



## केंद्रीय 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**

**SAHEBGANJ DISTRICTS, JHARKHAND**

राज्य एकक कार्यालय, रांची

State Unit Office, Ranchi

भारत सरकार

Government of India

जल संसाधन, नदी विकास एवं गंगा संरक्षण मंत्रालय

Ministry of Water Resources, River Development & Ganga Rejuvenation

केन्द्रीय भूमि-जल बोर्ड

Central Ground Water Board



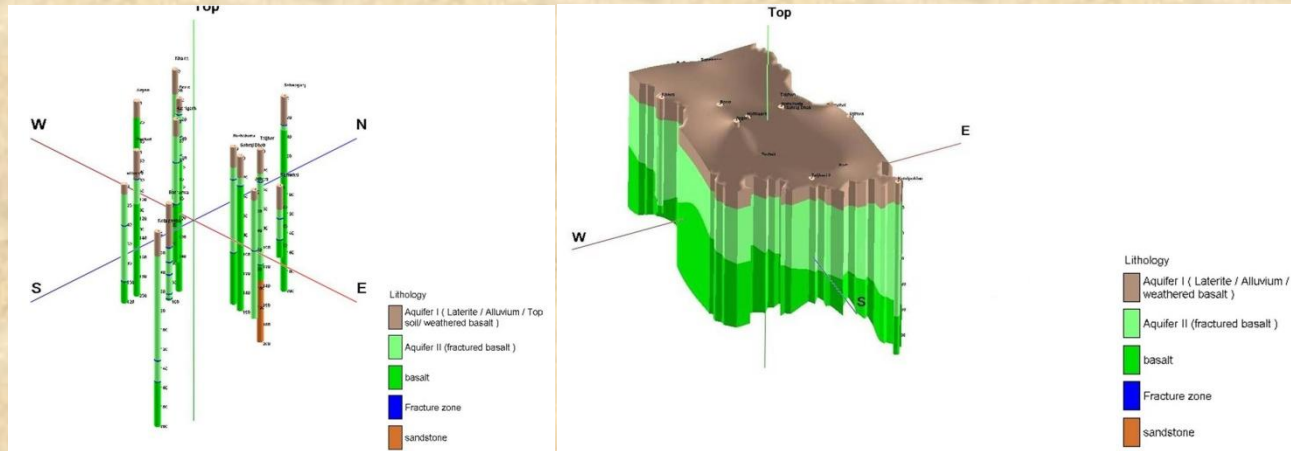
**PART - I / भाग - १**

***Aquifer Maps and Ground Water Management Plan of***

***Sahebganj district, Jharkhand***

***जलभृत नक्शे तथा भूजल प्रबंधन योजना***

***साहिबगंज जिला, झारखण्ड***



State Unit Office, Ranchi  
Mid-Eastern Region, Patna  
March 2019

राज्य एकक कार्यालय रांची  
मध्य-पूर्वी क्षेत्र पटना  
मार्च २०१९

***Aquifer Maps and Ground Water Management Plan  
of Sahebganj district, Jharkhand***

***जलभृत नकशे तथा भूजल प्रबंधन योजना***

***साहिबगंज जिला, झारखण्ड***

State Unit Office, Ranchi

Mid-Eastern Region, Patna

*March 2019*

राज्य एकक कार्यालय रांची

मध्य-पूर्वी क्षेत्र पटना

*मार्च २०१९*

**REPORT ON AQUIFER MAPPING AND MANAGEMENT PLAN (PART – I) OF SAHEBGANJ  
DISTRICT, JHARKHAND  
2017 – 18**

**CONTRIBUTORS'**

**Principal Authors**

Sunil Toppo : Junior Hydrogeologist  
(Scientist-B)

**Supervision & Guidance**

A.K.Agrawal : Regional Director  
G. K. Roy : Officer-In- Charge  
T.B.N. Singh : Scientist-D  
Dr Sudhanshu Shekhar : Scientist-D

**Hydrogeology, GIS maps and Management Plan**

Sunil Toppo : Junior Hydrogeologist  
Dr Anukaran Kujur : Assistant Hydrogeologist  
Atul Beck : Assistant Hydrogeologist

**Hydrogeological Data Acquisition and Groundwater Exploration**

Sunil Toppo : Junior Hydrogeologist  
Dr Anukaran Kujur : Assistant Hydrogeologist  
Atul Beck : Assistant Hydrogeologist

**Geophysics**

B. K. Oraon : Scientist-D  
S. Das : Scientist-B

**Chemical Analysis**

Suresh Kumar : Assistant (Chemist)

**AQUIFER MAPS AND MANAGEMENT PLAN OF SAHEBGANJ DISTRICT, JHARKHAND STATE  
(2017-18)**

**CONTENTS**

<b>Chapter No.</b>	<b>Details</b>	<b>Page No.</b>
<b>1.0</b>	<b>INTRODUCTION</b>	
	1.1 Objective and Scope of the study	1
	1.2 Approach and Methodology	2
	1.3 Area Details	2
	1.4 Data Availability, Data Adequacy and Data Gap Analysis	3
	1.4.1 Data available	3
	1.4.2 Data Adequacy and Data Gap Analysis	4
	1.5 Climate and Rainfall	4
	1.6 Physiography	6
	1.7 Geomorphology	6
	1.8 Land Use	7
	1.9 Soil	9
	1.10 Hydrology and Drainage	10
	1.11 Agriculture and Irrigation Practice	11
	1.12 Cropping Pattern	11
	1.13 Prevailing Water Conservation/Recharge Practices	12
<b>2.0</b>	<b>DATA COLLECTION AND GENERATION</b>	
	2.1 Data Collection and Compilation	14
	2.2 Data Generation	14
	2.2.1 Ground Water Monitoring Wells	14
	2.2.2 Ground Water Exploration	15
	2.2.3 Ground Water Quality	15
	2.2.4 Geophysical Survey	16
	2.2.5 Soil Infiltration Test	16
	2.2.6 Pumping Test	18
	2.2.7 Micro Level Hydrogeological Data Acquisition	18
	2.2.8 Thematic Layers	19
<b>3.0</b>	<b>DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING</b>	
	3.1 Geology	20
	3.2 Hydrogeology	21
	3.2.1 Ground Water in Aquifer – I (Alluvium/Laterite/Weathered Basalt)	22
	3.2.2 Ground Water in Aquifer – II (Fractured Basalt)	23
	3.3 Geophysical Survey	23
	3.4 Ground Water Dynamics	25
	3.4.1 Water Level Scenario – Aquifer – I (Shallow Aquifer)	25
	3.4.2 Long Term Water Level Trend (1998-2018)	29

	3.5 Ground Water Exploration	32
	3.6 Ground Water Quality	35
	3.6.1 General Range of Chemical Parameters of Aquifer – I & II	35
	3.6.2 Suitability of Ground Water of Aquifer – I & II for Drinking Purposes	36
	3.6.3 Suitability of ground water of Aquifer – I and II for irrigation Purposes	37
	3.7 3-D and 2-D Aquifer Disposition	43
	3.8 Hydrogeological cross section	44
	3.8.1 Hydrogeological cross section A-A'	44
	3.8.2 Hydrogeological cross section B-B'	46
	3.8.3 Hydrogeological cross section C-C'	47
	3.8.4 Hydrogeological cross section D-D'	48
	3.9 Aquifer characteristics	49
<b>4.0</b>	<b>Ground Water Resource</b>	
	4.1 Ground Water Resources – Aquifer-I	51
	4.1.1 Recharge Component	51
	4.2 Ground Water Resources – Aquifer-II	54
<b>5.0</b>	<b>Ground water related issues</b>	
	5.1 Low Ground Water Development	55
	5.2 Low Ground Water Potential / Limited Aquifer Thickness / Sustainability	55
	5.3 Ground water contamination	56
<b>6.0</b>	<b>Management strategies</b>	
	6.1 Ground Water Resource Development Strategy	58
	6.2 Supply side Interventions	59
	6.3 Ground water management strategy for Arsenic and Iron affected areas	60
	6.4 Stress aspect against future demand (2025, 2030)	61
<b>7.0</b>	<b>Sum Up</b>	64

### List of tables

<b>Table No.</b>	<b>List of table</b>	<b>Page No.</b>
Table - 1	Data adequacy and data gap analysis	4
Table - 2	Analytical data of monsoon rainfall (2008 – 17) of Sahebganj district	5
Table - 3	Land use pattern of Sahebganj district (2015– 2016)	8
Table - 4	Details of source wise irrigation of Sahebganj district (2012-13)	11
Table - 5	Cropping pattern of Sahebganj district (2015-16)	11
Table - 6	Check dam constructed under CAMPA by Forest Department	12
Table -7	Block wise number of VES conducted in Sahebganj district	16

Table – 8	Salient features of the soil infiltration test	16
Table – 9	Long term water level trend (1998-2018)	29
Table - 10	Number of flow encountered in exploratory wells	32
Table - 10	Range of Chemical constituents of Aquifer-I&II	36
Table - 12	Suitability of ground water of Aquifer – I for drinking purposes	36
Table - 13	Suitability of ground water of Aquifer – II for drinking purposes	37
Table - 14	Classification of ground water Aquifer – I & II based on EC	38
Table - 15	Classification of shallow ground water samples as per USSL	39
Table - 16	Summarized result of SDT	49
Table - 17	Summarized result of APT	49
Table - 18	Aquifer characteristic of Sahebganj district (hard rock area)	50
Table - 19	Assessment of In-storage ground water resource of soft rock	51
Table - 20	Assessment of In-storage ground water resource of hard rock (basalt)	51
Table - 21	Recharge Components evaluated for Resource Estimation	52
Table - 22	Ground Water Resources Availability, Draft and Stage of GW Development	53
Table - 23	Assessment of In-storage ground water resource of hard rock	53
Table - 24	Details of chemical result for Arsenic	56
Table - 25	Details of chemical analysis result for Iron	57
Table - 26	Future Irrigation Potential & Proposed number of Abstraction Structures based on SOD 70%	58
Table - 27	Created Irrigation Potential & No. of structure for assured irrigation	58
Table - 28	Detail Demographic particular of Sahebganj district	59
Table – 29	Projected population	61
Table – 30	Requirement of water for domestic use	61
Table - 31	List of villages covered under mega water supply scheme in Sahebganj district	61

## List of figures

Figure No.	List of figure	Page No.
Figure - 1	Location map of sahebganj district	3
Figure - 2	Average monsoon rainfall map of Sahebganj district	5
Figure - 3	Geomophology of Sahebganj district	6
Figure - 4	Disital elevation model (DEM) of Sahebganj district	7
Figure - 5	Land use map of Sahebganj district	9
Figure - 6	Drainage map of Sahebganj district	10
Figure - 7	Major crops of Sahebganj district (2015 – 16)	12
Figure - 8	Location of key wells and exploratory wells	15
Figure - 9	Plotting of soil infiltration data (9a to 9g)	17
Figure - 10	Geological map of Sahebganj district	21
Figure - 11	Hydrogeology of Sahebganj district	22
Figure - 12	Electrical logging map of Sahebganj district	24
Figure - 13	Pre monsoon (May 2016) depth to water level map of Aquifer – I (shallow aquifer)	26
Figure - 14	Post monsoon (Nov. 2016) depth to water level map of Aquifer – I (shallow aquifer)	26
Figure - 15	Pre monsoon (May 2017) depth to water level map of Aquifer – I (shallow aquifer)	27
Figure - 16	Post monsoon (Nov. 2017) depth to water level map of Aquifer – I (shallow aquifer)	27
Figure - 17	Pre monsoon (May 2018) depth to water level map of Aquifer – I (shallow aquifer)	28
Figure - 18	Seasonal water level fluctuation map of Sahebganj district (2016)	29
Figure - 19	Seasonal water level fluctuation map of Sahebganj district (2017)	29
Figure - 20	Hydroghaphs of Sahebganj district (20 a – e)	30
Figure - 21	Lithological section of selected exploratory wells	34
Figure - 22	Lithological section of selected exploratory wells	35
Figure - 23	Distribution of EC in ground water of Aquifer - I	38
Figure - 24	Distribution of EC in ground water of Aquifer - II	38
Figure - 25	US Salinity diagram for Aquifer - I	39
Figure - 26	US Salinity diagram for Aquifer - II	39
Figure - 27	Piper's diagram for Aquifer - I	41



Figure - 28	Piper's diagram for Aquifer - II	42
Figure - 29	3D Subsurface lithological model with Aquifer disposition in hard rock area of Sahebganj district	43
Figure - 30	Three dimensional strip-log of EW drilled in Rajmahal traps of Sahebganj district	44
Figure – 31A	Location map of section A-A'	45
Figure – 31B	Hydrogeological cross section of A-A'	45
Figure – 32A	Location map of section B-B'	46
Figure – 32B	Hydrogeological cross section of B-B'	46
Figure – 33A	Location map of section C-C'	47
Figure – 33B	Hydrogeological cross section of C-C'	47
Figure – 34A	Location map of section D-D'	48
Figure – 34B	Hydrogeological cross section of D-D'	48
Figure - 35	Recharge from various sources	52
Figure - 36	Ground Water Availability and Draft	53
Figure - 37	Ground Water stage of development in Sahebganj district	55
Figure - 38	Yield wise classification of bore wells drilled in Sahebganj district	56
Figure - 39	Interaction with local peoples	57
Figure - 40	Area proposed for artificial recharge	57

## List of Annexure

Annexure No.	List of annexure	Page No.
Annexure - I	Last ten years (2008 to 2017) monsoon rainfall (June to October) data of Sahebganj district	65
Annexure - II	Details of key wells established for national aquifer mapping study of Sahebganj district	68
Annexure - III	Water level data of key wells of national aquifer mapping study area of Sahebganj district	72
Annexure - IV	Data of soil infiltration test	73
Annexure - V	Aquifer parameters	80
Annexure – VI (A)	Details of exploratory wells drilled in <b>hard formation</b> of Sahebganj district	81
Annexure – VI (B)	Details of exploratory wells drilled in <b>soft formation</b> of Sahebganj district	85
Annexure - VII	Litholog of exploratory and observation wells drilled in hard rock area of Sahebganj district	86
Annexure - VIII	Analytical results of water samples for Arsenic and Iron concentration	112
Annexure - IX	Interpreted result of geophysical sounding (VES) of Sahebganj district	118

## **AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN OF SAHEBGANJ DISTRICT, JHARKHAND STATE**

### **1. INTRODUCTION**

During XII five year plan, National Aquifer Mapping (NAQUIM) study was taken up by CGWB to carry out detailed hydrogeological investigation. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers. The NAQUIM has been prioritised to study Over-exploited, Critical and Semi-Critical blocks and also in quality affected areas.

The vagaries of rainfall, inherent heterogeneity & unsustainable nature of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulation mechanism has a detrimental effect on ground water scenario of the country in last decade or so. Thus, prompting the paradigm shift from “**Traditional groundwater development concept**” to “**modern groundwater management concept**”.

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management plans will provide the “**Road Map**” for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus the crux of NAQUIM is not merely mapping, but reaching the goal-that of ground water management through community participation. The aquifer maps and management plans will be shared with the administration of Sahebganj district for its effective implementation.

#### **1.1 Objective and Scope of the Study:**

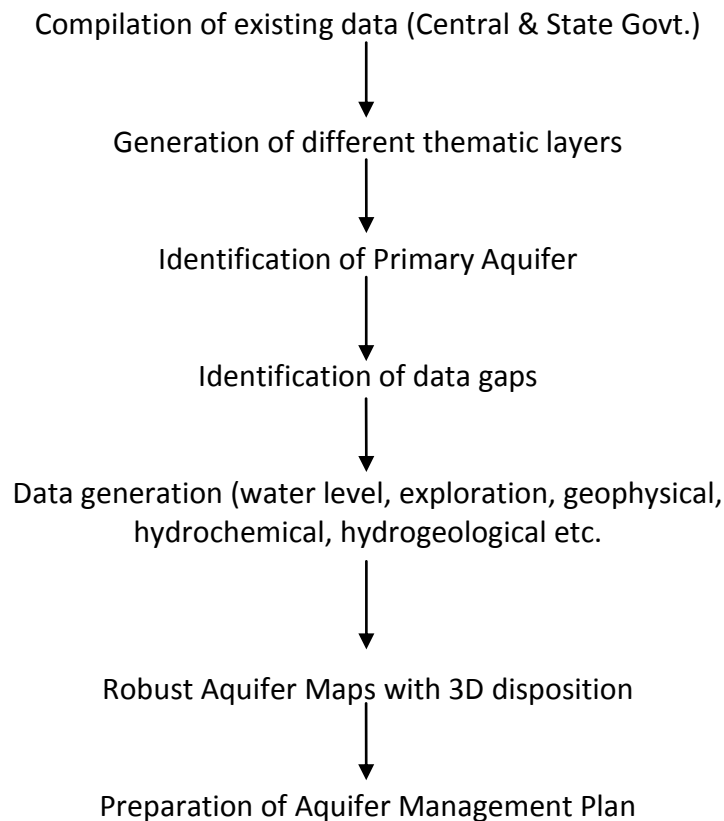
The main objective of aquifer mapping study is to develop groundwater management plan such as recharge, conservation, harvesting and protocols of managing groundwater. These protocols will be the real derivatives of the aquifer mapping exercise and will find a place in the output i.e, the aquifer map and management plan. The main activities under NAQUIM are as follows:

- a). Identifying the aquifer geometry
- b). Aquifer characteristics and their yield potential
- c). Quality of water occurring at various depths
- d). Aquifer wise assessment of ground water resources
- e). Preparation of aquifer maps and
- f). Formulation of ground water management plan.

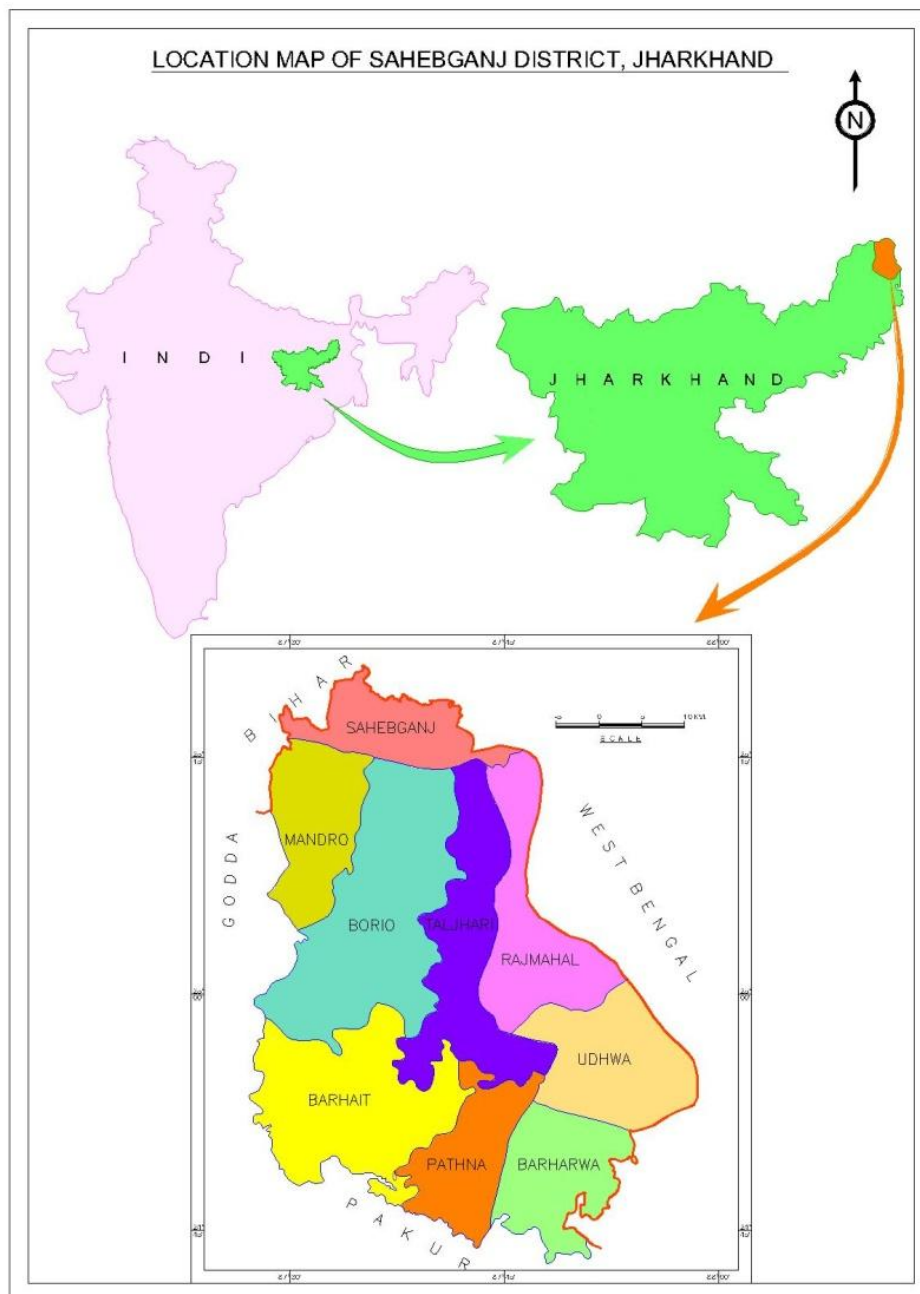
The demarcation of aquifers and their potential will help the agencies involved in water supply in ascertaining, how much volume of water is under their control. The robust and implementable ground water management plan will provide a “**Road Map**” to systematically manage the ground water resources for equitable distribution across the spectrum.

**1.2 Approach and Methodology:** The ongoing activities of NAQUIM include hydrogeological data acquisition supported by geophysical and hydro-chemical investigations supplemented with ground water exploration down to the depths of 200 meters in hard rocks and 300 meters in soft rocks.

Considering the objectives of the NAQUIM, the data on various components was segregated, collected and brought on GIS platform by geo-referencing the available information for its utilization for preparation of various thematic maps. The approach and methodology followed for Aquifer mapping is as given below:



**1.3 Area Details:** The district Sahebganj was taken for aquifer mapping study during 2016-17 and it continued to 2017-18. The district is spread over 1702 Sq. km of geographical area. Sahebganj district is situated in the north–eastern part of the Jharkhand state. It is bounded in the north by a small portion of Bhagalpur and Katihar districts of Bihar state, in the east by West Bengal, in the south by Pakur district and in the west by Godda district and a portion of Bhagalpur district (Bihar). The district is situated between 24<sup>0</sup> 43' 00" and 25<sup>0</sup> 50' 45" North latitude and 87<sup>0</sup> 27' 30" and 87<sup>0</sup> 58' 15" East longitude. The district covers Survey of India toposheets nos. 72 O/ 7, 72 O/ 8, 72 O/ 11, 72 O/ 12, 72 O/ 16, 72 P/5, 72 P/ 9, 72 P/10, 72 P/13 and 72 P/14. The district has two sub divisions i.e. Sahebganj and Rajmahal and nine blocks namely – Sahebganj, Borio, Taljhari, Rajmahal, Barharwa, Pathna, Barhait, Mandro and Udhwa (Fig. 1). Total population of the district is 1150567 (as per census of 2011). The location map of the study area is shown in figure – 1.



**Figure 1: Location map of Sahebganj district**

#### **1.4 Data Availability, Data Adequacy and Data Gap Analysis**

**1.4.1 Data Availability:** Central Ground Water Board has carried out exploratory drilling in the district and drilled five exploratory and four observation wells by departmental rig during the year 1981-82. Similarly, two exploratory wells and two observation wells were drilled at village Dihari in alluvial formation in 2015. Eight numbers of exploratory wells were drilled through outsourcing drilling during the year 2005 and three exploratory and one observation wells were drilled during the year 2012 in the district through outsourcing. Thus, at least two exploratory and one observation wells are to be drilled in each block to know the sub-surface geology, depth and thickness of water bearing formation with their

yield and determining the different aquifer parameters because of complicated geological formation and variable lithology in the area.

In addition, eleven numbers of permanent observation well (HNS) of Central Ground Water Board located in the district are being monitored for ground water regime and to assess the chemical quality of ground water.

**1.4.2 Data Adequacy and Data Gap Analysis:** The available data of the Exploratory wells drilled by Central Ground Water Board, Mid – Eastern Region, Patna, geophysical survey carried out in the area, ground water monitoring stations and ground water quality stations monitored by Central Ground Water Board were compiled and analyzed for adequacy of the same for the aquifer mapping studies.

After taking into consideration, the available data of ground water exploration, geophysical survey, ground water monitoring and ground water quality, the data adequacy is compiled and the summarised details of required, existing and data gap of exploratory wells, ground water monitoring and ground water quality stations is given in table – 1.

**Table – 1: Data adequacy and data gap analysis**

Exploratory data			Geophysical data			GW monitoring data			GW quality data		
Req.	Exist.	Gap	Req.	Exist.	Gap	Req.	Exist.	Gap	Req.	Exist.	Gap
36	32	4	61	35	26	18	27	0	27	47	0

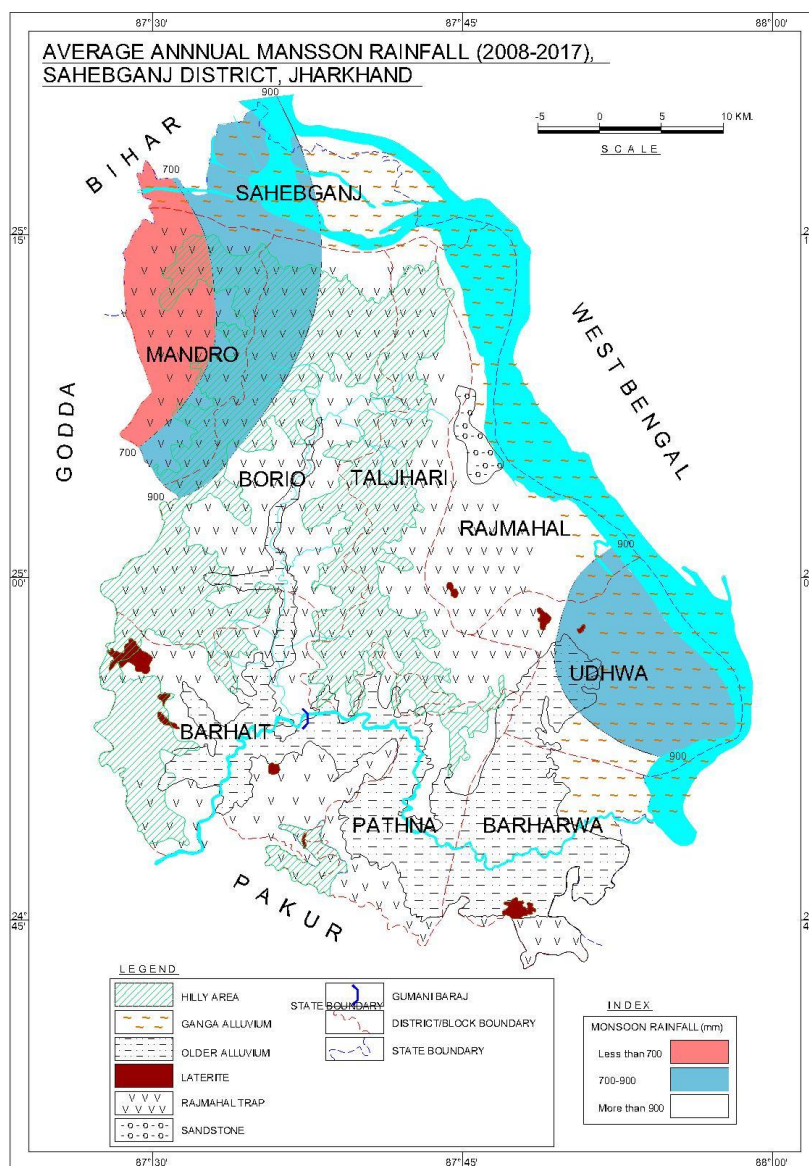
The data adequacy as discussed above indicates that the existing data is not sufficient for preparation of aquifer maps; hence data gap has been identified for Exploratory Wells, Geophysical Survey (VES), Ground Water Monitoring Wells and Ground Water Quality. Based on the data gap identification, the data generation activity was planned and completed in 2016-17 and 2017-18.

**1.5 Climate and Rainfall:** The district is characterized by humid to sub-humid climate. During summer the hot spell prevails from March to middle of June. Rainy season starts from middle of June to middle & end of October. Winter starts from the middle of November and continues till the end of February. The district experiences great heat from March to May, when the maximum temperature reaches upto 44.4<sup>0</sup>c. December is the coldest month, when the minimum temperatures fall down to 6.8<sup>0</sup>c.

The area receives rainfall by South-West monsoon. The blockwise average monsoon rainfall (2008 to 2017) of the district varies from 589 to 1173.61 mm. The rain fall data for the period of 2008 – 2017 has been analyzed for average annual monsoon rainfall, standard deviation and coefficient of variation which are given in table – 2. Based on available data, average monsoon rain fall map of the district has been prepared and presented in figure - 2. Block wise monsoon rainfall (2008 – 2017) is presented in Annexure - 1.

**Table – 2: Analytical data of monsoon rainfall (2008 – 2017) of Sahebganj district**

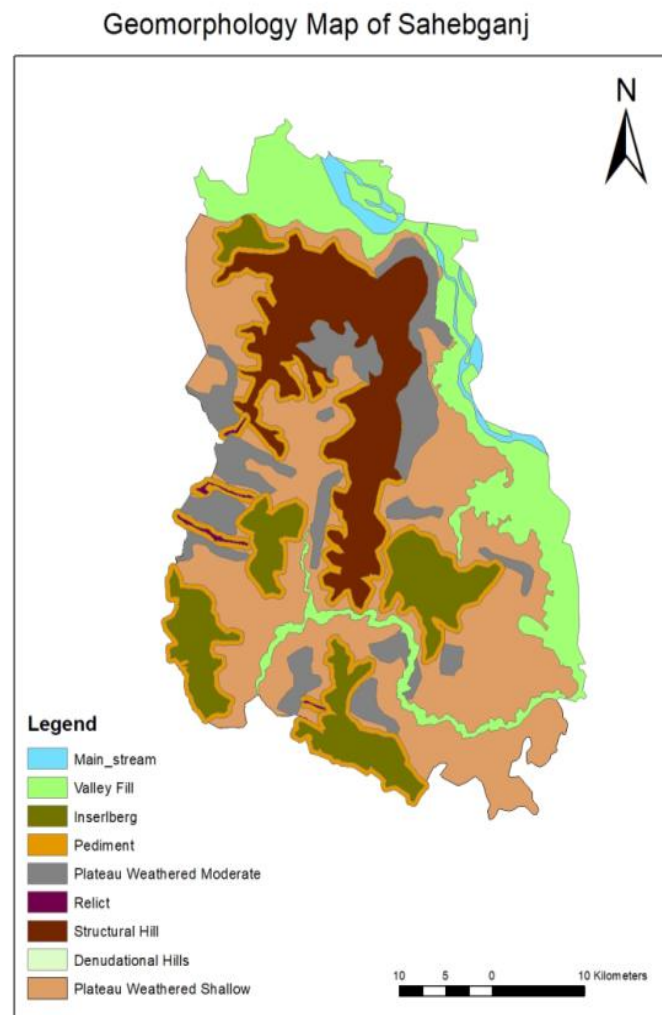
Sr. No.	Block	Average monsoon rainfall	Standard deviation	Coefficient of variation (%)
1	Sahebganj	962.28	279.17	29.01
2	Borio	1133.25	241.45	21.31
3	Mandro	589.77	308.50	52.31
4	Barhait	1045.42	234.44	22.43
5	Pathna	975.35	289.69	29.70
6	Barharwa	1061.74	278.11	26.19
7	Rajmahal	1173.61	177.31	15.11
8	Udhwa	796.76	247.53	31.07
9	Taljhari	984.63	207.90	21.11



**Figure – 2: Average Annual monsoon rainfall map of Sahebganj district**

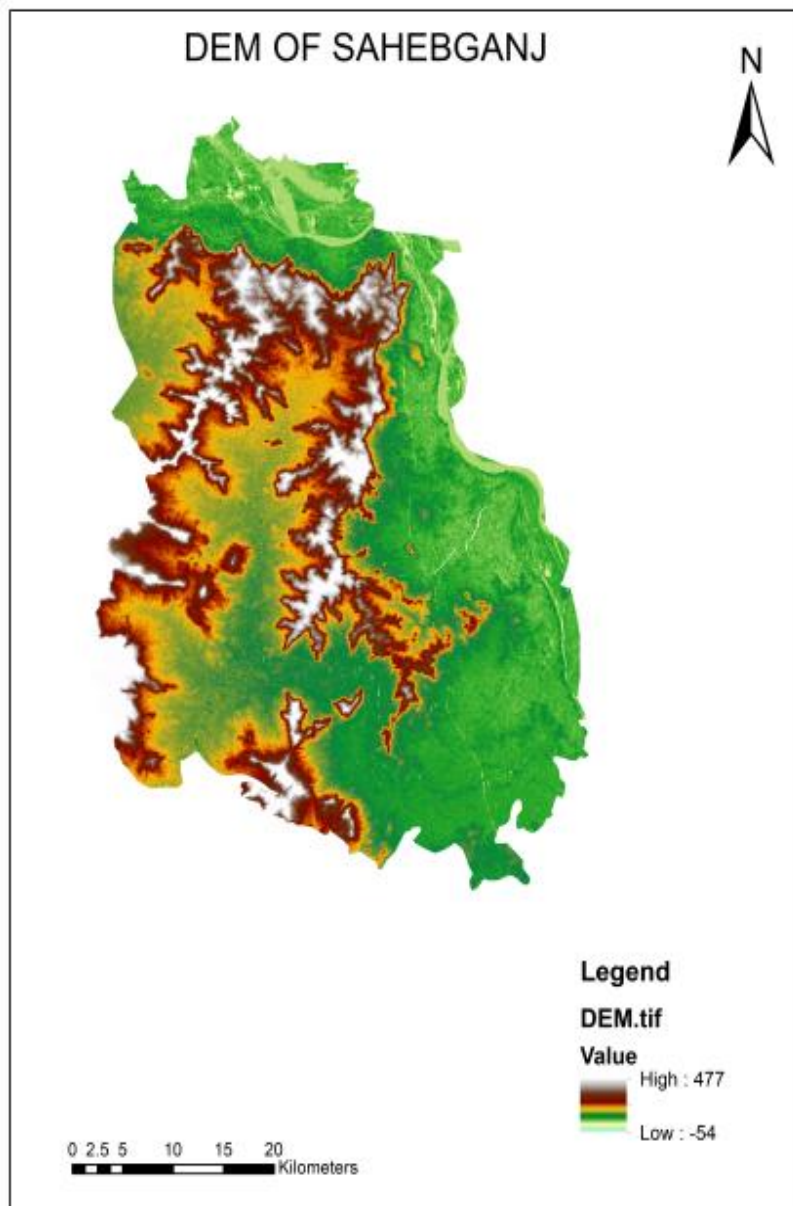
**1.6 Physiography:** The area is characterized by undulating topography with hills and plain. Major part of the area is covered by basaltic terrain of Rajmahal hills which is bounded on the north and partly on the east by the Ganges. The western part of the area is bounded by the hills.

**1.7 Geomorphology:** The area is characterized by hilly undulating topography covered by lateritic soil and Rajmahal basaltic flows with flat valleys separated by topographic highs. Originally this elevated area existed as a more or less regular plateau formed of successive flows of basaltic traps. The main geomorphological features of the district are scarp on the northern part of the area, flat alluvial terrain in the eastern fringe of the district and resistant lava plateau of Rajmahal which rises above the general level and occupies major part of the district. The general elevation of the hills and plateaus varies from 54 to 477 m above msl. Geomorphological and digital elevation model (DEM) of Sahebganj district are prepared and presented in figure – 3 and 4 respectively.



**Figure – 3: Geomorphology of Sahebganj district**



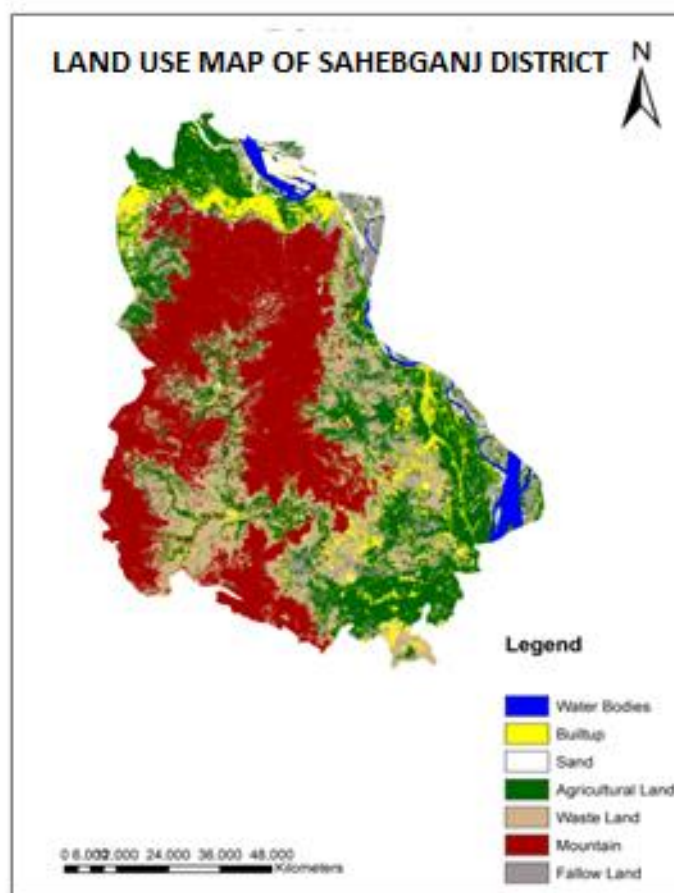


**Figure – 4: Digital elevation model of Sahebganj district**

**1.8 Land Use:** Geographical features play a major role in information of land use pattern. The land use pattern data of the area for the year 2015 – 16 is given below in table 3. Land use map of the Sahebganj district has been prepared and shown in figure – 5.

**Table: 3: Land use pattern of Sahebganj district (2015– 2016)****(Figures in Hactare.)**

<b>Block</b>	<b>Total area (Sq. Km)</b>	<b>Forest land</b>	<b>Barren &amp; non agricultural land</b>	<b>Cultivable waste land</b>	<b>Permanen t pastures &amp; other grassing land</b>	<b>Land under miscella- neous trees</b>	<b>Current fallow</b>	<b>Fallow land other than current fallow</b>	<b>Net area sown</b>
<b>Sahebganj</b>	173.27	--	1689.45	1794.68	0.87	23.42	4699.93	2243.29	3062.69
<b>Borio</b>	261.74	12336.27	1834.38	3439.01	1448.00	270.95	5763.64	6769.30	2663.81
<b>Mandro</b>	123.52	7892.23	375.33	398.74	292.63	88.09	6435.37	4281.97	2050.60
<b>Barhait</b>	308.82	4016.29	3623.08	2133.34	1396.08	1700.68	6464.55	8462.62	6786.80
<b>Rajmahal</b>	126.93	--	244.53	138.85	141.06	0.04	4040.04	2385.53	3391.19
<b>Udhwa</b>	199.13	--	127.67	47.16	25.97	115.37	4190.34	673.86	2674.29
<b>Taljhari</b>	158.28	2650.61	1726.35	1056.88	313.05	106.51	7600.10	4300.93	4333.54
<b>Pathna</b>	163.16	1112.49	1641.11	1014.17	585.21	392.60	996.66	3946.30	6323.15
<b>Barharwa</b>	187.25	--	47.31	74.33	386.47	87.59	1144.10	2794.03	13443.11
<b>Total</b>	1702.10	28007.89	11309.21	10097.16	4589.34	3085.25	41334.73	35857.83	44729.18



**Figure – 5: Land Use Map of Sahebganj district**

**1.9 Soil:** The area is characterized by the following type of soils –

- (i) Rajmahal trap soil
- (ii) Red soil
- (iii) Eroded scarp soil
- (iv) Foothill soils
- (v) Tal soil
- (vi) Alluvial soil

**1.9.1 Rajmahal trap soil:** Soils derived from basaltic lava occurs in major part of the area. These soils, black in colour are very fertile and restricted to Rajmahal lava areas.

**1.9.2 Red Soil:** Red soils are light to medium and are red to yellow and light gray in colour. These soils are mildly acidic in reaction and low in organic constituent. Dry crops and paddy grow in these soils.

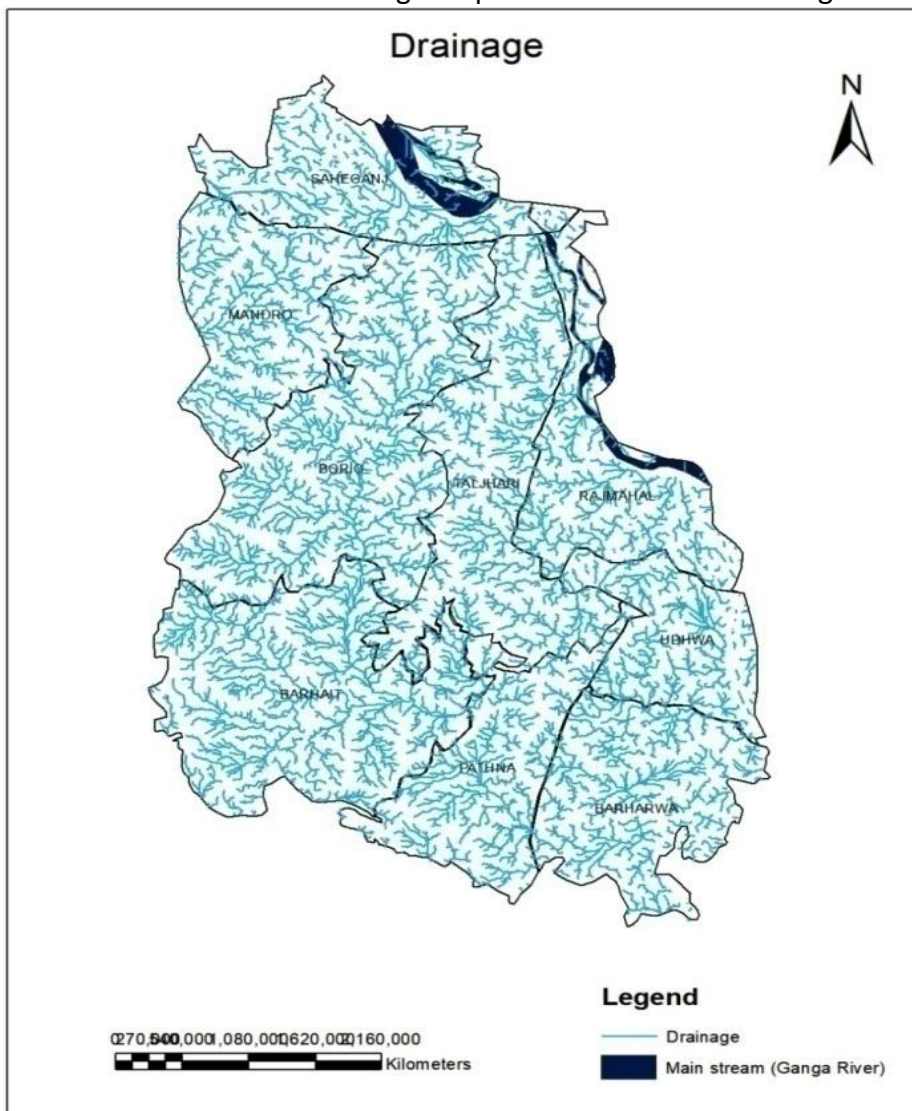
**1.9.3 Eroded scarp soil:** This type of soil occurs in transverse section of dissected, descending scarp land at various altitude of upland. This type of soil has poor fertility with shallow thickness.

**1.9.4 Foothill soil:** Foothill soils occur in the eastern fringe of the area. The soil is deep and acidic in reaction. The soil is yellowish red in colour crops like maize, arhar etc. grow in these soils.

**1.9.5 Tal soil:** Tal soil is found in the back water belt around Berharwa areas when the rain water remains collected in the rainy season. The soil is very fertile. Kharif crop is cultivated in these soils since the area remain submerged in rain water.

**1.9.6 Alluvial soil:** Alluvial soil occurs near Sahebganj plains. The texture is clayey loam type. Paddy, wheat, sugarcane grow in these soils.

**1.10 Hydrology and Drainage:** The river Ganga and its tributaries form the source of surface water in the area. There is no major, medium and minor irrigation projects located in the area except one medium lift irrigation project on river Ganga near Sakrigali. The district Sahebganj falls in the Lower Ganga basin. The area is mainly drained by the river Ganges, Gumani and Morang. The Ganga flowing along extreme northern to eastern part of the district is the perennial river. River Gumani flows west to east direction in southern part of the district while river Morang flows north to south direction in middle part of the district and finally joined by the river Gumani near village Barhait.. The Gumani and Morang are seasonal in nature. The drainage map of the area is shown in figure - 6.



**Figure – 6: Drainage Map of Sahebganj district**

**1.11 Agriculture and Irrigation Practice:** The local population of the district mostly depends on agriculture and forestry for their sustenance. The agriculture activity of the area is solely dependent upon the monsoon rainfall. Paddy is the main crop of the district. Gram and Khesari are other crops grown widely in Rajmahal and its adjoining areas. Irrigational facilities are not adequate in this district. The most common source is the dug well, but this is not a very dependable source of irrigation. The major part of the district being rocky in nature, it is difficult to dig wells. The undulating nature of land makes it possible to store rain water by bunding. Apart from being dependent upon rains, these are by no means adequate. The result is that failure of rains invariably involves failure of crops except in small pockets. Minor irrigation structures like surface water tanks and ponds are the other source for irrigation. Available source wise irrigation for the 2012-13 is given in table - 4.

**Table 4: Details of source wise irrigation of Sahebganj district (2012-13)**  
(Area in hectare)

Block	Surface water			Ground water			Other sources
	Canal	Tank	LI	DTW	STW	DW	
Sahebganj	0	0	0	12	0	0	0
Borio	0	16	0	0	0	11	24
Mandro	0	31	0	19	0	19	13
Barhait	0	59	0	175	0	13	100
Pathna	0	41	0	86	0	16	81
Barharwa	0	209	0	14	0	73	0
Rajmahal	0	71	0	270	0	37	43
Udhwa	0	56	0	175	0	21	88
Taljhari	0	26	0	27	0	11	50
Total	0	506	0	778	0	201	399

**1.12 Cropping Pattern:** The major crops cultivated in the area are paddy, wheat, maize, gram, oil seeds, pulses and vegetable. The paddy is grown in all the three cropping season viz., Aghani, Bhadaï and summer. Summer paddy is mainly cultivated in the low lying area along the river course where water is available for sufficient irrigation. But the land available for cultivation is very limited because of the hilly and rugged topography. Area under crop for the year 2015 – 16 of the district is presented in table - 5.

**Table – 5: Cropping pattern of Sahebganj district (2015-16)**  
(Area in hectare)

Block	Major Crops				
	Paddy	Wheat	Gram	Maize	Pulses
Sahebganj	28.96	399.97	47.15	811.03	18.26
Borio	1661.59	141.58	93.30	--	177.29
Mandro	2291.92	16.13	0.55	--	6.47
Barhait	4665.54	315.45	326.55	--	406.96
Rajmahal	2497.6	387.49	116.68	--	78.42
Udhwa	2167.84	334.46	67.91	--	19.46
Taljhari	3017.48	308.99	184.77	--	167.45
Pathna	2886.91	599.73	686.80	--	356.3
Barharwa	6993.25	725.06	296.60	--	448.66
Total	26211.08	3228.86	1820.31	811.03	1679.27

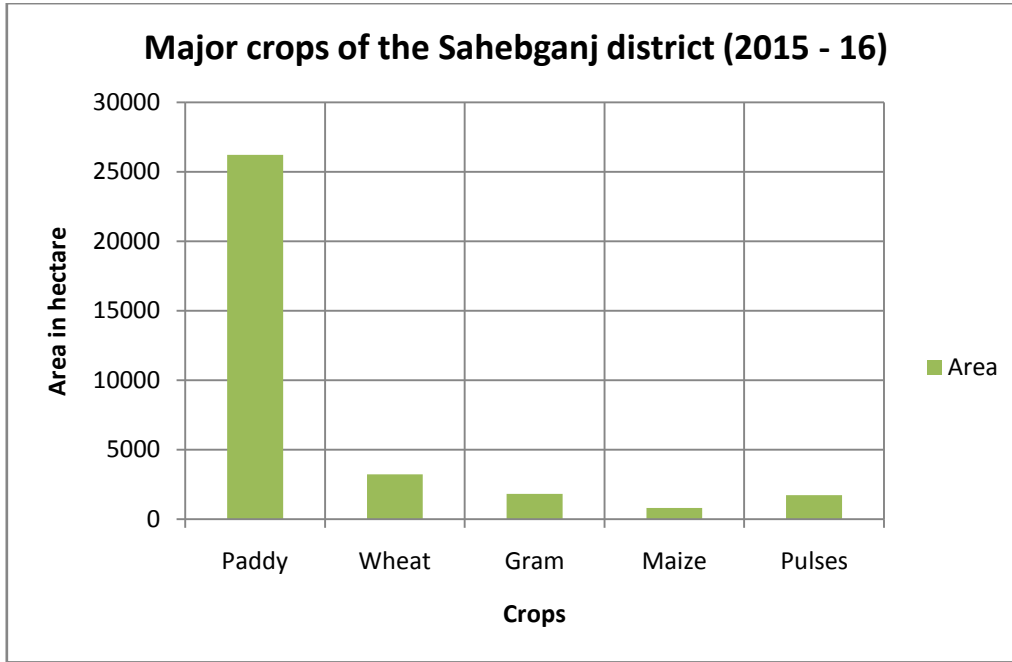


Figure – 7: Major crops of Sahebganj district (2015 – 16)

**1.13 Prevailing water conservation/recharge practices:** State Government such as drinking water & Sanitation Department, Forest Department, Director Soil conservation etc. have constructed number of water conservation and artificial recharge. Available data of forest department is given below in table – 6.

**Table 6: Check dam constructed by forest department, Govt. of Jharkhand in Sahebganj district during 2010-11, 2011-12 & 2013-14**

Sr. No.	Name of forest range	Name of site/ village	Name of block	Co-ordinates	
				Latitude	Longitude
1	Rajmahal Damin Range	Malitok	Taljhari	25°56'430"	87°48'549"
2		Gamharia	Taljhari	25°08'243"	87°43'143"
3		Tetaria	Taljhari	24°55'745"	87°45'645"
4		Paderkola	Taljhari	24°55'950"	87°45'295"
5		Kalajhor	Rajmahal	25°08'243"	87°45'645"
6		Kalyani	Taljhari	25°12'197"	87°44'442"
7	Barharwa Damin Range	Budhibasti-1	Barharwa	24°53'460"	87°45'727"
8		Budhibasti-2	Barharwa	24°53'430"	87°45'763"
9		Chandola-1	Borio	24°53'854"	87°45'470"
10		Chandola-2	Borio	24°53'872"	87°45'564"
11	Sakrogarh Damin Range	Marangtanr-I	Borio	25°08'373"	87°36'394"
12		Marangtanr-II	Borio	25°07'935"	87°37'183"
13		Marangtanr-III	Borio	25°08'197"	87°37'217"
14		Paharpur - I	Borio	25°09'025"	87°40'491"
15		Paharpur - II	Borio	25°09'243"	87°40'068"

16		Paharpur - III	Borio	25°09'375"	87°40'197"
17	Mandro Damin Range	Tetaria - I	Mandro	--	--
18		Tetaria - I	Mandro	--	--
19		Ghaghro - I	Mandro	--	--
20		Ghaghro - II	Mandro	--	--
21		Ghaghro - III	Mandro	--	--
22	Rajmahal Damin Range	Ghardwara	Rajmahal	24°55'304"	87°43'757"
23		Bathani	Rajmahal	24°55'556"	87°45'017"
24		Bajjnathpur	Rajmahal	24°54'971"	87°44'982"
25		Manoharpur	Rajmahal	25°04'640"	87°42'469"
26	Sakrogarh Damin Range	Gawaibhita	Borio	25°09'871"	87°40'698"
27		Singhli	Borio	25°09'825"	87°41'232"
28		Simaljori	Borio	25°09'820"	87°41'393"
29	Mandro Damin Range	Chunakhari-1	Mandro	25°14'104"	87°30'552"
30		Chunakhari-2	Mandro	25°14'104"	87°30'551"
31		Khasari	Mandro	25°08'917"	87°44'400"
32	Rajmahal Damin Range	Motijharna	Rajmahal	25°14'314"	87°38'729"
33		Mehndipokhar	Rajmahal	25°11'056"	87°44'191"
34		Jhikhra Harinkol	Rajmahal	25°08'356"	87°44'352"
35		Jhikhra Santhali	Rajmahal	25°09'232"	87°42'951"
36	Barharwa Damin Range	Kamardiha - 1	Barharwa	24°50'662"	87°37'207"
37		Kamardiha - 2	Barharwa	24°50'712"	87°37'241"
38		Manjhladih -1	Barharwa	24°52'337"	87°43'423"
39		Manjhladih -2	Barharwa	24°52'367"	87°47'459"
40	Mandro Damin Range	Dhobna - 1	Mandro	25°05'087"	87°25'526"

## 2. DATA COLLECTION AND GENERATION

The primary Data such as water level, quality, geophysical data and exploration details were available with CGWB has been collected and utilised as baseline data. The Central Ground Water Board has established a network of observation wells under National Hydrograph Network programme to study the behavior of ground water level and quality of ground water in the district. To understand the sub – surface geology, identify the various water bearing horizons including their depth, thickness and compute the hydraulic characteristics such as transmissivity and storativity of the aquifers, exploratory drilling programme was carried out by Central Ground Water Board. For other inputs such as hydrometeorological, Landuse, cropping pattern etc were collected from concerned state and central govt departments and compiled.

**2.1 Data collection and Compilation:** The data collection and compilation for various components was carried out as given below -

**i. Hydrogeological Data:** Water level data of 27 key wells and historical water level trend of monitoring wells were collected and compiled representing Aquifer-I. Four pumping tests were conducted on exploratory wells drilled in district. Also conducted seven numbers of soil infiltration tests.

**ii. Hydrochemical Data:** To evaluate the quality of ground water, 23 samples were collected from dug wells and 24 samples from hand pumps representing shallow aquifer (Aquifer – I) and deeper aquifer (Aquifer – II).

**iii. Geophysical survey:** 38 VES were carried out to identify the weathered zone resistivity and its thickness as wells as find out deeper fracture zone and different layer of basaltic formation.

**iv. Exploratory drilling:** 18 exploratory and 11 observation wells drilled in hard rock area and 1 exploratory well drilled in soft rock (alluvium) area of the district through departmental rigs. In addition to this 11 Exploratory wells were also drilled in hard rock formation and three in alluvial formation through outsourcing.

**v. Hydrometeorological Data:** Last ten years (2008 – 2017) monsoon rainfall data for each of the block from the office of District Agriculture Department, Sahebganj.

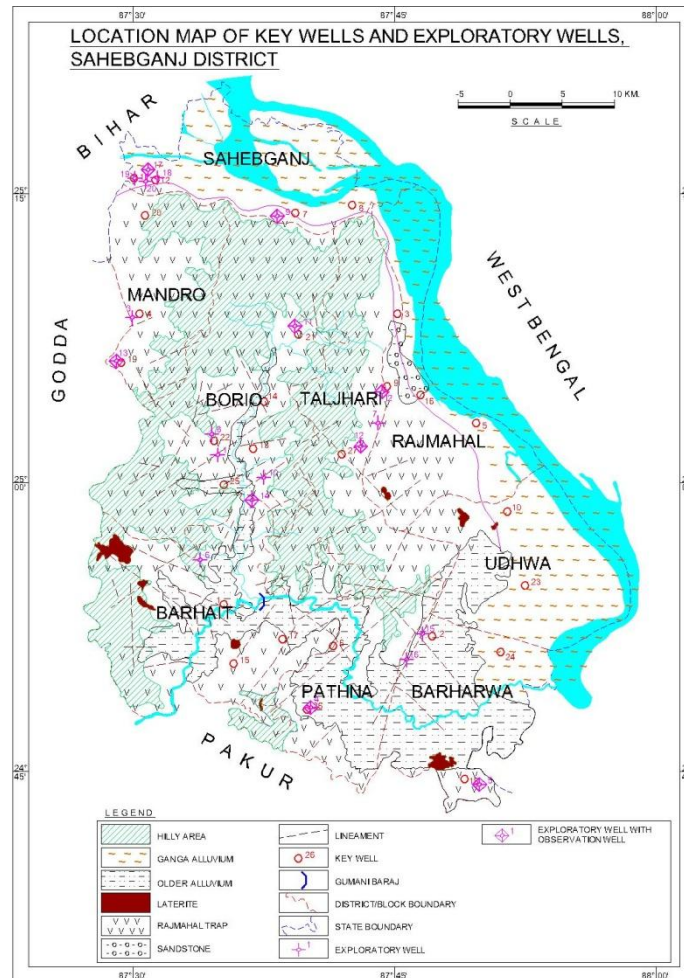
**vi. Land use and cropping pattern data:** data of land use and cropping pattern from the office of Director Statistics, Ranchi.

**2.2 Data Generation:** After taking into consideration, the data available with CGWB on ground water monitoring wells (GWMW), ground water quality, geophysical survey and ground water exploration, the data adequacy was compiled and it indicated that exploratory drilling is required at least 6 locations of Rajmahal, Udhwa and Barharwa blocks, geophysical survey (VES) are required in Barharwa, Barhait, Pathna, Borio, Taljhari and Mandro blocks. The requirement, availability and gap of major data inputs i.e., exploratory wells, geophysical data, ground water monitoring wells and ground water quality data are detailed in the table – 1.

**2.2.1 Ground water Monitoring Wells:** 27 key wells were established to assess the ground water scenario of shallow aquifer (Aquifer-I) of the area. The depth of these dug well varies from 5.77 to 14.80 mbgl. Similarly, the diameters of key wells (dug wells) ranges from 0.80 to 4.46 m. During 2016, the pre monsoon (May) depth to water level in these wells was between 2.84 to 11.51 mbgl. The post monsoon depth to water level (Nov. 2016) in the dug



wells ranges from 1.48 to 7.50 mbgl. In 2017, water level of key wells monitored was between 2.58 to 11.15 and 1.14 to 6.51 mbgl for the period of pre and post monsoon respectively. A detail of key wells and water level data is presented in Annexure – II & III. Location of key wells and exploratory wells are shown in figure – 8.



**Figure – 8: Location of key wells and exploratory wells**

**2.2.2 Ground Water Exploration:** On perusal of table- 1, exploratory drilling in Rajmahal, Barharwa and Udhwa blocks is required. Accordingly additional data generation were undertaken in hard rock area and soft rock formation (alluvium) to assess the lithological disposition of shallow aquifer (Aquifer-I) and deeper aquifer (Aquifer-II). The details of exploratory and observation wells are given in Annexure-VI A & VI B.

**2.2.3 Ground Water Quality:** To assess the quality of ground water, 23 samples were collected from dug wells representing Aquifer – I. Similarly, 24 samples from hand pumps were collected to evaluate the ground water quality of Aquifer – II. In addition, 60 sample in 2007, 61 sample in 2015 and 33 samples from Sahebganj, Rajmahal and Udhwa blocks were collected for the study of Arsenic and Iron contamination in ground water which is given in annexure - VIII.

**2.2.4 Geophysical Survey:** From table – 1, at least 4 VES is required in each block of Barharwa, Barhait, Pathna, Borio, Taljhari and Mandro blocks. 35 VES have been conducted in the district. Block wise number of VES conducted in Sahebganj district is given below in table –7.

**Table –7: Block wise number of VES conducted in Sahebganj district**

Year	Block	No. of VES
2011 - 12	Taljhari	3
	Udhwa	2
	Barharwa	1
	Borio	2
2016 - 17	Sahebganj	3
	Rajmahal	5
2017 - 18	Sahebganj	13
	Udhwa	13
	Barharwa	1
Total		43

**2.2.5 Soil Infiltration Test:** To obtain the actual rate of infiltration of various soil cover and their impact on recharge to ground water, 7 infiltration tests have been conducted in the area of different geological formation. The data has been analyzed and the salient features of the infiltration tests are presented in table -8, whereas the data is presented in Annexure -IV and the plots of soil infiltration tests are presented in figure - 9 (a – g).

**Table – 8: Salient features of the soil infiltration test**

Sr. No	Village	Block	Co-ordinates	Date	Formation	Initial water level (mm)	Final infiltration rate (mm/hr)
1	Rajmahal	Rajmahal	25 <sup>0</sup> 02' 15" 87 <sup>0</sup> 37' 15"	02/05/2017	Ganga alluvium	185	15
2	Risaur	Barharwa	24 <sup>0</sup> 50' 04" 87 <sup>0</sup> 49' 15"	03/05/2017	Older alluvium	127	19.8
3	Barhait	Barhait	24 <sup>0</sup> 53' 42" 87 <sup>0</sup> 36' 05"	03/05/2017	Older alluvium	165	21.6
4	Dihari	Sahebganj	25 <sup>0</sup> 16' 35" 87 <sup>0</sup> 30' 55"	04/05/2017	Ganga alluvium	154	3.6
5	Bachcha	Mandro	25 <sup>0</sup> 06' 13" 87 <sup>0</sup> 29' 23"	08/05/2017	Rajmahal trap	155	-
6	Dumaria	Borio	25 <sup>0</sup> 01' 41" 87 <sup>0</sup> 37' 30"	08/05/2017	Rajmahal trap	183	8.4
7	Brindavan	Taljhari	25 <sup>0</sup> 00' 46" 87 <sup>0</sup> 43' 05"	22/05/2017	Rajmahal trap	155	19.2

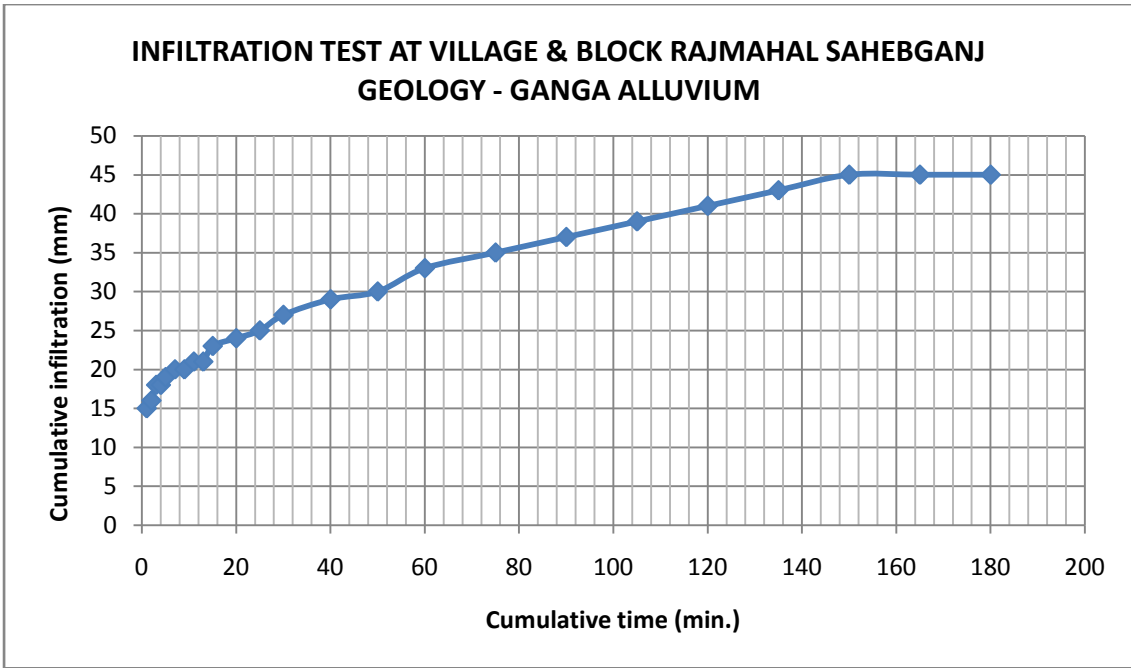


Figure – 9 (a)

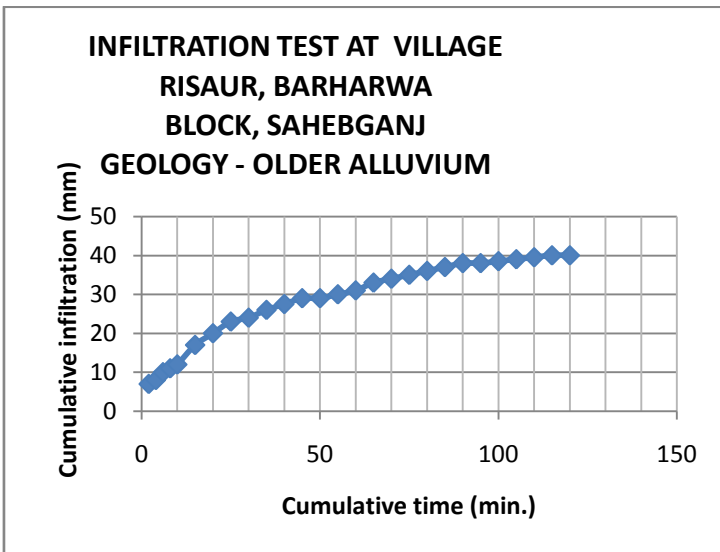


Figure – 9 (b)

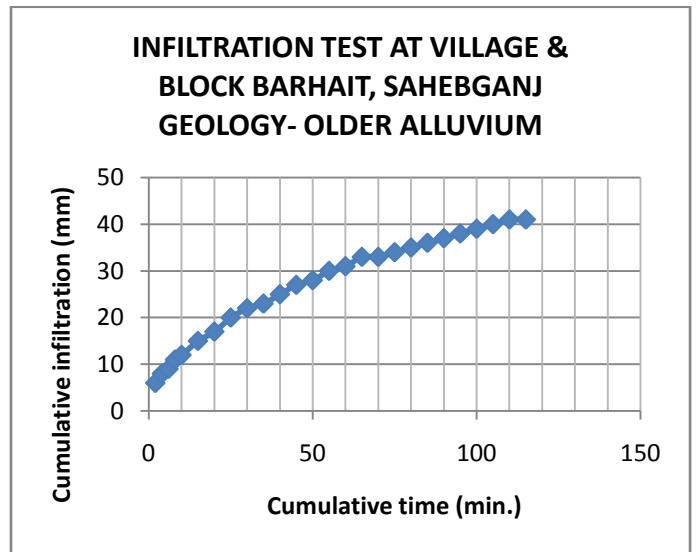


Figure – 9 (c)

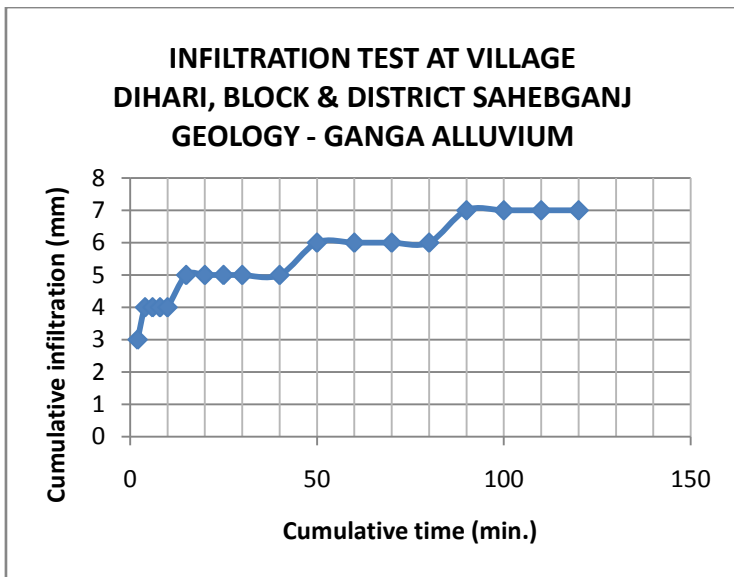


Figure – 9 (d)

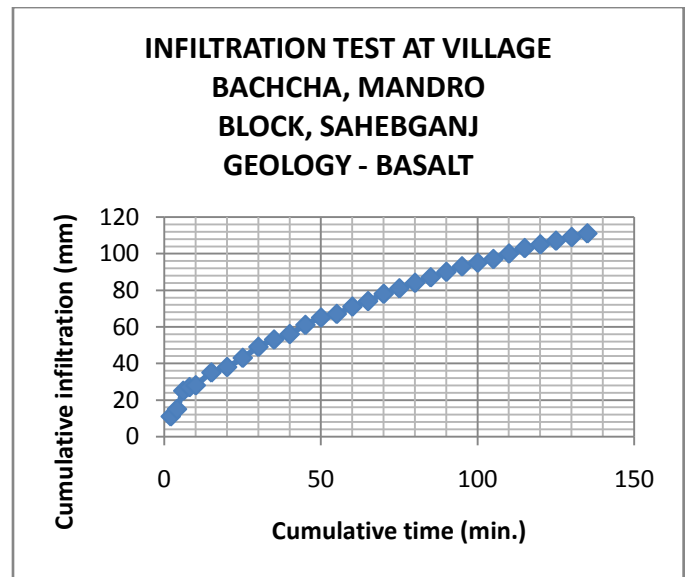


Figure – 9 (e)

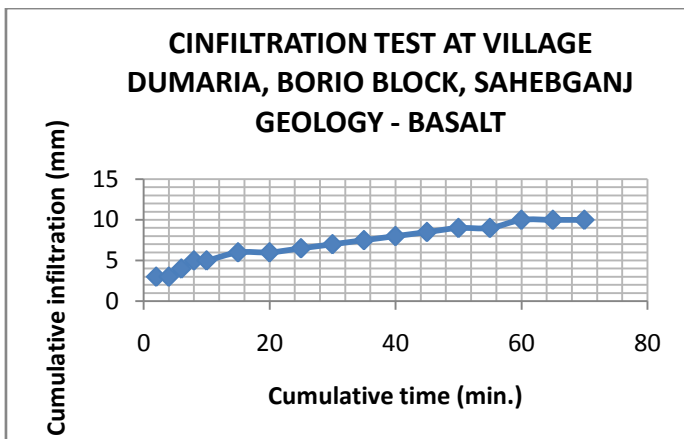


Figure – 9 (f)

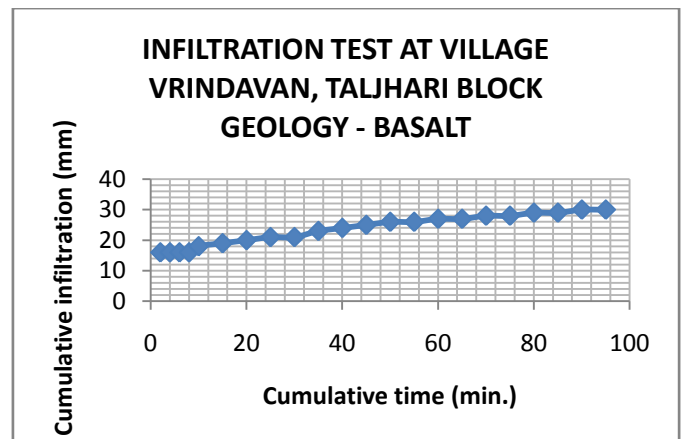


Figure – 9 (g)

**2.2.6 Pumping Test:** For evaluating the well characteristics and for determining the hydraulic parameters of the aquifer- II, pumping tests (step drawdown test and aquifer performance test) were conducted on 5 exploratory wells. Step drawdown test (SDT) data was analyzed and calculated the well efficiency in percentage. The drawdown data of aquifer performance test (APT) was analyzed by using Jacob's straight line method and Theis type curve method and calculated aquifer parameters such as Transmissivity (T) Storage coefficient (S) value of Aquifer – II. The recovery data APT was analyzed by Theis recovery method and calculated the Transmissivity (T) value.

**2.2.7 Micro Level Hydrogeological Data Acquisition**

In addition to the Hydrograp Monitoring Wells, micro level hydrogeological data was also acquired for deciphering the sub-surface lithological disposition, water level scenario and other hydrogeological inputs such as weathered thickness etc., of shallow aquifer (Aquifer-

l). Thus 27 wells in the district, were inventoried for micro level data acquisition. The details of dugwells inventoried for micro-level data acquisition are given in Annexure-II&III..

**2.2.8 Thematic Layers:** The following thematic layers were also generated which supported the primary database and provided precise information to assess the present ground water scenario and also to propose the future management plan.

1. Drainage
2. Geomorphology
3. Elevation
4. Land use
5. Geology & structure

The thematic layers such as drainage, geomorphology, DEM and land use have been described in Chapter – I.

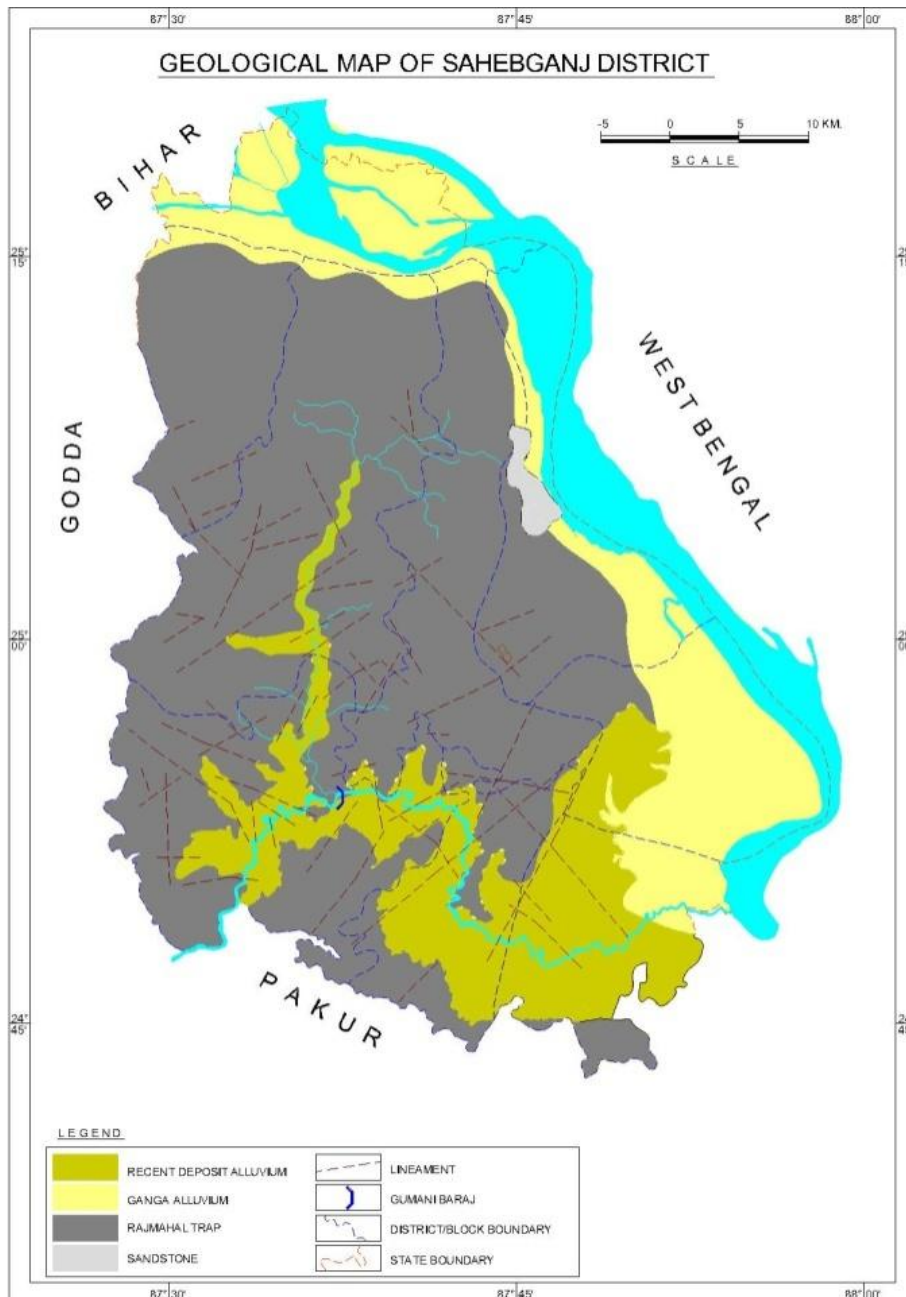
### 3. DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

The data collected and generated on various parameters viz., water levels, water quality, exploration, aquifer parameters, geophysical, hydrology, hydrometeorology, irrigation, thematic layers was interpreted and integrated. Based on this the various aquifer characteristic maps on hydrogeology, aquifer wise water level scenario both current and long term scenarios, aquifer wise ground water quality, 2-D and 3-D sub surface disposition of aquifers by drawing fence and lithological sections, aquifer wise yield potential, aquifer wise resources, aquifer maps were generated and as discussed in details.

#### 3.1 Geology

Geologically major part of the area is represented by Rajmahal traps having huge thickness of basaltic lava flows with intercalated shales and Clays. The type area is the Rajmahal hills at the head of the Ganges delta near the border of Jharkhand and west Bengal. The Rajmahal ranges extend with a north-south trend for more than 120 kms through the districts of Santhal Parganas in Jharkhand and Birbhum in West Bengal( GSI, 1989). It consists of long flat topped hills attaining a maximum altitude of about 600 m. The basaltic lava flows of the Rajmahal Trap of middle Jurassic to lower cretaceous age occupy the major part of the district. It has been found that there are at least seven successive flows of basalt in the area, each flow ranging in thickness between 20m and 75 m. Rajmahal Traps are underlain by Gondwana formations. Rajmahal Traps are overlain by Laterites and Alluvium. The river Ganga deposit recent alluvium occurs in the northern to eastern boundary of the area. The alluvium comprising of sand, silt, gravel and sub – ordinate clay. Laterites are mainly in situ origin and have been formed by sub – aerial erosion of underlying basalt under favorable climatic conditions. The stratigraphic sequence of the area is as under.

	<u>Age</u>	<u>Formation</u>
	Recent	Alluvium
	Cenozoic	Laterite
Upper Gondwana	Middle Jurassic to Lower Cretaceous	Rajmahal Trap with intertrappeans
	..... Igneous Contact .....	
	Lower Triassic to lower Jurassic	Dubrajpur Formation
Lower Gondwana	.....Unconformity and overlap .....	
	Upper Permian	Barakar Formation
	Lower Permian	Talchir Formation
	..... Unconformity.....	
	Precambrians	Metamorphics( Granite-Gniess, etc)



**Figure – 10: Geological map of Sahebganj district**

**3.2 Hydrogeology:** The occurrence and movement of ground water in the area is variable , which is broadly governed by geological frameworks i.e., nature of rock formations including their porosity (primary and secondary) and permeability. The principal aquifer in the area is Basalt, where the occurrence and movement of ground water primarily depends on the degree of interconnection of secondary pores/voids developed by fracturing and weathering. Rajmahal Traps in the area constitutes number of basaltic flows separated by intertrappean beds which are often agillaceous and arenaceous in nature. The intertrappean beds separates two flows occurs as impermeable beds. The distinctive hydrogeological features of the basaltic rocks is the significant primary porosity in the form of vesicles, cracks etc. The secondary porosity is developed due to fracturing during cooling of lavas, tectonic disturbances, weathering etc. Laterites are mainly of insitu origin and have formed by subaerial erosion of underlying basalts under favourable climatic condition. The study

reveals that vesicular basalts, laterites, intertrappeans formation etc form suitable condition for ground water storage. The alluvium occurs in the northern and eastern boundary of the district, which is composed mainly of sand and sub ordinate clay. Younger alluvium (upto 70 m) is most productive rather than older alluvium.

The hydrogeological map of area is prepared and presented in figure -11.

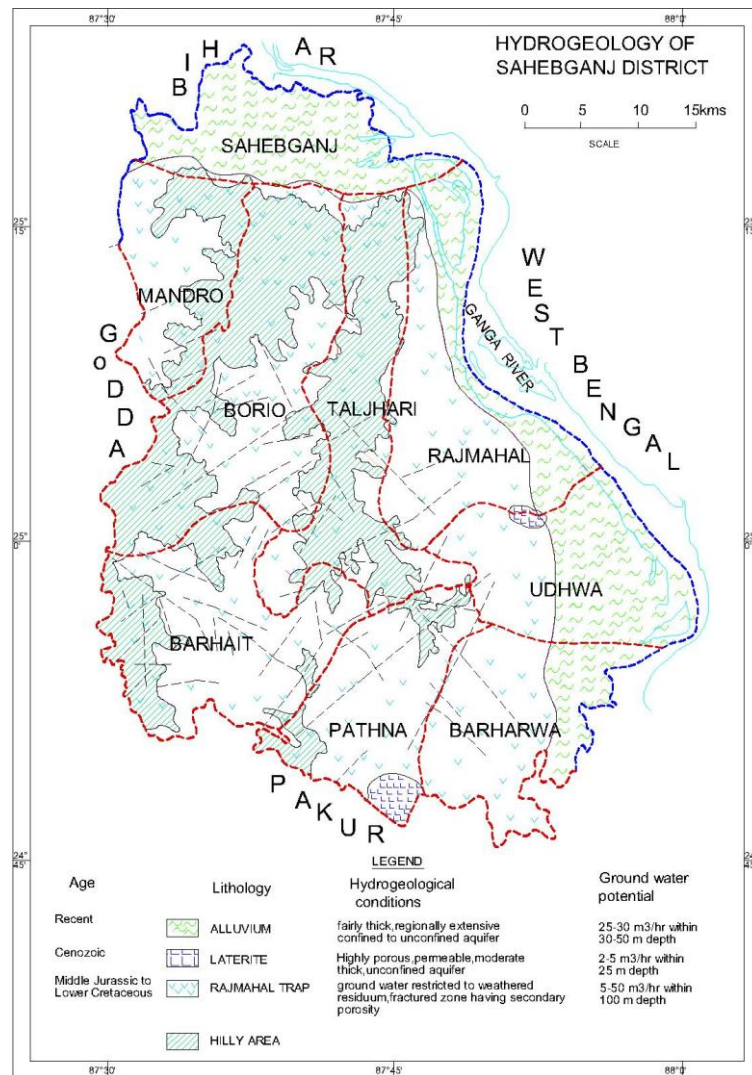


Figure – 11: Hydrogeology of Sahebganj district

**3.2.1 Ground Water In Aquifer-I(Alluvium/Laterite/ Weathered Basalt):** Ground water occurs under phreatic/ unconfined to semi-confined conditions in Aquifer-I which is represented by Alluvium, Laterite, weathered Basalt. In the eastern and northern margin of the area recent alluvium of the Ganges fringe the older rocks which is composed mainly of sand and sub-ordinate clays

Ground water occurs in unconfined state in shallow Aquifer-I tapped by laterites, weathered basalts ( Upto 30 m depth) , however in some cases where alluvium thickness is more( upto 150 m in Sahebganj block). Ground water occurs in unconfined to semi-confined state in Aquifer-I ( upto the depth of 60m). Yield of the wells in Aquifer-I ranges from 25-30 m<sup>3</sup>/hr in alluvium and 5 m<sup>3</sup>/hr in Laterites/Weathered Basalt.



**3.2.2 Ground Water In Aquifer-II( Fractured Basalt):** Ground water occurs under Semi-confined to confined condition in Aquifer-II represented by Fractured/Jointed /Vesicular Basalt upto the depth of 156.0m depth . Yield of the wells in Aquifer-II is upto 50m<sup>3</sup>/hr. The high yielding aquifers are generally encountered in fractures/joints between 45-100 depth, however in some cases deeper fractures were encountered between 110-150m at Taljhari, Barharwa, Nishinta , Khaira etc

**3.3 Geophysical survey:** To identify the weathering thickness, depth of bed rock, fractures depth etc. geophysical surveys (35 Nos.) were carried out in district. The geophysical data was analyzed and interpreted VES result presented in annexure IX.

VES data interpreted results reveal that four to five geoelectrical layers have been deciphered in Sahebganj block. The top soil resistivities vary from 15 - 74 ohm-m with a thickness 0.75 - 3.51m. The second Clay layer resistivity varies from 5.12 to 6.65 ohm-m with a thickness of 5.31 to 7.88m at VES- 5 and VES- 7. The resistivity of 167 ohm-m indicating gravel with lateritic formation with a thickness of 11.10 m. at Hazipur Diara site. The third layer resistivity varies from 20.5 – 47.10 ohm-m with a thickness of 18.8 -21.0 m. The fourth layer clay with sand formation resistivities vary with fine to coarse sand presence.

The interpreted results show that four to five geoelectrical layers have been identified in Udhwa block. The top soil resistivity varies from 14.6-83.5 ohm-m with a thickness of 0.5 – 2.88m. The second layer resistivity varies from 2.33 – 48 ohm-m with a thickness of 0.81-30.4m except VES-1.The third layer resistivity 4.80 – 139 ohm-m indicating Clay with fine sand to coarse sand in the formation and having thickness 2.05-65.9m except VES-5, Shridhar. The fourth layer is underlain by fifth layer having thickness from 20.4 – 41.4m at VES No. 1, 3 & 5 in Udhwa block sites. The hard rock was deciphered at Radha Nagar site down to depth 39.5m.

In Rajmahal block area, five VES were carried out. The interpreted results indicate four to five geoelectrical layers. The top layer thickness varies from 1m to 1.8m. The clay thickness varies from 1.8m to 28m. The maximum sand thickness was found 12m at Mansinga site.

In addition to vertical electrical sounding (VES), 4 numbers of electrical logging of tube wells were conducted to identify the granular zones which are presented in figure – 12(a-d).

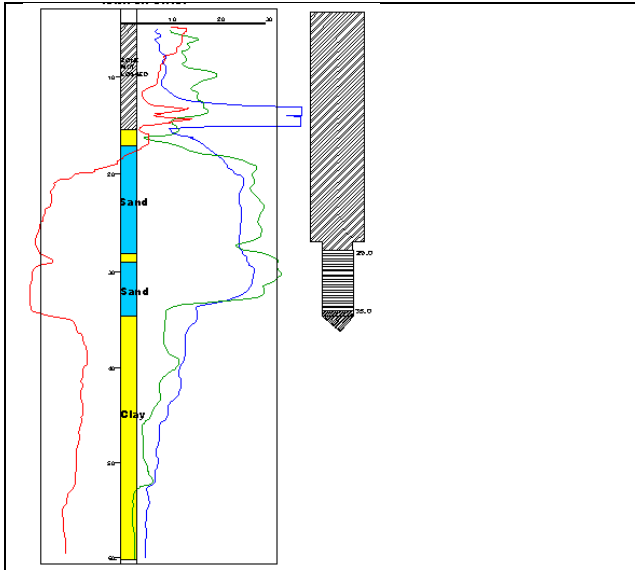


Figure – 12(a): E-log at village Hazipur Bhatta

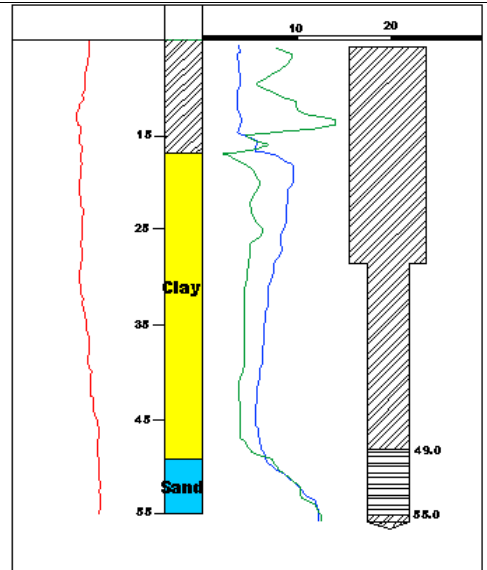


Figure – 12(b): E-log at village Rajgaon

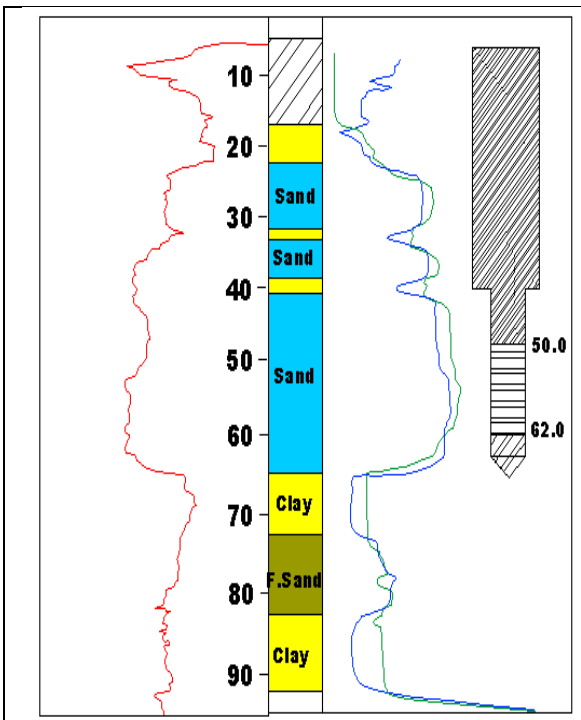


Figure – 12(c): E-log at village Dihari (near middle school)

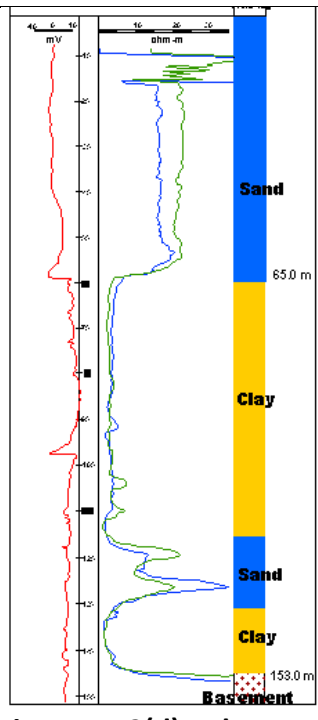


Figure – 12(d): E-log at village Dihari (Gaucher)

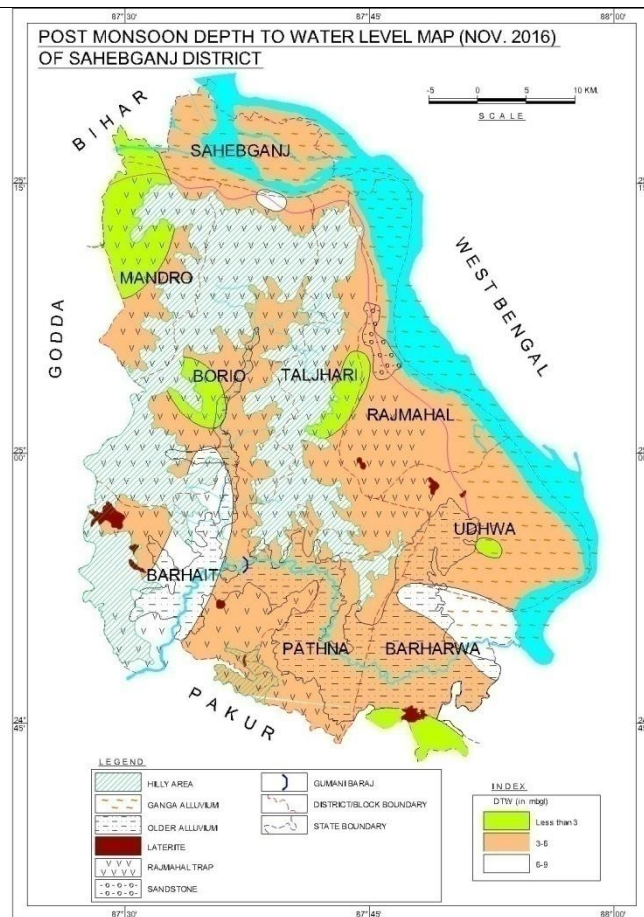
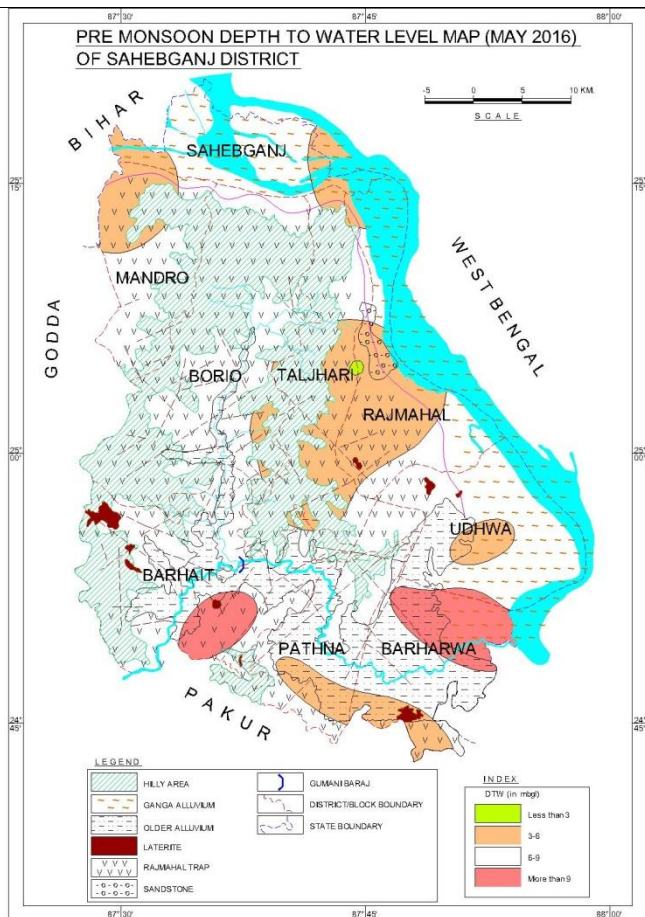
Figure: 12 a-d Electrical Logging in alluvial areas of Sahebganj district

**From the electrical logging data of alluvial area it is observed that-**

1. The thickness of the Quaternary alluvium, overlying the Rajmahal Trap, is varying widely because of the undulating nature of the basement.
2. The alluvium predominantly consists of clay.
3. Thick second aquifer zone is very rare in alluvial area.
4. The alluvium thickness decreases towards south. The chance of getting thick potential aquifer is remote towards south.
5. 2nd Aquifer encountered in EW drilled at Dehari Gauchar (well constructed down to depth of 138m - CGWB), is low yielding. However, the ground water in 2nd aquifer is arsenic safe.

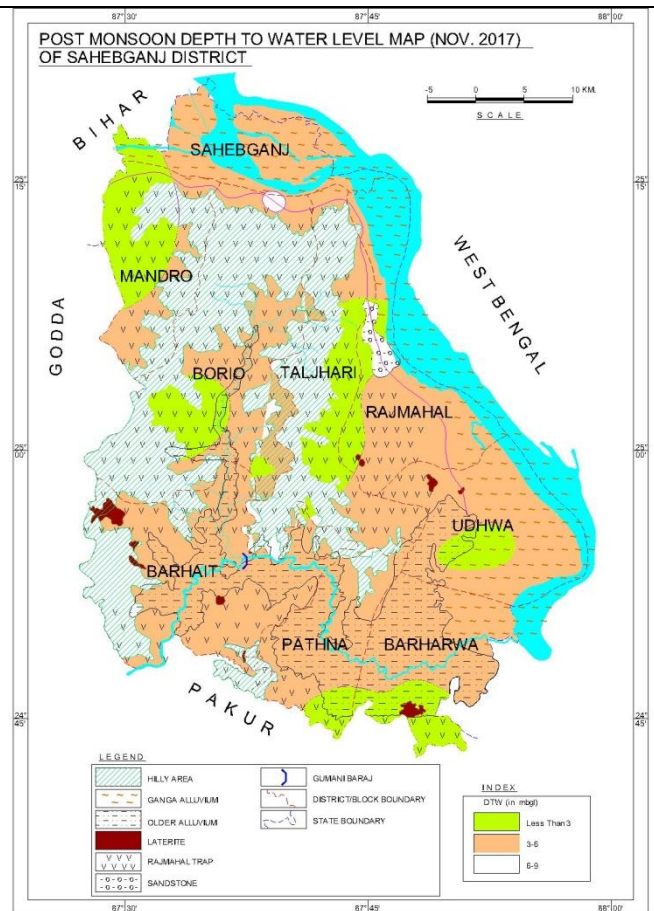
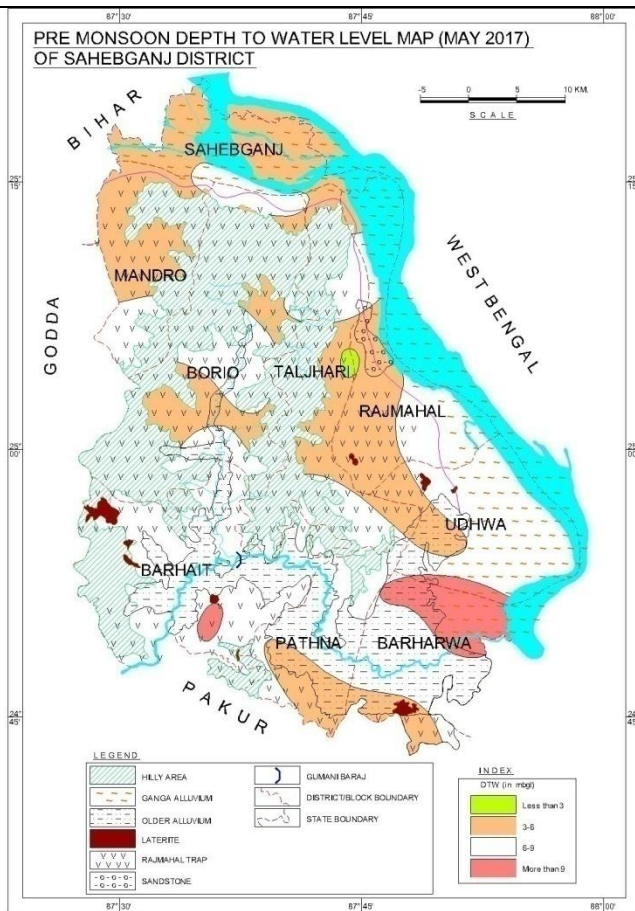
**3.4 Ground water Dynamics**

**3.4.1 Water Level Scenario – Aquifer – I (Shallow Aquifer):** water level scenario of shallow aquifer was generated by utilizing water level data of 27 monitoring wells representing shallow aquifer. The pre monsoon (May 2016) depth to water monitored between 2.84 to 11.51 mbgl. The post monsoon depth to water level (Nov. 2016) in the dug wells ranges from 1.48 to 7.50 mbgl. During 2017, the water level of shallow aquifer was monitored between 2.58 to 11.15 and 1.14 to 6.51 mbgl for the period of pre and post monsoon respectively. Similarly, post monsoon water level was monitored for the year 2018 and it is observed the water level varies from 2.45 to 9.62 mbgl. Pre and post monsoon depth to water level maps were prepared for the year 2016 and 2017 and presented in figure – 13, 14, 15, & 16. Pre monsoon (May 2018) depth to water level map has been prepared and shown in figure – 17.



**Figure – 13: Pre monsoon (May 2016) depth to water level map of Aquifer – I (shallow aquifer)**

**Figure – 14: Post monsoon (Nov. 2016) depth to water level map of Aquifer – I (shallow aquifer)**

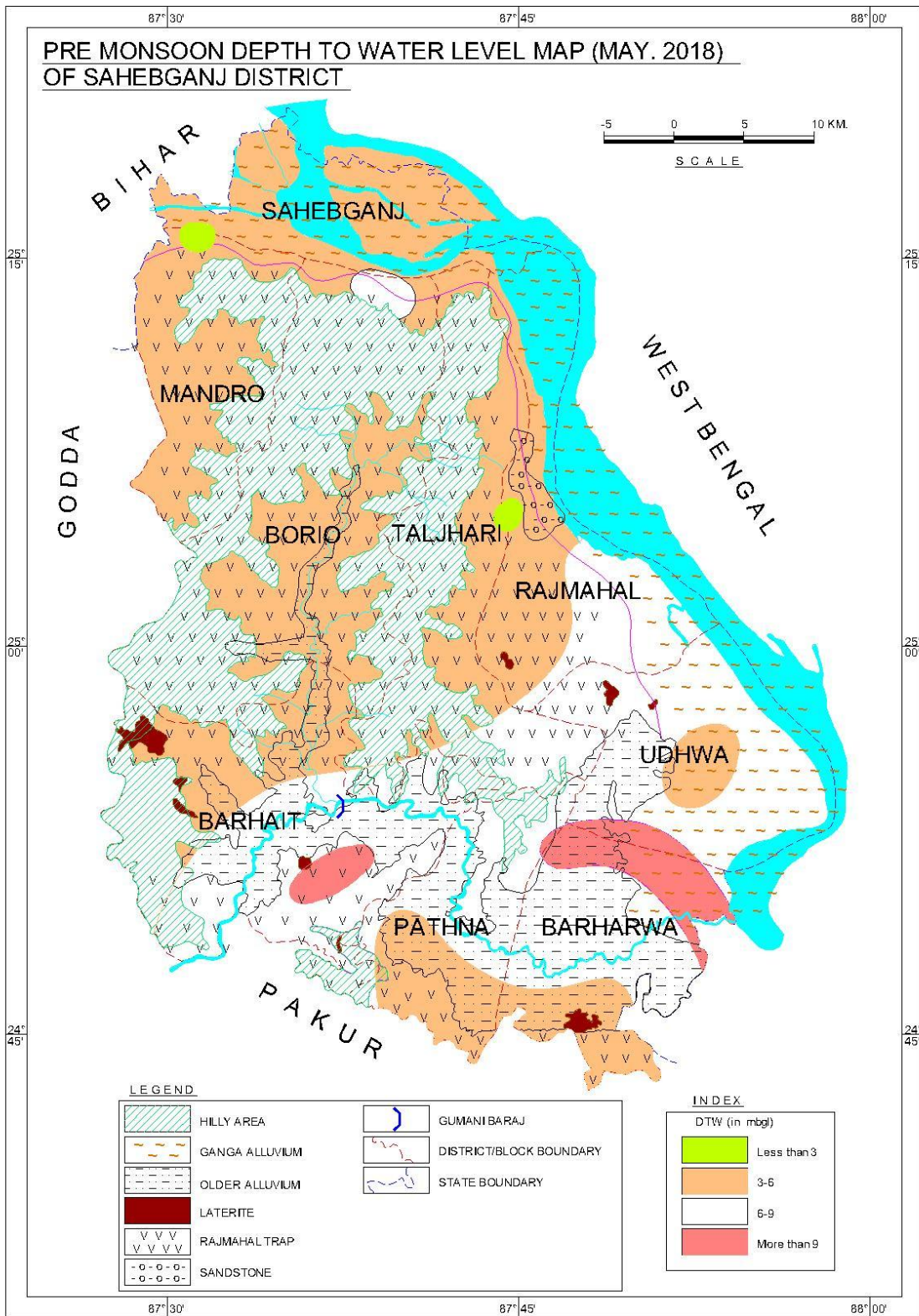


**Figure – 15: Pre monsoon (May 2017) depth to water level map of Aquifer – I (shallow aquifer)**

**Figure – 16: Post monsoon (Nov. 2017) depth to water level map of Aquifer – I (shallow aquifer)**

The water level monitored during pre and post monsoon period 2016 and 2017 was used to compute the seasonal fluctuation. The seasonal water level fluctuation was observed between 0.16 to 5.45 m and 0.77 to 6.65 m for the period between pre monsoon and post monsoon 2016 and 2017 respectively. Water level fluctuation maps between pre and post monsoon (2016 & 2017) have been prepared and presented in 18 & 19.





**Figure – 17: Pre monsoon (May 2018) depth to water level map of Aquifer – I (shallow aquifer)**

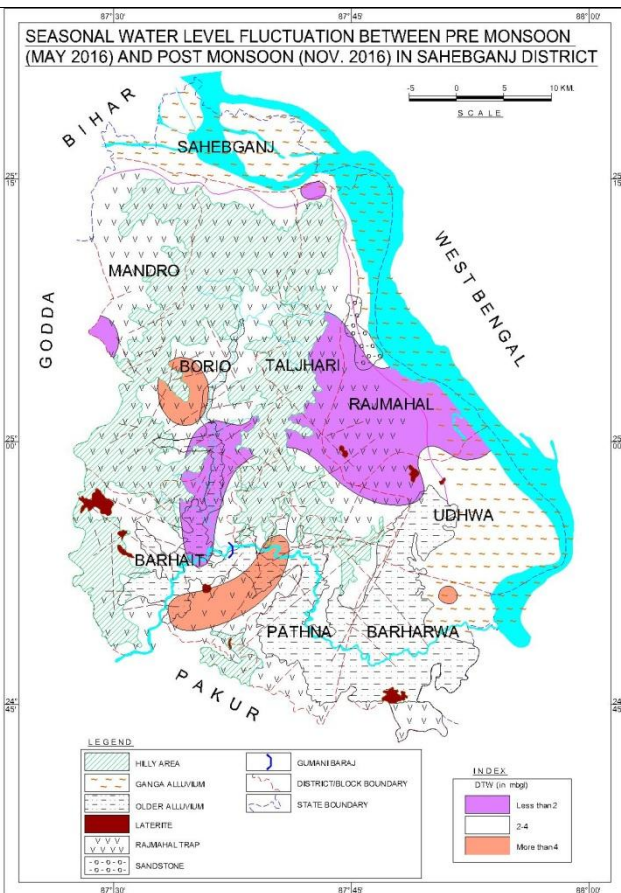


Figure – 18: Seasonal water level fluctuation map of Sahebganj district (2016)

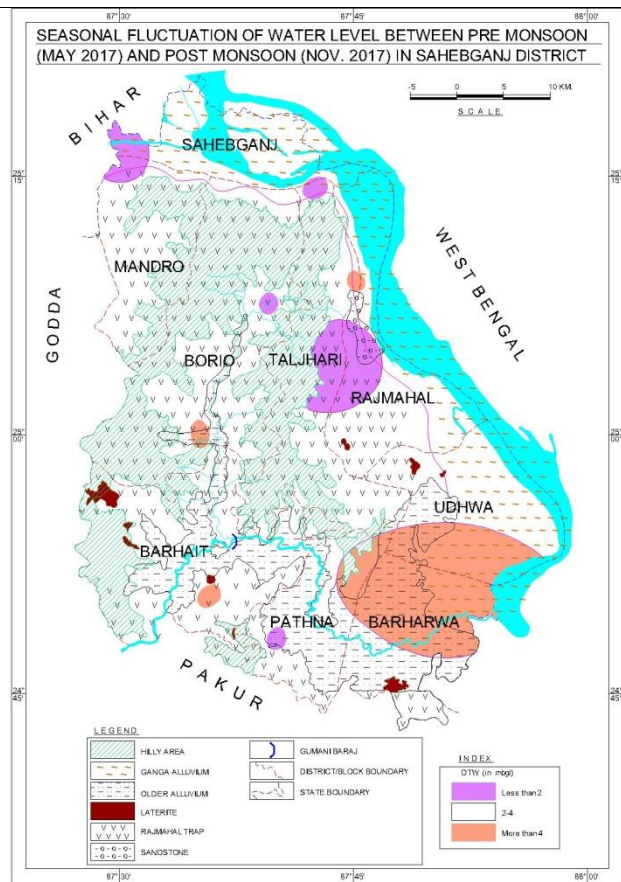


Figure – 19: Seasonal water level fluctuation map of Sahebganj district (2017)

**3.4.2 Long Term Water Level Trend (1998-2018):** In order to study long term behavior of the water levels and also the effect of various developmental activities with time, the data for the period 1998-2018 have been computed and analyzed presented in table - 9. The pre monsoon water level trend analysis showing declining trend in 83% wells. The post monsoon water level is showing rising and declining trend in 50% wells each.

**Table – 9: Long term water level trend of sahebganj district (1998 – 2018)**

Sr. No.	Location	Water level trend (m/year)			
		Pre monsoon		Post monsoon	
		Rise	Fall	Rise	Fall
1	Barharwa	--	0.1231	0.0646	--
2	Barhait	0.0733	--	0.0378	--
3	Rajmahal	--	0.1298	--	0.0176
4	Borio	--	0.2884	0.0293	--
5	Sahebganj	--	0.2415	--	0.1644
6	Sakrigali	--	0.0126	--	0.0091

**3.4.3 Hydrograph Analysis**

Analysis of five (05) hydrograph network stations, were carried out using GEMS software (Fig-20 a-e) and analysed for the period from 1998-2017. It is observed that the long-term

water level trends during pre and post-monsoon seasons are declining trend ( except Barhait) in shallow aquifer-I represented by dug wells.

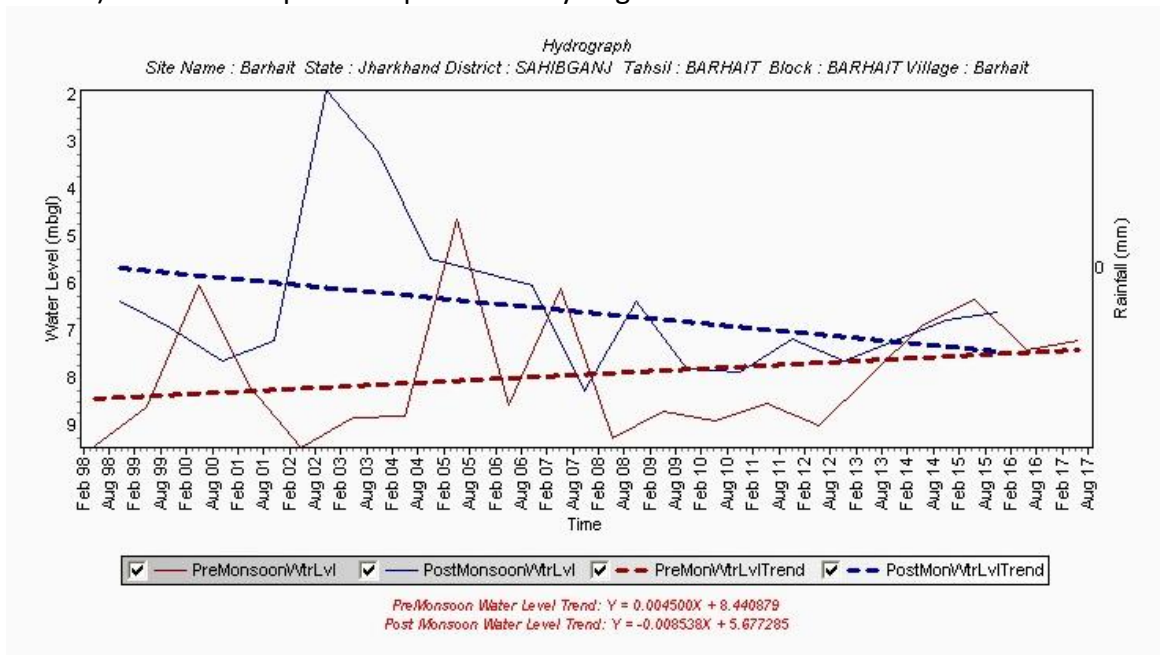


Fig 20a: Hydrograph (1998-2017), Barhait, Barhait block, Sahebganj district

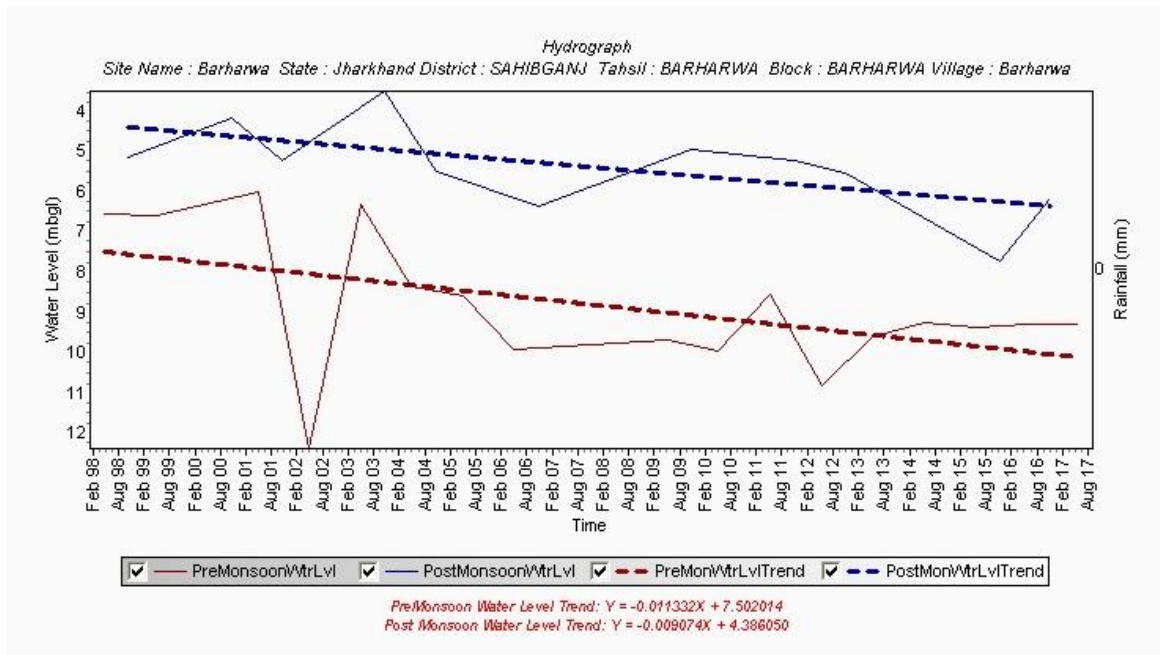
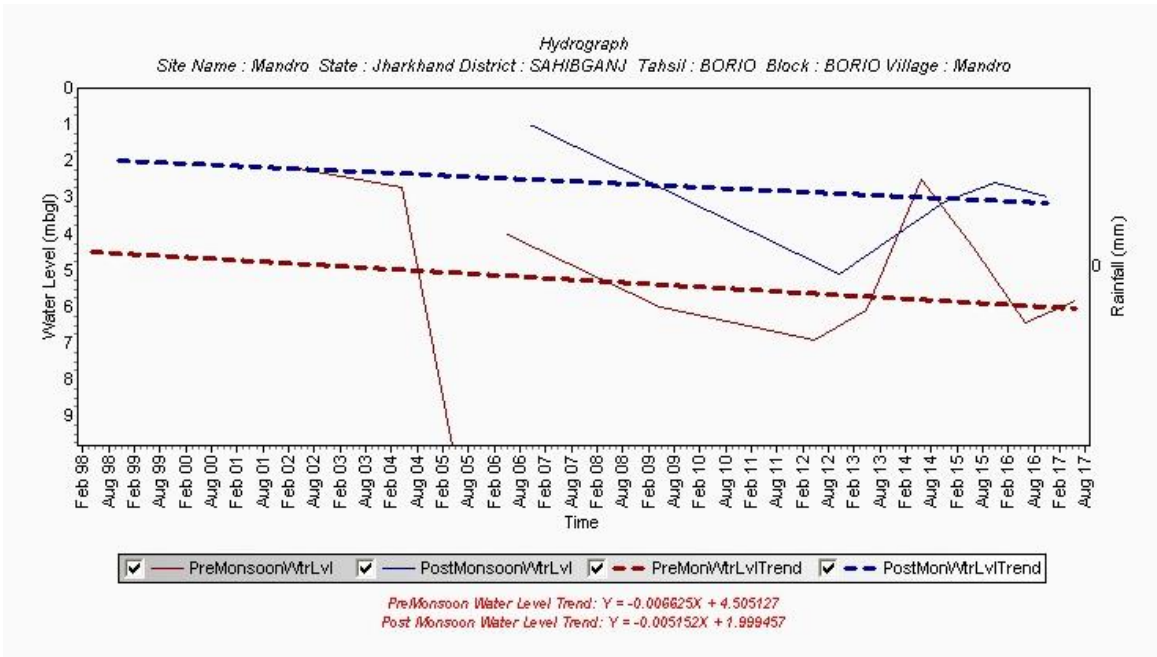
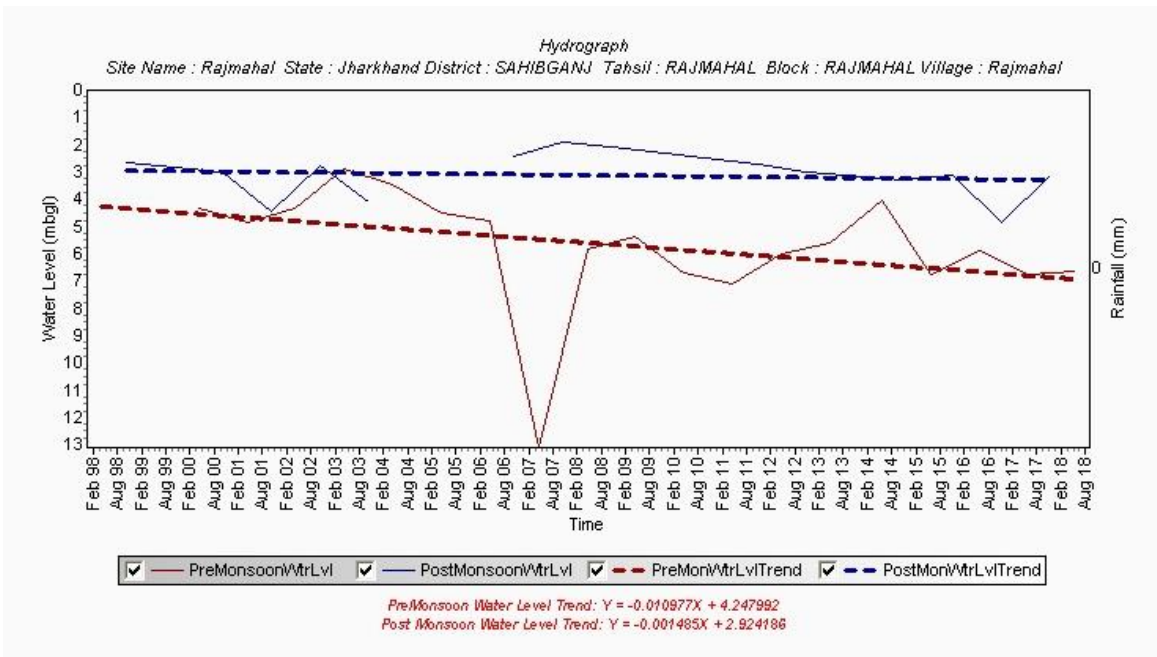


Fig-20b: Hydrograph (1998-2017), Barharwa, Barharwa block, Sahebganj district

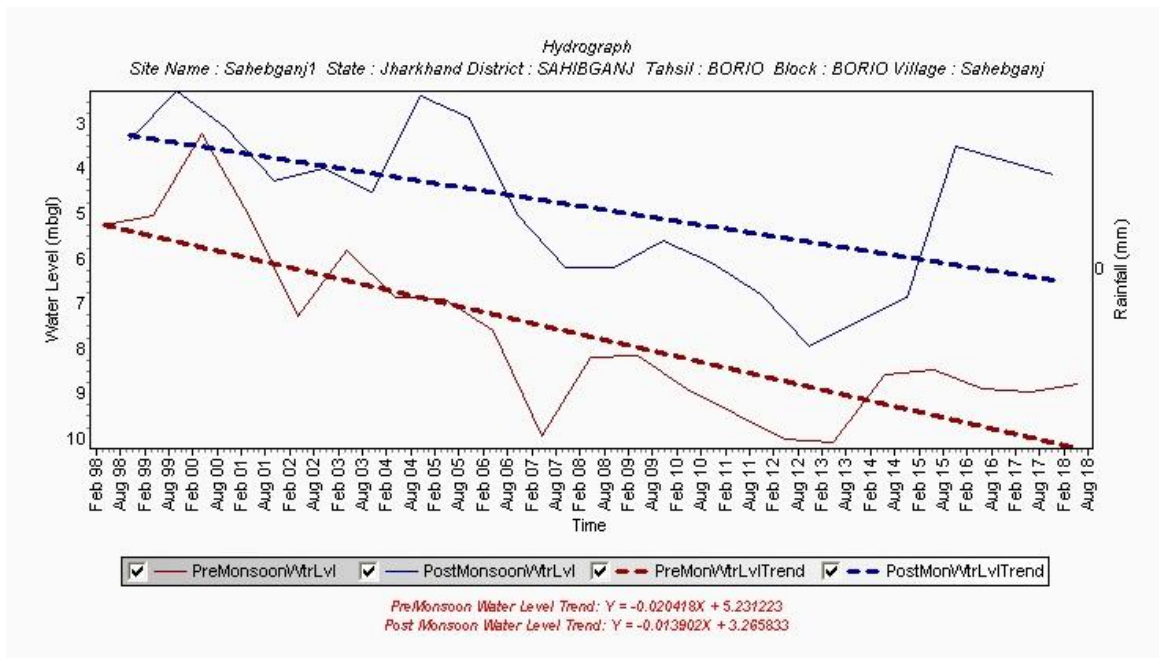




**Fig 20c: Hydrograph (1998-2017), Borio, Borio block, Sahebganj district**



**Fig 20 d: Hydrograph (1998-2017), Rajmahal, Rakmahal block, Sahebganj district**



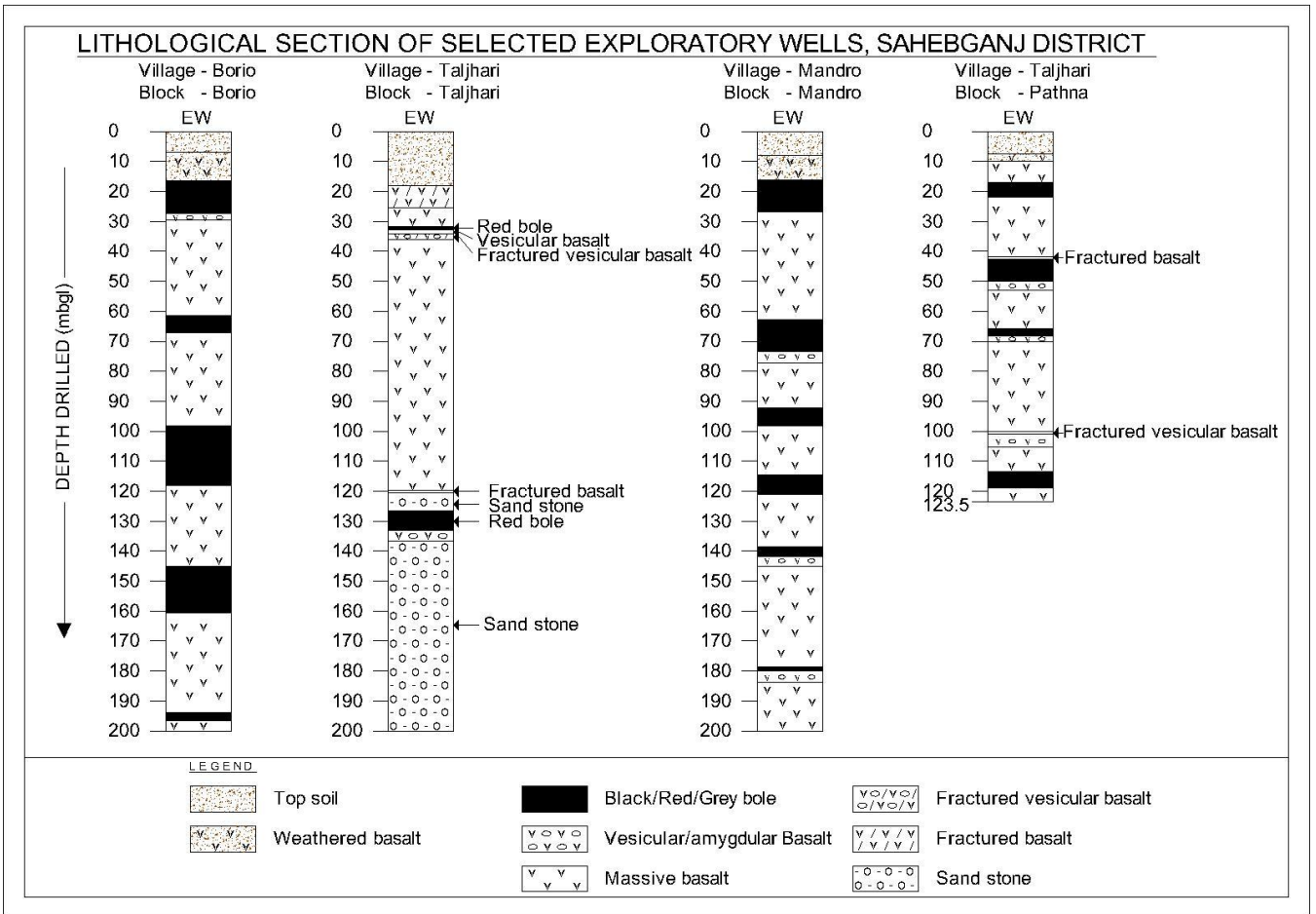
**Fig 20 e: Hydrograph (1998-2017), Sahebganj, Sahebganj block, Sahebganj district**

**3.5 Ground Water Exploration:** The exploratory data particularly includes the information on sub-surface geology, hydrogeological information and geometry of aquifer in Alluvium as well as in hard rocks. Based on exploration data, prepared litholog of EW & OW, identified the number of flow layer encountered within 200 m depth in basaltic formation Rajmahal trap and presented in table – 10. Drilling details of the exploratory and observation wells are presented in Annexure VI (a) and VI (b). Litholog of exploratory wells and observation wells are furnished in Annexure – VII. Lithological section of selected exploratory wells is shown in figure – 21 & 22.

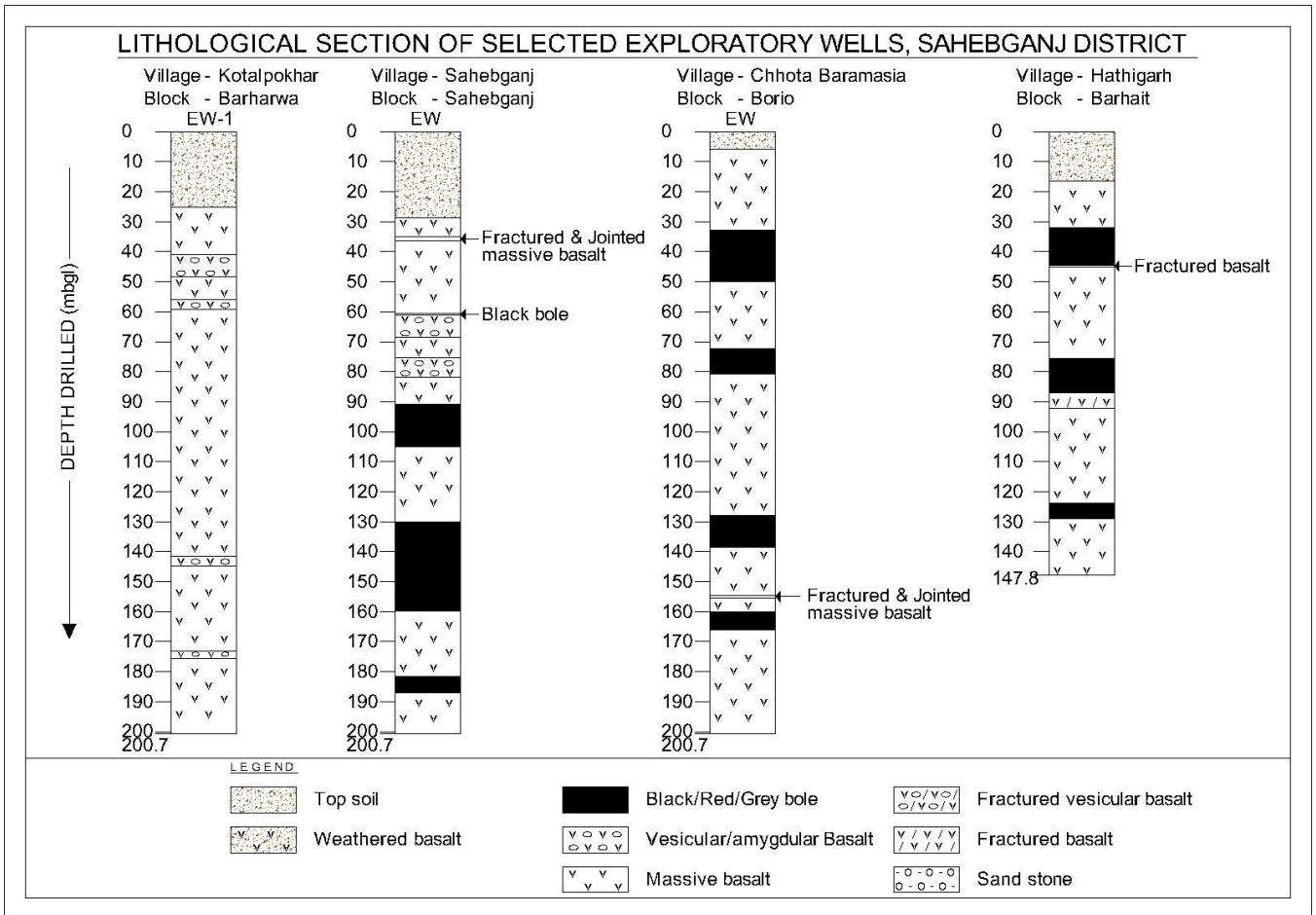
**Table – 10: Number Of Flow Encountered In Exploratory Wells (CGWB)**

Sr. No.	Location and type of well	Depth drilled (mbgl)	No. of flow encountered	Flow in which water bearing zone encountered	Yield (lps)
1.	Borio block campus - EW	200.00	6	Nil	Nil
2.	Taljhari block campus - EW	200.00 (120.20 m thickness of Rajmahal trap)	2	II	13.30
	OW	200.00 (109.88 m thickness of Rajmahal trap)	2	II	13.30
3.	Mandro block campus - EW	200.00	7	Nil	Nil
4.	Taljhari - EW (near Grampanchayat)	123.40	6	II & IV	2.00
	OW	160.00	7	III	2.00

5.	Kotal Pokhar – EW -I (PHED campus)	202.70	5	Nil	Nil
	EW - II	202.70	4	III	0.60
6.	Argori – EW (near school)	202.70	6	Nil	Nil
7.	Sahraj Dhab - EW (near school)	160.00	5	I	0.80
8.	Borio – EW (college campus)	202.70	6	VI	0.14
9.	Sahebganj - EW (Jawahar Navoday Vidyalaya)	202.70	6	I	4.50
	OW	71.00	2	I	0.14
10.	Chhota Baramasia - EW (Football ground)	202.70	5	IV	0.38
11.	Banjhi - EW (back side of Grampanchayat)	74.60	3	I, II & III	16.70
	OW	150.90	5	II	1.20
12.	Nishchinta - EW (near school)	163.00	4	II & IV	11.30
	OW	153.90	4	II	6.30
13.	Khaira - EW (near school)	135.00	5	V	14.50
	OW	132.60	4	IV	14.50
14.	Hathigarh - EW (near school)	147.80	4	II & III	3.00
	OW	105.10	4	IV	0.14
15.	Udhwa - EW (block campus)	133.10	7	III	1.20
16.	Chatradih - EW	190.80	6	Nil	Nil



**Figure – 21: Lithological section of selected exploratory wells**



**Figure – 22: Lithological section of selected exploratory wells.**

**3.6 Ground Water Quality:** To evaluate the quality of ground water, samples have been collected from 23 dug wells and 24 representatives bore wells. The analytical results of water samples dug wells and hand pumps are given in Appendix- VII and VII respectively. Since the samples are collected from the dug wells, they represent the quality of Aquifer I (phreatic/ shallow zone) and the bore well samples represent the Aquifer II (deeper zone) quality of ground water.

**3.6.1 General Range Of Chemical Parameters Of Aquifer – I & II:** - Evaluation of ground water suitability in relation to its different purposes has been classified for drinking / domestic and irrigation. The variation range of the concentration in ppm of different chemical constituents and quality parameters of Aquifer I (dug wells samples) in tables 11.

**Table-11: Ranges of chemical constituents of Aquifer – I & II**

Chemical Constituents and quality parameters	Aquifer – I (Dug well samples)	Aquifer – II (Hand pump sample)
pH	7.42 – 8.43	7.11 – 8.46
EC (micro siemens/cm at 25 <sup>0</sup> c)	92 - 2400	131 - 1494
TDS (ppm)	60 - 1560	85 - 971
TH as CaCO <sub>3</sub> (ppm)	90 - 1060	60 - 495
Ca (ppm)	10 - 304	6 - 114
Mg (ppm)	8.5 – 86.26	6.07 – 61.96
Na (ppm)	8 - 100	9.48 - 105
K (ppm)	0.29 – 10.01	0.23 – 6.28
HCO <sub>3</sub> (ppm)	61.5 - 603	55.4 - 387
Cl (ppm)	10.63 - 460	7.09 - 252
SO <sub>4</sub> (ppm)	9.96 – 126.74	13.35 - 112
NO <sub>3</sub> (ppm)	0 – 34	0 – 24.63
F (ppm)	0.03 – 0.29	0 – 0.11

The ground water of Aquifer – I (shallow aquifers) in the area is alkaline in nature. On the perusal of table - 11, the pH value of the area is 7.42 – 8.43. The TDS value is varies between 60 to 1560 mg/l. Overall values of Calcium and Magnesium varies between 10 to 304 mg/l and 8.5- 86.26 mg/l in the area respectively. Nitrate concentration is observed between 0 to 34 mg/l while the Fluoride value varies from 0 to 0.29 mg/l within the area.

The ground water of aquifer - II in the area is alkaline in nature. On the perusal of table - 14, the pH value ranges 7.11 to 8.46 mg/l. The EC value ranges between 131 to 1494 mg/l. The TDS value varies from 85 to 971 mg/l and the total hardness ranges between 60 to 495 mg/l. Calcium and Magnesium values varies from 6 to 114 mg/l and 6.07 to 61.96 mg/l respectively.

**3.6.2 Suitability Of Ground Water Of Aquifer – I & II For Drinking Purposes:** - The suitability of ground water for drinking purposes is determine on the basis of drinking water specification adopted by the Bureau of India Standards IS 10500 – 91 Revised 2012 and approved by World Health Organization (WHO). The number of water samples falling under various categories of permissible and desirable limits of various constituents and its percentage are given in table – 12 & 13 Aquifer – I & II.

**Table-12: Suitability of ground water of Aquifer- I for drinking purposes**

Chemical constituents and quality parameters	Ranges Desirable		No. of samples under desirable limits	No. of samples under permissible limit	No. of samples under excessive limits
	Desirable limit	Permissible limits in the absence of alternate source			
Ph	6.5 to 8.5	No relaxation	23 (100%)	Nil	Nil
TDS (ppm)	500	2000	11 (48%)	12 (52%)	Nil
TH as Caco <sub>3</sub> (ppm)	200	600	08 (35%)	12 (52%)	03 (13%)
Ca (ppm)	75	200	18 (78%)	04 (17%)	01 (5%)
Mg (ppm)	30	100	09 (39%)	14 (61%)	Nil

Cl (ppm)	250	1000	20 (87%)	03 (13%)	Nil
SO <sub>4</sub> (ppm)	200	400	23 (100%)	Nil	Nil
HCO <sub>3</sub> (ppm)	200	600	04 (17%)	19 (83%)	Nil
NO <sub>3</sub> (ppm)	45	No relaxation	23 (100%)	Nil	Nil
F (ppm)	1.0	1.5	23 (100%)	Nil	Nil

The table- 12 indicates that all the water samples are falling in desirable to permissible category except total hardness and calcium. The value of total hardness is observed beyond permissible limit (> 600 mg/l) in 03 samples. Similarly, the Calcium value is also found beyond permissible limit in 01 sample.

**Table- 13: Suitability of ground water of Aquifer- II for drinking purposes**

Chemical constituents and quality parameters	Ranges Desirable		No. of samples under desirable limits	No. of samples under permissible limit	No. of samples under excessive limits
	Desirable limit	Permissible limits in the absence of alternate source			
Ph	6.5 to 8.5	No relaxation	24 (100%)	Nil	Nil
TDS (ppm)	500	2000	19 (79%)	05 (21%)	Nil
TH as CaCO <sub>3</sub> (ppm)	200	600	12 (50%)	12 (50%)	Nil
Ca (ppm)	75	200	21 (88%)	03 (12%)	Nil
Mg (ppm)	30	100	11 (46%)	13 (54%)	Nil
Cl (ppm)	250	1000	23 (96%)	01 (4%)	Nil
SO <sub>4</sub> (ppm)	200	400	24 (100%)	Nil	Nil
HCO <sub>3</sub> (ppm)	200	600	10 (42%)	14 (58%)	Nil
NO <sub>3</sub> (ppm)	45	No relaxation	24 (100%)	Nil	Nil
F (ppm)	1.0	1.5	24 (100%)	Nil	Nil

On the perusal of table – 13, it is observed that about 92% average of ground water samples of aquifer – II falling under desirable limits category and only 8% of samples falling under permissible limits category.

### **3.6.3 Suitability Of Ground Water Of Aquifer – I And II For Irrigation Purposes:**

Various parameters viz. Total Dissolved Solids (TDS), Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC), Salt Index (SI), Soluble Sodium Percentage (SSP) & Water Class have been evaluated to assess the suitability of ground water for irrigation purposes.

#### **3.6.3.1 Classification Of Ground Water Of Aquifer – I & II Based On EC**

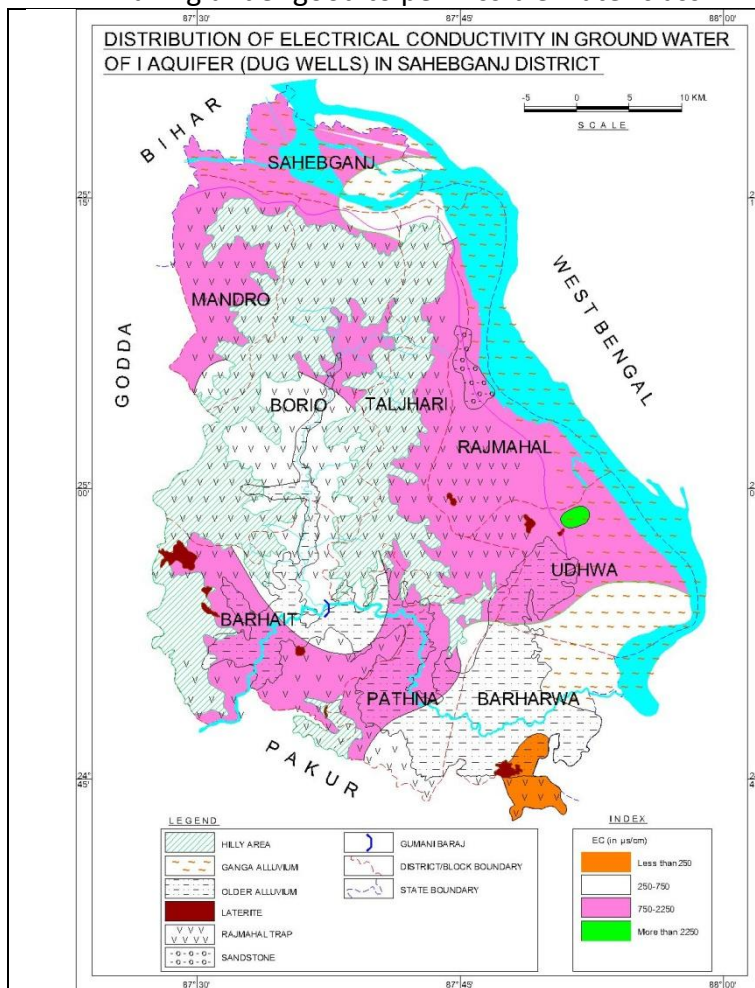
To better understanding the suitability of ground water for irrigation purpose chemical result of collected water samples have been analyzed and described the different water class based on Electrical Conductivity (EC) which is presented in table – 14. EC maps of water samples of Aquifer – I and Aquifer – II have been prepared and shown in figures- 23 and 24.



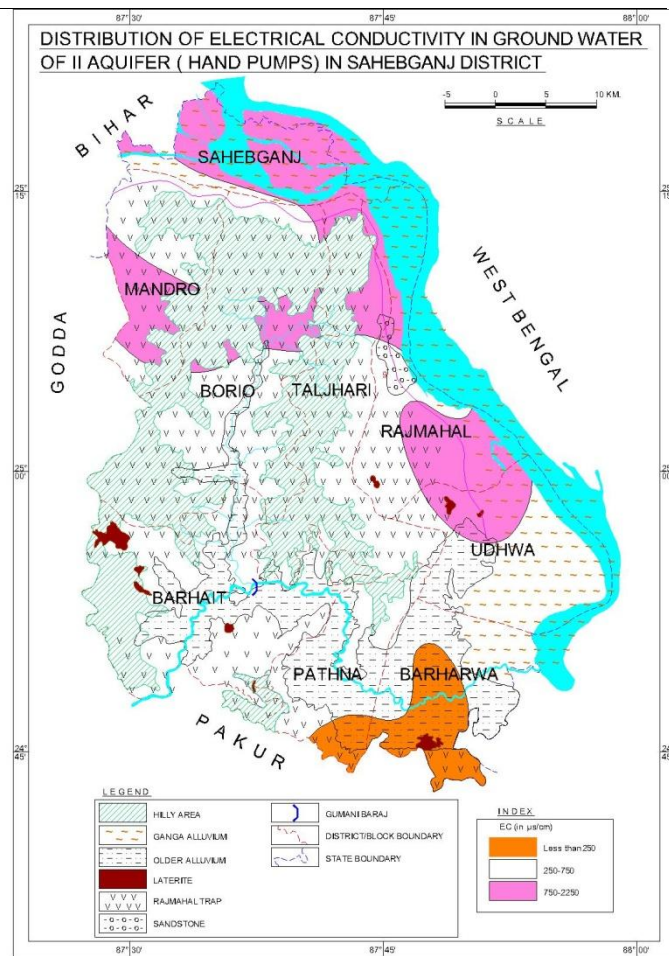
**Table- 14: - Classification of ground water of Aquifer – I & II based on EC**

Sl. No.	Water Class	Rages of EC	No. of samples falling and their percentage	
			Aquifer - I	Aquifer - II
1	Excellent	< 250	01 (4%)	01 (4%)
2	Good	250 – 750	10 (44%)	18 (75%)
3	Permissible	750 – 2250	10 (44%)	05 (21%)
4	Unsuitable	>2250	02 (8%)	Nil

On The perusal of table 14, about 92 % of water samples of Aquifer – I (dug well) falling under good to permissible water class. Rest about 04 % of water samples falling under doubtful water class. Similarly, 100% of water samples of Aquifer – II (hand pump) falling under good to permissible water class.



**Figure – 23: Distribution of EC in ground water of Aquifer – I**



**Figure – 24: Distribution of EC in ground water of Aquifer – II**

### 3.6.3.2 U.S Salinity Diagram for Classification of Irrigation Waters

The diagram illustrates the salinity and sodium hazards of irrigation water. It assumes that water is used under average conditions with respect to soil texture, drainage, infiltration rates, quantity of water used, climate and tolerance of crops. The diagram for the classification of irrigation water is based on salinity hazard i.e. Electrical Conductivity in  $\mu\text{S}/\text{cm}$  at  $25^\circ\text{C}$  versus the Sodium hazard i.e. Sodium Adsorption Ratio (SAR). USSL diagram for Aquifer-I&II has been prepared( Fig-25 & 26 )



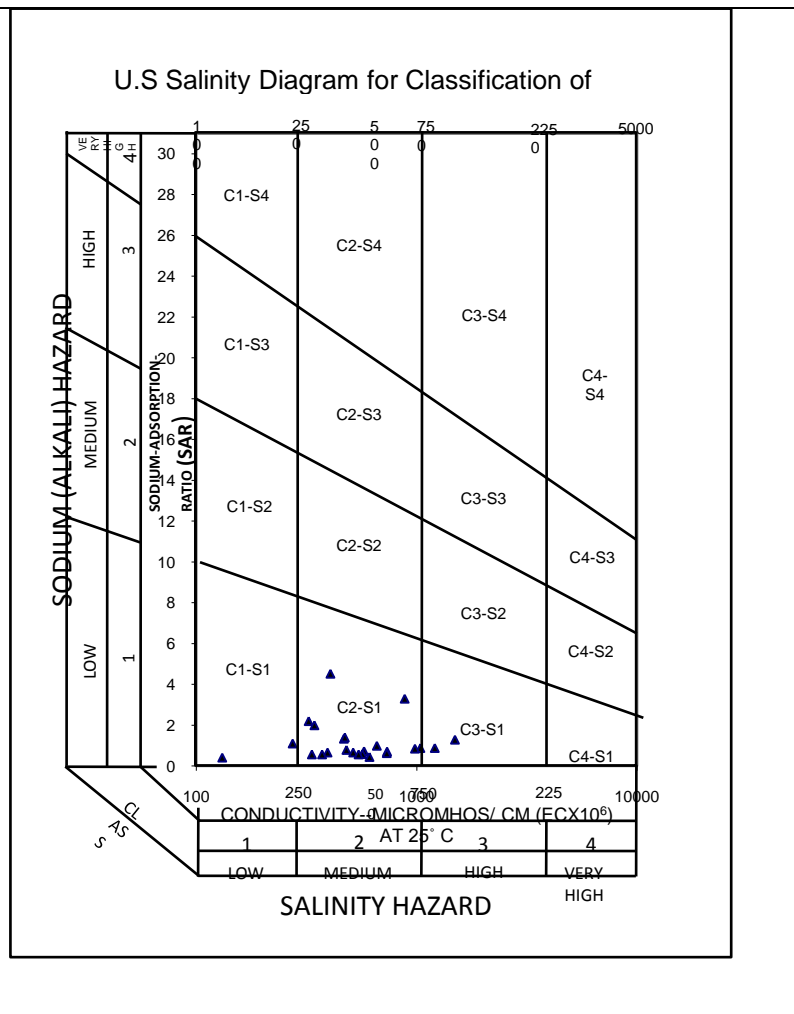
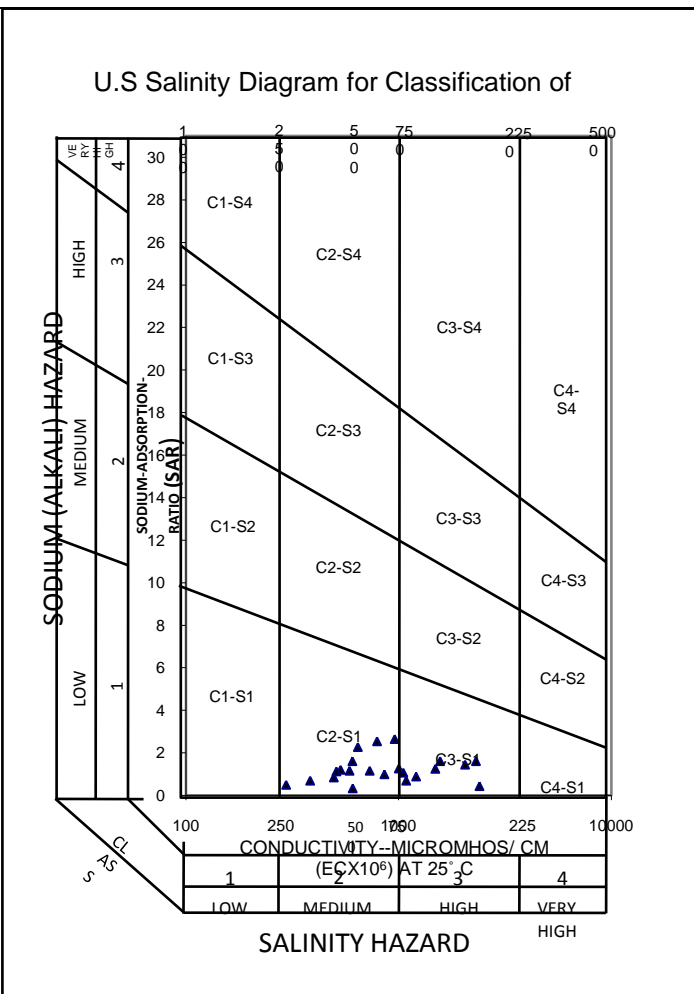


Figure:-25 & 26 US Salinity Diagram for Aquifer-I & Aquifer-II

As per US salinity Diagramme, the classification of ground water in the study area of Sahebganj has been tabulated in table-15 below –

Table - 15: Classification of Shallow Ground Water Samples as per USSL

S. No.	Water Class	No. of Samples	Percentage
1.	C <sub>1</sub> S <sub>1</sub>	2	4
2.	C <sub>2</sub> S <sub>1</sub>	35	66
3.	C <sub>3</sub> S <sub>1</sub>	9	20

From the above Table- 15, it is clear that by and large there is no sodium hazard as all the water samples fall in S<sub>1</sub> class. However, medium salinity is observed in majority of the samples and can be safely utilized for irrigation purposes. Around 20% of the water samples

fall in class C<sub>3</sub> which can create problem in irrigation of fields, so they cannot be used under normal conditions but may be used occasionally after taking suitable measures.

### 3.6.3.3 Piper Diagram for Classification of Irrigation Waters

Based on the major cation and major anion content in the water samples and plotting them in the trilinear diagram, hydrochemical facies could be identified. In Aquifer I cation chemistry is dominated Calcium followed by Magnesium and Sodium. In Aquifer II cation chemistry is dominated by Magnesium followed by Calcium and sodium. In Aquifer I most of the samples are Ca-HCO<sub>3</sub> and Mg-HCO<sub>3</sub> type and three samples are Na-Cl type. In Aquifer II most of the samples are Ca-HCO<sub>3</sub> and Mg-HCO<sub>3</sub> type. In both aquifers anion chemistry is dominated by Bicarbonate followed by Chloride, Sulphate and Nitrate. The Diamond part of the Piper Diagram reveals that most of the water samples fall in the temporary hardness region.

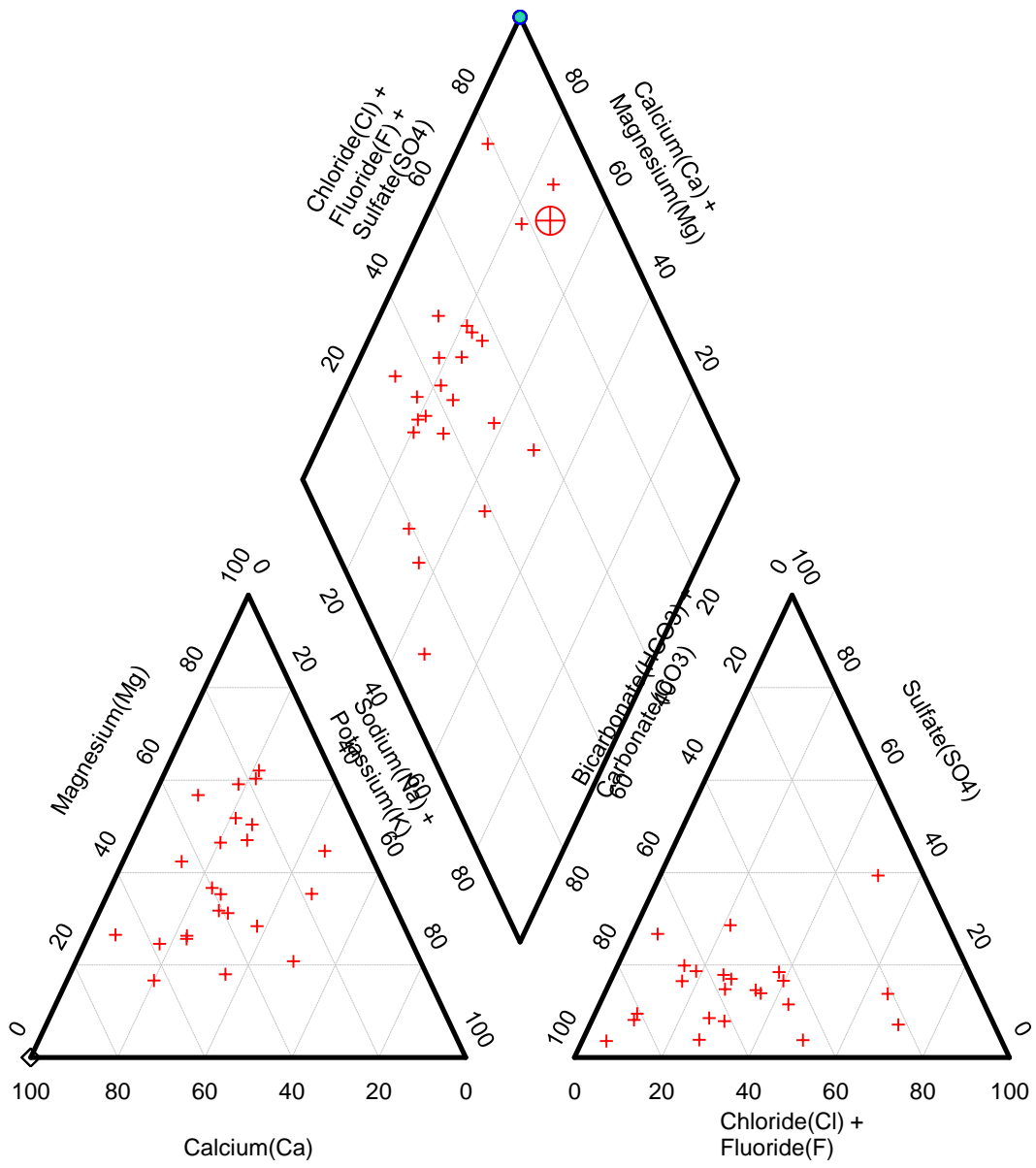
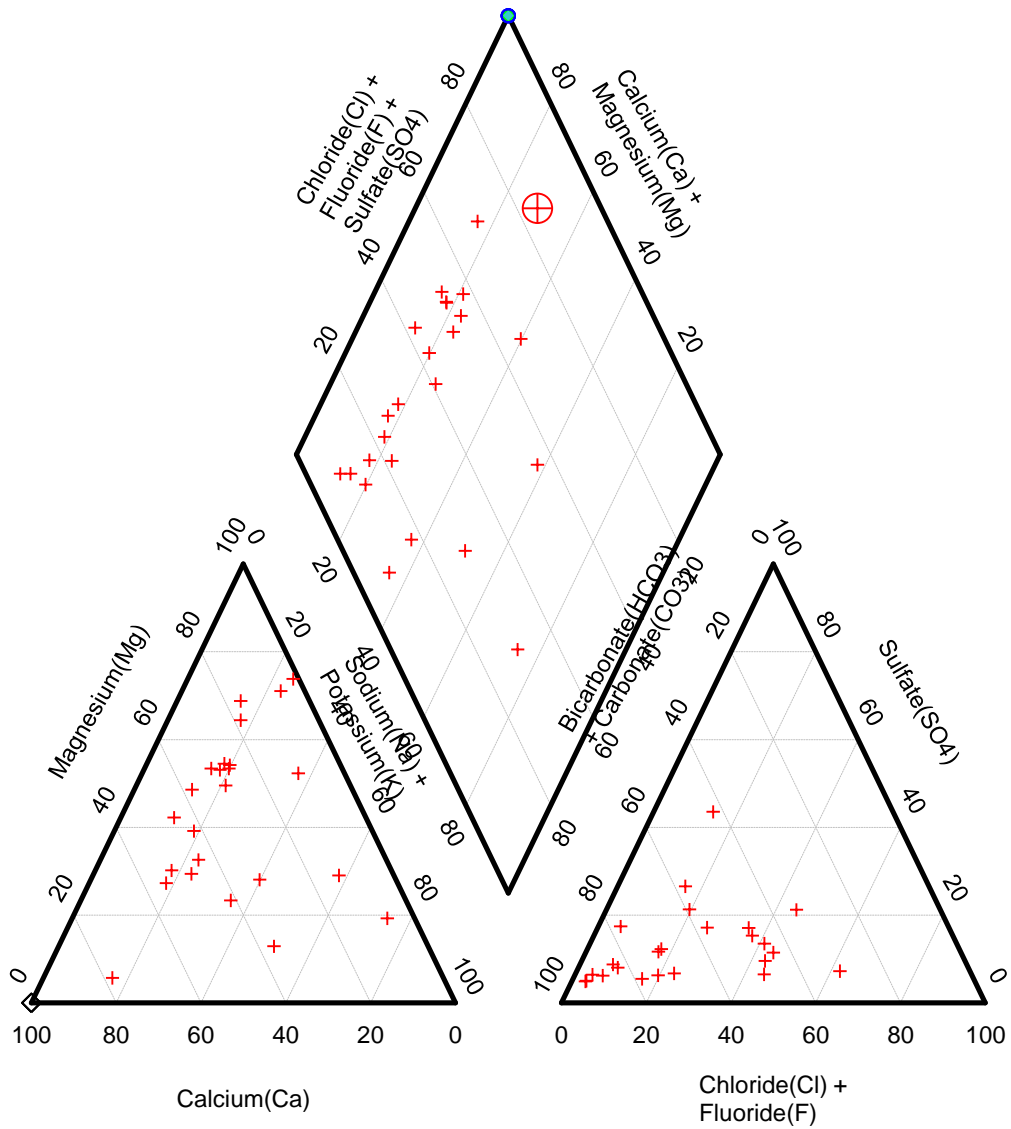


Figure:-27 Piper Diagrame for Aquifer – I

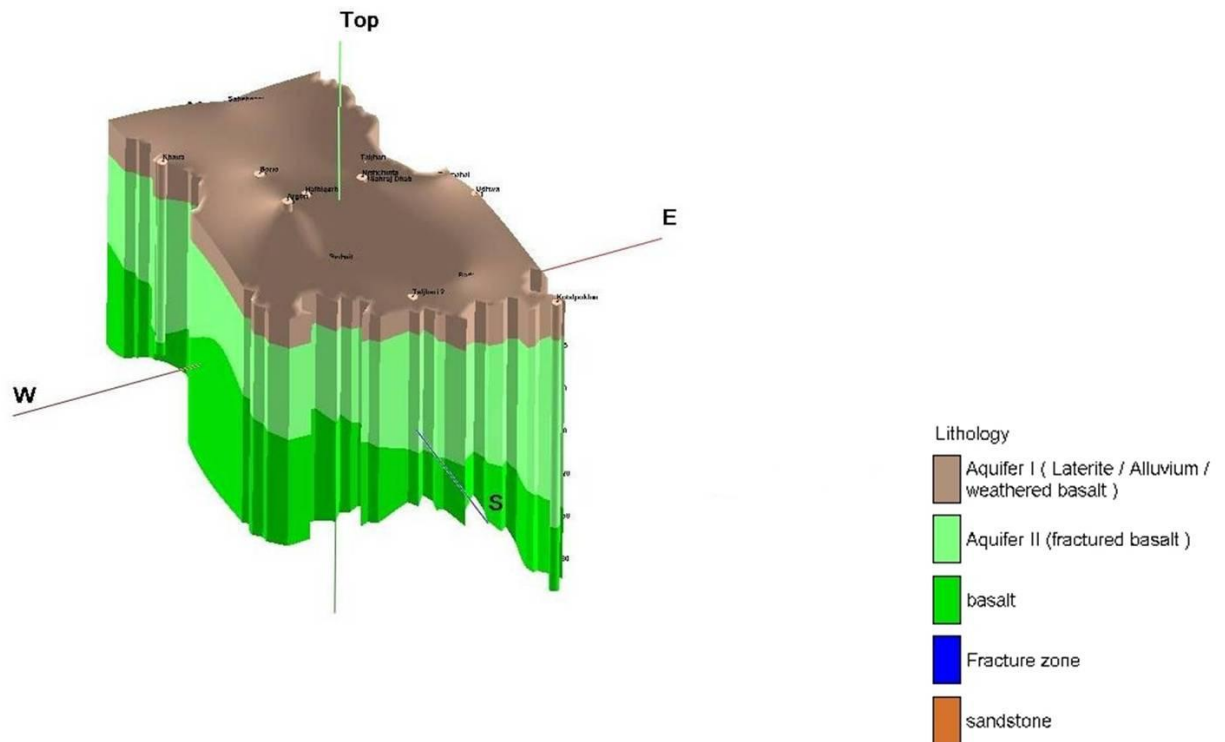


**Figure: 28 Piper Diagram for Aquifer – II**

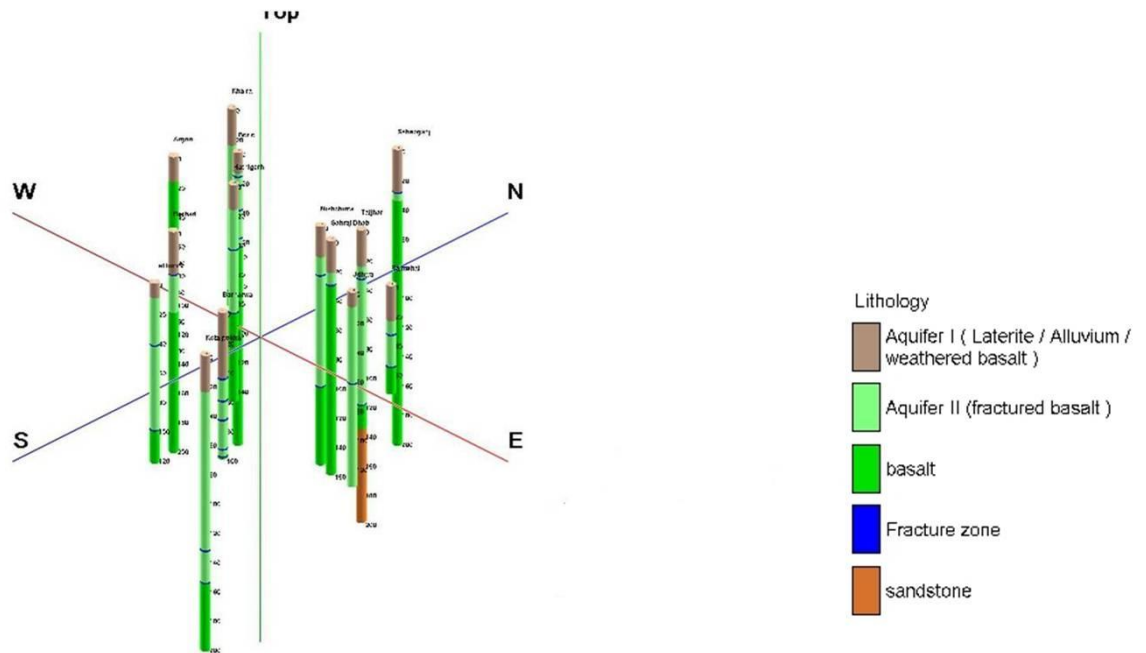
**3.6.4 High Arsenic and Iron in Ground Water in Sahebganj district:** - High arsenic and Iron in Ground Water in Sahebganj district has been discussed in Chapter 5.3, Table-16 & 17, Annexure-VIII

### 3.7 3-D and 2-D Aquifer Disposition

The 3-D map in hard rock area of the district showing spatial disposition and vertical extent of Aquifer-I indicating its depth of weathering while the Aquifer – II showing occurrence of fractured rock thickness is presented in **figure – 29 &30**. Based on the drilling data of exploratory wells maximum thickness of Aquifer - I (weathered zone) in **hard rock area** is 30.0 m. The depth of Aquifer – II (fracture zone) ranges from 30.00 to 156.00 mbgl.



**Fig: 29-3D Subsurafce lithological models with Aquifer Disposition in hard rock areas of Sahebganj district**

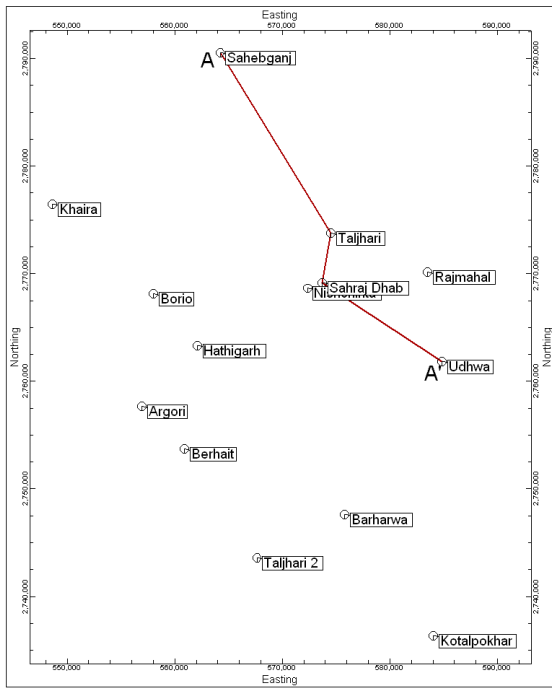


**Figure –30: Three dimensional strip-log of EW drilled in Rajmahal Traps of Sahebganj district**

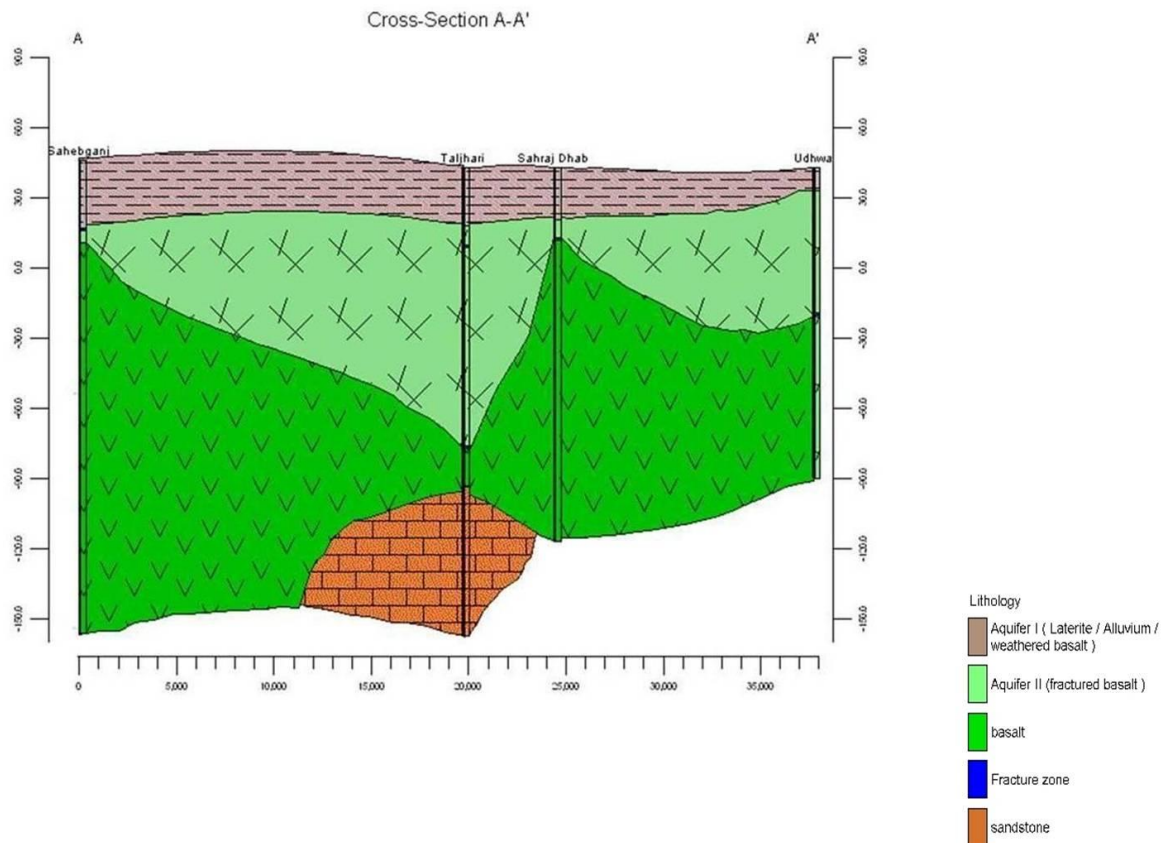
**3.8 Hydrogeological Cross Section:** To study the aquifer disposition in detail, various hydrogeological cross section indicating aquifer geometry has been prepared viz. A-A' (northern part ), B-B' (middle part) and C-C' (souther part) and D-D' representing NE-SW direction.

**3.8.1 Hydrogeological cross section A-A':**

Hydrogeological cross section A-A' represents the area in Northern Part except the alluvial portion of Saheganj district. The data of 4 exploratory wells i.e. Sahebganj, Taljhari, Sahraj Dhab and Udhwa have been utilised. The Aquifer- I ranges 5- 29 m representing weathered Basalt and Laterites, while Aquifer-II ranges from 10-120 m representing Fractured Basalt. Generally 1-2 fracture zones were encluntered. At Taljhari below 135.00 m Gondwana Sandstone was encountered below the Basaltic Formation. Hydrogeological cross section of A-A' is shown in figure- 31 A & 31B.



**Fig-31A: Location Map of section A-A'**



**Fig-31B: Hydrogeological cross section along A-A'**

### 3.8.2 Hydrogeological cross section B-B':

Hydrogeological cross section B-B' represents the area in Western Part of Saheganj district. The data of 3 exploratory wells i.e. Khaira, Borio and Nischinta have been utilised. The Aquifer- I ranges 5- 25 m representing weathered Basalt and Laterites, while Aquifer-II ranges from 14-126 m representing Fractured Basalt. Generally 1-2 fracture zones were encountered. However at Borio 4-5 fracture zones were encountered within the depth of 75 m in Basalts. This zone is one of the most productive on ground water. Well yield varies from 6-14 lps. Hydrogeological cross section of B-B' is shown in figure- 32 A & 32 B.

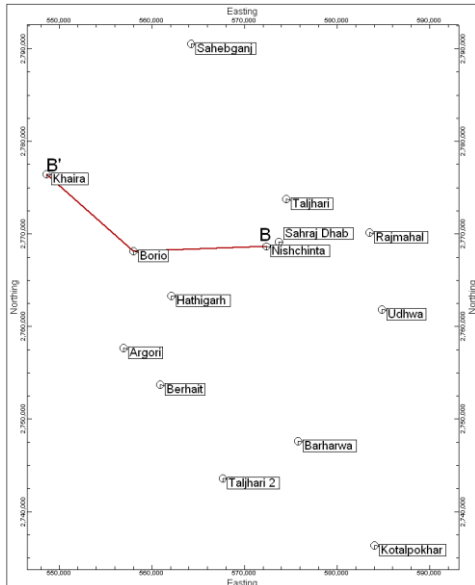


Fig-32A: Location Map of section B-B'

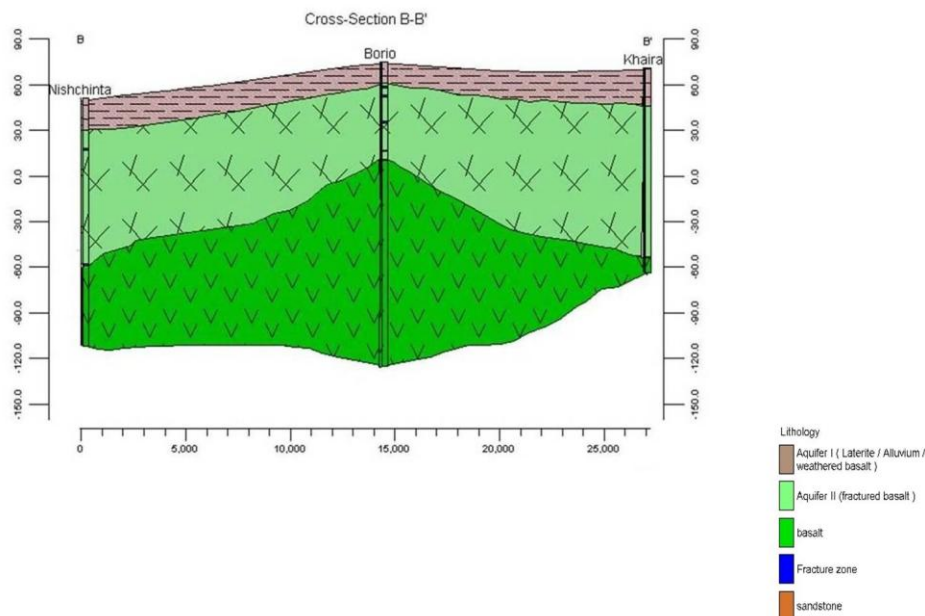


Fig-32B: Hydrogeological cross section along B-B'



### 3.8.3 Hydrogeological cross section C-C'

Hydrogeological cross section B-B' represents the area in southern Part of Saheganj district. The data of 3 exploratory wells i.e. Argori, Taljhari ( Pathna Block) and Kotal Pokhar have been utilised. The Aquifer- I ranges 5- 25 m representing weathered Basalt and Laterites, while Aquifer-II ranges from 10-155 m representing Fractured Basalt. Generally 1-2 fracture zones were encluntered. Hydrogeological cross section of B-B' is shown in figure- 33 A & 33 B. Well yield varies from dry- 3 LPS. Due of lack of fracture well at Argori gone dry.

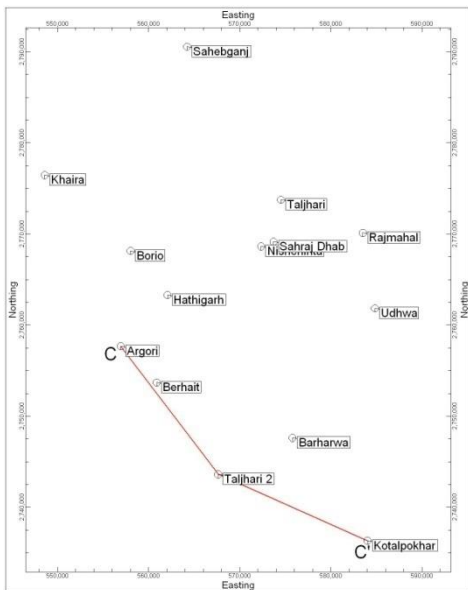


Figure -33A: Location Map of section C-C'

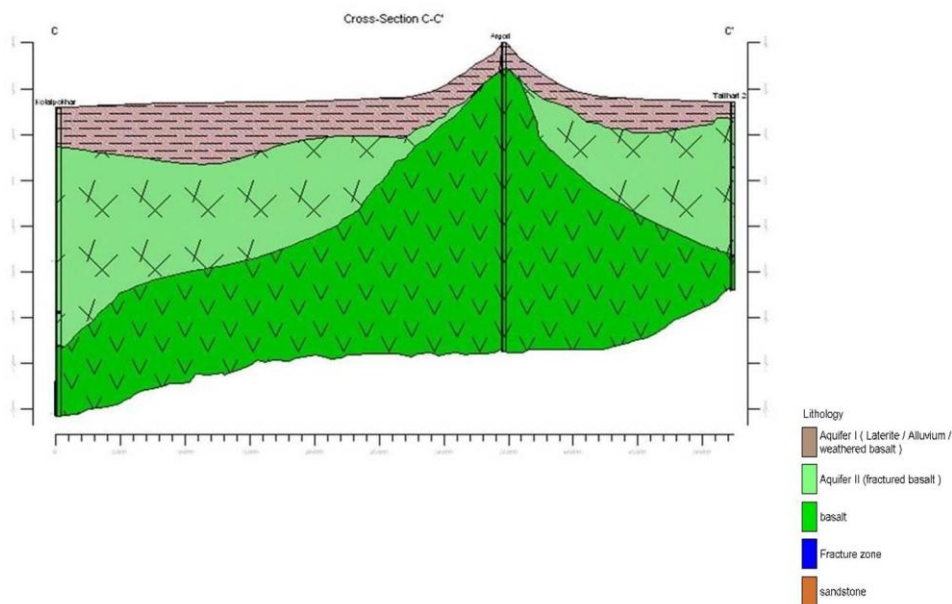


Figure -33B: Hydrogeological cross section along C-C'

### 3.8.4 Hydrogeological cross section D-D'

Hydrogeological cross section D-D' represents the area in NE-SW direction Part of Saheganj district. The data of 3 exploratory wells i.e. Rajmahal, Nischinta & Hathigarh have been utilised. The Aquifer- I ranges 5- 24 m representing weathered Basalt, while Aquifer-II ranges from 17-111 m representing Fractured Basalt. Generally 1-2 fracture zones were encountered. Well yield varies from 1-7 LPS. Hydrogeological cross section of D-D' is shown in figure- 34 A & 34 B.

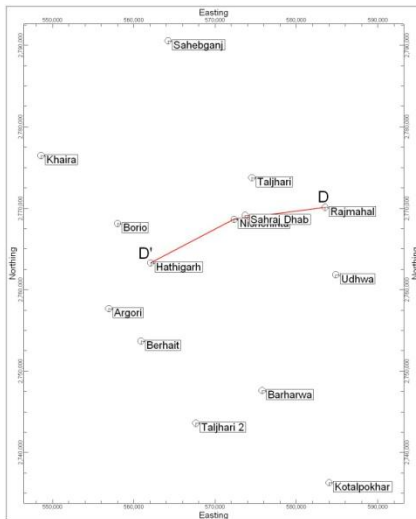


Figure -34A: Location Map of section D-D'

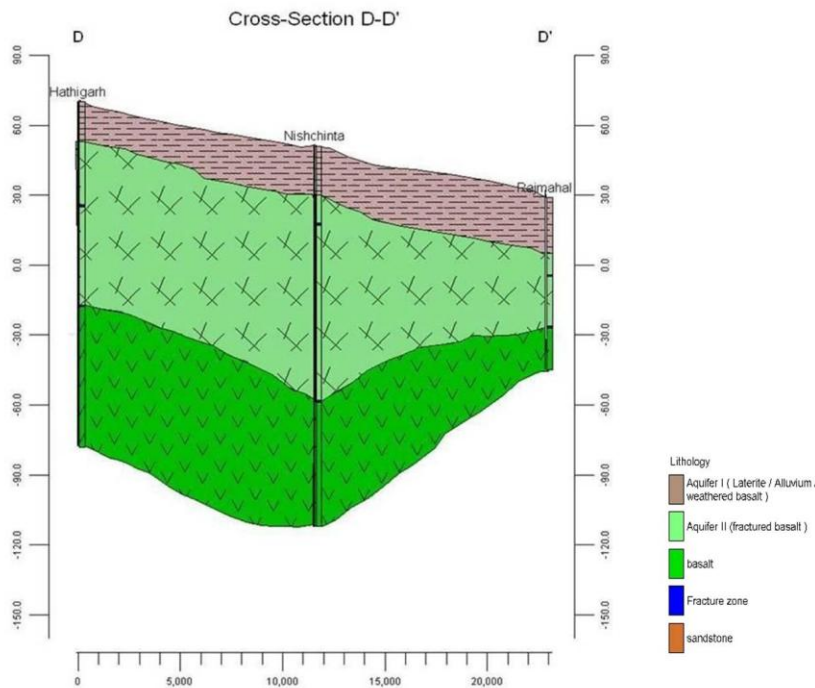


Figure -34B: Hydrogeological cross section D-D'

### 3.9 Aquifer Characteristics

To know the aquifer Characteristics, Step Drawdown test( SDT) and Aquifer Performance Tests( APT) were conducted. Analytical data of pumping test is given in Annexure – V. Summarized result of step drawdown test (SDT) and aquifer performance test (APT) is given below in table – 16 & 17.

**Table – 16: Summarized result of SDT**

Location	Discharge (m <sup>3</sup> /hr.) of each step				Well efficiency (%) of each step			
	I	II	III	IV	I	II	III	IV
Taljhari	14.04	20.16	24.48	30.24	91.02	87.59	85.32	82.47
Dihari	60.01	72.00	79.99	90.00	85.51	83.08	81.56	79.70
Sahebganj	15.62	18.00	19.48	20.56	93.57	92.66	92.12	91.70
Banjhi	18.47	20.02	26.68	36.00	88.89	87.91	84.43	80.27
Nishchinta	16.38	20.56	27.68	--	96.38	95.52	94.09	--

**Table – 17: Summarized result of APT**

Location	Formation	Type of well	SWL (mbgl)	Dis-charge (lps)	Draw-down (m)	T (m <sup>2</sup> /day)	S	Specific Capacity (lpm/m of DD)
Taljhari	Rajmahal trap	EW	7.92	6.80	25.14	11.69	--	16.23
		OW	7.84	--	11.76	21.24	0.0029	--
Dihari	Alluvium	EW	4.73	20.00	11.02	-	--	108.89
		OW	3.83	--	0.22	5395.28	0.0071	--
Sahebganj	Rajmahal trap	EW	4.57	4.55	21.82	9.35	--	12.51
		OW	4.96	--	17.61	8.93	0.00034	--
Banjhi	Rajmahal trap	EW	9.27	10.00	9.24	33.45	--	64.94
		OW	9.18	--	7.90	38.35	0.0032	--
Nishchinta	Rajmahal trap	EW	4.37	6.90	25.53	31.74	--	16.22
		OW	4.48	--	9.78	39.14	0.0043	--
Barharwa	Rajmahal Trap	EW	9.30	14.33	8.92	176.00	0.00014	96.39
Barhait	Rajmahal Trap	EW	7.65	5.86	15.34	44.00	-	22.92
Borio	Rajmahal Trap	EW	5.53	5.83	9.65	32.3	-	36.24

Basalt forms the main aquifer of the area and comprises two distinct units viz, upper vesicular unit and lower massive unit. The massive basalt is hard, compact and does not have primary porosity and hence impermeable. Weathering, jointing and fracturing induces secondary porosity in massive unit of basalt. In vesicular basalt, when vesicles are interconnected constitutes good primary porosity and when the vesicles are filled/ partly filled the porosity is limited. Ground water occurs under phreatic/ unconfined to semi-confined conditions in basalts.

Average thickness of fractures in Aquifer-II is about 2.0 m. Along with yield potential, the aquifer parameters viz., transmissivity and storativity also form an important aquifer characteristic and provide valuable input on sustainability of the aquifers. The transmissivity of Aquifer-II ranges from 8.43 – 176 m<sup>2</sup>/day, whereas storativity of the aquifer ranges from 0.00007 to 0.0071.

**Table 18: Aquifer characteristic of Sahebgabj district (hard rock area)**

Type of aquifer	Formation	Depth range of the aquifer	SWL (mbgl)		Thickness	Yield (m <sup>3</sup> /hr)	Aquifer parameter	
			Pre Monsoon (2017)	Post Monsoon (2017)			T (m <sup>2</sup> /day)	Sy/S
Aquifer - I	Alluvium/ Laterites/ Weathered basalt	5-30m	2.58-11.15	1.14-6.51	5- 20 m	Upto 5.0	-	-
Aquifer - II	Jointed/ fractured basalt	30-156 m	-		0.5-2.0 m	Upto 50.00	Upto 176.00	7x10 <sup>-5</sup> to 7.1x10 <sup>-3</sup>

#### 4. GROUND WATER RESOURCE

The ground water resources have been assessed for two types of aquifer existing in the area i.e., Aquifer-I and Aquifer-II. The details of the assessment are discussed below.

**4.1 Ground Water Resources – Aquifer-I:** The ground water resource assessment has been carried out by considering the district as a single unit and the salient features of the resources are given in table 19 & 20.

**Table – 19: Assessment of In-storage ground water resource of Soft Rock**

Area (A) in hectare	70859
Pre monsoon (average) depth to water level (m bgl) (B)	7.63
Depth to bed rock (m bgl) (C)	50
Specific yield (SY)	8 %
Saturated zone thickness(C-B) of aquifer (ST)	42.37
Resource (A *SY*ST) mcm	2401 mcm

**Table – 20: Assessment of In-storage ground water resource of hard rock (basalt)**

Area (A) (ha)	99341
Pre monsoon (average) depth to water level (m bgl) (B)	7.63
Depth to bed rock (m bgl) (C)	25
Specific yield (SY)	3 %
Saturated zone thickness (C-B) of aquifer (ST)	17.37
Resource (A *SY*ST) mcm	517 mcm

**4.1.1 Recharge Component:** During the monsoon season, the rainfall recharge is the main recharge parameter, which is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying groundwater level fluctuation between pre and post monsoon periods with the area of assessment and specific yield. Monsoon recharge can be expressed as:-

$$R = h \times Sy \times A + DG$$

where,

h = rise in water level in the monsoon season, Sy = specific yield

A = area for computation of recharge, DG = gross ground water draft

The monsoon ground water recharge has two components- rainfall recharge and recharge from other sources. The other sources of groundwater recharge during monsoon season include seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, and water conservation structures.

During the non-monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-monsoon recharge.

The season wise assessment of recharge from various components such as rainfall and other sources was done and presented in table - 21 and figure - 35. The recharge from rainfall contributes maximum component 22760.58 ham during monsoon season and recharge from other sources is 81.30 ham, whereas during non-monsoon season, recharge from rainfall is 2846.52 and the recharge from other sources is 312.93 ham. The total annual ground water recharge is 26001.33 ham and net ground water availability after natural discharge is estimated as 23592.49 ham.

**Table – 21: Recharge Components evaluated for Resource Estimation**

Block	Recharge from rainfall during monsoon season (ham)	Recharge from other sources during monsoon season (ham)	Recharge from rainfall during non-monsoon season (ham)	Recharge from other sources during non-monsoon season (ham)	Total annual ground water recharge (ham)	Provision for natural discharges (ham)	Net annual ground water availability (ham)
1	2	3	4	5	6	7	8
Barhait	2554.48	6.08	400.45	22.08	2983.09	149.15	2833.94
Barharw a	3404.71	11.76	691.18	45.66	4153.31	415.33	3737.98
Borio	873.98	3.11	197.21	10.54	1084.84	108.48	976.36
Mandro	691.23	17.58	64.51	69.43	842.75	42.14	800.61
Pathna	2602.78	8.38	159.40	32.34	2802.90	280.29	2522.61
Rajmahal	2575.62	5.64	340.02	21.66	2942.94	294.29	2648.65
sahebga nj	4418.12	2.03	320.35	6.89	4747.39	474.74	4272.65
Taljhari	573.36	13.08	9.69	51.21	647.34	64.73	582.61
Udhwa	5066.3	13.64	663.71	53.12	5796.77	579.68	5217.09
<b>Total</b>	<b>22760.58</b>	<b>81.30</b>	<b>2846.52</b>	<b>312.93</b>	<b>26001.33</b>	<b>2408.84</b>	<b>23592.49</b>

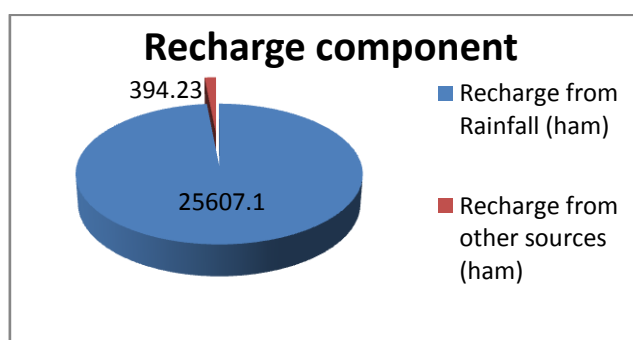
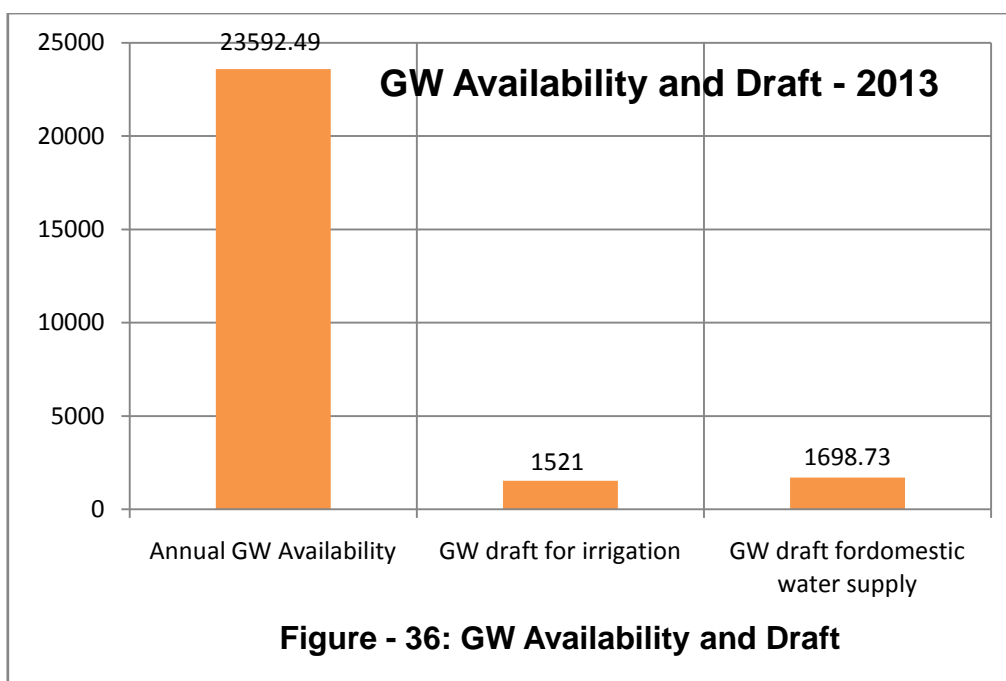


Figure – 35: Recharge from various sources



The utilisation of available ground water resources for various purposes is provided in table - 22 (As on 31<sup>st</sup> March 2013). The annual gross draft for all uses is estimated at 3254.21 ham with domestic sector being the major consumer having a draft of 1698.73 ham. The annual draft for irrigation use was estimated 1521 ham. The allocation of ground water available for future irrigation is 21424.49 ham. The stage of ground water development is low i.e., 13.79%.

**Table- 22: Ground Water Resources Availability, Draft and Stage of GW Development (as on 31<sup>st</sup> March 2013)**

(Figures in hectare meter)

Assessment Unit/ District	Net Ground Water Availability	Gross Ground Water Draft for Irrigation	Gross Ground Water Draft for Domestic water Supply	Gross Ground Water Draft for Industrial water Supply	Gross Ground Water Draft for all Uses	Future Domestic and Industry use	Future Irrigation use	Stage of Ground Water Development (%)
Barhait	2833.94	102.50	243.58	9.16	355.24	81.00	2650.44	12.54
Barharwa	3737.98	223.50	310.48	9.45	543.42	112.00	3402.48	14.54
Borio	976.36	46.00	168.55	4.98	219.52	61.00	869.36	22.48
Mandro	800.61	344.00	110.46	0.00	454.46	47.00	409.61	56.76
Pathna	2522.61	157.50	119.63	0.00	277.13	51.00	2314.11	10.99
Rajmahal	2648.65	105.00	232.70	3.26	340.96	91.00	2452.65	12.87
Sahebganj	4272.65	30.00	107.90	0.00	137.90	46.00	4196.65	3.23
Taljhari	582.61	252.00	111.44	0.00	363.44	48.00	282.61	62.38
Udhwa	5217.09	260.50	293.99	7.63	562.12	110.00	4846.59	10.77
<b>Total</b>	<b>23592.49</b>	<b>1521.00</b>	<b>1698.73</b>	<b>34.48</b>	<b>3254.21</b>	<b>647.00</b>	<b>21424.49</b>	<b>13.79</b>

**4.2 Ground Water Resources – Aquifer-II:** The ground water resource of the Aquifer –II was also assessed to have the correct quantification of resources so that proper management strategy can be framed. The ground water resource of Aquifer-II was estimated 39 MCM and is presented below in table – 23.

**Table – 23: Assessment of In-storage ground water resource of hard rock**

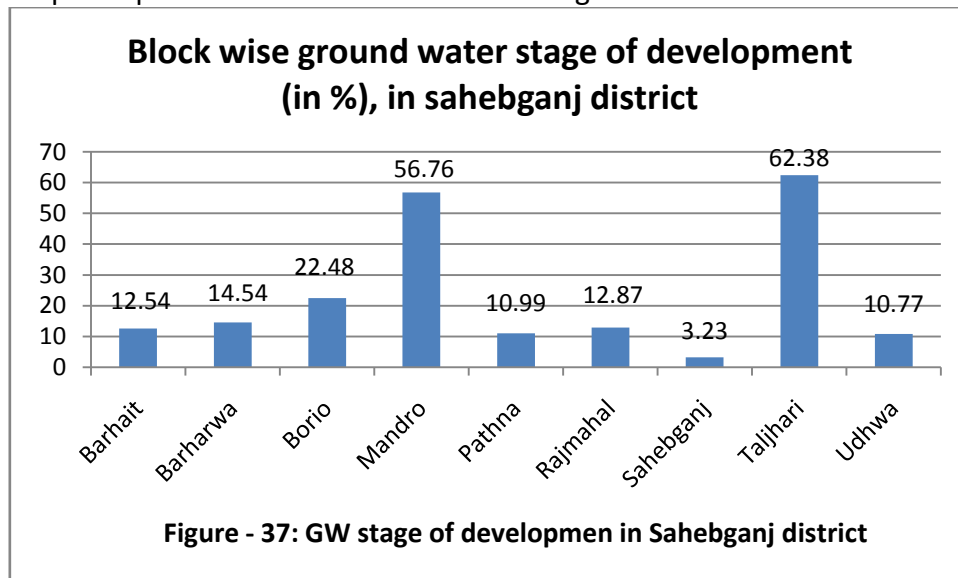
Area (A) (ha)	99341
Thickness of fracture zones below weathered zone to the depth of 156 m - (ST)	2.0 m
Specific yield (SY)	2 %
Resource (A *SY*ST) in mcm	39 mcm



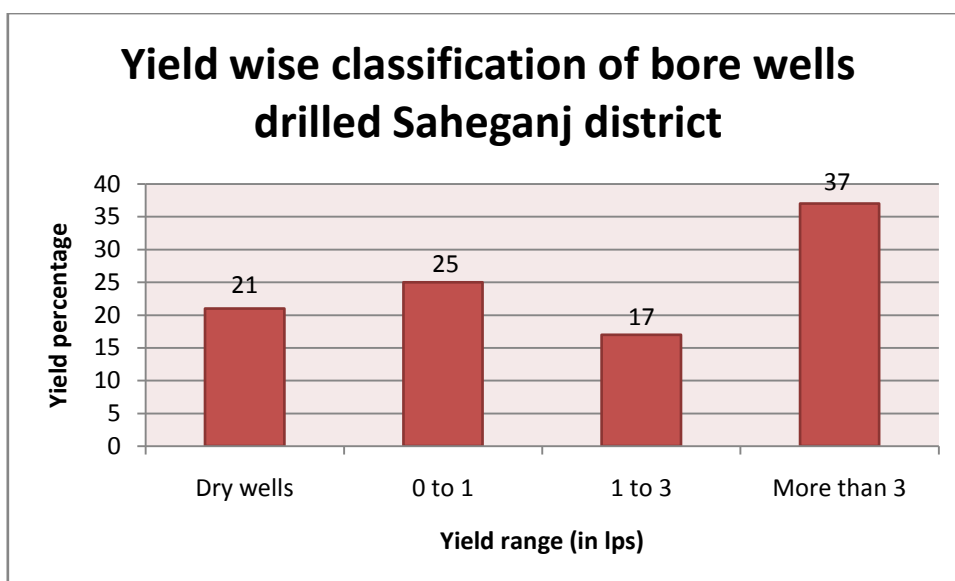
## 5. GROUND WATER RELATED ISSUES

The Sahebganj district forms part of predominantly tribal belt wherein villagers have got very small land holdings and they do not find it economical to engage in agricultural activity in comparison to the earning, they earn by working as labourer in industrial units and Govt. Dept.'s. Further, the cultivators are illiterate tribal and are ignorant of improved agricultural practices. By and large the district is not favoured with surface water irrigation system because of hilly and undulating geographical setting.

**5.1 Low Ground Water Development:** One major issue of the area that is low ground water development. At present the overall stage of ground water development is only around 13.79%. Block wise stage of ground water development (SOD) is varies from 3.23 to 62.38 percent. Graphical presentation of SOD is shown in figure – 37.



**5.2 Low Ground Water Potential / Limited Aquifer Thickness / Sustainability:** Central Ground Water Board has constructed 16 exploratory and 7 observation wells in hard area of the district. The percentage of success bore wells (more than 3 lps discharge) is very poor. Average thickness of weathering is 25 m and secondary porosity i.e. fracture zone is 2 m only. Transmissivity value is also very low which varies from 8.43 to 39.14 m<sup>2</sup>/day in hard rock area. Lithological condition is also not favourable for deep drilling due to occurrence of series of impermeable clay layer intertrappean beds. The intertrappean beds such as red bole, black bole, gray bole etc. are collapsible nature with contact of water. The yield of bore wells drilled in the area is classified and presented below in figure – 38.



**Figure – 38: Yield wise classification of bore wells drilled in Saheganj district**

In addition to drilling EW and OW in hard rock area of the district, 4 numbers of exploratory wells were constructed in Arsenic affected Ganga deposited alluvial area. The first zone (upto 70 m) is high discharge zone with Arsenic contaminated. Arsenic free/less second zone (more than 100 m) having poor discharge varies from 0.80 to 1.00 lps.

**5.3 Ground water contamination:** In Ganga deposit alluvium area of the district such as Saheganj, Rajmahal and Udhwa block, Arsenic and Iron concentration were found beyond permissible limits in ground water. For the study of Arsenic pollution water samples were collected in 2007, 2015 and 2017. Similarly, water samples were collected in 2015 collected for the study of Iron contamination in ground water and found 100% of water samples found beyond permissible limit. Summarized analytical result of Arsenic is given in table – 24 and 25.

**Table – 24: Details of chemical result of Arsenic**

Year	Name of block	Number of samples collected	Percentage of samples		Maximum value found (mg/l)
			Within permissible limit (< 0.05 mg/l)	Beyond permissible limit (> 0.05 mg/l)	
2007	Saheganj	60	80%	20%	0.09
2015	Saheganj	19	47%	53%	0.32
	Rajmahal	23	87%	13%	0.077
	Udhwa	18	83 %	17%	0.10
2017	Saheganj	14	50%	50%	0.29
	Rajmahal	14	94%	6%	0.072
	Udhwa	04	25%	75%	0.055

**Table – 25: Details of chemical result of Iron**

Year	Name of block	Minimum value found (mg/l)	Maximum value found (mg/l)
2015	Sahebganj	0.396	7.356
	Rajmahal	0.428	8.516
	Udhwa	1.782	6.55



Figure – 39: Interaction with local peoples and discussed regarding Arsenic and Iron contamination during the field visit

## 6. MANAGEMENT STRATEGIES

As discussed in previous chapter, the major ground water related issue in the Sahebganj is low ground water development owing to many socio-economic and hydrogeological reasons. To overcome these, it is imperative to have a robust ground water resource development plan for the district.

**6.1 Ground Water Resource Development Strategy:** In view of above, the focus of proposed management plan was to enhance the overall ground water development from the present 13.79% to 70%. Total 39991 dug wells (15-20 m depth; 2 to 4 m diameter @ Rs. 2.50 lakh/dug well) are recommended to be constructed in feasible areas. Similarly, 9720 shallow depth bore wells/tube wells (60 - 90 m depth; 100-150 mm dia @ Rs.0.60 lakh/ bore well) are also recommended to be drilled in feasible areas. Proposed number of abstraction structure.

**Table – 26: Future Irrigation Potential & Proposed number of Abstraction Structures based on SOD 70%**

District	Net GW Availability for Future Irrigation Development	future irrigation potential available (ha) considering (Δ) 0.45m	70% of future irrigation potential created (ha)	Proposed number of ground water structure (Dug wells)	Proposed number of ground water structure (TW/BW*)
Barhait	2650.44	5890	4123	4947	1203
Barharwa	3402.48	7561	5293	6351	1544
Borio	869.36	1932	1352	1623	394
Mandro	409.61	910	637	765	186
Pathna	2314.11	5142	3600	4320	1050
Rajmahal	2452.65	5450	3815	4578	1113
Sahebganj	4196.65	9326	6528	7834	1904
Taljhari	282.61	628	440	528	128
Udhwa	4846.59	10770	7539	9047	2199
<b>Total</b>	<b>21424</b>	<b>47609</b>	<b>33326</b>	<b>39991</b>	<b>9720</b>

\*TW-Tubewell, BW-Borewell

**Table – 27: Created Irrigation Potential & No. of structure for assured irrigation**

District	GW balance irrigation potential to be utilized for irrigation (ham)	Type of abstraction structures to be constructed	Unit draft/ command area (ham)	Proposed number of ground water abstraction structure
Barhait	2474	DW	0.5	4947
	1444	BW	1.2	1203
Barharwa	3176	DW	0.5	6351
	1853	BW	1.2	1544
Borio	812	DW	0.5	1623

	473	BW	1.2	394
Mandro	383	DW	0.5	765
	223	BW	1.2	186
Pathna	2160	DW	0.5	4320
	1260	BW	1.2	1050
Rajmahal	2289	DW	0.5	4578
	1336	TW/BW	1.2	1113
Sahebganj	3917	DW	0.5	7834
	2285	TW/BW	1.2	1904
Taljhari	264	DW	0.5	528
	154	BW	1.2	128
Udhwa	4524	DW	0.5	9047
	2639	TW/BW	1.2	2199
<b>Total</b>	<b>19995</b>	<b>DW</b>	<b>0.5</b>	<b>39991</b>
	<b>11664</b>	<b>TW/BW</b>	<b>1.2</b>	<b>9720</b>

It is necessary that proposed Additional ground water abstraction structure may be constructed in three phases with proper site selection. The results of the first phase of ground water development together with studies of the behavior of ground water regime will guide further ground water development to achieve 100% utilisation.

**6.2 Supply side Interventions:** At present as per Ground Water Resource Estimation 2013, the stage of ground water development is very low i.e., 13.79% and all the block of the district comes under safe category. However in some parts of the district long term declining trend has been noticed. Therefore, the ground water development should also be coupled with ground water augmentation, so that there is no stress on ground water regime of the area. The supply side interventions envisages construction of Rainwater Harvesting and Artificial Recharge structures in the areas feasible for construction of recharge structures based on the long term water level scenario and recharge potential of the aquifer. Area feasible for artificial recharge interventions is shown in figure – 36. The implementation of water conservation through artificial recharge measures will have a positive impact on drinking water sources of the area. It will ensure that the wells don't go dry during summer/lean/stress period in the areas of implementation and sufficient ground water availability is there in the wells even during the summer season. Thus not only the drinking and domestic water sources will be strengthened but additional irrigation potential can be created through artificial recharge structures.

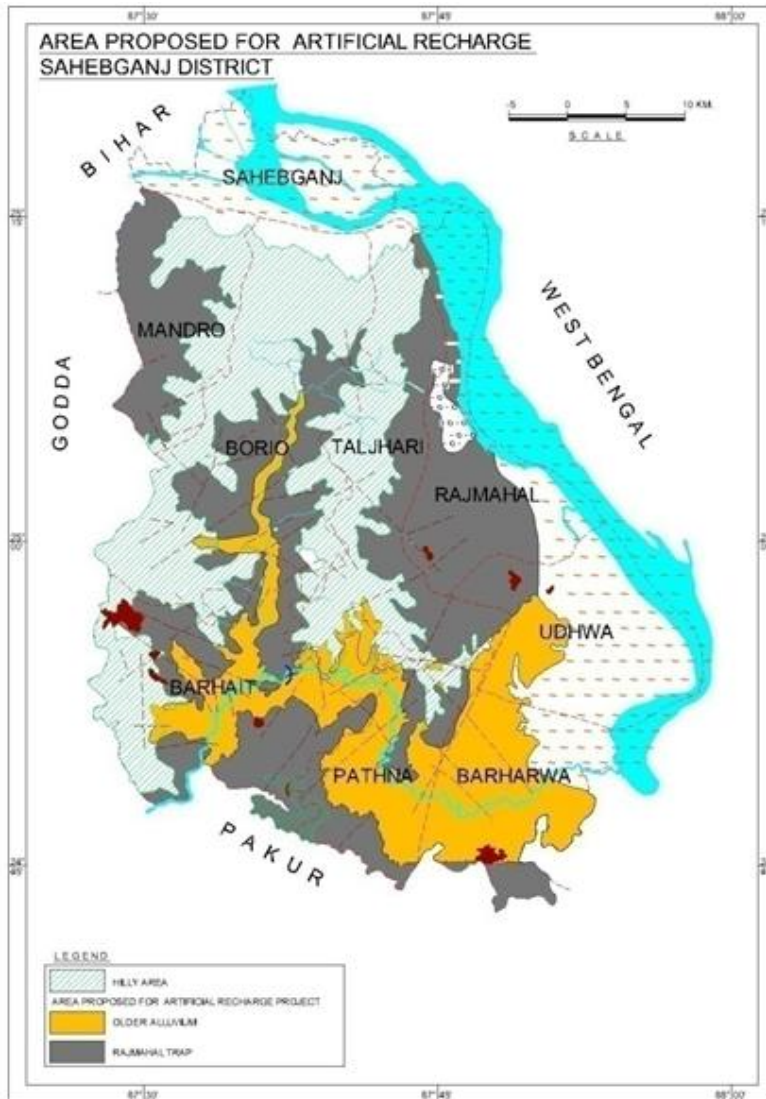


Figure – 40: Area proposed for Artificial Recharge

**6.3 Ground water management strategy for Arsenic and Iron affected areas:** Arsenic and Iron contamination occurring in alluvium deposit area along the river Ganga include Sahebganj, Rajmahal and Udhwa blocks. Remedial measures recommended for Arsenic and Iron affected areas are as follows-

**1. Surface Water Supply:**-Drinking water & sanitation Department, Government of Jharkhand is implementing the project of surface water supply from river Ganga “Mega Water Supply Scheme” for the population of 15678 persons including 24 villages. This project should be extended for all villages affected from Arsenic and Iron pollution.

**2. Purification/Filtration:**-Purification/ filtration of arsenic water through Organic Arsenic Sorber technique or other suitable techniques such as Nirmal filter, Sono filter, Asia Arsenic Network filter etc.

**3. Awareness raising Program /Participatory approach:** Peoples should aware about the ground water pollution of Arsenic and Iron. Management of schemes or project related Arsenic and Iron removal should be in hand of local peoples, so that peoples will keep the proper maintenance of machines and equipments.

**6.4 Stress aspect against future demand (2025, 2030):** Demand of water is increasing day by day against the increasing population. The detail demographic particular of the Sahebganj district and water requirement for domestic purpose is worked out for the year 2025 and 2030 is presented in table – 30, 31 & 32.

**Table 28: Detail demographic particular of Sahebganj district**

Population as per census					
1991		2001		2011	
Rural	Urban	Rural	Urban	Rural	Urban
673620	63215	829639	98131	990901	159666

**Table – 29: Projected population**

Method applied	Projected population			
	2021		2031	
	Rural	Urban	Rural	Urban
Incremental increase method	1154785	234511	1323913	335976
Arithmetical increase method	1149542	207892	1308183	256118
Current ratio method	1208899	308155	1466533	696144
Average	1171075	250186	1366210	429413

**Table – 30: Requirement of water for domestic use**

	Water requirement (assuming 90 liters per day per person for rural population and 130 liters per day per person for urban population)			
	2025		2030	
	Rural	Urban	Rural	Urban
		11242179	41844140	121203090
Total	53086319 litres / day		174697180 litres / day	

On perusal of table – 30, the requirement of water will be 174697180 litres per day in 2030. The demand of water is increasing due to highly increasing of population. Thus, recommended for surface water supply from river Ganga to reduce the stress of ground water. Drinking water & Sanitation Department, Government of Jharkhand is implementing Mega water supply scheme from the river Ganga for Sahebganj, Rajmahal and Udhwa blocks to solve the drinking water problem. Similarly, surface water supply scheme from the river Gumani is being implemented for the block headquarter Barhait. Block wise list of the villages covered under these schemes are given in table 31.

**Table – 31: List of villages covered under Mega water supply schemes in Sahebganj district (source – DW & SD).**

Sr. No.	Block	Panchayat	Village
1.	Sahebganj	Hazipur West	Hazipur Diara
			Rajgaon
			Dihari
		Hazipur East	Hazipur Bhatta
		Makhmalpur South	Makhmalpur part
		Makhmalpur North	Lalbathani

		Kishanprasad	Kishanprasad
		Ganga Prasad West	Majhi Kola
		Ganga Prasad West Middle	Ganga Prasad West Middle
		Ganga Prasad East Middle	Ganga Prasad East Middle
		Ganga Prasad East	Ganga Prasad part
		Sahebganj Municipal area	Bara Jirwabari (Chanan)
2.	Rajmahal	Kaswa	Kaswa
			Eraji Mokimpur
			Ray Bazar
			Saiyad Bazar
		Saidpur	Mahali Tola
			Dergama
			Shobhapur
		East Narayanpur	Narayanpur part
		West Narayanpur	Narayanpur part
		Lakhipur	Lakhipur
			Samaspur
			Mastangarh
Sr. No.	Block	Panchayat	Village
	Rajmahal	West Jamnagar	Jamnagar part
		East Jamnagar	Jamnagar
		Middle Narayanpur	Middle Narayanpur
		Ghatjamni	Ghatjamni
			Yogi Ckak
			Budhwariya
			Ghatselampur
		Momikpur	Jayrampur
			Shobhapur
			Chandipur
		Samaspur	Samaspur
3.	Udhwa	North Sarfraganj	Sarfraganj
			Fudkipur
		South Piyarpur	Piyarpur part
		Norht Piyarpur	Piyarpur part
		Middle Piyarpur	Piyarpur part
		Shridhar Diara	Shridhar Diara
		Amanatpur	Amanatpur
		South Palashgachhi	South Palashgachhi
		South Sarfrajanj	South Sarfrajanj
4.	Barhait	Bhognadih	Bhognadih
			Bara daldali
		Kadma	Kadma
			Tiyo tola
		Gopladih	Gopladih
			Harwadih
			Bhagabandh



			Dhanjori
		Barhait Bazar	Barhait Bazar
			Babupur
		Barhait North	Sonajori
			Singa
Sr. No.	Block	Panchayat	Village
		Barhait South	Barhait Santhali
		Panchkathiya Bazar	Panchkathiya Bazar
			Raksi
		Phulbhanga	Phulbhanga
		Simaldhab	Simaldhab
			Jhabri
			Kundli
		Lavri	Lavri
			Gilha
			Karamtoli
		Panchkathiya Santhali	Panchkathiya Santhali
		Khairwa	Petkhasa

## 7.0 Sum-up

- Aquifer Mapping Study was carried in Sahebganj district, Jharkhand covering 1702 sqkm area falling in 9 blocks through data gap analysis, data generated in-house, data acquired from State/Central Govt. departments . All the available data were integrated to prepare aquifer maps and aquifer management plans of the district.
- Geologically, the area is occupied mostly by Rajmahal Trap having huge thickness of basaltic lava flows with intercalated shales and clays. Rajmahal traps are overlain by laterites and alluvium , however underlain by Gondwana formations.
- Ground water occurs in unconfined state in shallow Aquifer-I in laterites, weathered basalts ( Upto 30 m depth) , however in some cases where alluvium thickness is more( upto 150 m in Sahebganj block), ground water occurs under unconfined to semi-confined state in Aquifer-I ( upto the depth of 60m). Yield of the wells in Aquifer-I ranges from 25-30 m<sup>3</sup>/hr in alluvium and 5 m<sup>3</sup>/hr in Laterites/Weathered Basalt.
- Ground water occurs under Semi-confined to confined condition in Aquifer-II represented by Fractured/Jointed /Vesicular basalts, upto the depth of 156.0m depth . Yield of the wells in Aquifer-II is upto 50m<sup>3</sup>/hr. The high yielding aquifers are generally encountered in fractures/joints between 45-100m depth.
- To know the Aquifer characteristics, step drawdown test( SDT) and Aquifer Performamce Tests( APT) were conducted. The test results reveal that in hard rock areas of Sahebganj district, aquifer-II represented by jointed/fractured basalts are having transmissivity value upto 39 m<sup>2</sup>/day and storativity value ranges from 0.00034 to 0.0071.
- Ground Water quality is generally potable , however arsenic and iron concentration in three blocks of Sahebganj, i.e Sahebganj, Udhwa and Rajmahal are found beyond permissible limit.
- The stage of ground water development in sahebganj district is 13.79% and all the block comes under safe category. Therefore there is sufficient scope for further ground water development.
- Three major ground water related issues in Sahebganj district are Low ground awter development, Low ground water potential and arsenic/Iron contaomination in Sahebganj, Udhwa and Rajmahal blocks.
- Ground Water Management strategy suggested are construction of 39991 dugwells and 9720 Shallow Tubewells/borewells in the feasible ares in the district to enhance the overall ground water development to 70%. Rain water harvesting and artificial recharge to be encouraged in feasible areas for ground water augmentation so that there is less possibility of development of ground water stressed condition in the area. Alternative surface water supply in three Arsenic infested blocks of Sahebganj district may be extended. Inadditiona purification/filtration of Arsenic may also be adopted.

**LAST TEN YEARS (2008 TO 2017) MONSOON RAINFALL (JUNE TO OCTOBER) DATA OF SAHEBGANJ DISTRICT**

Block: Sahebganj (2008 – 2017)

Average monsoon rainfall (mm): 962.28

Standard deviation: 279.17

Coefficient of variation (in %): 29.01

Year	Monsoon rainfall (mm)	Departure %	Category
2008	579.3	- 39.80	Moderate
2009	879.70	- 8.58	Normal
2010	709.80	- 26.24	Moderate
2011	1114.40	15.81	Normal
2012	949.90	- 1.29	Normal
2013	990.00	2.88	Normal
2014	831.40	- 13.60	Normal
2015	1599.50	66.22	Excess
2016	850.30	- 11.64	Normal
2017	1118.50	16.23	Normal

Block: Borio (2008 – 2017)

Average monsoon rainfall (mm): 1133.25

Standard deviation: 241.45

Coefficient of variation (in %): 21.31

Year	Monsoon rainfall (mm)	Departure %	Category
2008	968.80	- 14.51	Normal
2009	851.30	- 28.20	Moderate
2010	899.70	- 20.61	Normal
2011	1536.40	35.57	Excess
2012	1079.00	- 4.79	Normal
2013	1154.90	1.91	Normal
2014	1009.60	- 10.91	Normal
2015	1557.4	37.43	Excess
2016	1103.00	- 2.67	Normal
2017	1172.40	3.45	Normal

Block: Mandro (2008 – 2017)

Average monsoon rainfall (mm): 589.77

Standard deviation: 308.50

Coefficient of variation (in %): 52.31

Year	Monsoon rainfall (mm)	Departure %	Category
2008	359.20	- 39.09	Moderate
2009	317.60	- 46.15	Moderate

2010	250.00	- 57.61	Severe
2011	597.30	1.28	Normal
2012	539.70	- 8.49	Normal
2013	340.60	- 42.25	Moderate
2014	516.20	- 12.47	Normal
2015	1166.00	97.70	Excess
2016	827.10	40.24	Excess
2017	984.00	66.84	Excess

Block: Barhait (2008 – 2017)

Average monsoon rainfall (mm): 1045.42

Standard deviation: 234.44

Coefficient of variation (in %): 22.43

Year	Monsoon rainfall (mm)	Departure %	Category
2008	817.00	- 21.85	Normal
2009	877.20	- 16.09	Normal
2010	976.30	- 6.61	Normal
2011	1337.70	27.96	Excess
2012	854.20	- 18.28	Normal
2013	986.60	- 5.63	Normal
2014	871.10	- 16.67	Normal
2015	1423.60	36.17	Excess
2016	1363.10	30.39	Excess
2017	947.40	- 9.38	Normal

Block: Pathna (2008 – 2017)

Average monsoon rainfall (mm): 975.35

Standard deviation: 289.69

Coefficient of variation (in %): 29.70

Year	Monsoon rainfall (mm)	Departure %	Category
2008	756.70	- 22.42	Normal
2009	1083.80	11.12	Normal
2010	792.20	- 18.78	Normal
2011	1127.60	15.61	Normal
2012	872.80	- 10.51	Normal
2013	962.60	- 1.31	Normal
2014	696.40	- 28.60	Moderate
2015	1701.60	74.46	Excess
2016	830.60	- 14.84	Normal
2017	929.20	- 4.73	Normal

Block: Barharwa (2008 – 2017)

Average monsoon rainfall (mm): 1061.74

Standard deviation: 278.11

Coefficient of variation (in %): 26.19

Year	Monsoon rainfall (mm)	Departure %	Category
2008	823.70	- 22.42	Normal
2009	1139.00	7.28	Normal
2010	830.40	- 21.79	Normal
2011	1351.60	27.30	Excess
2012	972.50	- 8.41	Normal
2013	1100.70	3.67	Normal
2014	809.30	- 23.78	Normal
2015	1686.20	58.81	Excess
2016	1018.00	- 4.12	Normal
2017	886.00	- 16.55	Normal

Block: Rajmahal (2008 – 2017)

Average monsoon rainfall (mm): 1173.61

Standard deviation: 177.31

Coefficient of variation (in %): 15.11

Year	Monsoon rainfall (mm)	Departure %	Category
2008	1085.70	- 7.49	Normal
2009	1147.70	- 2.21	Normal
2010	907.40	- 22.68	Normal
2011	1176.80	0.27	Normal
2012	1315.90	12.12	Normal
2013	1414.00	20.48	Normal
2014	999.20	- 14.86	Normal
2015	1204.40	2.62	Normal
2016	1036.60	- 11.67	Normal
2017	1448.40	23.41	Normal

Block: Udhwa (2008 – 2017)

Average monsoon rainfall (mm): 796.76

Standard deviation: 247.53

Coefficient of variation (in %): 31.07

Year	Monsoon rainfall (mm)	Departure %	Category
2008	720.60	- 9.56	Normal
2009	516.60	- 35.17	Moderate
2010	512.50	- 35.68	Moderate
2011	589.70	- 25.99	Moderate
2012	1149.80	44.31	Excess

2013	976.60	22.57	Normal
2014	739.20	- 7.22	Normal
2015	886.60	11.28	Normal
2016	678.00	- 14.91	Normal
2017	1198.00	50.36	Excess

Block: Taljhari (2008 – 2017)

Average monsoon rainfall (mm): 984.63

Standard deviation: 207.90

Coefficient of variation (in %): 21.11

Year	Monsoon rainfall (mm)	Departure %	Category
2008	1343.90	36.49	Excess
2009	919.80	- 6.58	Normal
2010	859.00	- 12.76	Normal
2011	1126.70	14.43	Normal
2012	961.50	- 2.35	Normal
2013	712.50	- 27.64	Moderate
2014	832.00	- 15.50	Normal
2015	1178.40	19.68	Normal
2016	752.90	- 23.53	Normal
2017	1159.60	17.77	Normal

## DETAILS OF KEY WELLS ESTABLISHED FOR NATIONAL AQUIFER MAPPING STUDY OF SAHEBGANJ DISTRICT, 2016 –17 &amp; 2017 – 18

Well No.	Village	Block	Owner	Location	Toposheet No. & Co-ordinates	Type of well	Geology	Lifting device	MP (magl)	Depth (mbgl)	Dia. (m.)
1	Berhait	Berhait	Govt.	Within the PWD IB compound.	72 P / 9 24 <sup>0</sup> 53' 20" 87 <sup>0</sup> 45' 23"	Dug well	Rajmahal Trap	Rope & bucket	0.40	10.18	1.20
2	Barharwa	Barharwa	Govt.	Southern part of weekly market area.	72 P / 13 24 <sup>0</sup> 50' 48" 87 <sup>0</sup> 45' 34"	Dug well	Rajmahal Trap	Rope & bucket	0.95	11.15	1.30
3	Ghat Selampur	Rajmahal	Shri Dukhu Mandal	Near house of Shri Dukhu Mandal and LHS of Rajmahal – Sahebganj road,	72 O / 16 25 <sup>0</sup> 03' 24" 87 <sup>0</sup> 49' 17"	Dug well	Alluvium	Rope & bucket	0.70	9.40	1.40
4	Mandro	Mandro	Shri Hira Lal Mishra	Within the house campus of Shri Hira Lal Mishra	72 O / 12 25 <sup>0</sup> 08' 45" 87 <sup>0</sup> 48' 00"	Dug well	Rajmahal Trap	Rope & bucket	0.50	11.10	1.15
5	Rajmahal	Rajmahal	Govt.	LHS of Rajmahal – Sahebganj road near Govt. school	72 O / 16 25 <sup>0</sup> 03' 17" 87 <sup>0</sup> 49' 33"	Dug well	Alluvium	Rope & bucket	0.55	9.50	1.75
6	Ranga	Pathna	Govt.	Near Shiv Mandir	72 P / 9 24 <sup>0</sup> 50' 40" 87 <sup>0</sup> 42' 49"	Dug well	Rajmahal Trap	Rope & bucket	0.70	10.90	1.15
7	Sahebganj	Sahebganj	Govt.	At the more Bagwa on right side of road Pirpainti - Sahebganj	72 O / 12 25 <sup>0</sup> 14' 00" 87 <sup>0</sup> 38' 20"	Dug well	Alluvium	Rope & bucket	0.50	13.50	2.40
8	Sakrigali	Sahebganj	Govt.	Within the campus of class III staff quarter on Sahebganj – Rajmahal road.	72 O / 12 25 <sup>0</sup> 14' 00" 87 <sup>0</sup> 42' 10"	Dug well	Rajmahal Trap	Rope & bucket	0.45	9.84	2.10
9	Taljhari	Taljhari	Govt.	Adjacent to railway station within the railway compound	72 O / 12 25 <sup>0</sup> 03' 31" 87 <sup>0</sup> 47' 25"	Dug well	Rajmahal Trap	Rope & bucket	0.78	12.50	1.15

10	Udhwa	Udhwa	Public well	Back side of the Masjid	72 P / 13 24° 55' 47" 87° 51' 21"	Dug well	Rajmahal Trap	Rope & bucket	0.85	8.65	1.90
11	Hazipur	Sahebganj	Ram Kailash Mandal	NHO owner, LHS of Sahebganj – Bhagalpur Road.	72 O / 11 25° 15' 57" 87° 30' 03"	Dug well	Alluvium	Rope & bucket	0.58	7.02	4.46
12	Dihari	Sahebganj	Bishambar Yadav	NHO owner, RHS of Sahebganj – Bhagalpur road, opposite to school.	72 O / 11 25° 15' 59" 87° 31' 23"	Dug well	Alluvium	Rope & bucket	0.35	6.35	1.95
13	Harinchara chowk	Borio	Govt.	Tri-junction of Borio – Sahebganj – Tinpahar road	72 O / 12 25° 01' 46" 87° 36' 58"	Dug well	Rajmahal Trap	Rope & bucket	0.77	7.53	1.96
14	Maricho	Borio	Govt.	Near primary school	72 O / 12 25° 04' 19" 87° 37' 35"	Dug well	Rajmahal Trap	Rope & bucket	0.58	7.72	1.60
15	Chota Kadma	Berhait	Public well	Back side of the Jama Masjid on Berhait – Litipara road (LHS)	72 P / 9 24° 50' 39" 87° 35' 52"	Dug well	Rajmahal Trap	Rope & bucket	0.63	10.97	1.22
16	Mangalhat	Rajmahal	QRS Company	The well is located within the Guest House premises of QRS Company.	72 O / 16 25° 04' 34" 87° 46' 36"	Dug well	Rajmahal Trap	Rope & bucket	0.50	9.50	3.10 (outer)
17	Baramasia	Berhait	Govt.	The well is located near house of Shri Lal Pandith and near Hanuman temple.	72 P / 9 24° 51' 54" 87° 38' 46"	Dug well	Rajmahal Trap	Rope & bucket	0.52	9.76	1.25
18	Kotalpokhar	Barharwa	Govt.	Well is located near primary & middle school and Masjid.	72 P / 14 24° 44' 05" 87° 40' 30"	Dug well	Rajmahal Trap	Rope & bucket	0.50	11.65	1.60
19	Khaira	Mandro	Govt.	In front of health centre/ Utkramit primary school	72 O / 8 25° 06' 10" 87° 29' 06"	Dug well	Rajmahal Trap	Rope & bucket	0.60	7.80	2.38
20	Belbhadri	Mandro	Govt.	About 100 m north of school on open ground	72 O / 8 25° 14' 51"	Dug well	Rajmahal Trap	Rope & bucket	0.53	6.85	1.89



					87° 29' 20"						
21	Banjhi	Borio	Govt.	RHS of Sahebganj – Borio road near house of Shri Sebiya Thakur	72 O / 12 25° 07' 47" 87° 39' 29"	Dug well	Rajmahal Trap	Rope & bucket	0.55	11.05	1.88
22	Bichpura	Borio	Govt.	LHS of Borio – Boarijor road and about 03 km from Borio	72 O / 12 25° 02' 11" 87° 34' 50"	Dug well	Rajmahal Trap	Rope & bucket	0.57	6.68	1.87
23	Kathalwadi	Udhwa	Shri Press Mandal	Near house of owner	72 P / 13 24° 54' 42" 87° 52' 34"	Dug well	Alluvium	Rope & bucket	0.70	7.15	0.80
24	Ramnagar	Barharwa	Govt.	Near Anganwadi centre	72 P / 13 24° 51' 08" 87° 51' 02"	Dug well	Alluvium	Rope & bucket	0.70	14.80	1.80
25	Telo	Borio	Sanjay Pandith	Opposite to the house of Shri Sanjay Pandith, LHS of Borio – Barhait road	72 O / 12 24° 59' 56" 87° 35' 11"	Dug well	Rajmahal Trap	Rope & bucket	0.00	7.10	1.90
26	Taljhari	Pathna	Govt.	Near Grampanchayat Sachivalay Office, Taljhari	72 P / 9 24° 48' 21" 87° 40' 09"	Dug well	Rajmahal Trap	Rope & bucket	0.83	5.77	0.85
27	Brindavan	Taljhari	Paulus Murmu	NHO owner	72 O / 12 25° 00' 44" 87° 43' 02"	Dug well	Rajmahal Trap	Rope & bucket	0.40	7.35	1.40

**WATER LEVEL DATA OF KEY WELLS OF NATIONAL AQUIFER MAPPING STUDY AREA OF SAHEBGANJ DISTRICT, JHARKHAND, 2016 –17 & 2017 - 18**

Well No.	Village	Block	Water level (mbgl)							
			May 2016	Aug. 2016	Nov.2016	Jan. 2017	May 2017	Nov. 2017	Jan. 2018	May 2018
1	Berhait	Berhait	7.40	4.85	6.40	6.65	7.20	4.10	7.10	5.88
2	Barharwa	Barharwa	9.28	4.21	6.16	7.58	9.30	4.21	7.17	9.40
3	Ghat Selampur	Rajmahal	7.81	2.23	4.27	5.05	7.21	3.05	6.95	5.33
4	Mandro	Mandro	6.42	1.22	2.98	4.34	5.81	2.10	3.64	3.00
5	Rajmahal	Rajmahal	5.87	4.72	4.85	5.78	6.77	3.10	5.35	6.61
6	Ranga	Pathna	7.54	2.52	4.18	5.48	7.76	4.51	4.76	7.55
7	Sahebganj	Sahebganj	8.90	6.61	6.65	6.86	8.95	6.51	6.80	8.77
8	Sakrigali	Sahebganj	5.35	3.24	3.40	4.37	4.99	3.12	3.72	3.90
9	Taljhari	Taljhari	2.84	1.70	2.68	2.76	2.58	2.02	2.70	2.67
10	Udhwa	Udhwa	7.85	3.86	5.65	5.78	7.30	4.90	5.53	7.06
11	Hazipur	Sahebganj	5.91	2.13	2.50	2.96	3.08	2.31	2.44	3.22
12	Dihari	Sahebganj	4.94	1.85	2.25	2.48	4.10	2.12	3.05	2.45
13	Harinchara Chowk	Borio	6.30	2.16	3.80	4.15	5.59	3.55	4.50	5.55
14	Maricho	Borio	6.97	3.59	4.52	5.40	7.33	4.35	5.26	6.60
15	Chota Kadma	Berhait	10.84	2.38	5.65	6.38	9.50	5.27	7.38	9.62
16	Mangalhat	Rajmahal	6.06	2.88	4.00	4.52	5.61	3.69	5.20	5.65
17	Baramasia	Berhait	8.92	1.03	4.13	8.24	7.46	4.00	6.02	9.06
18	Kotalpokhar	Barharwa	5.50	1.58	2.60	3.91	5.47	2.32	3.71	4.42
19	Khaira	Mandro	6.47	4.28	5.15	5.38	6.97	4.92	5.09	6.57
20	Belbhadri	Mandro	5.53	2.69	2.56	3.33	5.62	2.22	3.33	4.89
21	Banjhi	Borio	7.55	3.67	4.10	4.87	5.79	3.86	4.69	5.57
22	Bichpura	Borio	6.93	1.30	1.48	2.65	4.49	1.14	2.07	3.00
23	Kathalwadi	Udhwa	4.70	2.32	2.42	2.95	6.20	2.16	2.63	5.15
24	Ramnagar	Barharwa	11.51	4.77	7.50	8.70	11.15	4.50	7.94	9.52
25	Telo	Borio	7.45	3.26	6.50	7.00	7.40	3.18	6.69	7.38
26	Taljhari	Pathna	5.70	2.12	3.70	3.80	5.30	3.38	3.59	5.05
27	Brindavan	Taljhari	3.85	2.06	2.51	3.73	4.25	2.23	3.79	4.81

## DATA OF SOIL INFILTRATION TEST

Unique ID: SIT - 1	Rajmahal
Date	02/05/2017
Location	Near newly constructed the water supply tank
Block	Rajmahal
District	SAHEBGANJ
Latitude	25 <sup>0</sup> 02' 15"
Longitude	87 <sup>0</sup> 37' 15"
RL (m amsl)	
Initial Water level (mm)	185
Geology	Ganga Alluvium
Final infiltration rate (mm/hr)	15

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	13.46	1	1	170	15	15	900
2	13.47	1	2	169	16	8	480
3	13.48	1	3	167	18	6	360
4	13.49	1	4	167	18	4.5	270
5	13.50	1	5	166	19	3.8	228
6	13.52	2	7	165	20	2.86	171.6
7	13.54	2	9	165	20	2.22	133.2
8	13.56	2	11	164	21	1.91	114.6
9	13.58	2	13	164	21	1.62	97.2
10	14.00	2	15	162	23	1.53	91.8
11	14.05	5	20	161	24	1.2	72
12	14.10	5	25	160	25	1.00	60
13	14.15	5	30	158	27	0.90	54
14	14.25	10	40	156	29	0.73	43.8
15	14.35	10	50	155	30	0.60	36
16	14.45	10	60	152	33	0.55	33
17	15.00	15	75	150	35	0.47	28.2
18	15.15	15	90	148	37	0.41	24.6
19	15.30	15	105	146	39	0.37	22.2
20	15.45	15	120	144	41	0.34	20.4
21	16.00	15	135	142	43	0.32	19.2
22	16.15	15	150	141	45	0.30	18
23	16.30	15	165	141	45	0.27	16.2
24	16.45	15	180	141	45	0.25	15

### SOIL INFILTRATION TEST

<b>Unique ID: SIT - 2</b>	Risaur
Date	03/05/2017
Location	Middle school premises
Block	Barharwa
District	SAHEBGANJ
Latitude	24 <sup>0</sup> 50' 04"
Longitude	87 <sup>0</sup> 49' 15"
RL (m amsl)	
Initial Water level (mm)	127
Geology	Older Alluvium
Final infiltration rate (mm/hr)	19.8

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	10.02	2	2	120	7.00	3.50	210
2	10.04	2	4	119	8.00	2.00	120
3	10.06	2	6	117	10.00	1.67	100.2
4	10.08	2	8	116	11.00	1.38	82.8
5	10.10	2	10	115	12.00	1.20	72
6	10.15	5	15	110	17.00	1.13	67.8
7	10.20	5	20	107	20.00	1.00	60
8	10.25	5	25	104	23.00	0.90	54
9	10.30	5	30	103	24.00	0.80	48
10	10.35	5	35	101	26.00	0.74	44.4
11	10.40	5	40	99.5	27.50	0.69	41.4
12	10.45	5	45	98	29.00	0.64	38.4
13	10.50	5	50	98	29.00	0.58	34.8
14	10.55	5	55	97	30.00	0.55	33
15	11.00	5	60	96	31.00	0.52	31.2
16	11.05	5	65	94	33.00	0.51	30.6
17	11.10	5	70	93	34.00	0.49	29.4
18	11.15	5	75	92	35.00	0.47	28.2
19	11.20	5	80	91	36.00	0.45	27
20	11.25	5	85	90	37.00	0.44	26.4
21	11.30	5	90	89	38.00	0.42	25.2
22	11.35	5	95	89	38.00	0.40	24
23	11.40	5	100	88.5	38.50	0.39	23.4
24	11.45	5	105	88	39.00	0.37	22.2
25	11.50	5	110	87.5	39.50	0.36	21.6
26	11.55	5	115	86	40.00	0.35	21
27	12.00	5	120	86	40.00	0.33	19.8

### SOIL INFILTRATION TEST

<b>Unique ID: SIT - 3</b>	Barhait
Date	03/05/2017
Location	+ S.S. High school premises
Block	Barhait
District	SAHEBGANJ
Latitude	24 <sup>0</sup> 53' 42"
Longitude	87 <sup>0</sup> 36' 02"
RL (m amsl)	
Initial Water level (mm)	165
Geology	Older Alluvium
Final infiltration rate (mm/hr)	21.6

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	14.02	2	2	159	6	3.00	180
2	14.04	2	4	157	8	2.00	120
3	14.06	2	6	156	9	1.5	90
4	14.08	2	8	154	11	1.38	82.8
5	14.10	2	10	153	12	1.2	72
6	14.15	5	15	150	15	1.00	60
7	14.20	5	20	148	17	0.85	51
8	14.25	5	25	145	20	0.80	48
9	14.30	5	30	143	22	0.73	43.8
10	14.35	5	35	142	23	0.66	39.6
11	14.40	5	40	140	25	0.63	37.8
12	14.45	5	45	138	27	0.60	36
13	14.50	5	50	137	28	0.56	33.6
14	14.55	5	55	135	30	0.55	33
15	15.00	5	60	134	31	0.52	31.2
16	15.05	5	65	132	33	0.51	30.6
17	15.10	5	70	132	33	0.47	28.2
18	15.15	5	75	131	34	0.45	27
19	15.20	5	80	130	35	0.44	26.4
20	15.25	5	85	129	36	0.42	25.2
21	15.30	5	90	128	37	0.41	24.6
22	15.35	5	95	127	38	0.40	24
23	15.40	5	100	126	39	0.39	23.4
24	15.45	5	105	125	40	0.38	22.8
25	15.50	5	110	124	41	0.37	22.2
26	15.55	5	115	124	41	0.36	21.6

### SOIL INFILTRATION TEST

Unique ID: SIT - 4	Dihari
Date	04/05/2017
Location	Near exploratory well of CGWB (Gauchar land)
Block	Sahebganj
District	SAHEBGANJ
Latitude	25 <sup>0</sup> 16' 35"
Longitude	87 <sup>0</sup> 30' 55"
RL (m amsl)	
Initial Water level (mm)	154
Geology	Ganga Alluvium
Final infiltration rate (mm/hr)	3.6

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	10.02	2	2	151	3	1.50	90
2	10.04	2	4	150	4	1.00	60
3	10.06	2	6	150	4	0.67	40.2
4	10.08	2	8	150	4	0.50	30
5	10.10	2	10	150	4	0.40	24
6	10.15	5	15	149	5	0.33	19.8
7	10.20	5	20	149	5	0.25	15
8	10.25	5	25	149	5	0.20	12
9	10.30	5	30	149	5	0.17	10.2
10	10.40	10	40	149	5	0.13	7.8
11	10.50	10	50	148	6	0.12	7.2
12	11.00	10	60	148	6	0.10	6
13	11.10	10	70	148	6	0.09	5.4
14	11.20	10	80	148	6	0.08	4.8
15	11.30	10	90	147	7	0.08	4.8
16	11.40	10	100	147	7	0.07	4.2
17	11.50	10	110	147	7	0.06	3.6
18	12.00	10	120	147	7	0.06	3.6

### SOIL INFILTRATION TEST

<b>Unique ID: SIT - 5</b>	Bachcha
Date	08/05/2017
Location	Utkramit middle school premises
Block	Mandro
District	SAHEBGANJ
Latitude	25 <sup>0</sup> 06' 13"
Longitude	87 <sup>0</sup> 29' 23"
Initial Water level (mm)	155
Geology	Basalt
Final infiltration rate (mm/hr)	49.2

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	12.47	2	2	144	11	5.50	330
2	12.49	2	4	140	15	3.75	225
3	12.51	2	6	130	25	4.17	250.2
4	12.53	2	8	128	27	3.38	202.8
5	12.55	2	10	127	28	2.80	168
6	13.00	5	15	120	35	2.33	139.8
7	13.05	5	20	117	38	1.90	114
8	13.10	5	25	112	43	1.72	103.2
9	13.15	5	30	106	49	1.63	97.8
10	13.20	5	35	102	53	1.51	90.6
11	13.25	5	40	99	56	1.40	84
12	13.30	5	45	94	61	1.36	81.6
13	13.35	5	50	90	65	1.30	78
14	13.40	5	55	88	67	1.22	73.2
15	13.45	5	60	84	71	1.18	70.8
16	13.50	5	65	81	74	1.14	68.4
17	13.55	5	70	77	78	1.11	66.6
18	14.00	5	75	74	81	1.08	64.8
19	14.05	5	80	71	84	1.05	63
20	14.10	5	85	68	87	1.02	61.2
21	14.15	5	90	65	90	1.00	60
22	14.20	5	95	62	93	0.98	58.8
23	14.25	5	100	60	95	0.95	57
24	14.30	5	105	58	97	0.92	55.2
25	14.35	5	110	55	100	0.91	54.6
26	14.40	5	115	52	103	0.90	54
27	14.45	5	120	50	105	0.88	52.8

28	14.50	5	125	48	107	0.86	51.6
29	14.55	5	130	46	109	0.84	50.4
30	15.00	5	135	44	111	0.82	49.2

### SOIL INFILTRATION TEST

<b>Unique ID: SIT - 6</b>	Dumaria
Date	08/05/2017
Location	SW corner of football ground
Block	Borio
District	SAHEBGANJ
Latitude	25 <sup>0</sup> 01' 41"
Longitude	87 <sup>0</sup> 37' 30"
Initial Water level (mm)	183
Geology	Basalt
Final infiltration rate (mm/hr)	8.4

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	16.02	2	2	180	3	1.50	90
2	16.04	2	4	180	3	0.75	45
3	16.06	2	6	179	4	0.67	40.2
4	16.08	2	8	178	5	0.63	37.8
5	16.10	2	10	178	5	0.50	30
6	16.15	5	15	177	6	0.40	24
7	16.20	5	20	177	6	0.30	18
8	16.25	5	25	176.5	6.5	0.26	15.6
9	16.30	5	30	176	7	0.23	13.8
10	16.35	5	35	175.5	7.5	0.21	12.6
11	16.40	5	40	175	8	0.20	12
12	16.45	5	45	174.5	8.5	0.19	11.4
13	16.50	5	50	174	9	0.18	10.8
14	16.55	5	55	174	9	0.16	9.6
15	17.00	5	60	173	10	0.17	10.2
16	17.05	5	65	173	10	0.15	9
17	17.10	5	70	173	10	0.14	8.4



### SOIL INFILTRATION TEST

Unique ID: SIT - 7	Brindavan
Date	22/05/2017
Location	Football ground of Awashiya Vidyalaya
Block	Taljhari
District	SAHEBGANJ
Latitude	25 <sup>0</sup> 00' 46"
Longitude	87 <sup>0</sup> 43' 05"
Initial Water level (mm)	155
Geology	Basalt
Final infiltration rate (mm/hr)	19.2

Sr.No.	Clock time	Time interval (min.)	Cumulative time (min.)	Water level depth (mm)	Infiltrated water depth (mm)	Infiltration rate (mm/min.)	Infiltration rate (mm/hr)
1	15.17	2	2	139	16	8.00	480
2	15.19	2	4	139	16	4.00	240
3	15.21	2	6	139	16	2.67	160.2
4	15.23	2	8	139	16	2.00	120
5	15.25	2	10	137	18	1.80	108
6	15.30	5	15	136	19	1.27	76.2
7	15.35	5	20	135	20	1.00	60
8	15.40	5	25	134	21	0.84	50.4
9	15.45	5	30	134	21	0.70	42
10	15.50	5	35	132	23	0.66	39.6
11	15.55	5	40	131	24	0.60	36
12	16.00	5	45	130	25	0.56	33.6
13	16.05	5	50	129	26	0.52	31.2
14	16.10	5	55	129	26	0.47	28.2
15	16.15	5	60	128	27	0.45	27
16	16.20	5	65	128	27	0.42	25.2
17	16.25	5	70	127	28	0.40	24
18	16.30	5	75	127	28	0.37	22.2
19	16.35	5	80	126	29	0.36	21.6
20	16.40	5	85	126	29	0.34	20.4
21	16.45	5	90	125	30	0.33	19.8
22	16.50	5	95	125	30	0.32	19.2

## Annexure - V

## AQUIFER PARAMETERS

Unique ID	Village / Location	Block	Formation	Co-ordinates	Type of well	Date of pumping test	SWL (mbgl)	Dis-charge (lps)	Draw-down (m)	T (m <sup>2</sup> /day)	S	Specific Capacity (lpm/m of DD)	Source / Agency
1	Taljhari (Block campus)	Taljhari	Basalt	25 <sup>0</sup> 04'40" 87 <sup>0</sup> 44'20"	EW	14.12.2012	7.92	6.80	25.14	Theis recovery method= 11.69	--	0.27	CGWB
					OW		7.84	--	11.76	1. Jacob's Method = 17.19 2. Theis method= 25.28	1. 0.0013 2. 0.0016	--	
2	Dihari (Gauchar)	Sahebganj	Alluvium	25 <sup>0</sup> 16'35" 87 <sup>0</sup> 30'55"	EW	07/05/2017	4.73	20.00	11.02	-	--	108.89	CGWB
					OW		3.83	--	0.22	Theis method = 5395.28	0.0071	--	
3	Sahebganj (Jawahar Navoday Vidyalay)	Sahebganj	Basalt	25 <sup>0</sup> 13'48" 87 <sup>0</sup> 38'15"	EW	25/10/2017	4.57	4.55	21.825	Theis recovery method= 9.35	--	0.21	CGWB
					OW		4.96	--	17.61	1. Jacob's Method = 7.06 2. Theis method = 10.79	1. 0.00022 2. 0.00046	--	
4	Banjhi (Grampan-chayat office)	Borio	Basalt	25 <sup>0</sup> 08'03" 87 <sup>0</sup> 39'19"	EW	11/12/2017	9.27	10.00	9.24	Theis recovery method= 33.45	--	64.94	CGWB
					OW		9.18	--	7.90	1. Jacob's Method = 35.00 2. Theis method = 41.69	1. 0.0029 2. 0.0034	--	
5	Nishchinta	Taljhari	Basalt	25 <sup>0</sup> 01'54" 87 <sup>0</sup> 43'01"	EW	18/02/2018	4.37	6.90	25.53	Theis recovery method= 31.74	--	16.22	CGWB
					OW		4.48	--	9.78	1. Jacob's Method = 18.50 2. Theis method = 20.64	1. 0.0029 2. 0.0056	--	

## ANNEXURE-VI (A)

## DETAILS OF EXPLORATORY WELLS DRILLED IN HARD FORMATION OF SAHEBGANJ DISTRICT

Sl. No.	Location with coordinates	Block	Depth drilled (m)	Depth of Well (m)	Thickness of weathering (m)	Length of casing lowered with dia. (m)	Fractures Encountered (mbgl)		Aquifer	SWL (mbgl)	Dis-charge (lps)	D.D. (m)	T (m <sup>2</sup> /d) /Storativity (S)
							From	To					
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Borio EW 25° 02' 15" 87° 37' 15"	Borio	200.00	200.00	29.50	29.70	--	--	--	--	Dry	--	--
2	Taljhari EW 25° 04' 40" 87° 44' 20"	Taljhari	200.00	200.00	30.50	31.00	33.00 119.50	33.70 120.20	Fracture basalt	7.92	13.30	25.14	T= 12.0
	Taljhari OW		200.00	200.00	31.50	32.00	88.50 108.00	89.50 109.00	Fracture basalt	7.84	13.30	11.76	T = 17.50 S = 0.0013
3	Mandro EW 25° 08' 34" 87° 29' 59"	Mandro	200.00	200.00	31.50	32.00	--	--	--	--	Dry	--	
4	Taljhari EW 24° 48' 21" 87° 40' 09"	Pathna	123.40	123.40	10.50	10.50 (Dia. 7")	42.00  100.00	43.00  101.00	Slightly fractured basalt Slightly fractured vesicular basalt	8.54	2.00	--	
	OW	Pathna	160.00	160.00	19.00	19.00 (Dia. 7")	48.00	49.00		8.66	2.00	--	
5	Kotal Pokhar EW – I 24° 44' 21" 87° 49' 51"	Barharwa	202.70	202.70	25.00	25.50 (Dia. 7")	--	--	--	--	Dry	--	
	Kotal Pokhar EW – II	Barharwa	202.70	202.70	25.00	25.50 (Dia. 7")	133.00  154.50	134.00  155.00	Slightly fractured basalt	15.90	0.60	--	

1	2	3	4	5	6	7	8	9	10	11	12	13	14
6	Argori EW 24° 56' 00" 87° 33' 50"	Barhait	202.70	202.70	3.00	3.00 (Dia. 7")	--	--	--	--	Dry	--	
7	Sahraj Dhab EW 25° 02' 10" 87° 43' 50"	Taljhari	160.00	160.00	18.00	18.30 (Dia. 7")	30.00	31.00	Slightly fractured, jointed basalt	--	0.80	--	
8	Borio 25° 02' 18" 87° 34' 37"	Borio	202.70	202.70	13.00	19.00 (Dia. 7")	176.00	177.00	Slightly fractured, jointed basalt	42.76	0.14	--	
9	Sahebganj EW 25° 13' 48" 87° 38' 15"	Sahebganj	202.70	202.70	31.00	31.20 (Dia. 7")	35.00	36.00	Fractured & jointed basalt	4.57	4.50	21.83	T= 9.35
	OW	Sahebganj	71.00	71.00	31.00	31.20 (Dia. 7")	34.50	35.00	Slightly fractured & jointed basalt	4.96	0.14	17.61	T= 8.93 S=0.00034
10	Chhota Baramasia EW 25° 00' 10" 87° 37' 29"	Borio	202.70	202.70	12.35	12.85 (Dia. 7")	155.00	156.00	Slightly fractured & jointed basalt	13.22	0.38	--	--
11	Banjhi EW 25° 08' 03" 87° 39' 19"	Borio	74.60	74.60	25.00	25.50 (Dia. 7")	33.00  39.00  57.00	34.00  40.00  59.00	Fractured vesicular basalt Fractured basalt Fractured vesicular basalt	9.27	16.70	9.24	T= 33.45
	OW	Borio	150.90	150.90	25.00	25.50 (Dia. 7")	39.00	40.00	Fractured vesicular basalt	9.18	1.20	7.90	T= 38.38 S= 0.0032
12	Nishchinta EW 25° 01' 54" 87° 43' 01"	Taljhari	163.00	163.00	21.00	21.35 (Dia. 7")	33.00  109.00	35.00  111.00	Fractured basalt Fractured amygdular/ vesicular basalt	3.25	11.30	25.53	T= 31.74
	OW	Taljhari	153.90	153.90	24.50	24.90 (Dia. 7")	42.00	44.00	Fractured basalt	3.48	6.30	9.78	T= 19.57 S= 0.0043

1	2	3	4	5	6	7	8	9	10	11	12	13	14
13	Khaira EW 25° 06' 12" 87° 28' 55"	Mandro	135.00	135.00	25.00	27.76 (Dia. 7")	124.00	126.50	Fractured & jointed basalt	14.86	14.5		
	Khaira OW	Mandro	132.60	132.60	25.80	29.00 (Dia. 7")	124.00	126.50	Fractured & jointed basalt		14.50		
14	Hathigarh EW 24° 59' 02" 87° 36' 54"	Barhait	147.80	147.80	16.50	16.50 (Dia. 7")	44.00	45.00	Slightly fractured basalt	7.30	3.00		
	Hathigarh OW	Barhait	105.10	105.10	16.00	16.50 (Dia. 7")	87.00	92.00					
	Hathigarh OW	Barhait	105.10	105.10	16.00	16.50 (Dia. 7")	87.00	88.00	Slightly fractured basalt		0.14		
15	Udhwa EW 24.969566 87.840435	Udhwa	133.10	133.10	26.00	26.00 (7" dia.)	62.00	63.00	Slightly fractured & jointed basalt	--	1.20		
16	Chatradih EW 24.96531 87.81848	Udhwa	190.80	190.80	12.00	12.80 (7" dia.)	--	--	--	--	Dry		
17	Barharwa EW 24° 50' 30" 87° 45' 00"	Barharwa	100.00	100.00	44.00	44.70	45.00 60.00 73.00 93.50 98.85	46.00 60.90 74.45 94.00 99.00	Fractured basalt	9.30	14.33	8.92	T-176.00 S-0.00014
18	Barhait EW 24° 53' 50" 87° 36' 10"	Barhait	90.65	90.65	15.50	16.00	29.00 55.00	40.00 56.50	Fractured basalt	7.65	5.86	15.34	T-44.00
19	Borio EW 25° 01' 40" 87° 34' 30"	Borio	75.20	75.20	14.00	14.20	16.00 22.00 39.54 58.00 64.00	18.00 23.00 54.00 60.00 75.00	Fractured basalt	5.53	5.83	9.65	T-32.3 S-0.000070

1	2	3	4	5	6	7	8	9	10	11	12	13	14
20	Rajmahal EW 25° 02' 40" 87° 49' 40"	Rajmahal	74.45	74.45	24.00	24.30	33.50 55.80	36.50 59.90	Fractured basalt	6.90	6.12	3.67	T-88.00 S-0.000073
21	Pathna EW 24° 51' 05" 87° 44' 10"	Pathna	134.00	134.00	48.00	48.50	--	--	--	--	--	--	--
22	Tinpahar EW 24° 44' 30" 87° 44' 20"	Taljhari	150.00	150.00	8.00	8.50	--	--	--	6.16	6.67	--	--
23	Borio EW 25° 02' 00" 87° 36' 00"	Borio	150.00	150.00	24.00	24.50	--	--	--	--	Low	--	--
24	Taljhari EW 24° 48' 21" 87° 40' 09"	Pathna	150.00	150.00	26.00	26.50	--	--	--	--	Low	--	--
25	Udhwa EW 24° 58' 30" 87° 50' 50"	Udhwa	150.00	150.00	27.00	27.50	--	--	--	--	Low	--	--
26	Borio (PHC) EW 25° 01' 30" 87° 36' 00"	Borio	150.00	150.00	14.00	14.50	--	--	--	4.12	6.75	--	--
27	Panchkatia EW 24° 55' 00" 87° 35' 20"	Barhait	150.00	150.00	24.00	24.50	--	--	--	--	Low	--	--

## DETAILS OF EXPLORATORY WELLS DRILLED IN SOFT FORMATION OF SAHEBGANJ DISTRICT

Sl. No.	Location with coordinates	Block	Depth drilled (m)	Depth of Well (m)	Depth of granular zone (mbgl)		Aquifer	SWL (mbgl)	Discharge (lps)	D.D. (m)	T (m <sup>2</sup> /d) /Storativity
					From	To					
1	Dihari Gaucher 25 <sup>0</sup> 16' 35" 87 <sup>0</sup> 30' 55"	Sahebganj	156.00	69.00	45.00	64.00	Fine to medium grain sand	4.73	20	11.02	T = 5395
	Dihari Gaucher	Sahebganj	156.00	139.00	132.00	139.00	Fine to medium grain sand	0.30	0.80	--	--
2	Dihari (village) EW 25 <sup>0</sup> 15' 58" 87 <sup>0</sup> 31' 22"	Sahebganj	103.62	65.00	50.00	62.00	Fine to medium grain sand	--	10.8	--	--
3	Hazipur Bhatta EW 25 <sup>0</sup> 15' 58" 87 <sup>0</sup> 30' 07"	Sahebganj	60.95	38.00	29.00	35.00	Medium grain sand	--	-	--	--
4	Rajgaon EW 25 <sup>0</sup> 15' 48" 87 <sup>0</sup> 30' 08"	Sahebganj	64.00	57.00	49.00	55.00	Medium grain sand	--	-	--	--

## LITHOLOGS OF EXPLORATORY /OBSERVATION WELLS IN SAHEBGANJ DISTRICT

Unique ID: 1	EW
Village	BORIO
Block	BORIO
District	SAHEBGANJ
Toposheet No.	72 O/ 12
Latitude	25 <sup>0</sup> 02' 15"
Longitude	87 <sup>0</sup> 37' 15"
RL (m amsl)	
Drilled Depth (mbgl)	200.00
Casing depth (m bgl)	29.70
SWL(m bgl)	--
Discharge (lps)	Dry
Date / Year	07/12/2012

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	7.00	7.00	Top soil: variable in colour such as light brown, red and black mixed with kankar, sticky nature
7.00	16.40	9.40	Massive basalt: grayish black, weathered
16.40	27.00	10.60	Black bole: deep black in colour.
27.00	29.50	2.50	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
29.50	62.00	32.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
62.00	66.50	4.50	Black bole: deep black in colour.
66.50	98.50	32.00	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)
98.50	118.00	19.50	Black bole: deep black in colour.
118.00	144.00	26.00	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)
144.00	160.50	16.50	Black bole: deep black in colour.
160.50	193.00	32.50	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)
193.00	195.50	2.50	Black bole: deep black in colour.
195.50	200.00	4.50	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)



### LITHOLOG

<b>Unique ID: 2</b>	EW
Village	TALJHARI
Block	TALJHARI
District	SAHEBGANJ
Toposheet No.	72 O/ 12
Latitude	25 <sup>0</sup> 04' 40"
Longitude	87 <sup>0</sup> 44' 20"
RL (m amsl)	
Drilled Depth (mbgl)	200.00
Casing depth (m bgl)	31.00
SWL(m bgl)	7.92
Discharge (lps)	13.30
Date / Year	08/12/2012

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	18.50	18.50	Soil: light to deep yellowish brown colour mixed with laterite and kankar
18.50	25.50	7.00	Massive basalt: grayish black, jointed, slightly fractured & weathered.
25.50	31.50	6.00	Massive basalt: grayish black, powdery to angular to sub angular chips of rock cuttings.
31.50	32.00	0.50	Red bole
32.00	33.00	1.00	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
33.00	33.70	0.70	Fractured vesicular basalt
33.70	36.50	2.80	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
36.50	119.00	82.50	Massive basalt: grayish black, powdery to angular to sub angular chips of rock cuttings.
119.00	120.20	1.20	Fractured basalt.
120.20	127.00	6.80	Sandstone: white in colour, fine to coarse grain.
127.00	134.00	7.00	Red bole
134.00	136.50	2.50	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
136.50	200.00	63.50	Sandstone: white in colour, fine to coarse grain.

### LITHOLOG

<b>Unique ID: 3</b>	OW
Village	TALJHARI
Block	TALJHARI
District	SAHEBGANJ
Toposheet No.	72 O/ 12
Latitude	25 <sup>0</sup> 04' 40"
Longitude	87 <sup>0</sup> 44' 20"
RL (m amsl)	
Drilled Depth (mbgl)	200.00
Casing depth (m bgl)	32.00
SWL(m bgl)	7.84
Discharge (lps)	13.30
Date / Year	11/12/2012

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	16.00	16.00	Soil: light to deep yellowish brown colour mixed with laterite and kankar
16.00	32.00	16.00	Massive basalt: grayish black, weathered
32.00	36.00	4.00	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
36.00	88.78	52.78	Massive basalt: grayish black, powdery to angular to sub angular chips of rock cuttings.
88.78	89.50	0.72	Fractured massive basalt
89.50	108.88	19.38	Massive basalt: grayish black, powdery to angular to sub angular chips of rock cuttings.
108.88	109.88	1.00	Fractured basalt
109.88	129.00	19.12	Sandstone: white in colour, fine to coarse grain.
129.00	134.00	5.00	Red bole
134.00	200.00	66.00	Sandstone: white in colour, fine to coarse grain.

### LITHOLOG

<b>Unique ID: 4</b>	EW
Village	MANDRO
Block	MANDRO
District	SAHEBGANJ
Toposheet No.	72 O/ 12
Latitude	25 <sup>0</sup> 08' 34"
Longitude	87 <sup>0</sup> 29' 59"
Drilled Depth (mbgl)	200.00
Casing depth (m bgl)	32.00
SWL(m bgl)	--
Discharge (lps)	Dry
Date / Year	15/12/2012

Depth range(m bgl)		Thickness (m)	Litholog
From	To		
0.00	9.00	9.00	Top soil: light brown to black mixed with kankar, sticky nature
9.00	16.50	7.50	Massive basalt: highly weathered
16.50	27.00	10.50	Black bole: deep black in colour.
27.00	62.00	35.00	Massive basalt: grayish black, hard & compact (po
62.00	73.00	11.00	Black bole: deep black in colour.
73.00	77.00	4.00	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
77.00	91.50	14.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings (50%) and powdery cutting of rock formation (50%), hard & compact.
91.50	98.00	6.50	Black bole: deep black in colour.
98.00	114.00	16.00	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)
114.00	121.00	7.00	Black bole: deep black in colour.
121.00	138.50	17.50	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)
138.50	141.00	2.50	Black bole: deep black in colour.
141.00	145.50	4.50	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
145.50	179.00	33.50	Massive basalt: grayish black, hard & compact (powdery cutting of rock formation)
179.00	180.00	1.00	Black bole: deep black in colour.
180.00	183.00	3.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
183.00	200.00	17.00	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.

### LITHOLOG

<b>Unique ID: 5</b>	EW
Village	TALJHARI
Block	PATHNA
District	SAHEBGANJ
Toposheet No.	72 P / 9
Latitude	24 <sup>0</sup> 48' 21"
Longitude	87 <sup>0</sup> 40' 09"
Drilled Depth (mbgl)	123.40
Casing depth (m bgl)	10.50
SWL(m bgl)	8.54
Discharge (lps)	2.00
Date / Year	18/11/2016

Depth range (m bgl)		Thick- ness (m)	Litholog
From	To		
0.00	7.50	7.50	Top soil: soil mixed with kankar, brown in colour, sticky nature.
7.50	10.00	2.50	Massive basalt: light grayish black in colour, slightly weathered and jointed, angular to sub angular chips of rock cutting
10.00	17.00	7.00	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting
17.00	22.00	5.00	Black bole: deep black in colour, easily breakable
22.00	42.00	20.00	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting
42.00	43.00	1.00	Slightly fractured basalt
43.00	50.00	7.00	Black bole: light black in colour, breakable
50.00	52.00	2.00	Vesicular basalt: light grayish black, white colour secondary minerals filled with vesicles.
52.00	66.00	14.00	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting
66.00	68.00	2.00	Black bole: light black in colour, breakable
68.00	70.00	2.00	Vesicular basalt: light grayish black, white colour secondary minerals filled with vesicles.
70.00	100.00	30.00	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting
100.00	101.00	1.00	Slightly fractured vesicular basalt
101.00	105.00	4.00	Vesicular basalt: light grayish black, white colour secondary minerals filled with vesicles.
105.00	114.00	9.00	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting
114.00	119.00	5.00	Black bole: light black in colour, breakable
119.00	123.40	4.40	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 6</b>	OW
Village	TALJHARI
Block	PATHNA
District	SAHEBGANJ
Toposheet No.	72 P / 9
Latitude	24 <sup>0</sup> 48' 21"
Longitude	87 <sup>0</sup> 40' 09"
RL (m amsl)	
Drilled Depth (mbgl)	160.00
Casing depth (m bgl)	19.00
SWL(m bgl)	8.66
Discharge (lps)	2.00
Date / Year	30/11/2016

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	7.50	7.50	Top soil: soil mixed with kankar, brown in colour, sticky nature.
7.50	13.50	6.00	Massive basalt: light grayish black in colour, weathered and jointed.
13.50	17.50	4.00	Black bole: deep black in colour, easily breakable
17.50	45.50	28.00	Massive basalt: light grayish black in colour, angular to sub angular chips of rock cutting
45.50	48.00	2.50	Black bole: light black in colour, breakable
48.00	49.00	1.00	Slightly fractured basalt
49.00	65.50	16.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
65.50	70.50	5.00	Black bole: light black in colour, breakable
70.50	102.00	31.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
102.00	105.00	3.00	Vesicular basalt: grayish black, white colour secondary minerals filled with vesicles.
105.00	114.50	9.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
114.50	117.00	2.50	Black bole: light black in colour, breakable
117.00	151.00	34.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
151.00	157.00	6.00	Black bole: light black in colour, breakable
157.00	160.00	3.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 7</b>	EW - I
Village	KOTAL POKHAR
Block	BARHARWA
District	SAHEBGANJ
Toposheet No.	72 P / 14
Latitude	24 <sup>0</sup> 44' 21"
Longitude	87 <sup>0</sup> 49' 51"
RL (m amsl)	
Drilled Depth (mbgl)	202.70
Casing depth (m bgl)	25.50
SWL(m bgl)	--
Discharge (lps)	Dry
Date / Year	11/01/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	25.00	25.00	Top soil: soil mixed with kankar, brown in colour, sticky nature.
25.00	41.00	16.00	Massive basalt: light grayish black in colour, slightly weathered and jointed, angular to sub angular chips of rock cutting
41.00	47.00	6.00	Light pink colour amygdular basalt, angular to sub angular chips of rock cutting
47.00	56.00	9.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
56.00	59.00	3.00	Light pink colour amygdular basalt, angular to sub angular chips of rock cutting
59.00	141.50	82.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
141.50	143.50	2.00	Vesicular basalt: deep black in colour, white colour secondary minerals filled with vesicles.
143.50	172.00	28.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
172.00	174.00	2.00	Vesicular basalt: grayish black, white colour secondary minerals filled with vesicles.
174.00	202.70	28.70	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 8</b>	EW - II
Village	KOTAL POKHAR
Block	BARHARWA
District	SAHEBGANJ
Toposheet No.	72 P / 14
Latitude	24 <sup>0</sup> 44' 21"
Longitude	87 <sup>0</sup> 49' 51"
RL (m amsl)	
Drilled Depth (mbgl)	202.70
Casing depth (m bgl)	25.50
SWL(m bgl)	15.90
Discharge (lps)	0.60
Date / Year	21/01/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	7.50	7.50	Red colour lateritic top soil.
7.50	25.00	17.50	Brown colour soil mixed with kankar, sticky nature.
25.00	38.00	13.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
38.00	44.00	6.00	Light pink colour amygdular basalt, angular to sub angular chips of rock cutting
44.00	76.00	32.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
76.00	80.50	4.50	Vesicular basalt: grayish black, white colour secondary minerals filled with vesicles.
80.50	133.00	52.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
133.00	134.00	1.00	Slightly fractured basalt.
134.00	154.50	20.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
154.50	155.00	0.50	Slightly fractured basalt.
155.00	184.00	29.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
184.00	187.00	3.00	Light pink colour amygdular basalt, angular to sub angular chips of rock cutting
187.00	202.70	15.70	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 9</b>	EW
Village	ARGORI
Block	BARHAIT
District	SAHEBGANJ
Toposheet No.	72 P / 9
Latitude	24 <sup>0</sup> 56' 00"
Longitude	87 <sup>0</sup> 33' 50"
RL (m amsl)	
Drilled Depth (mbgl)	202.70
Casing depth (m bgl)	3.00
SWL(m bgl)	--
Discharge (lps)	Dry
Date / Year	02/02/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	17.00	17.00	Massive basalt: slightly weathered, jointed, grayish black in colour.
17.00	22.00	5.00	Black bole: light black in colour, breakable
22.00	59.50	37.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
59.50	65.50	6.00	Black bole: light black in colour, breakable
65.50	93.00	27.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
93.00	99.00	6.00	Black bole: light black in colour, breakable
99.00	135.50	36.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
135.50	141.50	6.00	Black bole: light black in colour, breakable
141.50	190.50	49.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
190.50	196.50	6.00	Black bole: light black in colour, breakable
196.50	202.70	6.20	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting



### LITHOLOG

<b>Unique ID:10</b>	EW
Village	SAHRAJ DHAB
Block	TALJHARI
District	SAHEBGANJ
Toposheet No.	72 P / 9
Latitude	25 <sup>0</sup> 02' 10"
Longitude	87 <sup>0</sup> 43' 50"
Drilled Depth (mbgl)	160.00
Casing depth (m bgl)	18.30
SWL(m bgl)	--
Discharge (lps)	0.80
Date / Year	05/03/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	18.00	18.00	Top soil mixed with kankar, brown in colour
18.00	22.00	4.00	Massive basalt: slightly weathered, jointed, grayish black in colour.
22.00	30.00	8.00	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting
30.00	31.00	1.00	Slightly fractured & jointed basalt
31.00	41.00	10.00	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting
41.00	50.00	9.00	Vesicular basalt, grayish black, vesicles filled with white colour secondary mineral.
50.00	60.00	10.00	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting
60.00	63.00	3.00	Vesicular basalt, grayish black, vesicles filled with white colour secondary mineral.
63.00	87.00	24.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
87.00	90.00	3.00.00	Vesicular basalt, grayish black, vesicles filled with white colour secondary mineral.
90.00	119.00	29.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
119.00	125.00	6.00	Black bole: light black in colour, breakable
125.00	141.00	16.00	Vesicular basalt, grayish black, vesicles filled with white colour secondary mineral.
141.00	160.00	19.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 11</b>	EW 2
Village	BORIO (Janjatiya College)
Block	BORIO
District	SAHEBGANJ
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 02' 18"
Longitude	87 <sup>0</sup> 34' 37"
RL (m amsl)	
Drilled Depth (mbgl)	202.70
Casing depth (m bgl)	19.00
SWL(m bgl)	42.76
Discharge (lps)	0.14
Date / Year	31/03/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	19.50	19.50	Top soil mixed with boulder/ kankar
19.50	38.00	18.50	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting
38.00	44.00	6.00	Vesicular basalt, grayish black in colour
44.00	68.50	24.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
68.50	98.00	29.50	Black bole: light black in colour, breakable
98.00	105.00	7.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
105.00	111.00	6.00	Black bole: light black in colour, breakable
111.00	121.00	10.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
121.00	126.00	5.00	Vesicular basalt, grayish black in colour
126.00	161.00	35.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
161.00	165.00	4.00	Black bole: light black in colour, breakable
165.00	176.00	11.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
176.00	177.00	1.00	Slightly fractured & jointed basalt
177.00	202.70	25.70	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 12</b>	EW
Village	Sahebganj (Jawahar Navoday Vidyalay)
Block	Sahebganj
District	Sahebganj
Toposheet No.	72 O / 11
Latitude	25 <sup>0</sup> 13' 48"
Longitude	87 <sup>0</sup> 38' 15"
Drilled Depth (mbgl)	202.70
Casing depth (m bgl)	31.20
SWL(m bgl)	
Discharge (lps)	4.5
Date / Year	08/05/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	29.00	29.00	Top soil mixed with kankar/ grey bole
29.00	35.00	6.00	Massive basalt: deep black in colour, jointed, angular to sub angular chips of rock cutting
35.00	36.00	1.00	Fractured & jointed basalt
36.00	61.00	25.00	Massive basalt: deep black in colour, jointed, angular to sub angular chips of rock cutting
61.00	61.50	0.50	Black bole: light black in colour, breakable
61.50	67.50	6.00	Vesicular basalt: grayish black in colour, hard & compact, vesicles filled with white colour secondary mineral
67.50	75.00	7.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
75.00	82.00	7.00	Vesicular basalt: deep black in colour, vesicles filled with white colour secondary mineral
82.00	91.00	9.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
91.00	105.00	14.00	Black & grey bole: light black to grey in colour,
105.00	130.00	25.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
130.00	160.00	30.00	Black & grey bole: light black to grey in colour,
160.00	181.50	21.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
181.50	187.50	6.00	Grey bole: light black to grey in colour.
187.50	202.70	15.20	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 13</b>	OW
Village	Sahebganj (Jawahar Navoday Vidyalay)
Block	Sahebganj
District	Sahebganj
Toposheet No.	72 O / 11
Latitude	25 <sup>0</sup> 13' 48"
Longitude	87 <sup>0</sup> 38' 15"
RL (m amsl)	
Drilled Depth (mbgl)	71.00
Casing depth (m bgl)	31.20
SWL(m bgl)	
Discharge (lps)	0.14
Date / Year	31/05/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	26.00	26.00	Top soil mixed with kankar, brown in colour, sticky nature
26.00	34.50	8.50	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting
34.50	35.00	0.50	Slightly fractured and jointed basalt
35.00	58.00	23.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
58.00	71.00	13.00	Bole bed: grey in colour, breakable, sticky nature

### LITHOLOG

<b>Unique ID: 14</b>	EW
Village	Chhota Barmasia
Block	Borio
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 00' 10"
Longitude	87 <sup>0</sup> 37' 29"
RL (m amsl)	
Drilled Depth (mbgl)	202.70
Casing depth (m bgl)	12.85
SWL(m bgl)	13.22
Discharge (lps)	0.38
Date / Year	30/06/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	10.50	10.50	Top soil mixed with kankar, brown in colour, sticky nature
10.50	12.00	1.50	Bouldery formation of Massive basalt
12.00	32.00	20.00	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting
32.00	50.00	18.00	Bole bed: grey to deep black in colour, breakable, sticky nature
50.00	73.00	23.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
73.00	80.50	7.50	Bole bed: deep black in colour, breakable, sticky nature
80.50	128.00	47.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
128.00	138.50	10.50	Bole bed: deep black in colour, breakable, sticky nature
138.50	155.00	16.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
155.00	156.00	1.00	Slightly fractured and jointed basalt
156.00	160.00	4.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
160.00	166.00	6.00	Bole bed: deep black in colour, breakable, sticky nature
166.00	202.70	36.70	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting

### LITHOLOG

<b>Unique ID: 15</b>	EW
Village	Banjhi
Block	Borio
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 08' 03"
Longitude	87 <sup>0</sup> 39' 19"
RL (m amsl)	
Drilled Depth (mbgl)	74.60
Casing depth (m bgl)	25.50
SWL(m bgl)	
Discharge (lps)	16.70
Date / Year	29/07/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	13.50	13.50	Top soil: deep yellowish brown in colour mixed with laterite and kankar
13.50	19.60	6.10	Weathered massive basalt
19.60	33.00	13.40	Massive basalt: grayish black in colour, H/C.
33.00	34.00	1.00	Fractured vesicular basalt
34.00	39.00	5.00	Vesicular basalt: black in colour
39.00	40.00	1.00	Fractured basalt
40.00	57.00	17.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting
57.00	59.00	2.00	Fractured vesicular basalt
59.00	74.60	15.60	Massive basalt: grayish black in colour, hard and compact (H/C)

### LITHOLOG

<b>Unique ID: 16</b>	OW
Village	Banjhi
Block	Borio
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 08' 03"
Longitude	87 <sup>0</sup> 39' 19"
RL (m amsl)	
Drilled Depth (mbgl)	150.90
Casing depth (m bgl)	25.50
SWL(m bgl)	
Discharge (lps)	1.20
Date / Year	17/08/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	25.00	25.00	Top soil mixed with kankar, deep brown in colour, sticky nature
25.00	34.00	9.00	Black bole
34.00	39.00	5.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
39.00	40.00	1.00	Fractured vesicular basalt.
40.00	50.50	10.50	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.
50.50	56.50	6.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
56.50	93.00	36.50	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.
93.00	97.50	4.50	Gray bole
97.50	123.50	26.00	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.
123.50	129.50	6.00	Gray bole
129.50	150.90	21.40	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.

### LITHOLOG

<b>Unique ID: 17</b>	EW
Village	Nishchinta
Block	Taljhari
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 01' 54"
Longitude	87 <sup>0</sup> 43' 01"
RL (m amsl)	
Drilled Depth (mbgl)	163.00
Casing depth (m bgl)	21.35
SWL(m bgl)	
Discharge (lps)	11.30
Date / Year	22/09/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	21.00	21.00	Top soil mixed with kankar, deep brown in colour, sticky nature
21.00	26.00	5.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
26.00	33.00	7.00	Black bole
33.00	35.00	2.00	Fractured basalt
35.00	88.00	53.00	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.
88.00	97.00	9.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
97.00	106.00	9.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
106.00	109.00	3.00	Amygdular basalt, grayish black in colour, vesicles filled with white colour secondary mineral, jointed and filled with white colour secondary mineral.
109.00	111.00	2.00	Fractured amygdular basalt
111.00	129.00	18.00	Amygdular basalt, grayish black in colour, vesicles filled with white colour secondary mineral, jointed and filled with white colour secondary mineral.
129.00	163.00	34.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.



### LITHOLOG

<b>Unique ID: 18</b>	OW
Village	Nishchinta
Block	Taljhari
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 01' 54"
Longitude	87 <sup>0</sup> 43' 01"
RL (m amsl)	
Drilled Depth (mbgl)	153.90
Casing depth (m bgl)	24.90
SWL(m bgl)	
Discharge (lps)	6.30
Date / Year	26/10/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	24.50	24.50	Top soil mixed with kankar, deep brown in colour, sticky nature
24.50	29.00	4.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
29.00	40.00	11.00	Black bole
40.00	42.00	2.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
42.00	44.00	2.00	Fractured basalt.
44.00	53.50	9.50	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.
53.50	56.50	3.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
56.50	102.00	45.50	Massive basalt: grayish black in colour, jointed, angular to sub angular chips of rock cutting.
102.00	105.00	3.00	Black bole
105.00	139.00	34.00	Amygdular basalt: black in colour, vesicles filled with white colour secondary mineral, hard & compact.
139.00	153.90	14.90	Massive basalt: black in colour, angular to sub angular chips of rock cutting, hard & compact.

### LITHOLOG

<b>Unique ID: 19</b>	EW
Village	Khaira
Block	Mandro
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 06' 12"
Longitude	87 <sup>0</sup> 28' 55"
RL (m amsl)	
Drilled Depth (mbgl)	135.00
Casing depth (m bgl)	27.76
SWL(m bgl)	14.86
Discharge (lps)	14.50
Date / Year	30/11/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	25.00	25.00	Top soil mixed with kankar, deep brown in colour, sticky nature
25.00	27.75	2.75	Bouldery formation of basalt
27.75	31.80	4.05	Black bole
31.80	61.00	29.20	Massive basalt: black in colour, angular to sub angular chips of rock cutting, hard & compact.
61.00	63.00	2.00	Black bole
63.00	105.00	42.00	Massive basalt: black in colour, angular to sub angular chips of rock cutting, hard & compact.
105.00	112.00	7.00	Grey bole
112.00	118.00	6.00	Massive basalt: black in colour, angular to sub angular chips of rock cutting, hard & compact.
118.00	124.00	6.00	Black bole
124.00	126.50	2.50	Fractured and jointed basalt
126.50	135.00	8.50	Massive basalt: black in colour, angular to sub angular chips of rock cutting, hard & compact.

### LITHOLOG

<b>Unique ID: 20</b>	OW
Village	Khaira
Block	Mandro
District	Sahebganj
Toposheet No.	72 O / 12
Latitude	25 <sup>0</sup> 06' 12"
Longitude	87 <sup>0</sup> 28' 55"
RL (m amsl)	
Drilled Depth (mbgl)	132.60
Casing depth (m bgl)	26.00
SWL(m bgl)	
Discharge (lps)	14.50
Date / Year	26/12/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	25.80	25.80	Top soil mixed with kankar, deep brown in colour, sticky nature
25.80	29.00	3.20	Bouldery formation of basalt
29.00	32.00	3.00	Slightly weathered massive basalt
32.00	38.00	6.00	Black bole
38.00	64.00	26.00	Massive basalt: black in colour, jointed, angular to sub angular chips of rock cutting.
64.00	68.50	4.50	Black bole
68.50	117.50	49.00	Massive basalt: black in colour, angular to sub angular chips of rock cutting.
117.50	120.50	3.00	Grey bole
120.50	124.00	3.50	Massive basalt: black in colour, angular to sub angular chips of rock cutting.
124.00	126.50	2.50	Fractured and jointed basalt
126.50	132.60	6.10	Massive basalt: black in colour, angular to sub angular chips of rock cutting.

### LITHOLOG

<b>Unique ID: 21</b>	EW
Village	Hathigarh
Block	Barhait
District	Sahebganj
Toposheet No.	72 P / 9
Latitude	24 <sup>0</sup> 59' 02"
Longitude	87 <sup>0</sup> 36' 54"
RL (m amsl)	
Drilled Depth (mbgl)	147.80
Casing depth (m bgl)	16.50
SWL(m bgl)	7.30
Discharge (lps)	3.00
Date / Year	19/03/2018

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	16.50	16.50	Top soil mixed with kankar, deep yellowish brown in colour, sticky nature
16.50	32.00	15.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
32.00	44.00	12.00	Black bole
44.00	45.00	1.00	Slightly fractured basalt.
45.00	76.15	31.15	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
76.15	87.00	10.85	Black bole
87.00	92.00	5.00	Fractured basalt.
92.00	123.50	31.50	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
123.50	128.50	5.00	Black bole
128.50	147.80	19.30	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.

### LITHOLOG

<b>Unique ID: 22</b>	OW
Village	Hathigarh
Block	Barhait
District	Sahebganj
Toposheet No.	72 P / 9
Latitude	24 <sup>0</sup> 59' 02"
Longitude	87 <sup>0</sup> 36' 54"
RL (m amsl)	
Drilled Depth (mbgl)	105.10
Casing depth (m bgl)	16.50
SWL(m bgl)	
Discharge (lps)	0.14
Date / Year	28/03/2018

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	16.00	16.00	Top soil mixed with kankar, deep yellowish brown in colour, sticky nature
16.00	26.00	10.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
26.00	28.00	2.00	Black bole
28.00	32.00	4.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
32.00	44.00	12.00	Black bole
44.00	75.00	31.00	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.
75.00	87.00	12.00	Black bole
87.00	88.00	1.00	Slightly fractured basalt
88.00	105.10	17.10	Massive basalt: grayish black in colour, angular to sub angular chips of rock cutting.

### LITHOLOG

<b>Unique ID: 23</b>	EW
Village	UDHWA (Block Office)
Block	UDHWA
District	SAHEBGANJ
Toposheet No.	72 P/ 13
Latitude	24.969566
Longitude	87.840435
RL (m amsl)	
Drilled Depth (mbgl)	133.10
Casing depth (m bgl)	26.00
SWL(m bgl)	--
Discharge (lps)	1.20
Date / Year	28/11/2017

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	3.00	3.00	Lateritic soil
3.00	41.50	38.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
41.50	44.50	3.00	Black bole
44.50	51.00	6.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
51.00	62.00	11.00	Black bole
62.00	63.00	1.00	Slightly fracture & jointed basalt
63.00	75.00	12.00	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
75.00	84.00	9.00	Black bole
84.00	90.50	6.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
90.50	93.00	2.50	Black bole
93.00	105.50	12.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
105.50	110.00	4.50	Black bole
110.00	118.00	8.00	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
118.00	121.00	3.00	Black bole
121.00	133.10	12.10	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.

### LITHOLOG

<b>Unique ID: 24</b>	EW - I
Village	CHATRADIH
Block	UDHWA
District	SAHEBGANJ
Toposheet No.	72 P/ 13
Latitude	24.96531
Longitude	87.81848
RL (m amsl)	
Drilled Depth (mbgl)	190.80
Casing depth (m bgl)	12.80
SWL(m bgl)	--
Discharge (lps)	Dry
Date / Year	07/02/2018

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	11.00	12.00	Jointed, weathered massive basalt
12.00	38.50	26.50	Massive basalt: grayish black, powdery & angular to sub angular chips of rock cuttings. Hard & compact.
38.50	44.50	6.00	Vesicular basalt: black in colour, some vesicles filled with white colour secondary mineral.
44.50	69.00	24.50	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
69.00	75.00	6.00	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
75.00	87.00	12.00	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
87.00	99.00	12.00	Black bole
99.00	133.00	34.00	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
133.00	135.00	2.00	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
135.00	162.00	27.00	Massive basalt: grayish black, angular to sub angular chips of rock cuttings.
162.00	166.00	4.00	Vesicular basalt: grayish black, some vesicles filled with white colour secondary mineral.
166.00	190.80	24.80	Massive basalt: grayish black, jointed, angular to sub angular chips of rock cuttings.

### LITHOLOG

Unique ID: 25	EW (old)
Village	BORIO
Block	BORIO
District	SAHEBGANJ
Toposheet No.	72 O/ 12
Latitude	250 01' 40"
Longitude	870 34' 30"
RL (m amsl)	
Drilled Depth (mbgl)	75.20
Casing depth (m bgl)	13.70
SWL(m bgl)	5.53
Discharge (lps)	22.00
Date / Year	January 1982

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	8.00	8.00	Laterite, clayey, brickred to reddish brown
8.00	16.00	8.00	Lithomarge, greenish white to brownish white
16.00	18.00	2.00	Traps, weathered and fractured, light grey
18.00	20.00	2.00	Shale, grayish
20.00	22.00	2.00	Traps, very fine grained greenish black, massive
22.00	23.00	1.00	Traps, highly fractured, black
23.00	29.00	6.00	Shale, black
29.00	35.00	6.00	Traps, fine grained, massive
35.00	37.00	2.00	Traps, dark grey to grayish, partly weathered
37.00	39.00	2.00	Traps, fine grained, massive
39.00	43.00	4.00	Traps, dark grey, slightly fractured with amygdaloids
43.00	50.00	7.00	Traps, doleritic, slightly fractured
50.00	54.00	4.00	Traps, fractured
54.00	58.00	4.00	Shale
58.00	60.00	2.00	Traps, grey, fractured
60.00	64.00	4.00	Shale, grayish black
64.00	74.00	10.00	Traps, fine grained, dark grey, slightly fractured
74.00	75.20	1.20	Traps, doleritic, dark, grey, fractured



## LITHOLOG

Unique ID: 26	OW (old)
Village	BORIO
Block	BORIO
District	SAHEBGANJ
Toposheet No.	72 O/ 12
Latitude	250 02' 15"
Longitude	870 37' 15"
RL (m amsl)	
Drilled Depth (mbgl)	44.20
Casing depth (m bgl)	--
SWL(m bgl)	--
Discharge (lps)	--
Date / Year	January 1982

Depth range (m bgl)		Thickness (m)	Litholog
From	To		
0.00	6.00	6.00	Lateritic clayey, yellowish to reddish brown
6.00	10.00	4.00	Lithomarge, reddish brown to earthy white
10.00	13.00	3.00	Traps, acidic, poorly fractured
13.00	15.00	2.00	Shale, grayish black
15.00	16.00	1.00	Contact of shale with trap, greenish with amygdaloids
16.00	22.00	6.00	Traps, doleritic highly to poorly fractured
22.00	23.00	1.00	Traps, acidic, white to grey, massive
23.00	25.00	2.00	Traps, doleritic, massive
25.00	28.00	3.00	Shale, greenish black
28.00	29.00	1.00	Contact of shale with trap, massive
29.00	36.00	7.00	Traps, grayish to greenish black, massive
36.00	44.20	7.00	Traps, acidic, white to grayish white, massive

## Annexure – VIII

## Analytical results of water samples for Arsenic and Iron concentration of Sahebganj block( 2017)

Sample No.	Village	Location	As concentration (mg/l)
1	2	3	4
1	Mahadevganj	Near house of Shri Dharmaraj Yadav	0.004
2	Mahadevganj	Near house of Shri Jugesh Yadav	0.0005
3	Ojha Tola	Near house of Shri Maina Ojha	BDL
4	Ojha Tola	Near house of Shri Manoj Ojha	0.012
5	Hazipur West	Near house of Shri Radha Mandal	BDL
6	Hazipur West	Near house of Shri Vishwanath Mandal	BDL
7	Hazipur East (Bihar)	Near Samudaik Vikash Bhawan	0.004
8	Hazipur East (Bihar)	Near house of Shri Gaya Prasad	BDL
9	Hazipur Bihta	Near house of Shri Dip Narayan Goswami	0.079
10	Hazipur Bihta	Near house of Shri Shiv Sankar Mandal	0.009
11	Hazipur Bihta	Near house of Shri Manohar Mandal	BDL
12	Rajgaon	Near house of Shri Sant Lal Paswan	BDL
13	Mirza Chowki	Near Hanuman Mandir	BDL
14	Mirza Chowki	Near house of Shri Tarakant Thakur	BDL
15	Hazipur Bihta	Near house of Shri Sita Ram Rajak	0.082
16	Dihari	Near house of Smt. Sumita Devi	0.089
17	Dihari	Near Hanuman Mandir	0.090
18	Dihari	Near house of Shri Dinanath Yadav	0.085
19	Bhulia Tola	Near house of Shri Vidyasagar Mandal	0.022
20	Bhulia Tola	Near house of Shri Dashrath Mandal	0.017
21	Patwar Tola	Near house of Shri Krishna Dev Mandal	BDL
22	Patwar Tola	Near house of Shri Laxman Mandal	0.0009
23	Bari Kudarjana	Near house of Shri Upendra Kr. Singh	0.073
24	Bari Kudarjana	Near house of Shri Ashok Das	0.009
25	Bari Kudarjana	Near house of Shri Anirudh Mandal	0.007
26	Nadhi Dera	Near house of Shri Bhaju Ram Mandal	0.067
27	Nadhi Dera	Entrance to the village (LHS)	0.015
28	Chhoti Kudarjana	Near house of Mohmad Shekh Mokin	0.004
29	Chhoti Kudarjana	Near house of Mohmad Bilal	0.004
30	Naya Tola	Near house of Mohmad Firoz	0.004
31	Reza Nagar	Near house of Mohmad Gaffar	0.059
32	Reza Nagar	Near house of Mohmad Allauddin	0.053
33	Reza Nagar	Near house of Mohmad Ijhar	0.077
34	Musahari Tola, Lalbathani	Near house of Shri Laxman Choudhary	0.025
35	Musahari Tola, Lalbathani	In front of Utkarmik Primary School	0.01
36	Krishna Prasad	Near house of Shri Madhusudan Rai	0.008

37	Krishna Prasad	Entrance to village (RHS) near Hanuman temple	0.037
38	Baluadiara	Near house of Mohmad Nijamuddin	0.042
39	Baluadiara	Entrance to village at tri junction (RHS)	0.071
40	Dera	Near house of Shri Jamuna Prasad	0.01
41	Kabutar Khopi	Near house of Shri Ashok Bhagat	0.009
42	Kabutar Khopi	Near house of Shri Kailash Mandal	0.006
43	Chanan	Near house of Shri Wakil Mandal	0.009
44	Chanan	Near Gor Temple	0.061
45	Madansahi	Near house of Mohmad Tarik Ansari	0.008
46	Soti Chowki Pangdo	Near house of Mohmad Alam	0.005
47	Bari Madansahi	Near house of Shri Sham Mohmad	0.003
48	Bari Madansahi	Near house of Shri Sham Mohmad	0.003
49	Soti Chowki Pangdo	Near house of Shri Kewra Oraon	BDL
50	Soti Chowki Pangdo	Near house of Shri Mehru Mundu	0.001
51	Khutari	Near house of Shri Rambali Choudhary	0.002
52	Khutari	Near house of Shri Sukhdev Mandal	0.001
53	Samda	Near house of Shri Bishnath Yadav	0.004
54	Hathigarh	Near house of Shri Dev Charan Yadav	0.004
55	Sakrigali	Near house of Shri Shrilal Yadav	0.004
56	Ambadiha	North of Utkarmik Middle School	0.004
57	Maharajpur	Near house of Shri Lakhan Mahto	0.003
58	Maharajpur	Near garage of Mohmad Anwar	0.003
59	Masleya	Near house of Shri Fakir Chand Rajak	0.004
60	Karim Bagicha	Near house of Shri Shirish Roy	0.031

### 2015 (Sahebganj block)

Sample No.	Village	Location	As concentration (mg/l)	Fe concentration (mg/l)
1	2	3	4	5
1	Dihari	Utkramit Middle school campus	0.206	7.356
2	Dihari	Utkramit Middle school campus	0.215	6.87
3	Hajipur Bihtta	Left side of main Road	0.322	2.2
4	Ojha tola, Dihari	Right side of main Road, inside village	0.198	7.06
5	Bhulia tola, Dihari	Right side of main Road	0.065	0.396
6	Bari Kodarjana	Right side of main Road, near Allahabad bank	0.042	2.456

7	Choti Kodarjana	Right side of main Road and Inside the village, urdu middle school campus	0.177	2.426
8	Baludiara	Inside the village and near Utkramit Middle school	0.136	2.716
9	Kishan Prasad	Govt. Middle school campus	0.225	3.36
10	Makhmalpur	In front of the house of Mr. Rehman	0.166	6.163
11	Lalbathani Sarpanch Tola	Govt. Utkramit school campus	0.126	3.199
12	Madansahi	Near Pragya Kendra	0	0.847
13	Samda	Utkramit Middle school campus	0.026	4.134
14	Chanan	Bipin Chourasia house	0	1.524
15	Sobhanpur Gangota	In front of the house of Sarwar mandal	0.005	2.136
16	Mahadevganj	In the house of Guneswar Yadav	0	1.814
17	Rajgaon	Utkramit Middle school campus	0	0.815
18	Nadhi diara	Near primary School	0	2.362
19	Rejanagar	Md.Sajjan house	0.029	1.202

### 2015 (Rajmahal block)

Sample No.	Village	Location	As concentration (mg/l)	Fe concentration (mg/l)
1	2	3	4	5
1	Budhbaria	Near house of Niran Ravidas	0.063	2.007
2	Jogichak	Opposite Temple	0.018	4.359
3	Chandipur	Primary school	0.077	5.874
4	Sobhapur	Near house of Nimai Sao	0.014	1.169
5	Dergama	Near house of Sahdeo Paswan	0.025	8.516
6	Malahitola	Near house of Chotelal mandal	0.014	1.234
7	Mansinghpur	Primary school Campus	0.016	2.555
8	Mundomala	Near house of Sunil Saha	0.013	3.489
9	Tetulia	Near Aanganbari Kendra	0.011	1.266
10	Harischandpur	Near house of Dharendra mandal	0.016	3.747

11	Manikpur	Utkramit primary School	0.016	0.428
12	Darla	Near house of Bhola Ravidas	0.022	0.944
13	Inayatpur	In front of middle school	0.028	0.847
14	Pranpur/Alampura	In front of house of Abdul Seikh	0.022	0.879
15	Begumpur	In front of the house of Gobind Mandal	0.016	1.073
16	Lakhipur	In the campus of KGBAV	0.025	1.653
17	Mansingha	In front of the house of usman gani seikh	0.026	1.943
18	Phulwaria	Adjacent to masjid	0.027	0.461
19	Nayabazar	Near house of Arjun Pramanik	0	0.912
20	Narainpur (Bendubi)	Near house of Kiddir Seikh	0.112	2.845
21	Naughara	Near house of Gopal Bagdi	0	2.309
22	Raibazar	In front of the house of rajan sardar	0	1.266
23	Jamnagar	Near Kirtan mandap	0	2.136

### 2015 (Udhwa block)

Sample No.	Village	Location	As concentration (mg/l)	Fe concentration (mg/l)
1	2	3	4	5
1	Balugram	Near house of Shamu Mistri	0.031	2.974
2	Ghasitola	In the house of Abu Tahir	0.015	1.427
3	Talebhaji	Near house of Suleman Sheikh	0.088	4.681
4	Piyarpur	Near house of Tajbul Sheikh	0	2.039
8	Sadikali tola	Utkramit primary school	0.106	5.906
6	Sridhar colony No.3	Utkramit primary School Sridhar diara	0.068	3.296
7	Sridhar Diara	Campus of Vivekanand high school	0	1.814
8	Kathalbari	Near house of Subodh Ghosh	0.009	3.521
9	Gobargari	Prathmik School Gobargari	0.013	2.684
10	North Begumganj	Begum trijunction	0.0008	1.782
11	Radhanagar	KGABV	0	1.911

12	Mirnagar	Health Sub-centre	0	2.233
13	South Begumganj (habutola)	Near house of Adu Sheikh	0	1.782
14	Manihari Tola	Backside of Masjid	0.046	6.55
15	Phudkipur (Naughariya)	Near house of Uttam Saha (near Chouraha)	0	2.877
16	Udhwa	Near Vananchal Gramin Bank	0	2.072
17	Suthiarpara	Maltola	0	2.233
18	Jonka	Near house of Sudhir Chandra Rai	0	3.36

### 2017 (Sahebganj block)

Sample No.	Village	Location	Arsenic concentration (mg/l)
1	Dihari	Utkramit Middle school campus	0.168
2	Dihari	Utkramit Middle school campus	0.287
3	Hazipur Bhatta	Left side of main Road (inside house)	0.163
4	Hazipur Bhatta	Right side of main Road & in the field	0.076
5	Ojha Tola	Right side of main Road, inside village	0.150
6	Bhulia Diara	Right side of main Road,	0.042
7	Choti Kudarjana	Inside village, Urdu middle school campus	BDL
8	Balua Diara	Inside village and near Utkramit Middle school (Md. Samsul house)	0.032
9	Kishan Prasad	Govt. Middle school campus	0.066
10	Makhmalpur south	In front of the house of Mr. Rehman	0.082
11	Lalbathani	In front of Utkramit school	BDL
12	Budhbaria	Near house of Niran Ravidas	0.043
13	Samda	Utkramit Middle school campus	BDL
14	Bari Kudarjana	Right side of main road, near Allahabad Bank	0.041

**2017 (Rajmahal block)**

Sample No.	Village	Location	Arsenic concentration (mg/l)
1	Chandipur	Near Primary school	0.072
2	Jogi chak	Opposite to Temple	0.005
3	Sobhapur	Near house of Nimai Sao	BDL
4	Dergama	Near house of Sahdeo Paswan	0.004
5	Malahitola	Near house of Chotelal Mandal	BDL
6	Mansinghpur	Primary school Campus	BDL
7	Mundomala	Near house of Sunil Saha	BDL
8	Harishchandpur	Near house of Dharendra Mandal	BDL
9	Manikpur Simri	Utkramit primary School	BDL
10	Darla	Near house of Bhola Ravidas	BDL
11	Inayatpur	In front of middle school	BDL
12	Begampur	In front of the house of Gobind Mandal	BDL
13	Lakhipur	In the campus of KGBAV	BDL
14	Mansingha	In front of the house of Usman Gani Seikh	0.029

**2017 (Udhwa block)**

Sample No.	Village	Location	Arsenic concentration (mg/l)
1	Phulwaria	Adjacent to masjid	0.022
2	Sadik Ali tola	Utkramit primary school	0.104
3	Sridhar colony - 3	Utkramit primary School Sridhar diara	0.127
4	Balugram	Near house of Shamu Mistri	0.055

## INTERPRETED RESULT OF GEOPHYSICAL SOUNDING (VES) OF SAHEBGANJ DISTRICT

Sl. No.	VES Location	Block	Layer thickness in m.	Total thickness in m.	Lithology
1.	Haripur Diara	Sahebganj	65.00 90.00	65 155 Below 155	Sand Clay Basement (basal)
2.	Dihari village	Sahebganj	1.0 62 93	1.0 63 155 Below 155	Top soil Sand Clay Basement
3.	Dihari Gaucher	Sahebganj	1.0 74 80	1.0 75 155 Below 155	Top soil Sand Clay Basement
4.	Parahira village	Rajmahal	1.2 1.8 3	1.2 3.0 6 Below 6	Top soil Sand Clay Basement
5.	Begampura	Rajmahal	2.0 28	2.0 30 Below 30	Top soil Clay Basement
6.	Mundli Rampur	Rajmahal	2.0	2.0 From 2.0	Top soil Weathered basalt
7.	Matwal Rajmahal	Rajmahal	1.0 25 16	1.0 26 42 Below 42	Top soil Fine Sand Clay Basement
8.	Mansinga	Rajmahal	1.0 12 22	1.0 13 35 Below 35	Top soil Sand Clay Basement
9.	Rajgaon	Sahebganj	1.0 18 11 32	1.0 19 30 62 Below 62	Top soil Sand Basement Fractures Basement
10.	Kishan Prasad	Sahebganj	1.2 84.8	1.2 86.0	Top soil Sand



	village		89	175 Below 175	Clay Basement
11.	Makhmalpur (South)	Sahebganj	2.5 94.5 105	2.5 97.0 202.0 Below 202	Top soil Sand Clay Basement
12.	Hazipur Diara	Sahebganj	1.0 73.0 85	1.0 74.0 159 Below 159	Top soil Sand Clay Basement
13.	Garamtola	Sahebganj	2.5 85.5 89.0	2.5 88.0 177.0 Below 177	Top soil Sand Sand + Clay Basement
14.	Sovanpur - Bangalitola	Sahebganj	1.0 105 88.0	1.0 106.0 194.0 Below 177	Top soil Sand Clay Basement
15.	Balua Diara	Sahebganj	1.0 101 87.0	1.0 102.0 189.0 Below 189	Top soil Sand Clay Basement
16.	Gopalpur	Udhwa	1.0 25.0	1.0 26.0 Below 26.0	Top soil Clay Basement
17.	Talbana - Sovanpur	Sahebganj	2.5 2.5 171	2.5 5.0 176.0 Below 176	Top soil Clay Sand Basement
18.	Bara Jirwabari - Chanan	Sahebganj	1.5 3.5 83.0	1.5 5.0 88.0 Below 88.0	Top soil Sand Clay Basement
19.	Pir Darga sakrigali	Sahebganj	1.0 59.0 131.0	1.0 60.0 191.0 Below 191	Top soil Sand Clay Basement
20.	Radha Nagar	Udhwa	0.90 3.98 14.6 20.4	0.90 4.88 19.5 39.5 Below 39.5	Surface soil Sticky clay with fine sand Clay with medium sand Sandy clay Hard rock
21.	Amanat Diara	Udhwa	0.74 5.90	0.74 6.64	Surface soil Clay with medium sand

			6.66 41.1 --	13.3 54.4 --	Clay Clay with medium sand Clay with coarse sand
22.	Piyarpur	Udhwa	1.52 8.88 18.90 --	1.52 10.40 29.30 --	Surface soil Clay with fine sand Clay with medium sand Clay with coarse sand
23.	Shridhar	Udhwa	1.02 20.08 --	1.02 21.10 --	Surface soil Clay with medium sand Coarse sand with gravel
24.	Fudkipur	Udhwa	2.88 9.72 20.70 --	2.88 12.60 33.3 --	Surface soil Clay with medium sand Clay Coarse sand with gravel
25.	Rajgaon	Sahebganj	1.15 7.88 18.77 --	1.15 9.03 27.8 --	Surface soil Clay Clay with fine sand Clay with medium sand
26.	Hazipur Bhita	Sahebganj	3.51 5.31 11.58 17.80 --	3.51 8.82 20.4 38.2 --	Surface soil Clay Clay with medium sand and kankar Clay with medium sand Clay
27.	Bari Kodarjana	Sahebganj	1.10 12.30 21.0 --	1.10 13.40 34.40 --	Surface soil Clay with medium sand and gravel Fine sand with clay Medium sand with clay and gravel

---

केन्द्रीय भूमि जल बोर्ड / Central Ground Water Board  
मध्य -पूर्वी क्षेत्र/ Mid-Eastern Region  
राज्य एकक कार्यालय / State Unit Office  
रांची /Ranchi

फोन /Phone: 0651-2242550

फैक्स /Fax :0651-2242550

ई-मेल /E-mail: suoranchi-cgwb@nic.in

वेबसाईट /Web site : [www.cgwb.gov.in](http://www.cgwb.gov.in)