole	31.20-31.40,89.91-90.30,180.00-180.60	2.92
9	Bhidwasan	Basoda	23.759515	78.064408	204.6	Basalt,Sst,Redbole	28.95-29.30,44.19-4510,82.29-83.50	8.2
10	Boodhar	Nateran	23.8495	77.7884	203	Basalt,Sst	16.20-16.50,40.10-40.40	0.75
11	Chouravar	Basoda	23.8269	77.8868	203	Basalt,Redbole,Sst	54.25-55.00,91.00-91.50,148.50-149.00	2.8
12	Deeghora	Basoda	23.81099	78.0616	204.6	Basalt,Redbole	15.24-15.50,89.91-90.35	0.21
13	Deyarpur	Gyaraspur	23.69168	78.248428	91	Basalt	31.50-31.80, 67.50-68.00	8.2
14	Gunnota	Gyaraspur	23.5801	78.1893	203	Basalt+sandstone+ Redbole	Dry	Dry
15	Hansua	Vidisha	23.4734	77.8841	117.8	Basalt	19.50-20.00,78.00-78.50	0.01

S. No	Site	Block	Latitude	Longitude	Drilling depth (m)	Major Formation	Zone trapped(m)	Discharge(lps)
16	Kagpur	Vidisha	23.74953	77.80385	204.6	Sandstone	54.25-55.00	0.75
17	Lashkarpur	Vidisha	23.6272	77.7903	179.8	Basalt+ Sandstone	41.15 -41.55,55.80-56.20,173.00-173.50	0.43
18	Masoodi	Sironj			204	Basalt+ Redbole	55.50 to55.80, 188.80 to189.00	0.43
19	Moondrabagal	Sironj	24.0299	77.7314	203	Basalt+ Redbole+ sandstone	Dry	Dry
20	Motipura	Nateran	23.770838	77.627454	204.6	Basalt+ Redbole+ Sandstone	18.30-18.60,57.90-58.30	0.43
21	ParasiGujjar	Vidisha	23.5565	77.6952	113	Basalt+ Sandstone	19.80-20.30,61.50-62.00,111.50-112.00	13.74
22	Rabrayai	Basoda	23.8867	77.9715	203	Basalt+ Sst	124.00-125.50,139.00-139.50	4.26
23	Ratanbarri	Sironj			204	Basalt +Red Bole	35.90-36.10, 121.50-122.20	0.21
24	Rehmanpur	Basoda	23.810702	78.213346	197	Basalt, Sst, Redbole	45.00-45.20, 95.00-95.30	0.75
25	Saloi	GanjBasoda	23.4642	77.5234	161	Basalt+ Redbole+ sandstone	83.40-83.70m	1.19
26	Santapur	Gyaraspur	23.700442	77.925841	204.6	Basalt	152.4mto153.00, 185.92to186.50	1.74
27	Siraswas	Sironj	24.27665	77.659633	93	Laterite, Basalt, Red bole	45.70-46.00,84.20-84.60	4.26
28	Summerdongi	Basoda	23.869222	78.205125	203	Basalt, Sst, Red bole	64.00-64.20,92.50-93.00	1.74
29	Udaypur	Basoda	23.899285	78.062821	204.6	Sst	19.81-20.10	1.19
30	Wardha	Vidisha	23.837338	77.632134	204.6	Basalt+ Redbole+ Sst	137-138	1.51

2.4 GEOPHYSICAL STUDIES

Surface and sub-surface geophysical investigations are the vital component in groundwater resources exploration, exploitation and management. As far as geophysical studies are concerned, no surface geophysical investigation has been done while the sub-surface geophysical logging of boreholes have been conducted in different parts of Sehore district.

- **VES studies**

Vidisha districtis mostly occupied by rocks belonging to Deccan trap formations. Alluvium formation is found at the top portion of Vidisha block.Vidhyan group of rocks are found at a few places at hilly areas. A total of 173 VES were conducted in this district (Refer Fig 14). The youngest rock Deccan Trap basalt is expected to hold potential aquifers in the weathered zone as well as deeper fractured zones. The Vindhyan group of rocks comprising sandstone, shale and limestone are highly compact and possibility of encountering potential aquifer is meagre. As such based on the interpreted results of VES sites were recommended for borehole drilling and dugwell. A total of 173 VES were conducted in Vidisha districts.The results are discussed below.

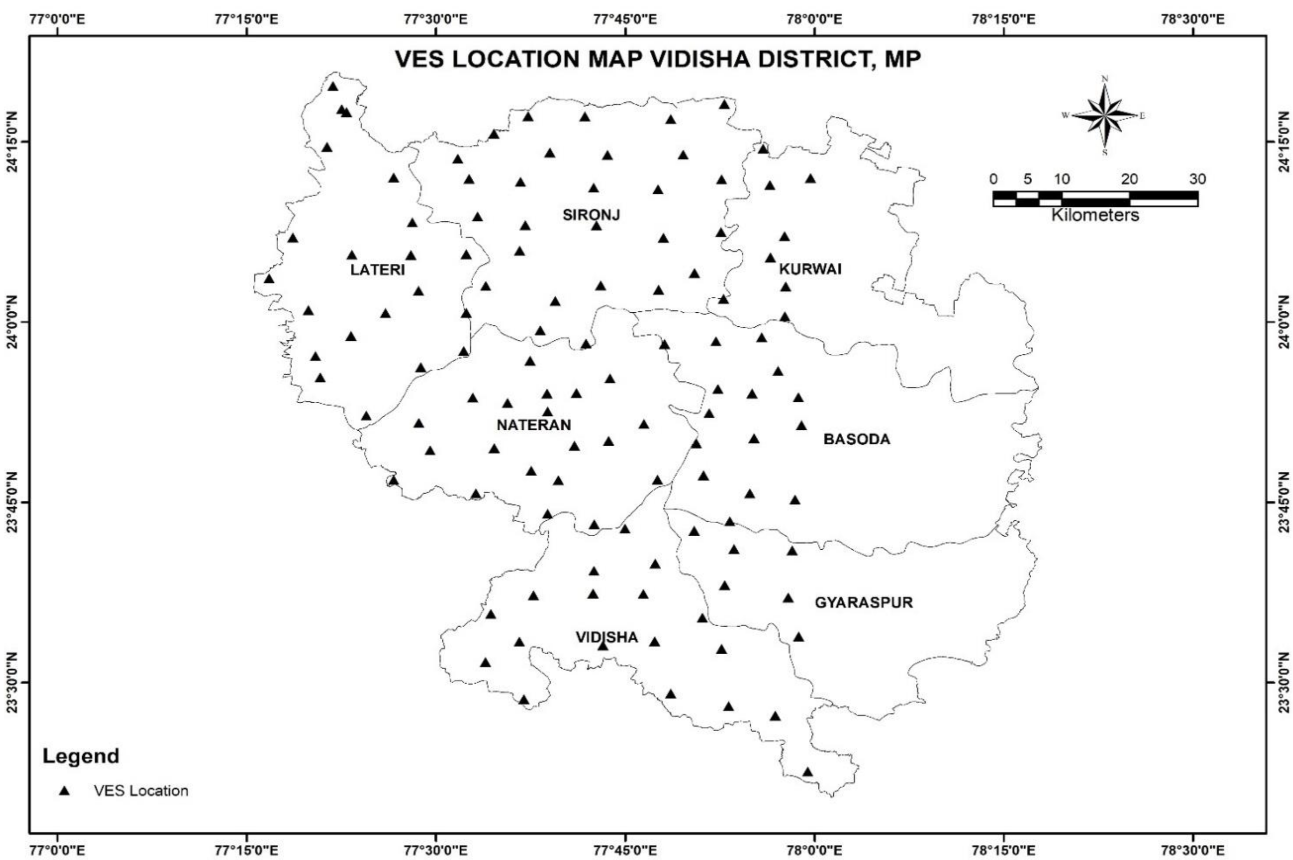
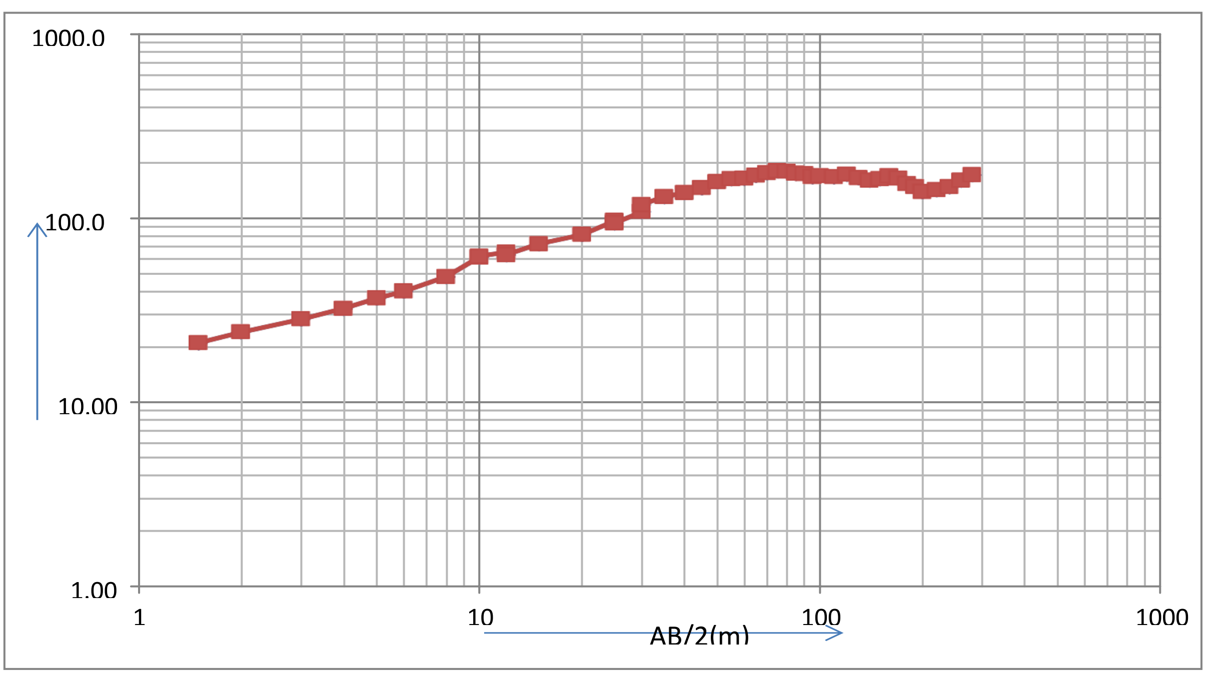


Fig 14: VES Location Map of Vidisha District

- **Interpreted Results of VES**

The interpreted results of the VES are given in Annexure II. In the basalt occupied area of the district 173 VES were conducted. Out of these at 137 VES sites weathered zone is delineated. The resistivity of the weathered zone ranges from 2 to 47ohm.m. It extends to a maximum depth of 39m at VES 358.At 80 sites it is more than 10m but out of 80 sites only at 31 sites the resistivity is more than 10 ohm-m. Hence these 31sites can be tapped by dugwells. However, out of these 137sites at 77sites the resistivity is less than 10ohm.m. It indicates the possible deterioration in water quality or increase in soil salinity.The weathered zone is underlain either by a highly resistive massive basalt layer or by a layer with resistivity higher than that of the weathered zone. In either case it is not possible to decline at the deeper vesicular and massive fractured basalt associated with lesser resistivity. Instead, a geoelectrical layer of varied thickness is delineated which cumulatively represents the succession of vesicular-massive–fractured basalt.The resistivity of this geoelectrical layer could be 20ohm.m,an indicator for the possible presence of fractured basalt. A range of resistivity value obtained for this layer is 3to200ohm.m.A resistivity value less than 50ohm.m for this geoelectrical layer is preferred.At 101sites this geoelectrical layer was delineated, out of which only at 42 sites the resistivity is more than 50ohm.m.At 9 VES sites resistivity values less than10ohm.m was inferred. It could be associated with deeper occurrences of poor quality water as well the presence of RedBole (clay).The depth to the bottom of this geoelectrical layer is maximum 282m at VES453 and the minimum15 m atVES 386.The qualitative analysis has indicated the presence of thin fractured zones at depth.

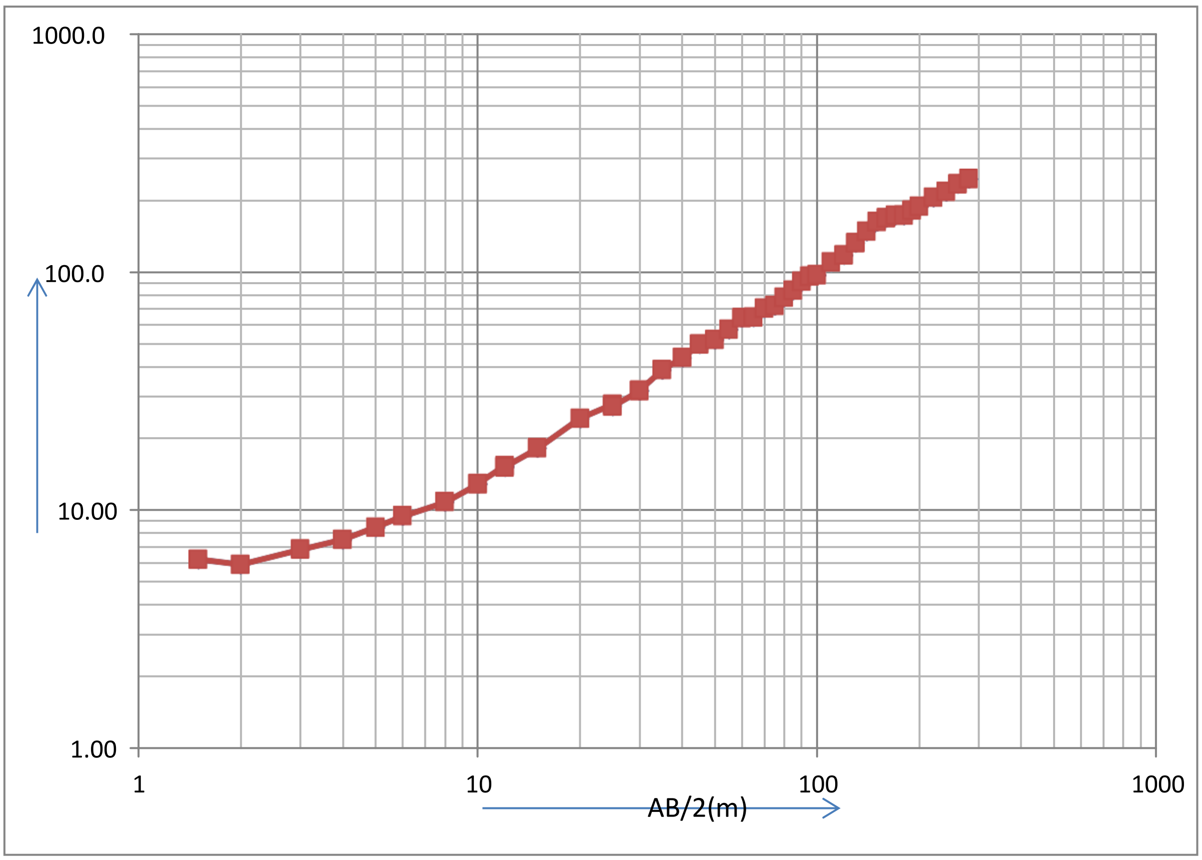
- **VES studies**



WAPCOS Fig 15: Dabar

Table 11: VES study at Dabar

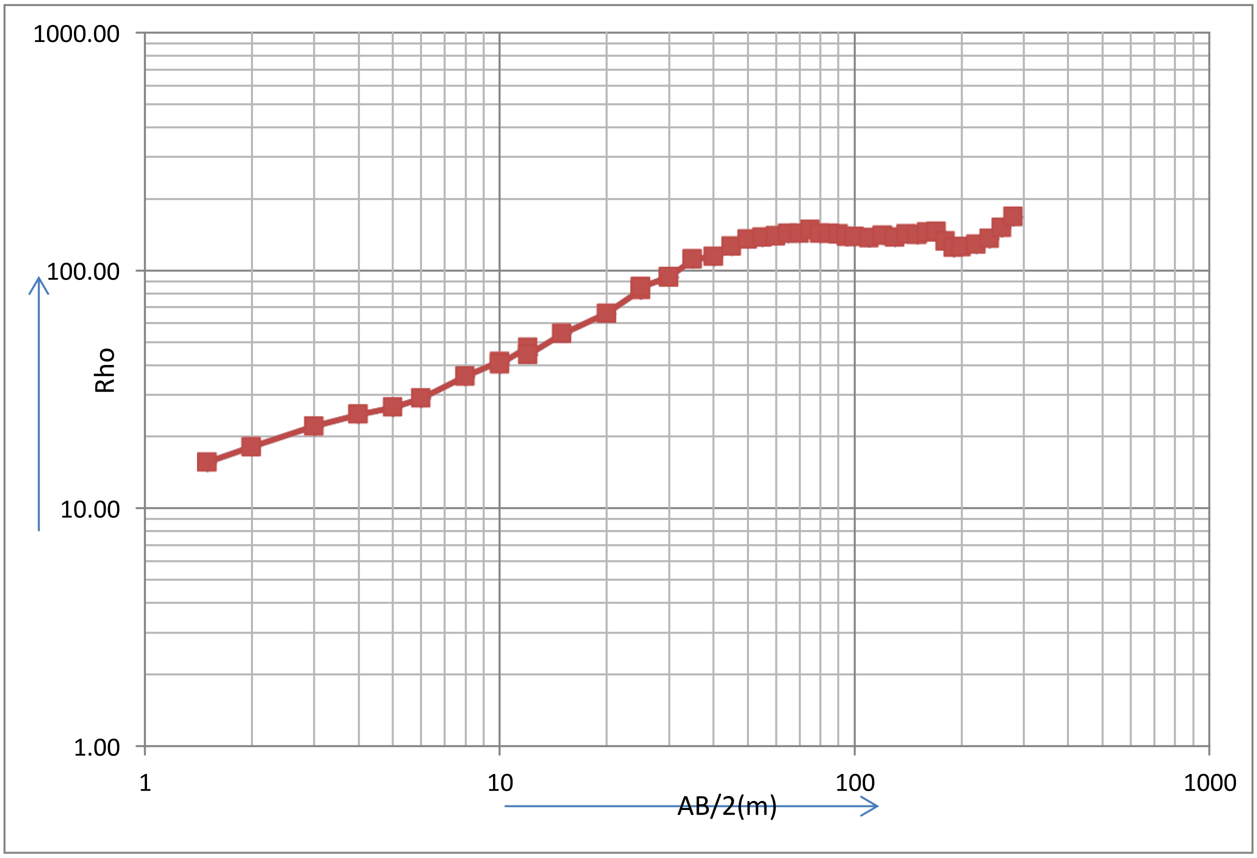
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	20	2	2	Top Soil
2	91	10	12	Semi weathered Zone
3	460	24	36	Compact
4	51	85	212	Weathered Zone
5	13421			Highly Compact



WAPCOS Fig 16: Boodhar

Table 12: VES study at Boodhar

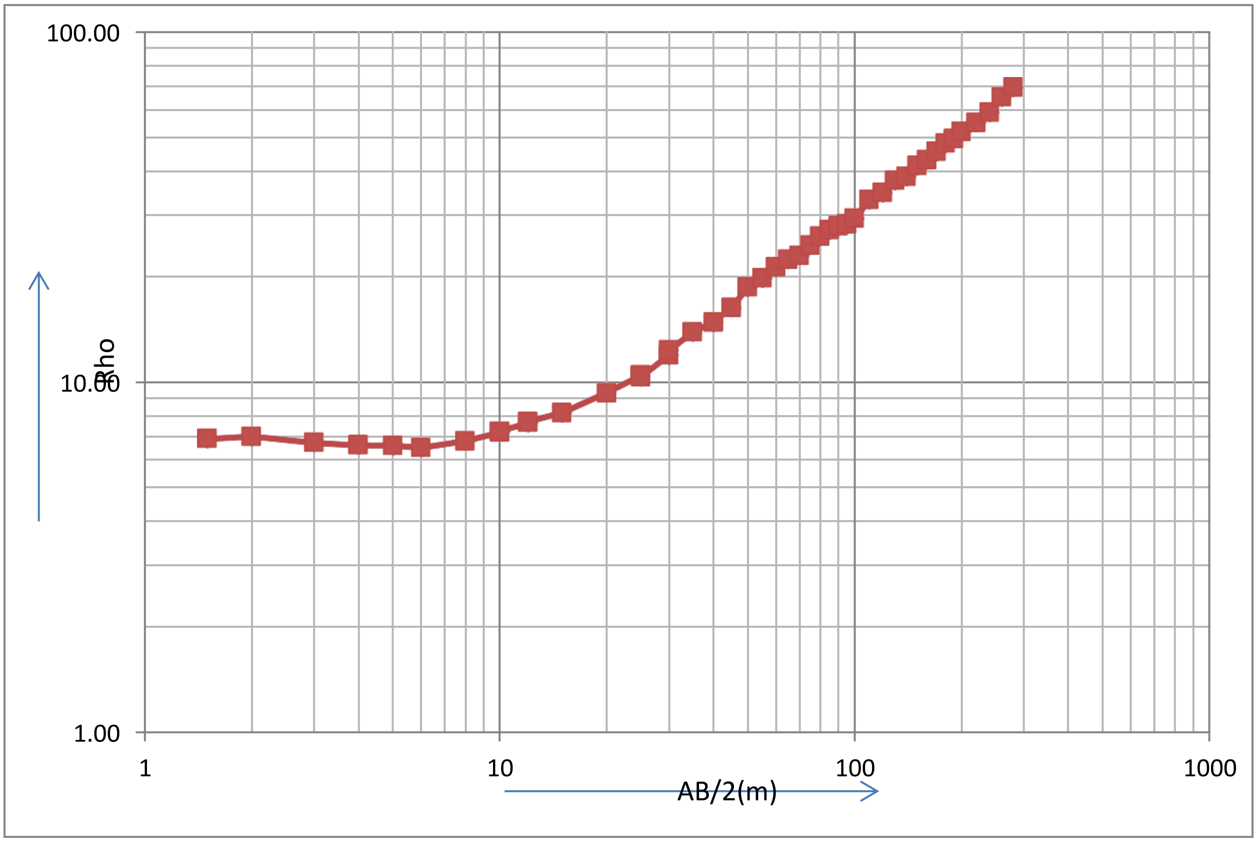
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	6.2	4	4	Top Soil
2	73	18	23	Weathered Zone
3	1405			Highly Compact



WAPCOS Fig 17: Ajeejpur

Table 13: VES study at Ajeejpur

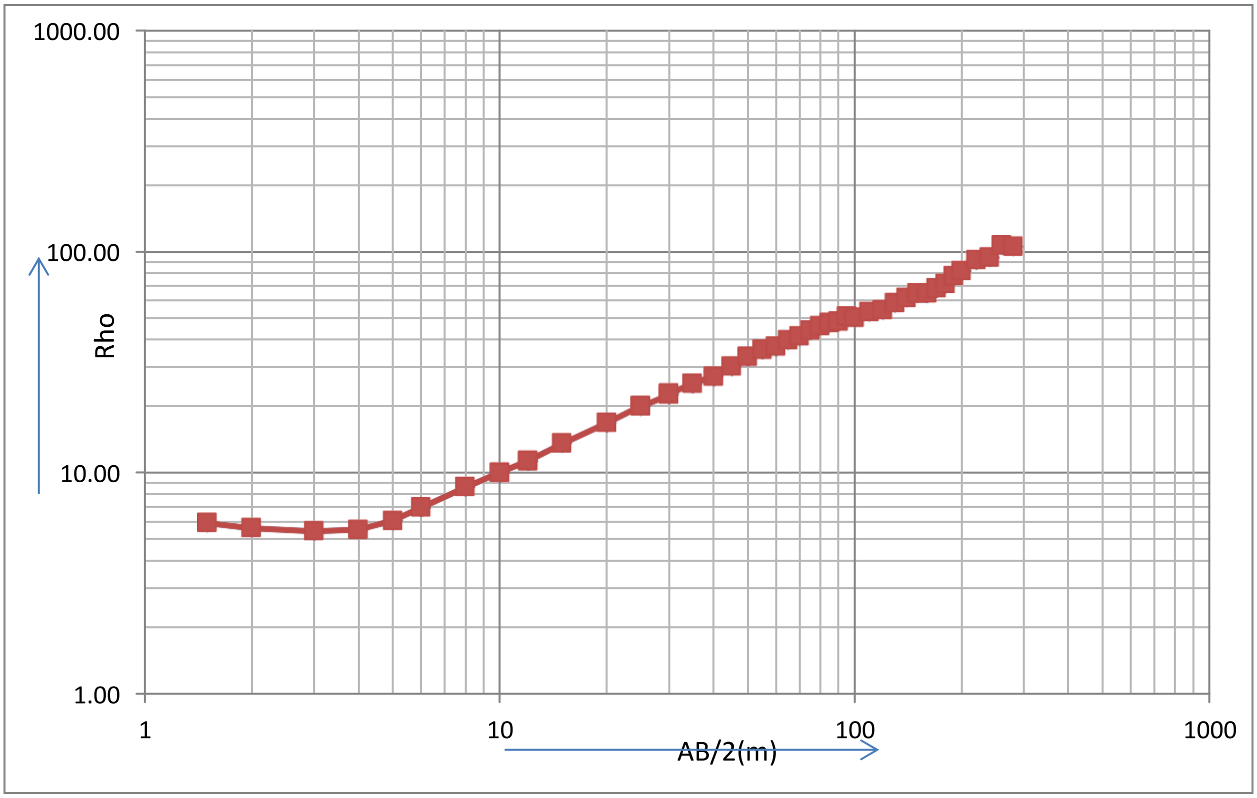
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	13	1	1	Top Soil
2	28	5	5	Weathered Zone
3	2751	4	10	Highly Compact
4	38	55	64	Weathered Zone
5	4513			Highly Compact



WAPCOS Fig 18: Amba Nagar

Table 14: VES study at Amba Nagar

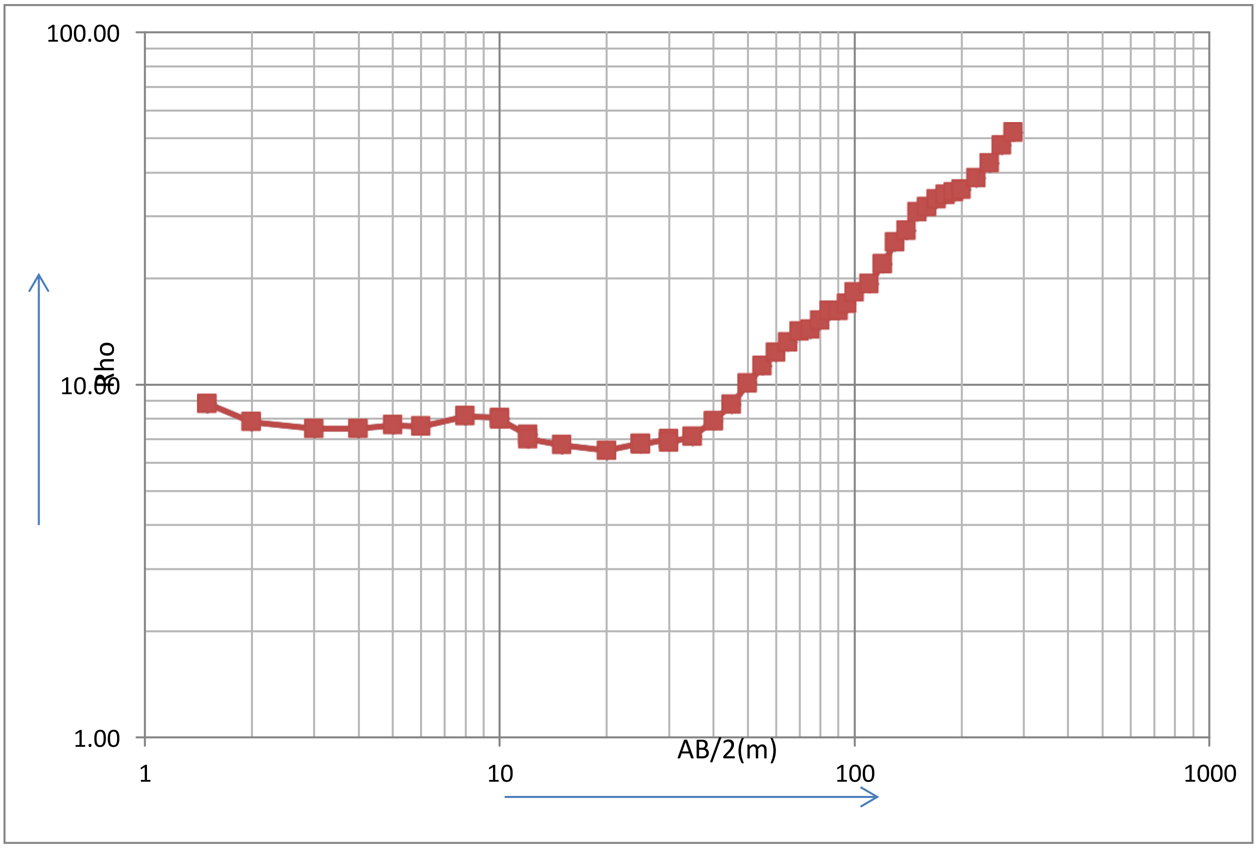
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	7	6	6	Top Soil
2	8	11	17	Weathered Zone
3	69	151	168	
4	10170			Highly Compact



WAPCOS Fig19: Masoodpur

Table 15: VES study at Masoodpur

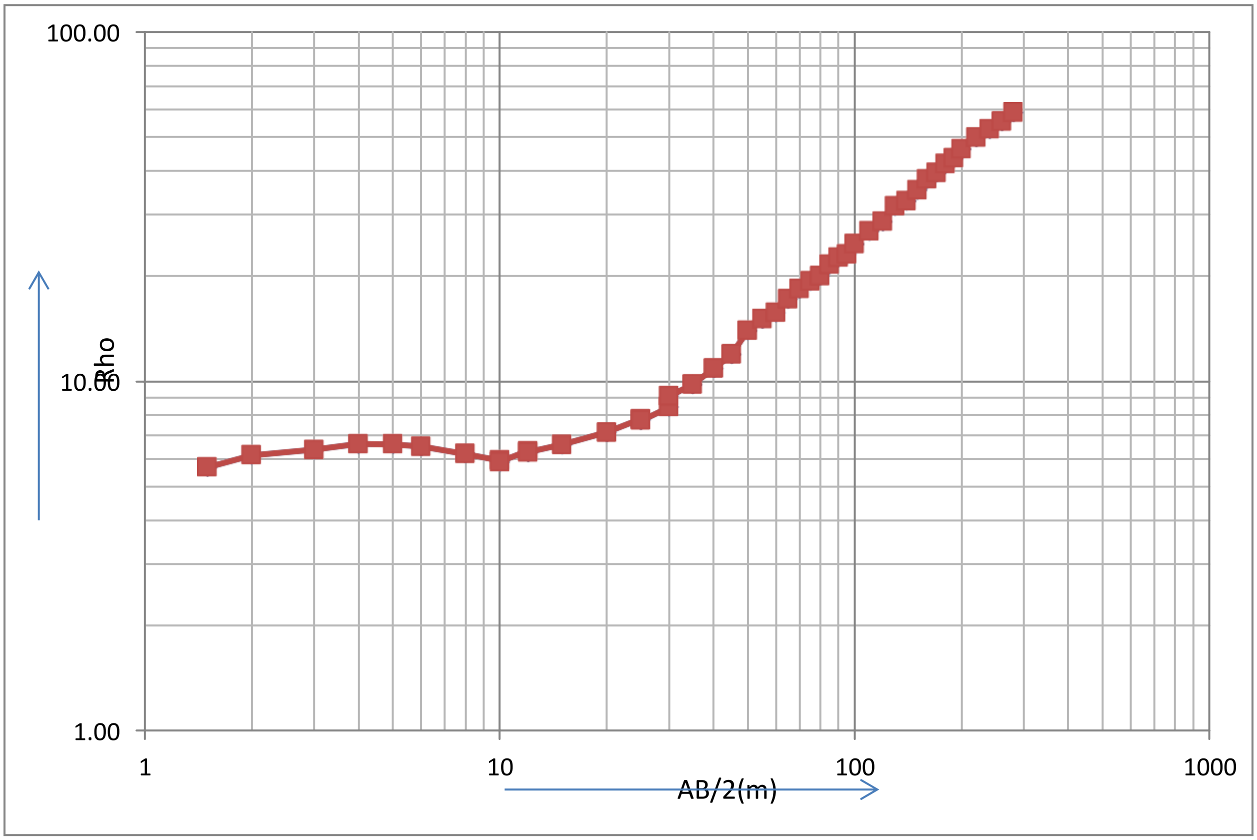
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	9	0.4	0.4	Top Soil
2	5	4	4	Weathered Zone with clay
3	39	10	14	Weathered Zone
4	77	127	141	
5	7676			Highly Compact



WAPCOS Fig. 20: PipariyaGhat

Table 16: VES study at Pipariya Ghat

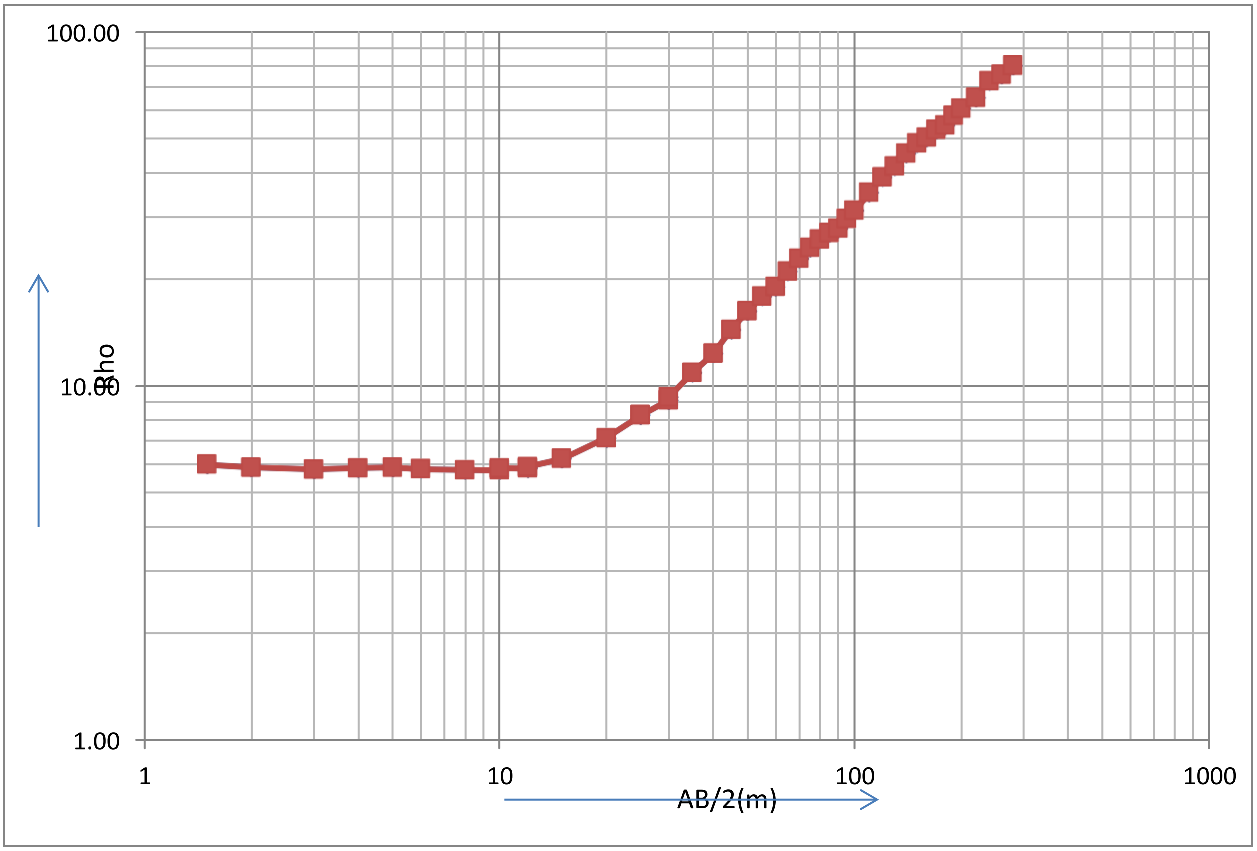
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	10	1	1	Top Soil
2	7	18	19	Weathered Zone
3	5	12	31	
4	1472			Compact Zone



WAPCOS Fig 21: Chorawar

Table 17: VES study at Chorawar

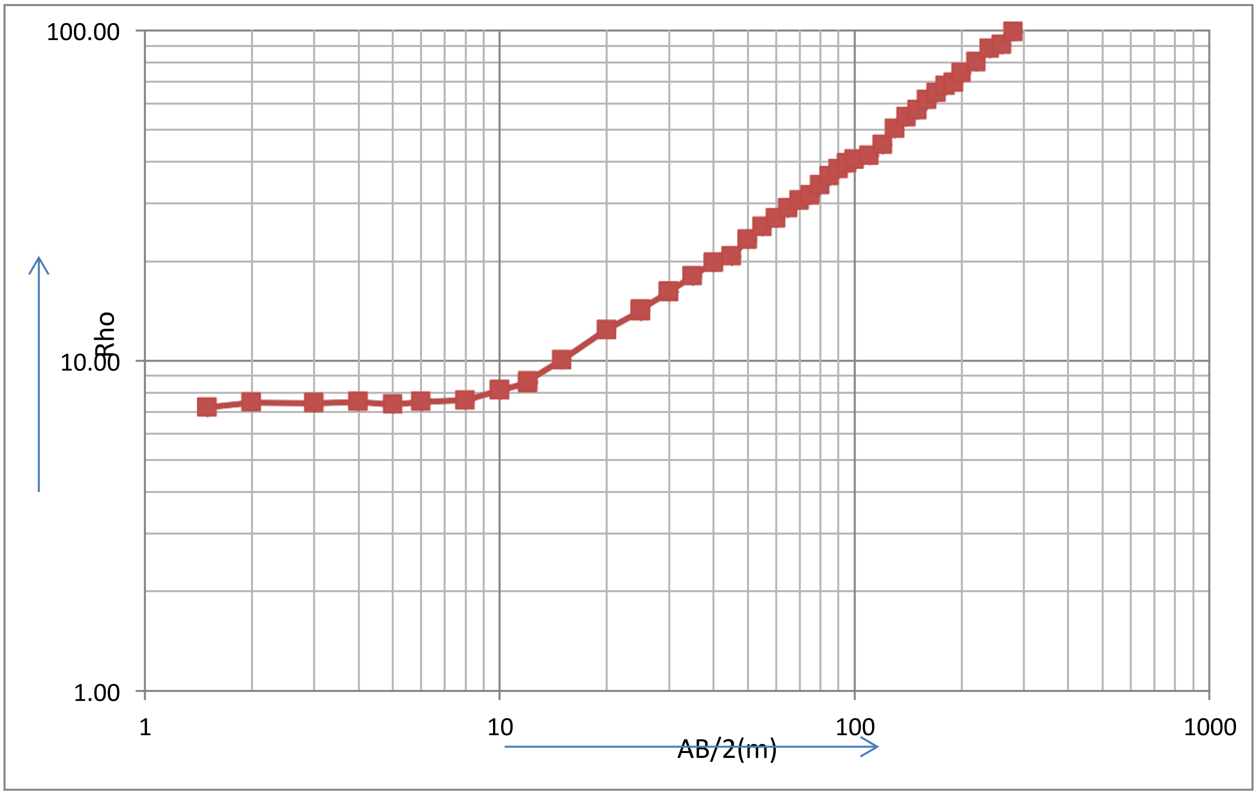
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	5	0.4	0.4	Top Soil
2	6	23	23	Weathered Zone
3	183			Semi Weathered Zone



WAPCOS Fig 22: Mahagaur

Table 18: VES study at Mahagaur

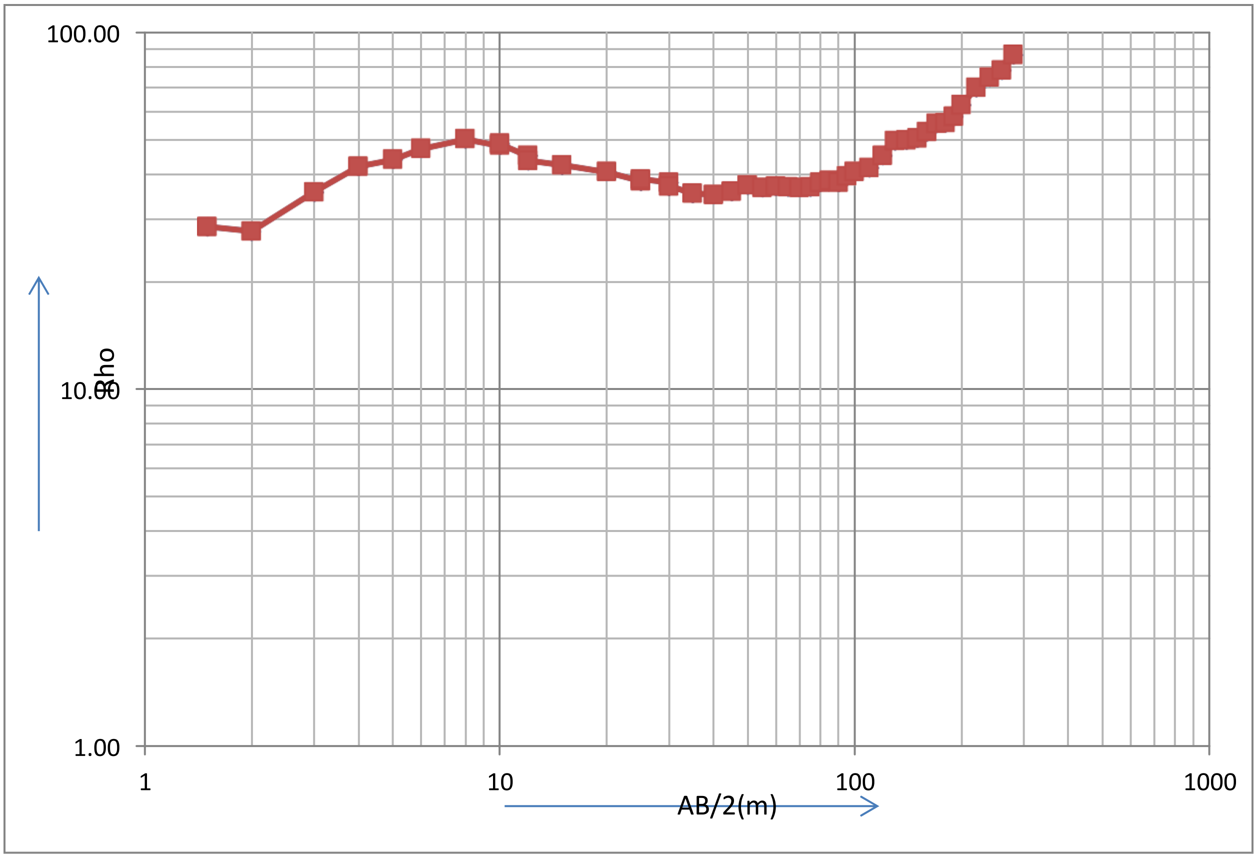
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	6	2	2	Top Soil
2	5	15	18	Weathered Zone
3	582	56	74	Compact Zone
4	2586			Highly Compact Zone



WAPCOS Fig 23: Bothi Jagir

Table 19: VES study at Bothi Jagir

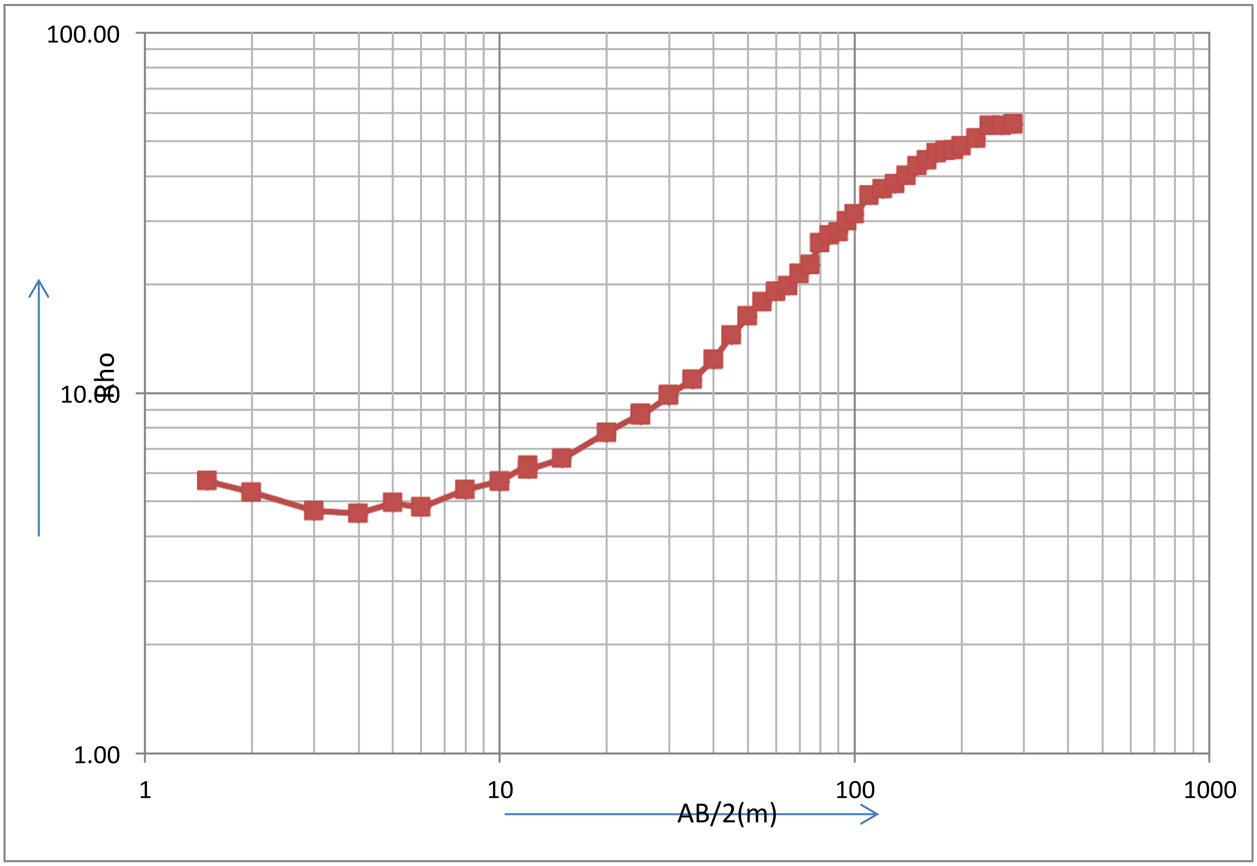
Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	7	2	2	Top Soil
2	7	8	10	Weathered Zone
3	205	3	13	Semi Weathered Zone
4	12	10	23	Weathered Zone
5	351			Compact Zone



WAPCOS Fig 24: Mujrabasuda

Table 20: VES study at Mujrabasuda

Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	24	1	1	Top Soil
2	93	2	3	Semi Weathered Zone
3	35	96	100	Weathered Zone
4	543			Compact Zone



WAPCOS Fig 25: Kirwaya

Table 21: VES study at Kirwaya

Layer	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Inferred Lithological Predominance
1	7	1	1	Top Soil
2	4	3	4	Weathered Zone
3	7	14	18	Weathered Zone with Clay
4	818	28	45	Compact Zone
5	22			Weathered Zone

2.5 HYDROCHEMICAL SCENARIO

The water samples were collected from National Hydrograph Stations in clean doublestopperedpolyethylenebottlesfrom27differentlocationsofVidishadistrict duringMay2020.

- **Quality of Ground Water for Drinking Purpose:**

The ground water samples from Vidisha district have varied range of pH from 6.78 to 7.93. As per BIS (IS 10500: 2012) recommendation, all the water samples have pH recorded within the permissible limits of 6.5to8.5,the maximum pH recorded in the water sample of Badrod crossing (7.93). The pH of ground water can be assessed as neutral to slightly alkaline in nature. The electrical conductivity of ground water samples in Vidisha district varies from 394to 1931 µS/cm at 25°C. The electrical conductivity from Vidisha district shows variability, three locations from Gyaraspur, Nateran and Bilari villages shows EC more than 1500 µS/cm i.e. 1551,1914 and 1931 µS/cm respectively, while 11 locations sample shows EC in between 1000 to1500 µS/cm; 13 locations sample EC is below 1000 µS/cm. So, overall ground water quality in Vidisha district is good.

The fluoride concentration in Vidisha district lies in between 0.07 to 0.67 mg/l, which represent that all the samples are within the permissible limit i.e. 1.5 mg/l as per BIS (IS 10500 :2012). Nitrate in ground water samples of Vidisha district fall within limits of 8 to 186 mg/l. It isobserved that 41% samples have Nitrate concentration more than the acceptable limit i.e. 45mg/l, while rest 59% samples have concentration less than acceptable limit. Highest nitrate isreported in the water sample collected from Ghatera (101 mg/l), Udaipur (109 mg/l), Patharia (125mg/l)and Salaiya (186mg/l).High nitrate in ground water samples may be due to anthropogenic activities or excessive use of fertilizers. The range of Total Hardness (as $CaCO_3$) inground water samples of study area is 130 to 490 mg/l.The maximum concentration of Total hardness has been observed in the village of Gyaraspur (490mg/l).

Piper diagram has three parts:a Cationtriangle,an Aniontriangle,and a Central diamond-shaped field. In Cation triangle, the relative percentages of the major cations (Ca^{2+}, Mg^{2+}, Na^{+},K^{+}) are plotted. In Anion triangle the major anions (HCO_3^{-}+CO_3^{2-}, SO_4^{2-},Cl^{-}) are plotted. These points are then projected to the central diamond shaped field.

In the district; piper diagram shows that the 26% of samples of ground water samples are Mixed type whereas 74% samples shows nature of water as Calcium-Bicarbonate type, hence show temporary hardness features. Overall the Ground water Quality of the district is good except the higher concentration of nitrate has been encountered in the district. Chemical analysis report of district is given in table 22.

- **Quality of Ground Water for Irrigation Purpose:**

In classification of water for irrigation purpose, it is assumed that the water will be used for irrigation purpose based upon its soil texture, infiltration rate, drainage and climate. The chemical data of all the water samples fromVidisha districtis plotted onU.S.Salinity Laboratory diagram (Fig.27).

In the district USSL diagram shows that the 15% wells of study area are observed underC2-S1Class (Medium Salinity & Low Sodium) which means that these waters can be used forirrigation purpose for most of the crops, 7% of total ground water samples fall under C3-S2 class (High Salinity & Medium Sodium) whereas 78% of total ground water samples fall under C3-S1class (High Salinity & Low Sodium). The water from C3-S2 class (High Salinity & Medium Sodium) may be used for irrigation purpose under proper soil management. Hill piper diagram is shown in fig. 26.

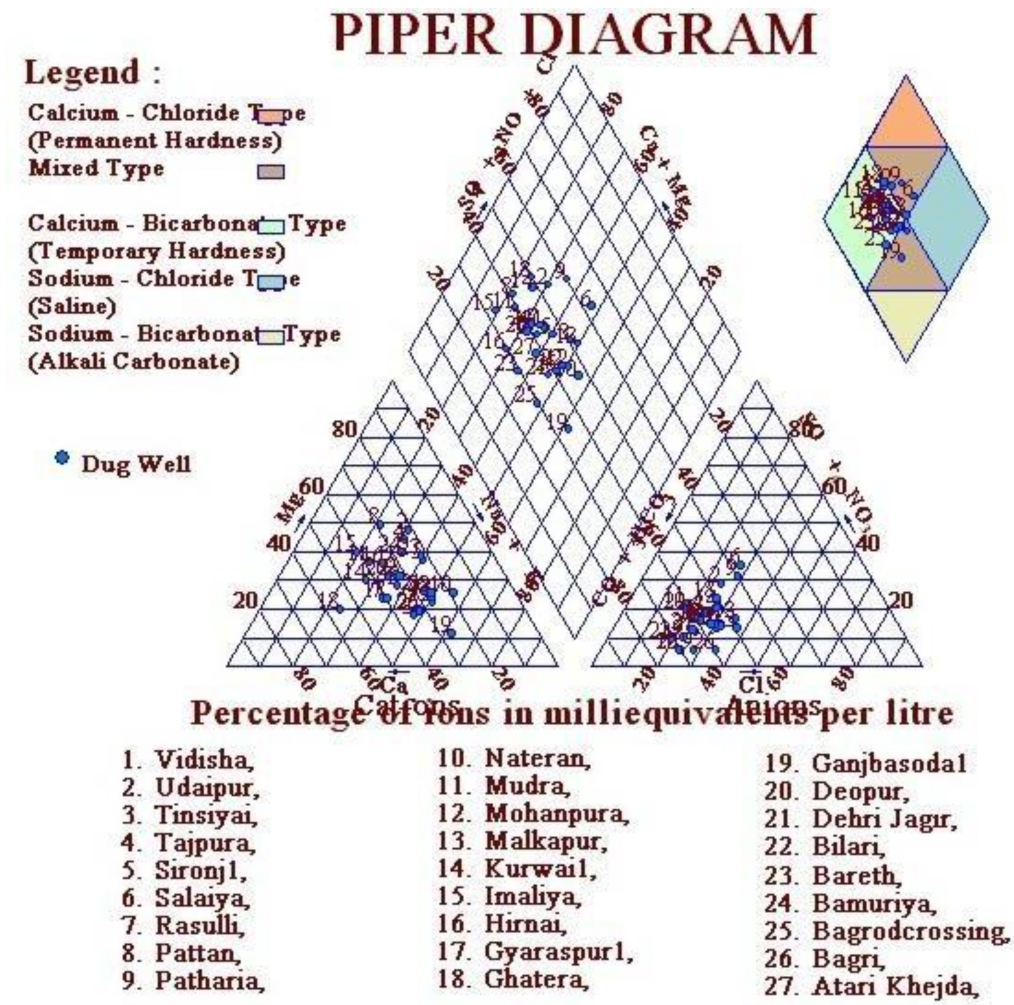


Fig 26: Hill Piper Diagram

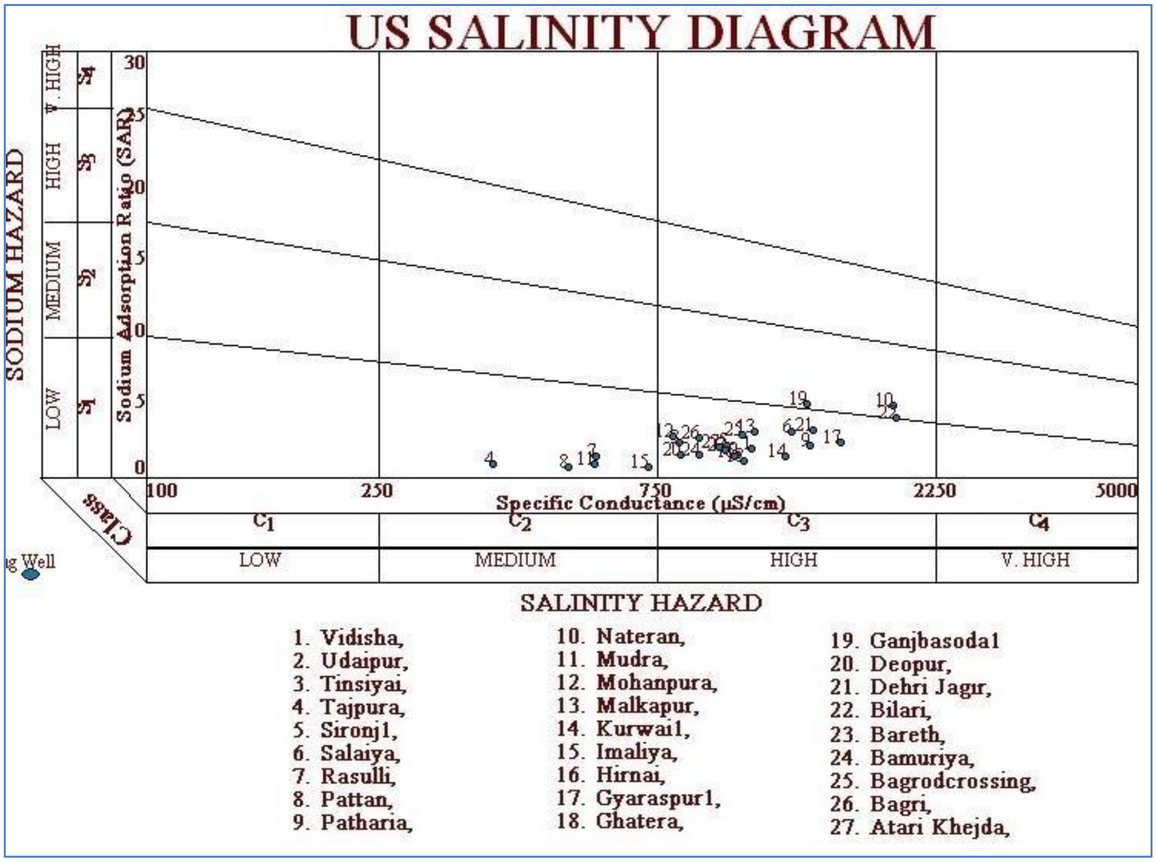


Fig 27: US Salinity Diagram

Table 22: Chemical Analysis Report of Vidisha District

S. No.	District	Block	Location	Lat.	Long.	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	F	PO_4	SiO_2	TH	Ca	Mg	Na	K
						at 25 °C	µS/cm at 25 °C	mg/l												
1	Vidisha	Gyaraspur	Atari Khejda	23.615	78.028	7.58	964	0	346	82	30	37	0.27	0.09	39	290	42	45	85	1.2
2	Vidisha	Vidisha	Bagri	23.568	77.765	7.43	889	0	298	105	17	11	0.3	BDL	21	225	56	21	96	2.3
3	Vidisha	Basoda	Bagrodcrossing	23.733	78.176	7.93	1053	0	431	87	11	22	0.54	BDL	55	270	66	26	114	1.8
4	Vidisha	Vidisha	Bamuriya	23.613	77.763	7.74	890	0	298	77	33	43	0.33	0.08	78	295	48	43	65	1.5
5	Vidisha	Basoda	Bareth	23.913	78	7.76	985	0	401	67	25	24	0.62	BDL	41	310	62	38	81	2.2
6	Vidisha	Vidisha	Bilari	23.578	77.7	7.48	1931	0	620	190	63	88	0.37	0.14	20	485	96	60	213	4.9
7	Vidisha	Sironj	Dehri Jagir	24.041	77.786	7.53	1391	0	504	122	43	49	0.22	BDL	31	370	74	45	147	1.8
8	Vidisha	Sironj	Deopur	24.155	77.621	7.49	828	0	292	55	27	63	0.12	BDL	33	275	58	32	61	1.2
9	Vidisha	Basoda	Ganjbasoda1	23.863	77.924	7.51	1358	0	516	132	31	11	0.46	0.2	29	255	70	19	190	2.6
10	Vidisha	Basoda	Ghatera	23.807	78.124	7.47	1064	0	310	97	40	101	0.07	BDL	51	395	116	26	53	11.1
11	Vidisha	Gyaraspur	Gyaraspur1	23.667	78.114	6.93	1551	0	529	137	57	80	0.18	BDL	38	490	122	45	127	2.8
12	Vidisha	Vidisha	Hirnai	23.568	77.95	7.76	1024	0	419	85	16	15	0.43	0.15	24	360	70	45	67	2.5
13	Vidisha	Vidisha	Imaliya	23.576	77.781	6.78	730	0	279	57	29	8	0.12	BDL	21	290	58	35	31	1.9
14	Vidisha	Kurwai	Kurwai1	24.125	78.043	7.6	1250	0	377	122	63	73	0.36	BDL	22	455	106	46	75	2.2
15	Vidisha	Basoda	Malkapur	23.979	77.851	7.23	1106	0	310	137	49	49	0.67	0.04	43	275	56	33	123	5.2
16	Vidisha	Neteran	Mohanpura	23.796	77.531	7.33	804	0	256	85	29	36	0.33	BDL	49	195	42	22	93	1.4
17	Vidisha	Basoda	Mudra	23.777	78.186	7.66	589	0	207	37	20	51	0.45	BDL	36	215	44	26	32	1.5
18	Vidisha	Neteran	Nateran	23.762	77.775	7.53	1914	0	592	215	96	41	0.4	0.6	18	420	70	60	241	6.5
19	Vidisha	Sironj	Patharia	24.115	77.819	7.21	1374	0	317	137	104	125	0.31	BDL	23	440	88	54	110	2
20	Vidisha	Vidisha	Pattan	23.725	77.657	7.58	533	0	177	45	31	17	0.4	BDL	38	205	30	32	25	1.6
21	Vidisha	Neteran	Rasulli	23.811	77.542	7.2	593	0	195	52	22	39	0.2	0.13	27	190	48	17	47	1.3
22	Vidisha	Vidisha	Salaiya	23.608	77.576	7.43	1278	0	275	122	69	186	0.21	BDL	52	330	66	40	138	1.3
23	Vidisha	Sironj	Sironj1	24.099	77.689	7.51	994	0	305	107	42	32	0.12	BDL	24	290	42	45	88	6.8
24	Vidisha	Lateri	Tajpura	24.062	77.293	6.96	394	0	134	30	21	13	0.16	0.21	54	130	18	21	27	1.5
25	Vidisha	Neteran	Tinsiyai	23.772	77.609	7.92	821	0	238	107	36	21	0.56	BDL	49	215	56	18	86	4.4
26	Vidisha	Basoda	Udaipur	23.901	78.055	7.5	1037	0	281	90	55	109	0.1	1	31	355	44	60	71	3.1
27	Vidisha	Vidisha	Vidisha	23.526	77.824	7.15	1094	0	348	117	62	10	0.27	BDL	33	340	74	38	87	9.5
Min	Vidisha District					6.78	394	0	134	30	11	8	0.07	0.04	18	130	18	17	25	1.2
Max	Vidisha District					7.93	1931	0	620	215	104	186	0.67	1	78	490	122	60	241	11.1

Chapter-3

DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

The lithological data collected from 30 Exploratory Borewells drilled through outsourcingby WAPCOS were studied, compiled and integrated to prepare the 2-Dimensional LithologicalCross sections. The 2-Dimensional Lithological Cross sections are presented in the fig 27 & 28. ithas been interpreted that the major water bearing zones hasbeen encountered in weatheredandfracturedbasalts.

3.1 3-D LITHOLOGICAL MODEL

A 3-Dimensional lithological model was prepared for the Vidisha district, Madhya Pradesh after detailed analysis of the pre-existing and available bore-log data collected from the Basic Data Reports of CGWB (Fig 28a & 28b) and field well inventory data. A comprehensive analysis was made as per lithology and stratigraphy of the area. The location details with RL values and their corresponding stratigraphic details as per the Rockworks format is provided in the Annexures- I.

The 3-D Model results showed that the region is dominantly occupied by Basalt, Sandstone and Shale. The sub-surface lithology has been broadly classified into Top soil/Unsaturated zone, underlain by Basalt weathered Sandstone and Shale and which has been considered as shallow aquifer (upto a depth of 30 mts).

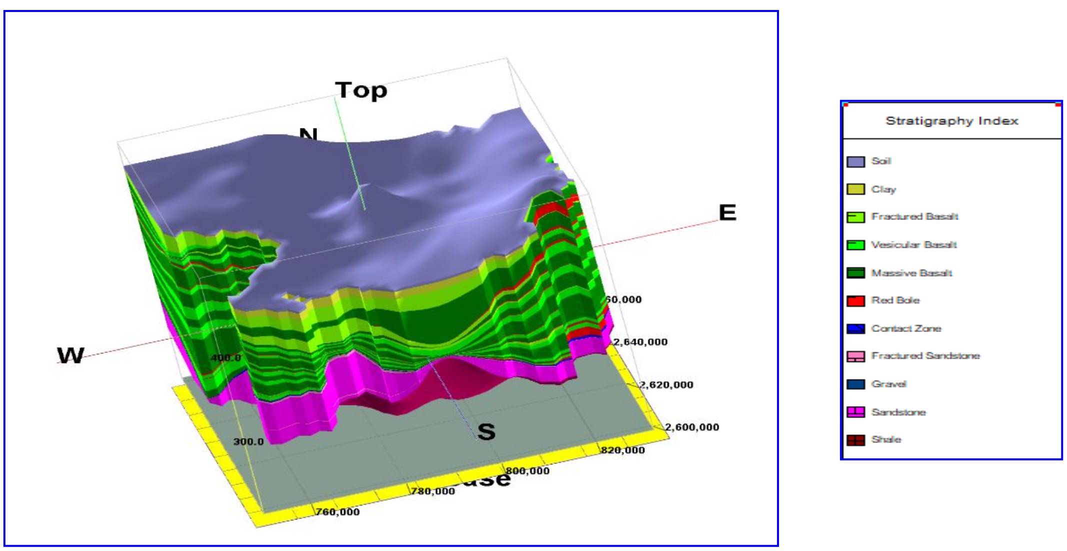


Fig 28(a): 3-D Lithological Model of Vidisha District, Madhya Pradesh

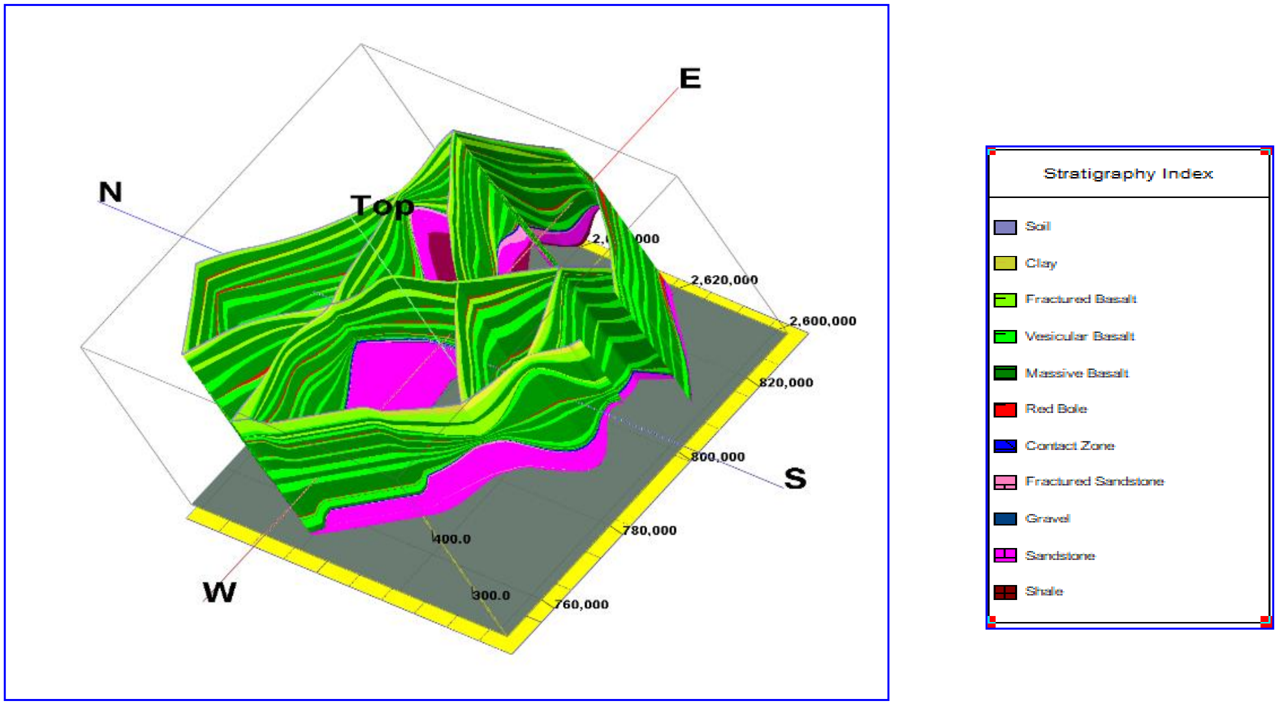


Fig 28(b): Fence Diagram, Vidisha District, Madhya Pradesh

3.2 2-D CROSS SECTION OF VIDISHA DISTRICT

2-Dimensional cross-sections along the section line A-A'(Siraswas- Ahmedpur- Kasba) (fig.29 a) NW-SE and B-B' (Summer dongi- Bhiakhedi) (fig.29 b)W-E direction covering the wells has been prepared using Mapinfo. The cross-section shows that the shallow aquifer is not continuing for the whole region and occurs as narrow pinches. The potential deeper aquifers whereas, occurs throughout the section line as vesicular basalt and can be encountered at depth where fractures are present.

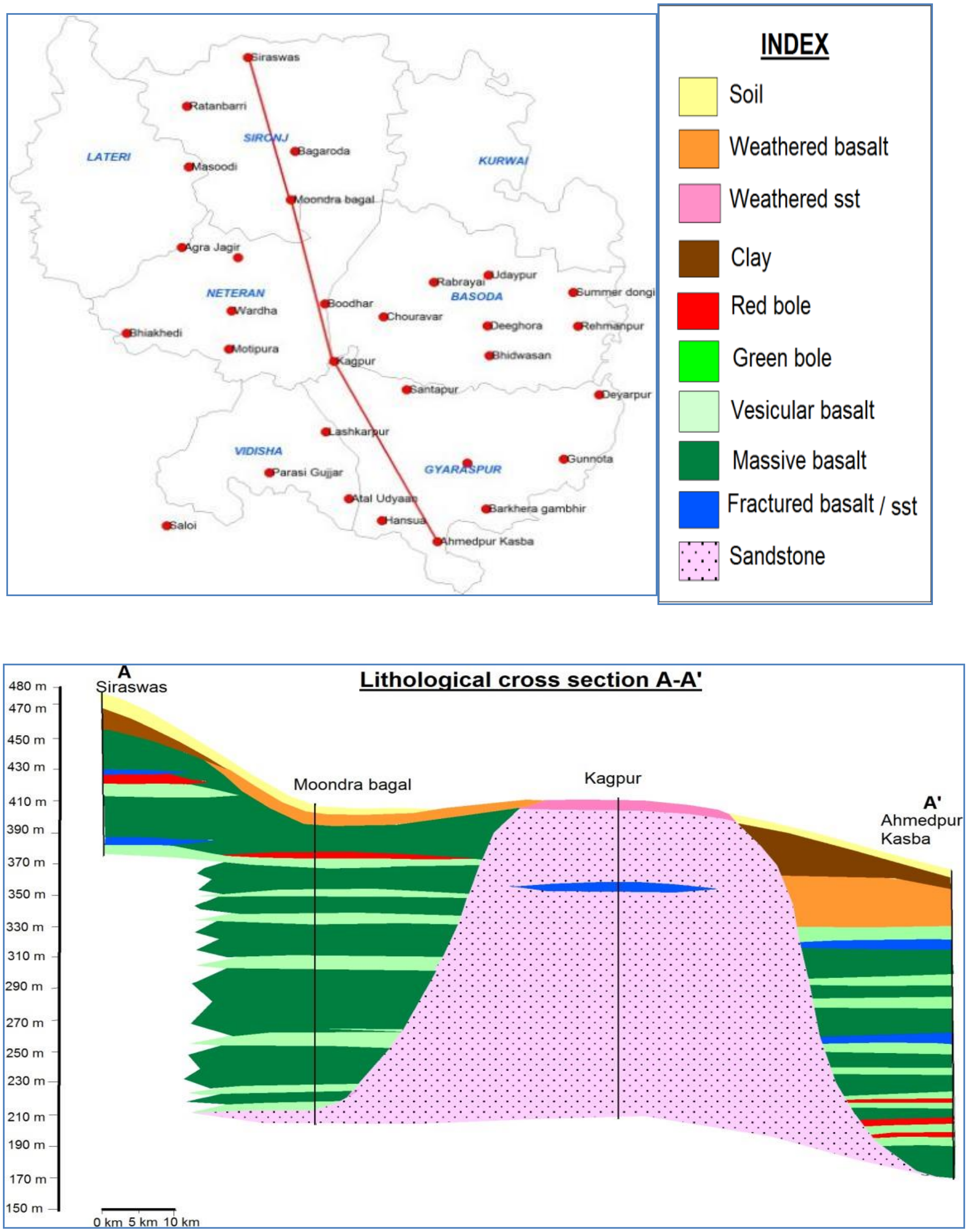


Fig 29(a):2-D Cross sections A-A'(Siraswas-Ahmedpur-Kasba)

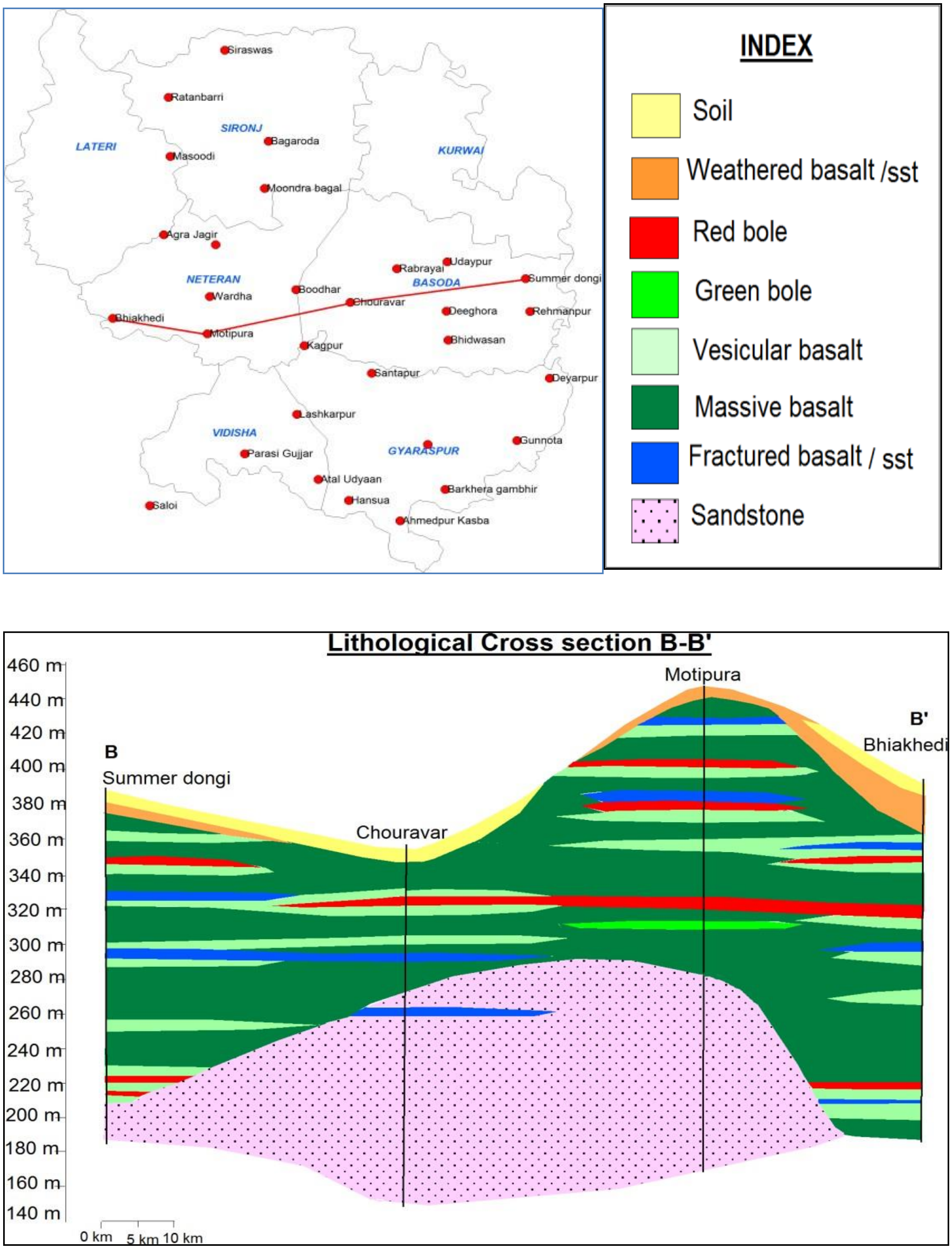


Fig 29(b): 2-DCrosssectionsB-B' (Summerdongi-Bhiakhedi)

Chapter-4

GROUNDWATER RESOURCES

4.1 DYNAMIC GROUNDWATER RESOURCES:

Vidisha district is underlain by Basaltic lava flows of Deccan trap and Vindhyan Sand stone. Out of 7,37,100 ha of geographical area, 6,70,770 ha (91%) is ground water recharge worthy area and 66,330 ha (9%) is hilly area.

Dynamic ground water resources have been estimated 2020 block-wise. There are seven number of assessment units (block) in the district in which 4 blocks having command and non command area and rest 3 block having the non command area only. Out of 7 blocks 5 block falls under safe category namely Vidisha, Bsoda, Sironj and Nateran & rest 2 blocks fall under semi-critical categoru namely Kurwai and Gyraspur. The highest stage of ground water extraction is computed as 71.96 % in Gyaspur block. As a whole the Stage of Ground Water Extraction of the district is 60.74 % which falls under safe category.

The Annual Extractable Ground Water Resource of the district is 84353.11 Ham, groundwater extraction for irrigation is 47660.09 Ham, groundwater extraction for domestic use is 3576.55 (total extraction of GW is 51236.64 Ham), making the Stage of Ground Water Extraction 60.74 % (safe category) in the district. Annual GW allocation for future domestic as on 2025 is 4027.89 Ham

4.2 STATIC GROUND WATER RESOURCES:

The Ground Water Resource of Vidisha District has also been calculated block-wise as an outcome of NAQUIM. The Static resource for the shallow aquifer below zone of fluctuation upto the dug well zone (upto 30 mbgl) is calculated as the product of recharge worthy area, specific yield of the formation and saturated thickness of the aquifer. It is computed to be around 374.53 MCM.

4.3 GROUND WATER EXTRACTION:

The unit extraction of dug well and tube well and the number of dug well and tube well in command and non-command area have been used to calculate and separately assess the ground water extraction for irrigation from shallow and deeper aquifers. The Ground Water extraction for all uses is 512.36 mcm The block-wise ground water resources and extraction as an outcome of NAQUIM is presented in the Table 23.

Table 23: Dynamic Ground Water Resources (as on March 2020)

Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Annual Extractable Ground Water Resource (Ham)	Stage of Ground Water Extraction (%)
VIDISHA	7660.332	627.3255	8287.65	703.16	7176.73	15540.21	53.33
BASODA	8445.762	785.48073	9231.24	931.3	6464.75	15841.81	58.27
SIRONJ	8321.67	621.40155	8943.08	702.31	5487.04	14511.03	61.63
NATERAN	5515.128	478.61136	5993.74	524.5	3941.49	9981.12	60.05
LATERI	4304.79	401.43357	4706.23	471.7	4010.3	8786.8	53.56
KURWAI	7477.704	352.70826	7830.41	357.01	3180.54	11015.25	71.09
GYRASPUR	5934.7	309.58716	6244.29	337.91	2404.28	8676.89	71.96
DISTRICT TOTAL	**47660.09**	**3576.55**	**51236.64**	**4027.89**	**32665.13**	**84353.11**	**60.74**

Chapter-5

GROUND WATER RELATED ISSUES

5.1 DECLINING OF GROUND WATER LEVEL

The long-term water level trend analysis indicates decreasing water level. Out of 23Hydrograph Stations, 11 stations are showing declining trend both during pre and post monsoon season Fig (30a, 30b, 30c, 30d, 30e).

Similarly, during pre-monsoon season, out of 23 stations 3 stations are showing falling trend in the district.

5.2 STAGE OF GROUND WATER EXTRACTION

Ground Water Resource Estimation reveals that the stage of ground water extraction is deteriorating gradually since 2013.

Over all stage of ground water extraction of the district is increasing from 54% in 2013.58.63% in 2015, 59% in 2017, 60.74% as per GWRE 2020.

5.3 GROUND WATER QUALITY

Excessive nitrate content is reported in the water sample collected from Ghatera (101mg/l), Udaipur (109 mg/l), Patharia (125 mg/l) and Salaiya (186 mg/l). High nitrate in ground water samples may be due to anthropogenic activities or excessive use of fertilizers.

The EC values higher than 1000 µS/cm has also been found at places like Bilari, Gyaraspur, Nateran, DehriJagir, Ganjbasoda, Kurwai, Pathariya, Salaiyain Vidisha district.

Collapsing Structure and improper well design

Collapsing formations are encountered in the inter-trappean clay formation and in the contact zone between basalt and vindhyan Sandstone formation. It has been observed that large numbers of deep tube wells constructed in the basaltic rock formation and in the contact zone as mentioned aboveeven-though having sufficient yield observed during well construction, are found to be abandoned or unused due to faulty well construction design.

Very Deep Water Level

At places, water level is very deep is due to formation of cavitiesin the lithological formations as mentioned above and Hand pumps becomes inoperative in the wells having water level more than 45 meters.

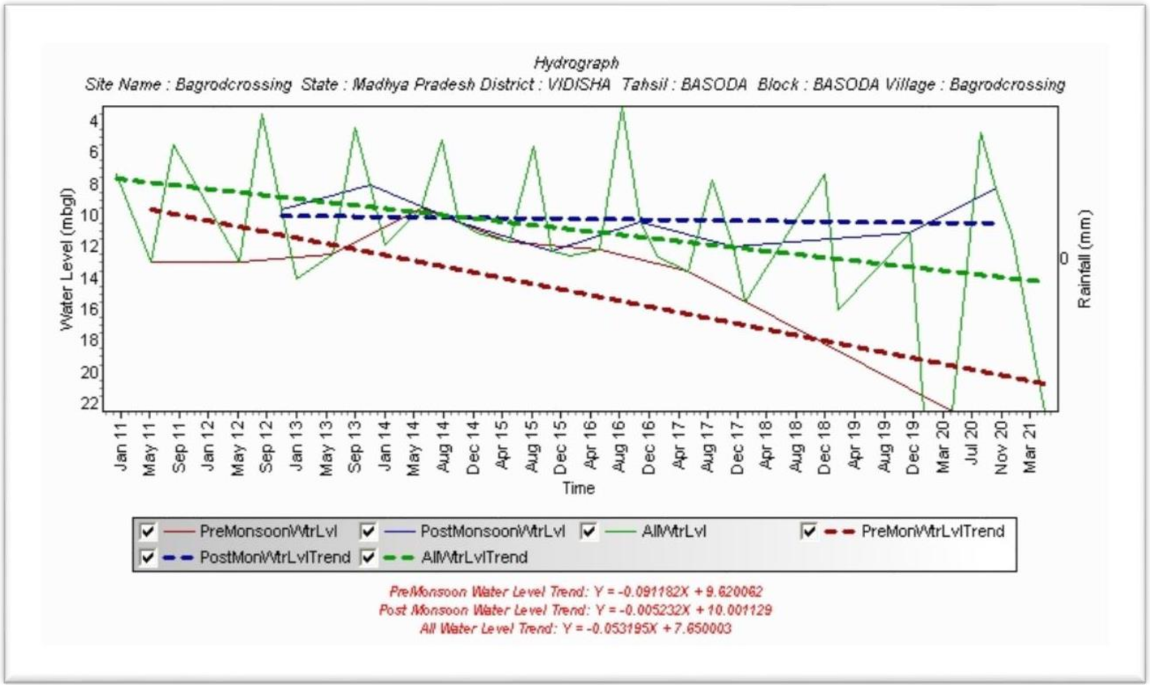


Fig 30(a): Bagrod Crossing, Block Basoda

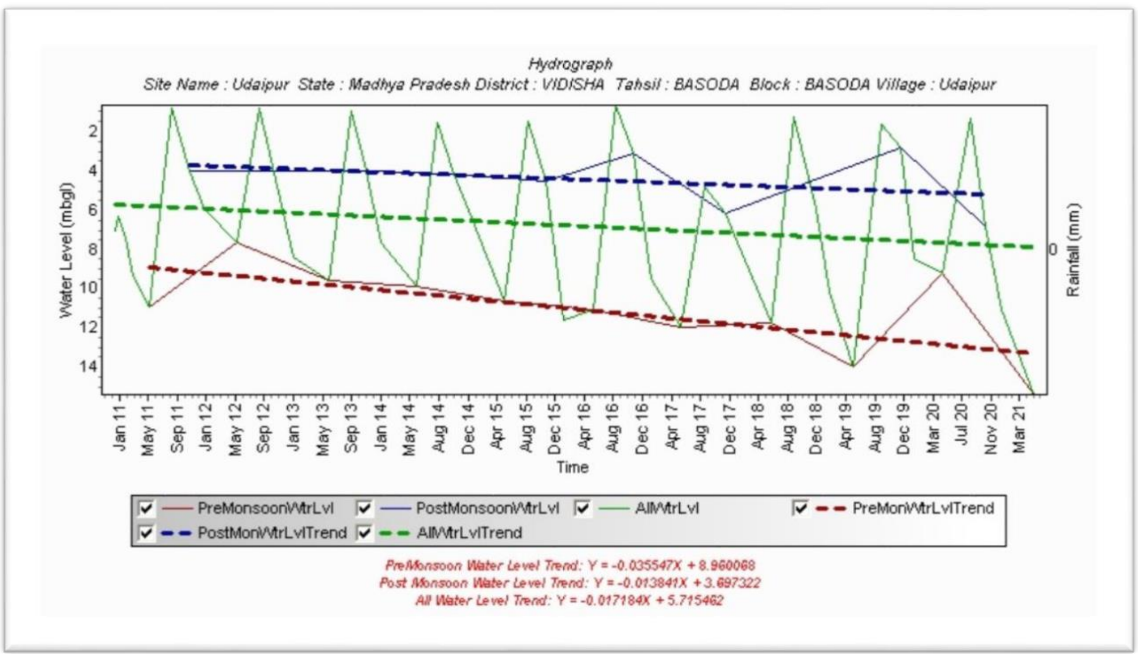


Fig 30(b): Udaipur, Block Basoda

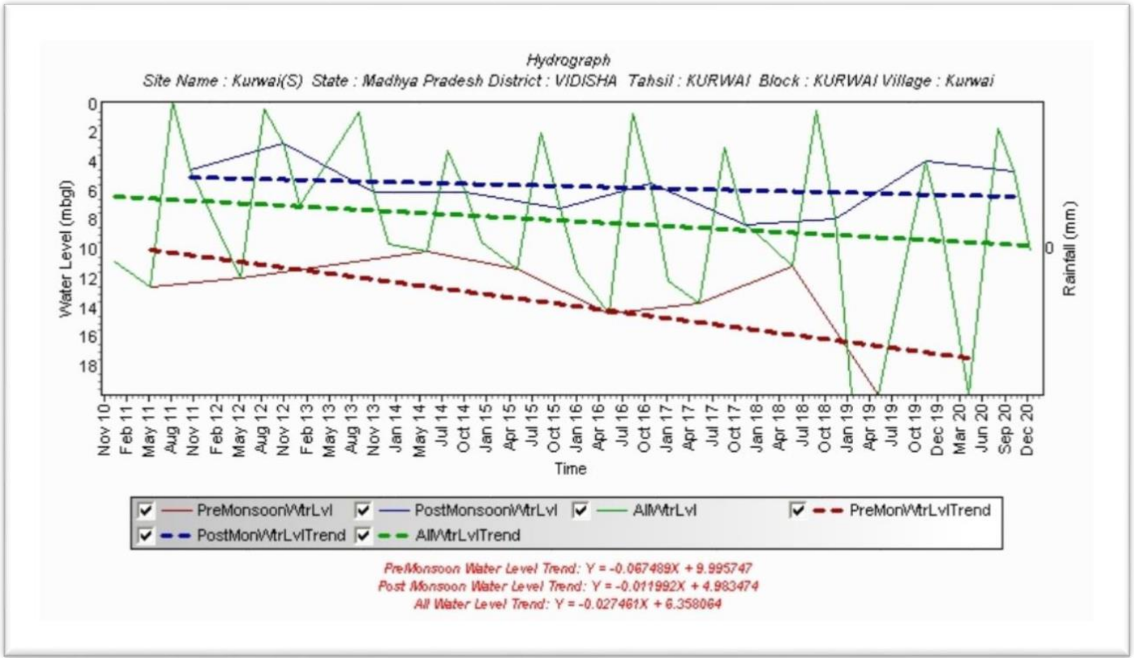


Fig 30(c): Kurwai (Shallow), Block Kurwai

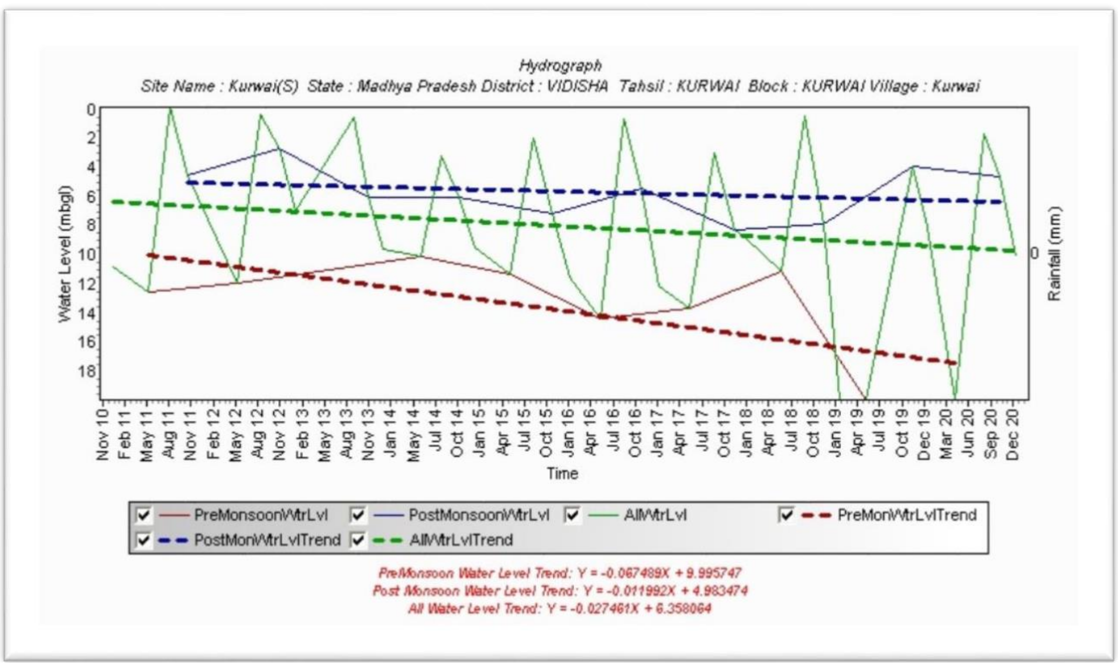


Fig 30(d): Bilari, Block Vidisha

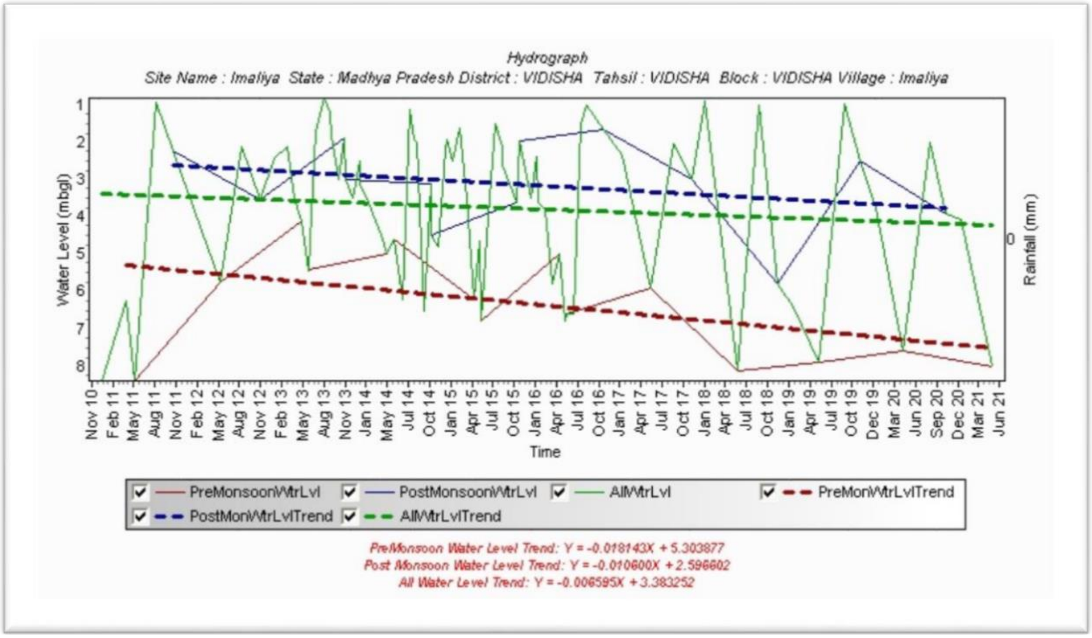


Fig 30(e): Imaliya, Block Vidisha

Fig 30: Hydrographs showing declining water level trend during pre and post-monsoon

Chapter-6

GROUND WATER MANAGEMENT STRATEGIES

Ground water has been contributing more to agricultural wealth than surface irrigation since ages. Tube wells are now the largest source of irrigation in the country. Since this sector has almost no dependence on the government, it is growing at a rapid rate and itis estimated that one million wells are added every year (Shah and Deb, 2004). Being an individually managed source, ground water irrigation is also a more efficient form of irrigation, with crop yields per cubic meter of water being 1.2 to 3 times higher than surface irrigation. However, since this sector has grown through investment by individual farmers,with little state involvement compared to canal irrigation, government support for understanding this sector and improving its performance is negligible. The major issues for the future growth of groundwater irrigation are declining resource base, demand driven growth, and a lack of policy and regulatory framework. Since groundwater extraction is primarily driven by the needs of the population and the density of farmer population andnot the quality of resource, groundwater irrigation is scaling up even in such hard rock areas causing irreversible depletion of the resource base (Shah and Deb, 2004).To warrant the current situation effective ground water management strategies needs to be evolved.

The management plan mentioned below is an effective measure for managing the declining groundwater level and deteriorating Stage of Ground Water Extraction.

6.1 District Ground Water Management Plan

There is a need of sustainable water conservation and management practices through an integrated approach for the optimal utilization of ground water resources in the district. The ground water management plan for Vidisha district has been made keeping in view the area specific details and includes the strategies like enhancing the ground water resources through construction of artificial recharge structures such as percolation tanks, check dams/nala bunds, recharge shafts, etc. and ensuring water use efficiency through maintenance/renovation of existing water bodies/water conservation structures. Also, adoption of micro-irrigation techniques such as sprinkler irrigation has been proposed, that would not only conserve ground water resources by reducing the draft, but would also increase the net cropping area there by augmenting the agricultural economy of the district.

6.1.1 Supply Side Management

Artificial recharge to ground water is one of the most efficient, scientifically proven and cost effective technology to mitigate the problems of over exploitation of ground water resources.The artificial recharge techniques simultaneously rejuvenates the depleted.

Ground water storage, reduces the ground water quality problems and also improves the sustainability of wells in the affected areas.

The supply side management plan for Vidisha district has been formulated using the basic concepts of hydrogeology. Sub-surface storage is calculated by multiplying the total area with the respective specific yield (considering the variable lithology) and the unsaturated zone thickness obtained by subtracting 3 mts from the post-monsoon water level. The surface water required to completely saturate the sub-surface storage is obtained by multiplying a factor of 1.33 to available storage potential.

A runoff coefficient factor of 0.23 has been considered forVidisha district to calculate the total surface water runoff, 30% of which accounts for the non-committed runoff which is available to sustain the proposed artificial recharge structures. Further, the number of structures has been calculated by allotting 35%, 45% and 15% of non-committed runoff to Percolation tanks, Recharge shafts and Nala bunds/Cement Plugs respectively.

The remaining runoff is considered to restore the pre-existing village tanks, ponds and water conservation structures. A detailed calculation of the proposed artificial recharge structures is presented in the Table 24.

A financial outlay plan has also been chalked out, assuming the cost for the artificial recharge structures to be Rs. 20 lakhs each for percolation tanks, Rs. 1 lakh each for Nalabunds/CementPlugs,Rs.10 lakh each for Recharge shafts and Rs.2.3 lakhs each for renovation of Village tanks/ponds/WCS. This accounts to a total of Rs. 277.00 Crores to successfully implement the supply side management strategy. Table 25 represents the complete financial outlay plan for the district.

6.1.2 Demand Side Management

Micro irrigation technologies such as drip and sprinkler systems are being increasingly promoted as technological solutions for achieving water conservation. Micro-irrigation comprises two technologies—drip and sprinkler irrigation. Both saves conveyance losses and improve water application efficiency by applying water near the root-zone of the plant. Some benefits of the micro-irrigation have been listed below:

1. The increase in yield for different crops ranges from 27percent to 88 per cent and water saving ranges from 36 per cent to 68 per cent vis-à-vis conventional flow irrigation systems (PhansalkerandVerma,2005).

2. It enables farmers to grow crops which would not be possible under conventional systems since it can irrigate adequately with lower water quantities.

3. It saves costs of hired labor and other inputs like fertilizer.

4. It reduces the energy needs for pumping, thus reducing energy per ha of irrigation.

Because of its reduced water needs. However, overall energy needs of the agriculture sector may not get reduced because most farmers use the increased water efficiency to bring more area under irrigation.

Adoption of Sprinkler irrigation techniques would save 20% of gross ground water draft for irrigation. Also, the 60% of additional recharge created by construction of artificial recharge structures can be utilized to increase the total cropping area, thereby enhancing the productivity and economy of the district.

Table 24: Ground Water Management–Supply Side, Vidisha District, Madhya Pradesh

Block	Rainfall (mm)	Rainfall (m)	Area (Sq Km)	Area suitable for recharge (Sq Km)	Average post-monsoon water level (m)	Unsaturated zone (m)	Average SP Yield (%)	Sub-surface storage (mcm)	Surface water required (mcm)	Surface water (Run-off) available (mcm)	Non-commited Run-off (mcm)	Percolation tank	CD/Recharge shaft/ Tube well	NB/ CP	Renovation of Village Ponds
Basoda	1650	1.65	1223	1088	4.44	1.44	0.02	35.2224	46.85	281.29	84.39	0	0	0	200
Gyaraspur	1500	1.5	872	841	4.85	1.85	0.02	32.264	42.91	200.56	60.17	43	150	172	128
Kurwai	1320	1.32	831	810	4.44	1.44	0.02	23.9328	31.83	191.13	57.34	32	111	127	201
Lateri	1660	1.66	986	892	6.03	3.03	0.02	59.7516	79.47	226.78	68.03	0	0	0	184
Nateran	1320	1.32	1130	977	5.78	2.78	0.02	62.828	83.56	259.90	77.97	0	0	0	83
Sironj	1330	1.33	1255	1037	2.41	0	0.02	0	0.00	288.65	86.60	0	0	0	200
Vidisha	1730	1.73	1074	1062.7	2.11	0	0.02	0	0.00	247.02	74.11	0	0	0	201
Total	10510	1.48	7371	6707.7	4.27	10.54	0.02	213.9988	284.62	1695.33	508.60	75	261	299	1197

Table 25: Financial Outlay Plan-Supply Side Management, Vidisha District, Madhya Pradesh

District	Area Suitable for AR	Volume of Surface Water available for AR (MCM)	Volume of Water required for recharge (MCM)	Proportionate Surface water for planning AR (MCM)	Percolation Tanks structure Nos	cost (crores)	NB/ CP structure Nos	cost (crores)	CD/Recharge shaft/ Tube well	cost (crores)	Renovation of Village Pondsstructure Nos	cost (crores)	Total Cost of RS in crores
Basoda	1088	1447.04	41.64	84.39	-	-	-	-	-	-	200	4	4
Gyaraspur	841	1118.53	41.38	60.17	43	9	172	17	150	15	128	3	43
Kurwai	810	1077.30	30.96	57.34	32	6	127	13	111	11	201	4	34
Lateri	892	1186.36	71.81	68.03	-	-	-	-	-	-	184	4	77
Nateran	977	1299.41	72.21	77.97	-	-	-	-	-	-	83	2	2
Sironj	1037	1379.21	0	86.60	-	-	-	-	-	-	200	4	4
Vidisha	1062.7	1413.39	0	74.11	-	-	-	-	-	-	201	4	4
Total	6707.7	8921.24	257.99	508.60	75	15	299	30	261	26	1197	24	168

6.1.3 Ground Water Quality

The management plan mentioned below is an effective measure for managing the Ground water quality

Remediation of Nitrate:

1. Less consumption of nitrogen containing fertilizers.
2. Proper disposal of domestic and industrial effluents through sewage treatment plants.

6.1.4 Well Construction Design (Collapsing Structure)

The faulty well construction design in which part assembly are not generally placed/lowered properly against the collapsible formation (inter-trappean clay/ contact zone) encountered at various intervening depth. These loose formation(clays) of thickness 2 to 9 meter generally occurring at variable depth 30-45, 70-90, 130-145 and 170-190arenon cohesive and non-collapsible under unsaturated condition when well is dry but when sufficient yield observed in well then these overlying clays start collapsing rapidly under saturated condition.

The recommended well design in the area is as given in Fig. 12

6.1.5 Very Deep Water Level

Bore wells having deep water level should be studied scientifically for utilizing this cavity as a subsurface storage/recharge in which surplus monsoon/ high intensity rain run off can be utilized effectively.

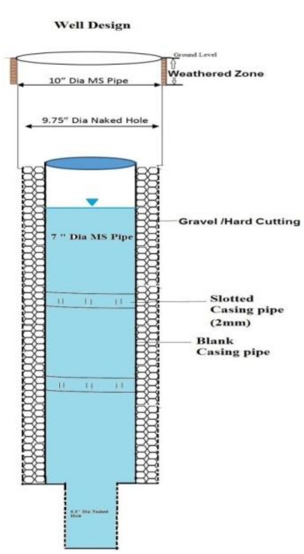


Fig. 31 Recommended well design in area

6.2 Post-Intervention Impact

The expected outcome of the proposed interventions from both supply side and demand side has been described in Table 26. It can be envisaged that the Stage of groundwater extraction for the entire Vidisha district, would reduce to 57.65% as compared to the present stage of ground water extraction of 60.74 % after implying and successful implementation of proposed interventions.

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Table 26: Post-Intervention Impact, Vidisha District, Madhya Pradesh

Block	Annual Extractable Ground Water Resource (Ham)	Total Extraction	Stage of Extrcation	Saving by Sprinkler	Additional recharge created by AR	After intervention of AR Structure Net GW AvL.	After intervention of AR Structure & utilization of additional GW created	Extraction after sprinkler & additional area created for agriculture	Additional area irrigated by GW after intervention	Stage of Extraction W/O GW use for additional Area Irrigation
	MCM	**MCM**	**%**	**MCM**	**MCM**	**MCM**	**MCM**	**MCM**	**Sq.Km**	**%**
Basoda	158.42	92.31	**58.27**	16.89	Groundwater extraction is advisable					**58.27**
Gyaraspur	86.77	62.44	**71.96**	11.87	32.26	119.03	19.35	69.94	46.67	**58.76**
Kurwai	110.15	78.30	**71.09**	14.96	23.93	134.08	14.35	77.71	34.91	**57.96**
Lateri	87.87	47.06	**53.56**	08.61	Groundwater extraction is advisable					**53.56**
Nateran	99.81	59.94	**60.05**	11.03	Groundwater extraction is advisable					**60.05**
Sironj	145.11	89.43	**61.63**	0.00	Groundwater extraction is advisable					**61.63**
Vidisha	155.40	82.88	**53.33**	0.00	Groundwater extraction is advisable					**53.33**
Total	**843.53**	**512.36**	**60.74**	**63.36**	**214.00**	**757.02**	**128.40**	**405.11**	**81.58**	**57.65**

6.3 Block-wise Ground Water Management Plan

As per directions of Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, Aquifer Management Plan for Vidisha district has been prepared block-wise. The plan for each block discusses the broad frame work of ground water situation in the block, status of water availability (both surface and ground water), feasibility of artificial recharge and other water conservation structures and their numbers.

Table 27: Block Basoda

Geographical area	1223.00Sq. km (NAQUIM Recharge worthy area 1088.00Sq. Km)
Basin/Sub Basin	Yamuna Basin
Principal Aquifer System	Basalt
Major Aquifer System	Weathered/Fractured Basalt and Sandstone
Normal Annual Rainfall	1650 mm

Aquifer Disposition	Two Types of Aquifer System Shallow Aquifer system (Aquifer-I): Depth range from 3 to 30m, Weathered Basalt. Deeper Aquifer System (Aquifer-II): Depth range from 30-204m, Fractured Basalt /sandstone.
Status of GW Exploration	Exploratory wells :7 Piezometer well: 1
Aquifer Characteristic	Aquifer I : Depth of Occurrence (m bgl): 3 to 30, Thickness average (m):2 DTWL(m bgl): 6 - 9 Yield (lps): 0.21 – 1.19 Specific yield :0.02 Aquifer I : Depth of Occurrence (m bgl): 30 m to 300m, Thickness average (m): 6 DTWL(m bgl): 6 - 9 Yield (lps): 2.8 – 8.2 T(m^2/day), Specific yield : 0.02
Ground water Monitoring Status	NHS: 8 DW, Piezometer well: 1
Groundwater Quality	Generally shallow and Deeper Aquifer Groundwater Quality potable
Aquifer potential	Mainly aquifer potential in weathered / Fracture Basalt
Groundwater Resource	GW Availability 158.42 MCMGW Draft 92.31 MCM Stage of GW extraction 58.27 %
Existing and Future water Demand	Present Demand for All usage 92.31 MCM Future Demand for Domestic and Industrial Use 9.31 MCM

MANAGEMENT PLAN

TYPE OF STRUCTURE	NUMBER	COST IN INR CRORES
Renovation of Village Ponds	200	4.00 (Rs 02 Lakh Per Structure)
Total Cost		4.0 **Crores**

Table 28: Block Gyaraspur

Geographical area	872.00Sq. km (NAQUIM Recharge worthy area 841.00Sq. Km)
Basin/Sub Basin	Yamuna Basin
Principal Aquifer System	Basalt
Major Aquifer System	Weathered/Fractured Basalt
Normal Annual Rainfall	1500 mm

Aquifer Disposition	Two Types of Aquifer System Shallow Aquifer system (Aquifer-I): Depth range from 3 to 30m, Weathered Basalt. Deeper Aquifer System (Aquifer-II): Depth range from 30-204m, Fractured Basalt /sandstone.
Status of GW Exploration	Exploratory wells :7 Piezometer well: 1
Aquifer Characteristic	Aquifer I : Depth of Occurrence (m bgl): 3 to 30, Thickness average (m): 2.44 DTWL(m bgl): 2.85 – 13.66 Yield (lps): 0 – 2.44 Specific yield :0.02 Aquifer I : Depth of Occurrence (m bgl): 30 m to 300m, Thickness average (m): 4.79 DTWL(m bgl): 7.65 Yield (lps): 1.74 -8.2 T(m^2/day), Specific yield : 0.02
Ground water Monitoring Status	NHS: 2 DW, Piezometer well: 1
Groundwater Quality	Generally shallow and Deeper Aquifer Groundwater Quality potable
Aquifer potential	Mainly aquifer potential in weathered / Fracture Basalt
Groundwater Resource	GW Availability 86.77 MCMGW Draft 62.44 MCM Stage of GW extraction 71.96%
Existing and Future water Demand	Present Demand for All usage 62.44 MCM Future Demand for Domestic and Industrial Use 3.38 MCM

MANAGEMENT PLAN

TYPE OF STRUCTURE	NUMBER	COST IN INR CRORES
Percolation Tanks	43	9.00 (Rs 20 Lakh Per Structure)
NB /CP	172	17.00(Rs 10 Lakh Per Structure)
CD /Recharge Shaft	150	15.00 (Rs05 Lakh Per Structure)
Renovation of Village Ponds	128	3.00 (Rs02 Lakh Per Structure)
Total Cost		**44.00 Crores**

Table 29: Block Kurwai

Geographical area	831.00Sq. km (NAQUIM Recharge worthy area 810.00Sq. Km)
Basin/Sub Basin	Yamuna Basin
Principal Aquifer System	Basalt
Major Aquifer System	Weathered/Fractured Basalt
Normal Annual Rainfall	1320 mm

Aquifer Disposition	Two Types of Aquifer System Shallow Aquifer system (Aquifer-I): Depth range from 3 to 30m, Weathered Basalt. Deeper Aquifer System (Aquifer-II): Depth range from 30-204m, Fractured Basalt /sandstone.
Status of GW Exploration	Exploratory wells :0 Piezometer well: 1
Aquifer Characteristic	Aquifer I : Depth of Occurrence (m bgl): 3 to 30, Thickness average (m): 0.00 DTWL(m bgl): 5.65 Yield (lps): 0.00 Specific yield :0.02 Aquifer I : Depth of Occurrence (m bgl): 30 m to 300m, Thickness average (m): 0 DTWL(m bgl): 19.93 Yield (lps): 0.00 T(m^2/day), Specific yield : 0.02
Ground water Monitoring Status	NHS: 1 DW, Piezometer well: 1
Groundwater Quality	Generally shallow and Deeper Aquifer Groundwater Quality potable
Aquifer potential	Mainly aquifer potential in weathered / Fracture Basalt
Groundwater Resource	GW Availability 110.15 MCMGW Draft 78.31 MCM Stage of GW extraction 71.09 %
Existing and Future water Demand	Present Demand for All usage 78.31 MCM Future Demand for Domestic and Industrial Use 3.57 MCM

MANAGEMENT PLAN

TYPE OF STRUCTURE	NUMBER	COST IN INR CRORES
Percolation Tanks	32	6.00 (Rs 20 Lakh Per Structure)
NB /CP	127	13.00(Rs 10 Lakh Per Structure)
CD /Recharge Shaft	111	11.00 (Rs05 Lakh Per Structure)
Renovation of Village Ponds	201	4.00 (Rs02 Lakh Per Structure)
Total Cost		**34.00Crores**

Table 30: Block Lateri

Geographical area	986.00Sq. km (NAQUIM Recharge worthy area 892.00Sq. Km)
Basin/Sub Basin	Yamuna Basin
Principal Aquifer System	Basalt
Major Aquifer System	Weathered/Fractured Basalt
Normal Annual Rainfall	1660 mm

Aquifer Disposition	Two Types of Aquifer System Shallow Aquifer system (Aquifer-I): Depth range from 3 to 30m, Weathered Basalt. Deeper Aquifer System (Aquifer-II): Depth range from 30-204m, Fractured Basalt /sandstone.
Status of GW Exploration	Exploratory wells :0 Piezometer well: 1
Aquifer Characteristic	Aquifer I : Depth of Occurrence (m bgl): 3 to 30, Thickness average (m): 0.00 DTWL(m bgl): 3.92 Yield (lps): 0.00 Specific yield :0.02 Aquifer I : Depth of Occurrence (m bgl): 30 m to 300m, Thickness average (m): 0 DTWL(m bgl): 7.12 Yield (lps): 0.00 T(m^2/day), Specific yield : 0.02
Ground water Monitoring Status	NHS: 4 DW, Piezometer well: 1
Groundwater Quality	Generally shallow and Deeper Aquifer Groundwater Quality potable
Aquifer potential	Mainly aquifer potential in weathered / Fracture Basalt
Groundwater Resource	GW Availability 87.87 MCMGW Draft 47.07 MCM Stage of GW Development 53.56 %
Existing and Future water Demand	Present Demand for All usage 47.07 MCM Future Demand for Domestic and Industrial Use 4.72 MCM

MANAGEMENT PLAN

TYPE OF STRUCTURE	NUMBER	COST IN INR CRORES
Renovation of Village Ponds	184	4.00 (Rs02 Lakh Per Structure)
Total Cost		4.00 **Crores**

Table 31: Block Nateran

Geographical area	1130.00Sq. km (NAQUIM Recharge worthy area 977.00Sq. Km)
Basin/Sub Basin	Yamuna Basin
Principal Aquifer System	Basalt
Major Aquifer System	Weathered/Fractured Basalt
Normal Annual Rainfall	1320 mm

Aquifer Disposition	Two Types of Aquifer System Shallow Aquifer system (Aquifer-I): Depth range from 3 to 30m, Weathered Basalt. Deeper Aquifer System (Aquifer-II): Depth range from 30-204m, Fractured Basalt /sandstone.
Status of GW Exploration	Exploratory wells :5 Piezometer well: 1
Aquifer Characteristic	Aquifer I : Depth of Occurrence (m bgl): 3 to 30, Thickness average (m): 0.43 – 1.74 DTWL(m bgl): 7.15 Yield (lps): 0.43 – 1.74 Specific yield :0.02 Aquifer I : Depth of Occurrence (m bgl): 30 m to 300m, Thickness average (m): 2.92 DTWL(m bgl): 19.93 Yield (lps): 0 T(m^2/day), Specific yield : 0.02
Ground water Monitoring Status	NHS: 4 DW, Piezometer well: 0
Groundwater Quality	Generally shallow and Deeper Aquifer Groundwater Quality potable
Aquifer potential	Mainly aquifer potential in weathered / Fracture Basalt
Groundwater Resource	GW Availability 99.81 MCMGW Draft 59.94 MCM Stage of GW Development 60.05 %
Existing and Future water Demand	Present Demand for All usage 59.94 MCM Future Demand for Domestic and Industrial Use 5.24 MCM

MANAGEMENT PLAN

TYPE OF STRUCTURE	NUMBER	COST IN INR CRORES
Renovation of Village Ponds	83	2.00 (Rs02 Lakh Per Structure)
Total Cost		**2.00 Crores**

Chapter-7

CONCLUSIONS AND RECOMMENDATIONS

- Vidisha district occupies an area of 7371 sq km out of which the ground water recharge worthy area is 6707.7 sq. km. and the rest is covered by hilly and forestarea.The major river draining the area includes the river Betwa & its tributaries.

- The major part of the district is covered by Deccan traps and remaining areas are covered by Vindhyan formations.

- Vidisha district comprises of seven blocks, namely Basoda, Gyaraspur, Kurwai, Lateri, Nateran, Sironj and Vidisha.

- The phreatic aquifer is recharged during monsoon and sustains for 3 to 4 months.

- More stress on Ground water,85% of irrigation carried out by Ground water and 15% of irrigation by surface water.

- Groundwater decline range in post-monsoon is 0.02 to 1.17 m/year and in pre-monsoon is 0.0042 to 0.8679 m/year.

- High nitrate content (upto186mg/l) is found in the water samples from isolated patches.

- As per the Dynamic Ground Water Resource Assessment Report (2020), the annual extractable groundwater resource in the district is 84353.11ham and ground water extraction for all uses is 51236.64 ham, resulting the stage of ground water extraction to be 60.74 % as a whole for district. Vidisha district falls under safe category.

- Out of 7 blocks 5 block falls under safe category namely Basoda, , Lateri, Nateran, Sironj and Vidisha whereas 2 blocks fall under semi-critical category namely , Gyaraspur, Kurwai

- After the implemented of project interventions in the report, the stage of Extraction is expected to improve from 60.74 % to 57.67% for the Vidisha district and district remains under safe category and additional area for the irrigation will be 81.85 sq km.

- As per the Management plan prepared under NAQUIM of all the blocks of Vidisha District, 75 Percolation Tanks, 261 Check dam (Recharge Shafts), 299 Nala Bunds/Cement Plugs and 1197 Renovation of village ponds have been proposed and financial expenditure is expected to be Rs 198 Crores in Vidisha District for sustainable development and management of ground water resources.

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Annexure I
Bore well details

Sr. No.	District	Block	Village	Site	Latitude	Longitude	Elevation	Total Depth
1	Vidisha	Nateran	Agra Jagir	Agra Jagir	23.94734	77.5487	405	204.6
2	Vidisha	Vidisha	Ahmedpur Kasba	Ahmedpur Kasba	23.437	77.9777	368	204.6
3	Vidisha	Gyaraspur	Ambar	Ambar	23.5732	78.02743	373	204
4	Vidisha	Vidisha	Atal Udyaan	Atal Udyaan	23.5108	77.8291	383	207.5
5	Vidisha	Nateran	Barkheda jat	Barkheda jat	23.92978	77.64293	403	203
6	Vidisha	Gyaraspur	Barkhera gambhir	Barkhera gambhir	23.49339	78.05907	389	203
7	Vidisha	Nateran	Bhiakhedi	Bhiakhedi	23.7984	77.4559	396	204.6
8	Vidisha	Basoda	Bhidwasan	Bhidwasan	23.75952	78.06441	421	204.6
9	Vidisha	Nateran	Boodhar	Boodhar	23.8495	77.7884	402	203
10	Vidisha	Basoda	Chouravar	Chouravar	23.8269	77.8868	353	203
11	Vidisha	Basoda	Deeghora	Deeghora	23.81099	78.0616	416	204.6
12	Vidisha	Gyaraspur	Deyarpur	Deyarpur	23.69168	78.24843	385	91
13	Vidisha	Gyaraspur	Gunnota	Gunnota	23.5801	78.1893	428	203
14	Vidisha	Vidisha	Hansua	Hansua	23.4734	77.8841	373	117.8
15	Vidisha	Vidisha	Lashkarpur	Lashkarpur	23.6272	77.7903	366	179.8
16	Vidisha	Sironj	Moondra bagal	Moondra bagal	24.0299	77.7314	409	203
17	Vidisha	Vidisha	Motipura	Motipura	23.77084	77.62745	453	204.6
18	Vidisha	Vidisha	Parasi Gujjar	Parasi Gujjar	23.5565	77.6952		113
19	Vidisha	Basoda	Rabrayai	Rabrayai	23.8867	77.9715	371	203
20	Vidisha	Basoda	Rehmanpur	Rehmanpur	23.8107	78.21335	403	197
21	Vidisha	Basoda	Saloi	Saloi	23.4642	77.5234	480	161
22	Vidisha	Gyaraspur	Santapur	Santapur	23.70044	77.92584	427	204.6
23	Vidisha	Sironj	Siraswas	Siraswas	24.27665	77.65963	478	93
24	Vidisha	Basoda	Summer dongi	Summer dongi	23.86922	78.20513	389	203
25	Vidisha	Basoda	Udaypur	Udaypur	23.89929	78.06282	412	204.6
26	Vidisha	Vidisha	Wardha	Wardha	23.83734	77.63213	456	204.6

Annexure-II

Aquifer Resistivity characteristics of weathered zone and deeper succession in DeccanTrap basalt

VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)	VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)
	Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence		Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence
	Resistivity(ohm.m)	Depth to bottom(m)		Resistivity (ohm.m)	Depth to bottom(m)
351	--	--	351	--	--
352	3	9	352	3	9
353	13	9	353	13	9
354	3-8	18	354	3-8	18
355	3	18	355	3	18
356	29	6	356	29	6
357	--	--	357	--	--
358	29	39	358	29	39
359	8	17	69	17-168	35-40,65-70,90-95 130-135
360	2	7	89	7-119	60-70,85-90,100-110 170-190
361	3-39	14	77	14-141	55-60,85-90,95-100 110-120
362	3-6	17	--	--	Nil
363	5-7	31	--	--	70-75,85-90,180-190
364	--	--	11	9-36	100-150
365	6	14	---	--	Nil
366	6	23	183	23-?	Nil
367	5	18	--	--	Nil
368	3	6	--	--	Nil
369	14	4	40	21-86	60-70,90-100,130-190
370	--	--	40	53-138	50-60,65-75,85-95 110-170,190-200
371	38	17	15	17-56	Nil
372	41	4	18	19-39	25-30,60-150
373	--	--	15	16-51	100-200
374	--	--	15	15-47	150-160,170-180
375	4	9	170	9-114	130-140

VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)	VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)
	Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence		Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence
	Resistivity(ohm.m)	Depth to bottom(m)		Resistivity (ohm.m)	Depth to bottom(m)
376	--	--	16 59	7-19 19-235	100-110,130-140,150-160
377	6	11	--	--	170-180,190-200
378	--	--	13	25-48	Nil
379	12	9	21	40-83	100-130,150-160,180-190
380	15	10	--	--	75-80,90-95,130-150, 160-180
381	12	7	54	21-55	60-65,90-120,140-150 180-200
382	13	8	21	10-44	40-50,60-95,120-130,160-180 170-180
383	3-18	7	31	13-63	80-90,120-130,140-160 170-180
384	45	13	15	31-62	30-35,55-70,75-80 85-120,140-200
385	21	3	3-129	6-98	90-100,130-140,160-170
386	7	7	81	7-15	100-110,130-140,160-170
387	2-3	12	--	--	85-100
388	--	--	13	2-87	50-55,60-65,180-190
389	2	5	--	--	Nil
390	14	9	--	--	130-140,150-160,190-200
391	5	15	--	--	Nil
392	7	8	--	--	Nil
393	5	14	--	--	Nil
394	5	4	17	4-39	30-35,55-65,70-75, 85-90,110-120,170-180
395	8	25	3	25-44	Nil
396	--	--	47	31-54	170-180
397	3	8	28	8-92	50-55,120-130,170-180
398	7	16	34	16-204	60-70,110-120
399	7	9	103	9-?	55-60,80-85,110-120
400	3	3	--	--	70-85,95-140
401	12	31	186	31-?	55-60,65-70,95-120 140-150
402	--	--	3	16-37	Nil
403	3	24	25	24-47	Nil
404	4	4	--	--	55-60,65-70,85-90 110-120,130-150,180-190
405	7	19	56	19-212	85-95,110-140,170-190
406	11	11	--	--	65-70,85-95,120-125, 130-140,150-160,180-200
407	11	9	--	--	55-65,160-180
408	4	9	29	9-161	50-55,80-85,90-95 100-110,120-130
409	26	3	--	--	30-50,60-70,120-150
410	10	17	--	--	Nil

VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)	VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)
	Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence		Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence
	Resistivity(ohm.m)	Depth to bottom(m)		Resistivity (ohm.m)	Depth to bottom(m)
411	--	--	195	3-131	70-75,85-90,130-170
412	24	5	--	--	55-60,70-75,90-95 110-120,130-140,150-190
413	6	9	11	9-68	55-65,70-75,90-95,110-120, 130-140,150-190
414	11	14	109	14-?	80-85,100-110,130-200
415	19	9	42	9-83	50-60,85-90,110-120
416	19	6	10	6-33	100-110
417	15	14	3	14-25	80-85,90-95
418	11	9	42	9-94	50-55,60-65,85-90, 100-110,150-170
419	5	21	--	--	Nil
420	3	18	--	--	Nil
421	--	--	44	16-121	60-180
422	7	32	156	32-54	Nil
423	10	25	--	--	130-140
424	31	6	49	6-60	35-70,75-85,95-100, 110-120,150-160
425	5	12	--	--	Nil
426	--	--	21	5-41	55-60,65-70,80-90, 150-160
427	5-8	18	72	18-83	110-120,130-140,170-180
428	6-8	13	--	--	45-50,90-100,140-160
429	12	18	24	29-107	65-70, 75-80, 85-100,110-120, 130-140,150-160 190-200
430	5	16	--	--	120-130,180-190
431	7	24	--	--	Nil
432	--	--	52	16-46	75-80,140-150,180-190
433	10	19	108	19-102	90-95,150-160,190-200
434	10	12	--	--	120-130,170-180
435	--	--	21	18-44	Nil
436	6	17	38	32-?	150-170,190-200
437	4	8	37	11-69	70-75,110-120,150-160
438	10	18	--	--	Nil
439	6-28	12	20	32-131	60-65,80-90,95-110, 120-200
440	5	9	--	--	Nil
441	--	--	92	11-237	130-140,170-180,190-200
442	--	--	122	16-209	65-80,85-100,110-120 130-140,170-180,190-200
443	44	14	79	13.9-214	55-60,70-80,90-100, 130-150,170-200
444	6	18	---	--	150-160
445	16	23	--	--	75-80,160-170
446	11	18	--	--	Nil
447	3	11	--	--	Nil
VES	Resistivity Characteristics	Possible presence of	VES	Resistivity	Possible presence of thin

		thin fractured zone in the depth range(m)		Characteristics	fractured zone in the depth range(m)
	Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence		Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence
	Resistivity(ohm.m)	Depth to bottom(m)		Resistivity (ohm.m)	Depth to bottom(m)
448	--	--	115	8-118	30-40,45-50,70-85,95-110, 130-140,170-180
449	21	53	--	--	Nil
450	4	3	5	14-41	110-120,140-180
451	3	22	--	--	Nil
452	--	--	104	23-?	150-160,170-180,190-200
453	6-26	30	110	30-282	40-45,65-70,85-90,140-160
454	47	19	9	19-39	Nil
455	--	--	8	19-40	130-140,150-160
456	--	--	184	3-100	50-60,70-80,140-160
457	15	6	41	13-54	90-95,100-120,130-200
458	10	14	--	--	130-140,160-180
459	7-11	22	89	22-91	100-110
460	--	--	22	17-59	45-110,120-130,140-170
561	10	20	--	--	80-85,100-110
462	4	12	--	--	Nil
463	37	4	--	--	75-80,110-120,140-200
464	6	13	30	14-95	65-70,80-95,100-110,130-140 170-180
465	4-8	25	--	--	70-75
466	6	11	--	--	Nil
467	5	16	--	--	Nil
468	8	19	--	--	Nil
469	4	6	--	--	Nil
470	6	13	--	--	Nil
471	6	14	--	--	170-180,190-200
472	4	36	--	--	60-65,75-80
473	--	--	36	126	55-60,75-80,90-95,120-130
474	7	8	--	--	Nil
475	7	30	--	--	Nil
476	8	29	--	--	Nil
477	3	10	--	--	120-180
478	--	--	24	20-73	65-70,75-80
479	10	25	--	--	65-75,130-135,140-160
480	3	7	--	--	Nil
481	6	12	82	12-60	90-95
482	2-7	11	--	--	NIL
483	6	13	40	15-100	55-90
484	19	7	--	--	80-85,90-95,130-140
485	--	--	40	8-108	55-60,90-95,110-120,180-190
486	11	9	--	--	Nil
487	7	20	--	--	Nil
488	--	--	78	5-125	70-75,90-130
489	17	18	59	18-89	50-55,65-70,90-100,110-120, 140-150,160-170

VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)	VES	Resistivity Characteristics	Possible presence of thin fractured zone in the depth range(m)
	Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence		Weathered Zone Aquifer	Aquifer in vesicular/ fractured basalt sequence
	Resistivity(ohm.m)	Depth to bottom(m)		Resistivity (ohm.m)	Depth to bottom(m)
490	15	5	--	--	70-75,120-130,140-150 180-200
491	4	28	--	--	Nil
492	6	8	--	--	Nil
493	4	1.4	71	51-140	40-45,70-75,90-120
494	5-13	14	--	--	Nil
495	8	4	--	--	35-40,90-100,110-120,130-180
496	25	7	--	--	90-100,180-200
497	14	15	--	--	Nil
498	65	8	--	--	65-90
499	16	2	27	46-90	110-120,140-150
500	--	--	97	21-85	55-110,150-180
501	--	--	108	18-39	60-65,110-120,150-160
502	--	--	122	20-68	65-80
503	--	--	30	18-39	100-140
504	6	15	--	--	130-140,150-170,180-190
505	5	6	--	--	Nil
506	9	4	50	26-107	50-55,70-130,150-170,180-200
507	5	14	67	14-75	Nil
508	--	--	47	9-86	70-75,85-90,95-100
509	--	--	81	11-107	75-85,100-110
510	29	29	102	29-?	65-75, 85-90,110-120,130-140, 180-190
511	34	18	6	18-37	Nil
512	10	4	93	4-116	60-70,90-95,100-110
513	5	9	4	18-39	75-85,110-130,150-160
514	--	--	60	23-52	55-120
515	--	--	189	25-65	80-95,110-130,140-160
516	43	5	24	11-36	150-200
517	8	7	84 75	7-26 26-?	65-70,85-95,120-130,140-170
518	39	3	200	3-33	50-65,80-85,110-120,170-190
519	4	6	188	6-?	130-140,180-190
520	6	7	8	16-34	55-100,140-150,180-190
521	7	13	31	13-202	70-80,90-100,120-140,180-190
522	--	--	44	41-?	120-130,150-160,170-180
523	9	6	17	21-79	50-95,110-170

Annexure III
Lithologs

Location: In front of Anganwadi and Primary school, Agra Jagir

1. Well No : EW 52 - 10/49	2. State : Madhya Pradesh	3.Dist : Vidisha		
4. Village/ Block : Agra Jagir, Nateran	5. Latitude 23.9473	6. Longitude E 77.5487		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Agra Jagir	Soil	0	3.1	3.1
Agra Jagir	Clay	3.1	9.3	6.2
Agra Jagir	Weathered basalt	9.3	13.71	4.41
Agra Jagir	**Fractured basalt**	**13.71**	**14**	0.29
Agra Jagir	Weathered basalt	14	24.8	10.8
Agra Jagir	Vesicular basalt	24.8	34.1	9.3
Agra Jagir	Massive basalt	34.1	60.35	26.25
Agra Jagir	**Fractured vesicular basalt**	**60.35**	**61**	0.65
Agra Jagir	Vesicular basalt	61	74.4	13.4
Agra Jagir	Massive basalt	74.4	86.8	12.4
Agra Jagir	Vesicular basalt	86.8	102.3	15.5
Agra Jagir	Massive basalt	102.3	124	21.7
Agra Jagir	Vesicular basalt	124	130.2	6.2
Agra Jagir	Massive basalt	130.2	161.2	31
Agra Jagir	Vesicular basalt	161.2	170.5	9.3
Agra Jagir	Massive basalt	170.5	199.2	28.7
Agra Jagir	**Red bole**	199.2	200	0.8
Agra Jagir	Vesicular basalt	200	204.6	4.6
Agra Jagir	Soil	0	3.1	3.1
Agra Jagir	Clay	3.1	9.3	6.2
Agra Jagir	Weathered basalt	9.3	13.71	4.41
Agra Jagir	**Fractured basalt**	**13.71**	**14**	0.29
Agra Jagir	Weathered basalt	14	24.8	10.8
Agra Jagir	Vesicular basalt	24.8	34.1	9.3
Agra Jagir	Massive basalt	34.1	60.35	26.25

Location: Govt. high school, Ahmedpur kasba

1. Well No : EW 45 - 03/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Ahmedpur kasba, Vidisha	**5. Latitude N 23.4370**	**6. Longitude E 77.9777**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Ahmedpur Kasba	Soil	0	3.1	3.1
Ahmedpur Kasba	Clay	3.1	15.5	12.4
Ahmedpur Kasba	Weathered basalt	15.5	37.2	21.7
Ahmedpur Kasba	Vesicular basalt	37.2	49.6	12.4
Ahmedpur Kasba	**Fractured basalt**	**49.6**	**52.7**	3.1
Ahmedpur Kasba	Vesicular basalt	52.7	55.8	3.1
Ahmedpur Kasba	Massive basalt	55.8	71.3	15.5
Ahmedpur Kasba	Vesicular basalt	71.3	77.5	6.2
Ahmedpur Kasba	Massive basalt	77.5	80.6	3.1
Ahmedpur Kasba	Vesicular basalt	80.6	93	12.4
Ahmedpur Kasba	Massive basalt	93	111.6	18.6
Ahmedpur Kasba	**Fractured basalt**	**111.6**	**114.7**	3.1
Ahmedpur Kasba	Vesicular basalt	114.7	120.9	6.2
Ahmedpur Kasba	Massive basalt	120.9	124	3.1
Ahmedpur Kasba	Vesicular basalt	124	136.4	12.4
Ahmedpur Kasba	Massive basalt	136.4	145.7	9.3
Ahmedpur Kasba	Vesicular basalt	145.7	148.5	2.8
Ahmedpur Kasba	**Red bole**	148.5	148.9	0.4
Ahmedpur Kasba	Vesicular basalt	148.9	158.1	9.2
Ahmedpur Kasba	Massive basalt	158.1	167.4	9.3
Ahmedpur Kasba	Vesicular basalt	167.4	169.3	1.9
Ahmedpur Kasba	**Red bole**	169.3	170.5	1.2
Ahmedpur Kasba	Vesicular basalt	170.5	175	4.5
Ahmedpur Kasba	**Red bole**	175	176	1
Ahmedpur Kasba	Vesicular basalt	176	180.3	4.3
Ahmedpur Kasba	**Red bole**	180.3	182	1.7
Ahmedpur Kasba	Vesicular basalt	182	189.1	7.1
Ahmedpur Kasba	Massive basalt	189.1	204.6	15.5

Location: In the front of vetenary hospital, Ambar

1. Well No : EW 65 - 23/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Ambar, Gyaraspur	**5. Latitude N 23.573197**	**6. Longitude E 78.027433**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Ambar	Soil	0	3.1	3.1
Ambar	Weathered basalt	3.1	6.2	3.1
Ambar	Massive basalt	6.2	10.6	4.4
Ambar	**Fractured massive basalt**	**10.6**	**10.9**	0.3
Ambar	Massive basalt	10.9	18.6	7.7
Ambar	Vesicular basalt	18.6	21.7	3.1
Ambar	Massive basalt	21.7	34.1	12.4
Ambar	Vesicular basalt	34.1	40.3	6.2
Ambar	Massive basalt	40.3	65.1	24.8
Ambar	Vesicular basalt	65.1	68.2	3.1
Ambar	Massive basalt	68.2	96.1	27.9
Ambar	Vesicular basalt	96.1	99.3	3.2
Ambar	**Fractured vesicular basalt**	**99.3**	**99.6**	0.3
Ambar	Massive basalt	99.6	124	24.4
Ambar	Vesicular basalt	124	136.4	12.4
Ambar	Massive basalt	136.4	179.8	43.4
Ambar	Vesicular basalt	179.8	189.1	9.3
Ambar	**Contact zone**	189.1	192.2	3.1

Location: In the premises of Atal udyaan

1. Well No : EW 43 - 01/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Atal udyaan, Vidisha	**5. Latitude N 23.5108**	**6. Longitude E 77.8291**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Atal udyan	Sandstone	192.2	204.6	12.4
Atal udyan	Clay	0	3.1	3.1
Atal udyan	**Red bole**	3.1	6.2	3.1
Atal udyan	Vesicular basalt	6.2	10.5	4.3
Atal udyan	**Fractured vesicular basalt**	**10.5**	**10.7**	0.2
Atal udyan	Vesicular basalt	10.7	20.9	10.2
Atal udyan	Massive basalt	20.9	82	61.1
Atal udyan	**Red bole**	82	85	3
Atal udyan	Vesicular basalt	85	89.9	4.9
Atal udyan	Massive basalt	89.9	102.3	12.4
Atal udyan	Vesicular basalt	102.3	108.5	6.2
Atal udyan	Massive basalt	108.5	158.1	49.6
Atal udyan	Vesicular basalt	155	164.3	9.3
Atal udyan	Massive basalt	164.3	167.4	3.1
Atal udyan	Contact zone	167.4	170.5	3.1
Atal udyan	Sandstone	170.5	207.7	37.2

Location: Govt. primary school, Parasi gujjar

1. Well No : EW 46 - 04/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Parasi gujjar, Vidisha	**5. Latitude N 23.5565**	**6. Longitude E 77.6952**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Parasi Gujjar	Soil	0	3.1	3.1
Parasi Gujjar	Clay	3.1	15.5	12.4
Parasi Gujjar	Weathered basalt	15.5	34.1	18.6
Parasi Gujjar	Massive basalt	34.1	37.2	3.1
Parasi Gujjar	Vesicular basalt	37.2	58.9	21.7
Parasi Gujjar	**Fractured sandstone**	**58.9**	**62**	3.1
Parasi Gujjar	Sandstone	62	111.6	49.6
Parasi Gujjar	**Fractured sandstone**	**111.6**	**114.7**	3.1

Location:Near Hanuman Temple and Rest house, Barkheda Jat				
1. Well No : EW 51 - 09/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Barkheda Jat, Nateran	**5. Latitude N 23.929780**	**6. Longitude E 77.642930**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Barkheda jat	Top soil	0	3.05	3.05
Barkheda jat	Weathered basalt	3.05	6.5	3.45
Barkheda jat	**Fractured basalt**	**6.5**	**6.7**	0.2
Barkheda jat	Massive basalt	6.7	30.5	23.8
Barkheda jat	Vesicular basalt	30.5	36.6	6.1
Barkheda jat	Massive basalt	36.6	54.9	18.3
Barkheda jat	Vesicular basalt	54.9	61	6.1
Barkheda jat	Massive basalt	61	91.5	30.5
Barkheda jat	Red bole	91.5	97.6	6.1
Barkheda jat	Vesicular basalt	97.6	100.2	2.6
Barkheda jat	**Fractured vesicular basalt**	**100.2**	**100.5**	0.3
Barkheda jat	Vesicular basalt	100.5	109.8	9.3
Barkheda jat	Massive basalt	109.8	137	27.2
Barkheda jat	Vesicular basalt	137	143	6
Barkheda jat	Massive basalt	143	167	24
Barkheda jat	Vesicular basalt	167	173	6
Barkheda jat	Massive basalt	173	203	30

Location: In the Premises of Govt. middle school, Barkheda Gambhir				
1. Well No : EW 66 - 24/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Barkheda Gambhir, Gyaraspur	**5. Latitude N 23.49339**	**6. Longitude E 78.05907**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Barkheda gambhir	Soil	0	3.05	3.05
Barkheda gambhir	Weathered basalt	3.05	9.15	6.1
Barkheda gambhir	**Fractured vesicular basalt**	**9.15**	**9.7**	0.55
Barkheda gambhir	Vesicular basalt	9.7	15.25	5.55
Barkheda gambhir	Massive basalt	15.25	24.4	9.15
Barkheda gambhir	Vesicular basalt	24.4	39.65	15.25
Barkheda gambhir	Massive basalt	39.65	45.75	6.1
Barkheda gambhir	Vesicular basalt	45.75	64.05	18.3
Barkheda gambhir	Massive basalt	64.05	76.25	12.2
Barkheda gambhir	Vesicular basalt	76.25	85.4	9.15
Barkheda gambhir	Massive basalt	85.4	112.85	27.45
Barkheda gambhir	Vesicular basalt	112.85	118.95	6.1
Barkheda gambhir	Massive basalt	118.95	146	27.05

Barkheda gambhir	Vesicular basalt	146	152	6
Barkheda gambhir	Massive basalt	152	167	15
Barkheda gambhir	Massive basalt	167	182	15
Barkheda gambhir	Vesicular basalt	182	197	15
Barkheda gambhir	Massive basalt	197	203	6
Location: Govt. high school, Bhiakhedi				
1. Well No : EW 50 - 08/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Bhiakhedi, Nateran	**5. Latitude N 23.7984**	**6. Longitude E 77.4559**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Bhiakhedi	Soil	0	3.1	3.1
Bhiakhedi	Weathered basalt	3.1	24.8	21.7
Bhiakhedi	Vesicular basalt	24.8	31.2	6.4
Bhiakhedi	**Fractured vesicular basalt**	**31.2**	**31.4**	0.2
Bhiakhedi	Vesicular basalt	**31.4**	**36.1**	4.7
Bhiakhedi	**Red bole**	36.1	38	1.9
Bhiakhedi	**Vesicular basalt**	38	40.3	2.3
Bhiakhedi	Massive basalt	40.3	64.1	23.8
Bhiakhedi	**Red bole**	64.1	65.1	1
Bhiakhedi	Vesicular basalt	65.1	71.3	6.2
Bhiakhedi	Massive basalt	71.3	89.9	18.6
Bhiakhedi	**Fractured vesicular basalt**	**89.9**	**90.3**	0.4
Bhiakhedi	Vesicular basalt	90.3	105.4	15.1
Bhiakhedi	Massive basalt	105.4	114.7	9.3
Bhiakhedi	Vesicular basalt	114.7	130.2	15.5
Bhiakhedi	Massive basalt	130.2	174.1	43.9
Bhiakhedi	**Red bole**	174.1	176	1.9
Bhiakhedi	Vesicular basalt	176	180	4
Bhiakhedi	**Fractured vesicular basalt**	**180**	**180.6**	0.6
Bhiakhedi	Vesicular basalt	180.6	195.3	14.7
Bhiakhedi	Massive basalt	195.3	204.6	9.3
Location: In the premises of Govt. high school, Bhidwasan				
1. Well No : EW 58 - 16/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Bhidwasan, Basoda	**5. Latitude N 23.759515**	**6. Longitude E 78.064408**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Bhidwasan	Soil	0	3.1	3.1
Bhidwasan	clay	3.1	6.2	3.1
Bhidwasan	Weathered basalt	6.2	15.5	9.3

Bhidwasan	Massive basalt	15.5	21.7	6.2
Bhidwasan	Vesicular basalt	21.7	27.9	6.2
Bhidwasan	**Fractured basalt**	**27.9**	**31**	3.1
Bhidwasan	Massive basalt	31	34.1	3.1
Bhidwasan	Vesicular basalt	34.1	43.4	9.3
Bhidwasan	**Sandstone**	**43.4**	**80.6**	37.2
Bhidwasan	**Fractured sandstone**	**80.6**	**83.7**	3.1
Bhidwasan	Sandstone	83.7	204.6	120.9
Location: In govt. land near Gaushala, Bodhar				
1. Well No : EW 53 - 11/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Bodhar, Nateran	**5. Latitude N 23.8495**	**6. Longitude E 77.7884.**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Boodhar	Soil	0	3.05	3.05
Boodhar	Clay	3.05	6.1	3.05
Boodhar	Weathered basalt	6.1	16.2	10.1
Boodhar	**Fractured basalt**	**16.2**	**16.5**	0.3
Boodhar	Weathered basalt	16.5	21.35	4.85
Boodhar	Massive basalt	21.35	36.6	15.25
Boodhar	Vesicular basalt	36.6	40.1	3.5
Boodhar	**Fractured vesicular basalt**	**40.1**	**40.4**	0.3
Boodhar	Vesicular basalt	40.4	45.75	5.35
Boodhar	Massive basalt	45.75	57.95	12.2
Boodhar	**Contact zone**	57.95	61	3.05
Boodhar	Sandstone	61	203	142
Location: In Govt. middle school, Chouravar				
1. Well No : EW 55 - 13/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Chouravar, Ganj Basoda	**5. Latitude N 23.8269**	**6. Longitude E 77.8868**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Chouravar	Soil	0	3.05	3.05
Chouravar	Massive basalt	3.05	18.3	15.25
Chouravar	Vesicular basalt	18.3	22.5	4.2
Chouravar	**Red bole**	22.5	25	2.5
Chouravar	Vesicular basalt	25	36.6	11.6
Chouravar	Massive basalt	36.6	42.7	6.1
Chouravar	Vesicular basalt	42.7	48.8	6.1
Chouravar	Massive basalt	48.8	57	8.2
Chouravar	**Fractured massive**	**57**	**57.2**	0.2

	basalt			
Chouravar	Massive basalt	57.2	76.25	19.05
Chouravar	**Contact zone**	76.25	79.3	3.05
Chouravar	Sandstone	79.3	91	11.7
Chouravar	**Fractured sandstone**	**91**	**91.5**	0.5
Chouravar	Sandstone	91.5	203	111.5
Location: In the premises of Govt. primary school, Deeghora				
1. Well No : EW 57 - 15/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Deeghora, Basoda	**5. Latitude N 23.81099**	**6. Longitude E 78.06160**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Deeghora	Soil	0	3.1	3.1
Deeghora	Clay	3.1	9.3	6.2
Deeghora	Soil	9.3	**15.5**	6.2
Deeghora	Weathered basalt	15.5	18.6	3.1
Deeghora	Massive basalt	18.6	27.9	9.3
Deeghora	Vesicular basalt	27.9	34.1	6.2
Deeghora	Massive basalt	34.1	58.9	24.8
Deeghora	Vesicular basalt	58.9	62	3.1
Deeghora	Massive basalt	62	89.9	27.9
Deeghora	**Fractured vesicular basalt**	**89.9**	**93**	3.1
Deeghora	Vesicular basalt	93	99.2	6.2
Deeghora	Massive basalt	99.2	135	35.8
Deeghora	**Red bole**	135	139	4
Deeghora	Vesicular basalt	139	142.6	3.6
Deeghora	Massive basalt	142.6	145.7	3.1
Deeghora	**Contact zone**	145.7	148.8	3.1
Deeghora	Shale	148.8	204.6	55.8
Location: In Govt. high school, Deyarpur				
1. Well No : EW 63 - 21/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Deyarpur, Gyaraspur	**5. Latitude N 23.691680**	**6. Longitude E 78.248428**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Deyarpur	Soil	0	3.05	3.05
Deyarpur	Weathered basalt	3.05	9.15	6.1
Deyarpur	Vesicular basalt	9.15	15.25	6.1
Deyarpur	Massive basalt	15.25	24.4	9.15
Deyarpur	Vesicular basalt	24.4	31.5	7.1
Deyarpur	**Fractured vesicular basalt**	**31.5**	**31.8**	0.3
Deyarpur	Massive basalt	31.8	42.7	10.9

Deyarpur	Vesicular basalt	42.7	48.8	6.1
Deyarpur	Massive basalt	48.8	61	12.2
Deyarpur	Vesicular basalt	61	67.5	6.5
Deyarpur	**Fractured vesicular basalt**	**67.5**	**68**	0.5
Deyarpur	Massive basalt	68	91.5	23.5
Location: In Govt. middle school, Gunnota				
1. Well No : EW 64 - 22/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Gunnota, Gyaraspur	**5. Latitude N 23.5801**	**6. Longitude E 78.1893**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Gunnota	Soil	0	3.05	3.05
Gunnota	Massive basalt	3.05	15.25	12.2
Gunnota	Vesicular basalt	15.25	27.45	12.2
Gunnota	Massive basalt	27.45	46	18.55
Gunnota	**Red bole**	46	49	3
Gunnota	Vesicular basalt	49	54.9	5.9
Gunnota	Massive basalt	54.9	61	6.1
Gunnota	Green bole	61	64.05	3.05
Gunnota	Vesicular basalt	64.05	76.25	12.2
Gunnota	Massive basalt	76.25	90.5	14.25
Gunnota	**Red bole**	90.5	91	0.5
Gunnota	Vesicular basalt	91	100.65	9.65
Gunnota	Massive basalt	100.65	118.95	18.3
Gunnota	Vesicular basalt	118.95	128	9.05
Gunnota	Massive basalt	128	158	30
Gunnota	Vesicular basalt	158	161.5	3.5
Gunnota	**Red bole**	161.5	164	2.5
Gunnota	Vesicular basalt	164	170	6
Gunnota	Massive basalt	170	182	12
Gunnota	**Contact zone**	182	185	3
Gunnota	Sandstone	185	203	18
Location: Gram Panchayat office, Hansua				
1. Well No : EW 44 - 02/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Hansua, Vidisha	**5. Latitude N 23.4734**	**6. Longitude E 77.8841**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Hansua	Soil	0	3.1	3.1
Hansua	Clay	3.1	12.4	9.3
Hansua	Weathered basalt	12.4	31	18.6
Hansua	Massive basalt	31	74.4	43.4

Hansua	Vesicular basalt	74.4	77.5	3.1
Hansua	**Fractured basalt**	**77.5**	**80.6**	3.1
Hansua	Vesicular basalt	80.6	86.8	6.2
Kagpur	Weathered sandstone	0	3.1	3.1
Kagpur	Sandstone	3.1	**54.25**	51.15
Kagpur	**Fractured sandstone**	**54.25**	**55**	0.75
Kagpur	Sandstone	55	204.6	149.6
Location: Govt. primary school, Lashkarpur				
1. Well No : EW 47 - 05/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Lashkarpur, Vidisha	**5. Latitude N 23.6272**	**6. Longitude E 77.7903**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Lashkarpur	Soil	0	3.1	3.1
Lashkarpur	Clay	3.1	12.4	9.3
Lashkarpur	Weathered basalt	12.4	18.6	6.2
Lashkarpur	Massive basalt	18.6	41.15	22.55
Lashkarpur	**Fractured vesicular basalt**	**41.15**	**41.55**	0.4
Lashkarpur	Vesicular basalt	41.55	46.5	4.95
Lashkarpur	Massive basalt	46.5	55.8	9.3
Lashkarpur	**Fractured vesicular basalt**	**55.8**	**56.2**	0.4
Lashkarpur	Vesicular basalt	56.2	68.2	12
Lashkarpur	Massive basalt	68.2	80.6	12.4
Lashkarpur	Vesicular basalt	80.6	93	12.4
Lashkarpur	Massive basalt	93	120.9	27.9
Lashkarpur	Vesicular basalt	120.9	127.1	6.2
Lashkarpur	**Red bole**	127.1	130.2	3.1
Lashkarpur	Vesicular basalt	130.2	139.5	9.3
Lashkarpur	Massive basalt	139.5	145.7	6.2
Lashkarpur	Vesicular basalt	145.7	155	9.3
Lashkarpur	Massive basalt	155	164.3	9.3
Lashkarpur	**Contact zone**	164.3	167.4	3.1
Lashkarpur	Red bole	167.4	173	5.6
Location: Near hanuman mandir, Moondra Bagal				
1. Well No : EW 68 - 26/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Moondra Bagal, Sironj	**5. Latitude N 24.0299**	**6. Longitude E 77.7314**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Moondra bagal	Soil	0	3.05	3.05
Moondra bagal	Weathered basalt	3.05	9.15	6.1
Moondra bagal	Massive basalt	9.15	28	18.85

Moondra bagal	**Red bole**	28	30.5	2.5
Moondra bagal	Vesicular basalt	30.5	33.55	3.05
Moondra bagal	Massive basalt	33.55	48.8	15.25
Moondra bagal	Vesicular basalt	48.8	51.85	3.05
Moondra bagal	**Red bole** with vesicular basalt	51.85	54.9	3.05
Moondra bagal	Massive basalt	54.9	67.1	12.2
Moondra bagal	Vesicular basalt	67.1	79.3	12.2
Moondra bagal	Massive basalt	79.3	106.75	27.45
Moondra bagal	Vesicular basalt	106.75	115.9	9.15
Moondra bagal	Massive basalt	115.9	143	27.1
Moondra bagal	Vesicular basalt	143	164	21
Moondra bagal	Massive basalt	164	182	18
Moondra bagal	Vesicular basalt	182	188	6
Moondra bagal	Massive basalt	188	197	9
Moondra bagal	Vesicular basalt	197	200	3
Moondra bagal	**Contact Zone**	200	203	3

Location: Govt. primary school, Motipura

1. Well No : EW 49 - 07/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Motipura, Vidisha	**5. Latitude N 23.7708**	**6. Longitude E 77.6274**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Motipura	Highly weathered basalt	0	3.1	3.1
Motipura	Weathered basalt	3.1	6.2	3.1
Motipura	Massive basalt	6.2	18.2	12
Motipura	**Fractured basalt**	**18.2**	**18.5**	0.3
Motipura	Massive basalt	18.5	21.7	3.2
Motipura	Vesicular basalt	21.7	27.9	6.2
Motipura	Massive basalt	27.9	43.4	15.5
Motipura	**Red bole**	43.4	46.5	3.1
Motipura	Vesicular basalt	46.5	49.6	3.1
Motipura	Massive basalt	49.6	57.9	8.3
Motipura	**Fractured vesicular basalt**	**57.9**	**58.3**	0.4
Motipura	Massive basalt	58.3	66.1	7.8
Motipura	R**ed bole**	66.1	67.5	1.4
Motipura	Vesicular basalt	67.5	77.5	10
Motipura	Massive basalt	77.5	89.9	12.4
Motipura	Vesicular basalt	89.9	99.2	9.3
Motipura	Massive basalt	99.2	125.2	26
Motipura	R**ed bole**	125.2	126.3	1.1
Motipura	Massive basalt	126.3	137	10.7
Motipura	G**reen bole**	137	139.1	2.1

Motipura	Massive basalt	139.1	158.1	19
Motipura	Contact zone	158.1	161.2	3.1
Motipura	Sandstone	161.2	204.6	43.4
Location: In the premises of Gram panchayat bhavan, Rabrayai				
1. Well No : EW 56 - 14/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Rabrayai, Ganj Basoda	**5. Latitude N 23.8867**	**6. Longitude E 77.9715**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Rabrayai	Soil	0	3.05	3.05
Rabrayai	Massive basalt	3.05	16.5	13.45
Rabrayai	**Red bole**	16.5	17	0.5
Rabrayai	Vesicular basalt	17	24.4	7.4
Rabrayai	Massive basalt	24.4	36.6	12.2
Rabrayai	Vesicular basalt	36.6	48.8	12.2
Rabrayai	Massive basalt	48.8	67.1	18.3
Rabrayai	Vesicular basalt	67.1	73.2	6.1
Rabrayai	Massive basalt	73.2	97.6	24.4
Rabrayai	Green bole	97.6	103.7	6.1
Rabrayai	Vesicular basalt	103.7	124.5	20.8
Rabrayai	**Fractured vesicular basalt**	124.5	**125**	0.5
Rabrayai	Vesicular basalt	125	131	6
Rabrayai	Massive basalt	131	139	8
Rabrayai	**Contact zone**	**139**	**139.5**	0.5
Rabrayai	Sandstone	139.5	203	63.5
Location: In Govt. high school, Rehmanpur				
1. Well No : EW 61 - 19/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Rehmanpur, Ganj Basoda	**5. Latitude N 23.810702**	**6. Longitude E 78.213346**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Rehmanpur	Soil	0	3.05	3.05
Rehmanpur	Weathered basalt	3.05	6.1	3.05
Rehmanpur	Vesicular basalt	6.1	11	4.9
Rehmanpur	**Red bole**	11	12.3	1.3
Rehmanpur	Vesicular basalt	12.3	24.4	12.1
Rehmanpur	Massive basalt	24.4	45	20.6
Rehmanpur	**Fractured vesicular basalt**	**45**	**45.2**	0.2
Rehmanpur	Vesicular basalt	45.2	48.8	3.6
Rehmanpur	Massive basalt	48.8	64.05	15.25
Rehmanpur	Vesicular basalt	64.05	73.2	9.15
Rehmanpur	Massive basalt	73.2	91.5	18.3

Rehmanpur	Vesicular basalt	91.5	95	3.5
Rehmanpur	**Fractured vesicular basalt**	**95**	**95.3**	0.3
Rehmanpur	Vesicular basalt	95.3	100.65	5.35
Rehmanpur	Massive basalt	100.65	135	34.35
Rehmanpur	**Red bole**	135	136	1
Rehmanpur	Green bole	136	140	4
Rehmanpur	Vesicular basalt	140	146	6
Rehmanpur	Massive basalt	146	158	12
Rehmanpur	Vesicular basalt	158	173	15
Rehmanpur	**Contact zone**	173	176	3
Location: In Front of mangalik bhavan, Saloi				
1. Well No : EW 67 - 25/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Saloi, Ganj basoda	**5. Latitude N 23.4642**	**6. Longitude E 77.5234**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Saloi	Weathered basalt	0	6.1	6.1
Saloi	Massive basalt	6.1	30.5	24.4
Saloi	Vesicular basalt	30.5	51.85	21.35
Saloi	Massive basalt	51.85	83.4	31.55
Saloi	**Fractured vesicular basalt**	**83.4**	**83.7**	0.3
Saloi	Vesicular basalt	83.7	88.45	4.75
Saloi	Massive basalt	88.45	115.9	27.45
Saloi	Greeen bole	115.9	122	6.1
Saloi	Vesicular basalt	122	131	9
Saloi	Massive basalt	131	140	9
Saloi	**Red bole**	140	143	3
Saloi	Vesicular basalt	143	146	3
Saloi	**Contact zone**	146	149	3
Saloi	Red bole	149	152	3
Saloi	Sandstone	152	161	9
Location: In the premises of Gram panchayat bhavan, Santapur				
1. Well No : EW 62 - 20/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Santapur, Gyaraspur	**5. Latitude N 23.700442**	**6. Longitude E 77.925841**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Santapur	Weathered basalt	0	3.1	3.1
Santapur	Massive basalt	3.1	31	27.9
Santapur	**Red bole**	31	34.1	3.1
Santapur	Vesicular basalt	34.1	43.4	9.3
Santapur	Massive basalt	43.4	49.6	6.2

Santapur	Green bole	49.6	52.7	3.1
Santapur	Vesicular basalt	52.7	71.3	18.6
Santapur	Massive basalt	71.3	89.9	18.6
Santapur	Vesicular basalt	89.9	108.5	18.6
Santapur	Massive basalt	108.5	142.6	34.1
Santapur	Green bole	142.6	145.7	3.1
Santapur	Vesicular basalt	145.7	148.8	3.1
Santapur	Massive basalt	148.8	152.4	3.6
Santapur	**Fractured massive basalt**	**152.4**	**153**	0.6
Santapur	Vesicular basalt	153	170.5	17.5
Santapur	Massive basalt	170.5	185.92	15.42
Santapur	**Fractured vesicular basalt**	**185.92**	**186.5**	0.58
Santapur	Vesicular basalt	186.5	195.3	8.8
Santapur	Massive basalt	195.3	204.6	9.3

Location: In front of Siddh baba temple, Siraswas

1. Well No : EW 71 - 29/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Siraswas, Sironj	**5. Latitude N 24.276650**	**6. Longitude E 77.659633**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Siraswas	Soil	0	9.3	9.3
Siraswas	Clay	9.3	24.8	15.5
Siraswas	Massive basalt	24.8	45.7	20.9
Siraswas	**Fractured vesicular basalt**	**45.7**	**47**	1.3
Siraswas	**Red bole**	47	52.7	5.7
Siraswas	Vesicular basalt	52.7	74.4	21.7
Siraswas	Massive basalt	74.4	84.2	9.8
Siraswas	**Fractured vesicular basalt**	**84.2**	**84.6**	0.4
Siraswas	Vesicular basalt	84.6	93	8.4

Location: Infront of newly contructed Govt. high school, Summer Dongi

1. Well No : EW 60 - 18/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Summer Dongi, Ganj Basoda	**5. Latitude N 23.869222**	**6. Longitude E 78.205125**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Summer dongi	Soil	0	3.05	3.05
Summer dongi	Weathered basalt	3.05	6.1	3.05
Summer dongi	Massive basalt	6.1	12.2	6.1
Summer dongi	Vesicular basalt	12.2	24.4	12.2
Summer dongi	Massive basalt	24.4	31	6.6

Summer dongi	**Red bole**	31	34	3
Summer dongi	Vesicular basalt	34	36.6	2.6
Summer dongi	Massive basalt	36.6	42.7	6.1
Summer dongi	Vesicular basalt	42.7	45.75	3.05
Summer dongi	Massive basalt	45.75	61	15.25
Summer dongi	**Fractured basalt**	**61**	**64.05**	3.05
Summer dongi	Vesicular basalt	64.05	67.1	3.05
Summer dongi	Massive basalt	67.1	88.45	21.35
Summer dongi	Vesicular basalt	88.45	91.5	3.05
Summer dongi	**Fractured basalt**	**91.5**	**94.55**	3.05
Summer dongi	Vesicular basalt	94.55	103.7	9.15
Summer dongi	Massive basalt	103.7	128	24.3
Summer dongi	Vesicular basalt	128	140	12
Summer dongi	Massive basalt	140	164	24
Summer dongi	Vesicular basalt	164	169	5
Summer dongi	**Red bole**	169	171	2
Summer dongi	Vesicular basalt	171	174	3
Summer dongi	**Red bole**	174	177	3
Summer dongi	Vesicular basalt	177	179	2
Summer dongi	Sandstone	179	203	24

Location: In the premises of Govt. primary health centre, Udaypur

1. Well No : EW 59 - 17/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Udaypur, Basoda	**5. Latitude N 23.899285**	**6. Longitude E 78.062821**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Udaypur	Weathered basalt	0	3.1	3.1
Udaypur	Weathered sanstone	3.1	9.3	6.2
Udaypur	Sandstone	9.3	19.81	10.51
Udaypur	**Fractured sanstone**	**19.81**	**20.1**	0.29
Udaypur	Sandstone	20.1	49.6	29.5
Udaypur	Shale	49.6	204.6	155

Location: In the premises of community hall, Wardha

1. Well No : EW 48 - 06/49	**2. State : Madhya Pradesh**	**3.Dist : Vidisha**		
4. Village/ Block : Wardha, Vidisha	**5. Latitude N 23.8373**	**6. Longitude E 77.6321**		
Borehole	**Lithology**	**Depth 2**	**Depth 1**	**Thickness**
Wardha	Weathered basalt	0	3.1	3.1
Wardha	Massive basalt	3.1	6.2	3.1
Wardha	Vesicular basalt	6.2	12.4	6.2
Wardha	Massive basalt	12.4	24.8	12.4
Wardha	Vesicular basalt	24.8	27.9	3.1

Wardha	Massive basalt	27.9	28	0.1
Wardha	**Red bole**	28	30.1	2.1
Wardha	Massive basalt	30.1	49.6	19.5
Wardha	R**ed bole**	49.6	52.7	3.1
Wardha	Vesicular basalt	52.7	62	9.3
Wardha	Massive basalt	62	65.1	3.1
Wardha	Vesicular basalt	65.1	71.3	6.2
Wardha	Massive basalt	71.3	96.1	24.8
Wardha	Vesicular basalt	96.1	102.3	6.2
Wardha	Massive basalt	102.3	136.4	34.1
Wardha	**Contact zone**	**136.4**	**139.5**	3.1
Wardha	Sandstone	139.5	204.6	65.1