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

RI BHOI HILLS DISTRICT, MEGHALAYA

उत्तर पूर्वी क्षेत्र, गुवाहाटी

North Eastern Region, Guwahati

GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION

CENTRAL GROUND WATER BOARD

REPORT
ON

"AQUIFER MAPPING AND MANAGEMENT PLAN OF RI BHOI DISTRICT, MEGHALAYA"

(AAP 2016-17)

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Preface

Under National Aquifer Mapping and Management Plan (NAQUIM) programme, Central Ground Water Board, State Unit Office, Shillong has carried out aquifer mapping and management plan in Ri Bhoi district of Meghalaya. The objective was to understand the aquifer system down to the depth of 200 meters, decipher the aquifer geometry, its characteristics, quantity, quality and formulate a complete sustainable and effective management plan for ground water development in the study area.

A multi disciplinary approach of geology, geophysics, hydrology and chemistry was adopted to achieve the objectives of the study.And also with the help of Agricultural Scientists, a management plan was made.

This report elaborates the different aquifer system prevailing in the study area, its characteristics and also provides the different scientific data which will help in proposing plans to achieve drinking water security, irrigation facilities etc through sustainable ground water development.

The groundwater management plan was made with an emphasis in providing irrigation facilities through ground water development as agriculture is the main means of livelihood of the people in the district which covers about 80% of the total population.To use the groundwater for irrigation purpose, a cropping plan has been designed for the district by using CROPWAT model developed by FAO. All the necessary input to design a cropping plan was made with the help of Principal Scientist (Agrometeorology), ICAR, Umiam and Agricultural Engineer of Assam Agricultural University, Jorhat.

The study of this Aquifer mapping and management plan of Ri Bhoi district was carried out under the supervision of Shri Tapan Chakraborty, Officer In Charge & Nodal officer of NAQUIM, NER who has helped in all the aspects of field work, technical inputs, report preparation and moral support.

I hope this report will help the stake holders, planners, policy makers, professionals, academicians and researchers dealing with water resources or ground water resources management.

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I thank all the Engineers and Drilling staff of CGWB, Division VII, Guwahati for their contribution in ground water exploratory drilling activities in the study area.

I sincerely thank Geological Survey of India, North East Space Application Centre, Survey of India and Indian Meteorological Department for providing the valuable data and maps.

I would also like to thank Meghalaya State Government officials of Water Resource Department, Public Health Engineering Department, Statistical Departmentand Agricultural Department for providing all the necessary information of the study area.

I thank all the officials and staff of CGWB, SUO, Shillongfor their help and support during the course of this work.

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ABBREVIATION

AAP	Annual Action Plan
CGWB	Central Ground Water Board
NER	North Eastern Region
NAQUIM	National Aquifer Mapping and Management Plan
GL	Ground Level
GSI	Geological Survey of India
IMD	Indian Meteorological Department
LPM	Litres per minute
LPS	Litres per second
m	metre
mbgl	meters below ground level
MCM	Million Cubic Meter
Mm	Milli meter
mg/l	milligram/litre
m amsl	Metre above mean sea level
Sq.Km	Square Kilometre
µS/cm	Microsimens/centimetre
AMP	Aquifer Management Plan
AQM	Aquifer Mapping
BIS	Bureau of Indian Standards
BDL	Below detectable level
BCM	Billion Cubic Metres
DGM	Directorate of Geology and Mining
DTW	Depth to water table
DW	Dug Well
BW	Bore well
EC	Electrical Conductivity
EW	Exploratory Well
GEC	Ground water Estimation Committee
Ha	Hectare
Ham	Hectare meter
Km	Kilometer
MP	Measuring Point
OW	Observation Well
°C	Degree Celsius
Ppm	Parts per million equivalents to mg/l
Pz	Piezometer
SWL	Static water level
TDS	Total dissolved solid

EXECUTIVE SUMMARY

Aquifer Mapping studies and Management Plan has been carried out in Ri Bhoi district, Meghalaya under National Aquifer Mapping and Management Plan (NAQUIM) programme with an objective to know the different aquifer system prevailing in the study area, to decipher the vertical and lateral extend of the aquifer down to the depth of 200 m, its characteristic, quantity as well as quality so as to bring a complete sustainable and effective aquifer management plan for ground water resources development in the study area.These studies has been done through multi-disciplinary approach so as to achieve the said objectives.

The total coverage area of aquifer mapping and management plan is 909 sq.km out of 2448 sq.km of the district and is underlain by consolidated rocks ofArchaean Gneissic complex, Granite pluton and Quartzite with a small patch of unconsolidated Tertiary alluvium in isolated patches of limited areal extent in North-Western part.

Occurrence of ground water in the study area is mainly of weathered and fractured Gneissic, Granite pluton and Quartzite formation. The different hydrogeological data are generated through intensive field data collection and testing.The aquifer system in this district can be dividedas a two aquifer systemviz., first aquifer (shallow) and second aquifer (deeper).Shallow or first aquifer consists of weathered residuum where ground water occurs under water table condition and is mainly developed by construction of dug wells or shallow bore wells as hand pump. The second aquifer is the deeper aquifer which tapped the fractured zone. Based on the study of litholog and analysis of depth of construction of dug wells and shallow bore wells, it is found that the first aquifer occur within 2 to 35 m bgl. Ground water in the second aquifer occurs under semi-confined to confined condition in the fractures upto the maximum depth of 213.59 m bgl.

Ground water exploration has been carried out in different parts of the district to delineate the potential aquifers and their geometry and to determine the hydrogeological parameters of the aquifer systems.To know the different parameters of an aquifer, Aquifer performance test, preliminary yield test, slug test and dug well pump test were carried out during the course of study.Soil infiltration test wasalso conducted in different parts of the study area to know the infiltration rates at different soil conditions, topography, geology and environment and also to know its suitability and the amount of water recharging in the area and its rainfall infiltration factor.

Study of water level trend and its behaviour both in phreatic and confined condition were carried out in the aquifer mapping area. Study of spring was also carried out in the study area.Most of these springs weredepression and topographic or fractured springs. It is observed that the discharge of springs in this area ranges from 0.576 to 81 litre/minute during pre-monsoon and 0.6 to 102.84 litre/minute during post-monsoon season.

In order to study the chemical quality of ground water in the district, water samples from first aquifer (dug wells and springs) and second aquifer (CGWB Bore well) were collected during the course of field work and were analyzed and it was found that there is a high concentration of iron in both shallow aquifer and deeper aquifer. A moderately high concentration of iron is also found in springs.

Surface Geophysical studies in the study area were carried out to delineate the subsurface geology as well as tosupplement the data gap under the assignment of Aquifer Mapping. A total of 20 VES were conducted with maximum available electrode spread (AB) of 250m respectively as part of electrical prospecting.

Dynamic Groundwater Resources of the study area has been estimated based on the methodology recommended by Groundwater Estimation Committee (GEC'97). The net ground water availability was 7133 ham and the stage of ground water development was 0.38% which comes under safe category.

Finally, the aquifer map of the study area is generated based on the inputs from geological, hydrogeological, geophysical and hydrochemical studies and a management plan was made with an emphasis in providing irrigation facilities through ground water development as agriculture is the main means of livelihood of the people living in the district. With the help of Agricultural professionals and using CROPWAT model software developed by FAO a cropping plan was designed for the district through using groundwater irrigation.

1. INTRODUCTION

Central Ground Water Board, North Eastern Region has carried out Aquifer mapping and management plan in Ri Bhoi district, Meghalaya during AAP 2012-13, 2015-16 and 2016-17covering an entire area of 909sq.km. Under National Aquifer Mapping and Management (NAQUIM) program, combination of geologic, geophysical, hydrologic and hydro chemical information is applied to characterize the quantity, quality and sustainability of ground water aquifers. Systematic aquifer mapping will improve ourunderstanding of the geologic framework of aquifers, their hydrogeologic characteristics, quality and also quantifying the available ground water resources potential and proposing plans appropriate to the scale of demand and the institutional arrangements for management.Aquifer mapping at the appropriate scale can help to prepare, implement and monitor the efficacy of various management interventions aimed at long-term sustainability of our precious ground water resources, which, in turn, will help achieve drinking water security, improved irrigation facilities and sustainability in water resources development.

1.1 Objectives

The objectives of this project are;to understand the aquifer systems up to 200 m depth,to define the aquifer geometry, type of aquifers, ground water regime behaviours, hydraulic characteristics and to establish groundwater quantity, quality, and sustainability, and to estimate the dynamic and static resources accurately through a multidisciplinary scientific approachon 1:50,000 scale and finally formulate a complete, sustainable andeffective management plan for ground water development.

1.2 Scope of the Study:

The activities of this Aquifer Mapping and management plan can be envisaged asfollows:

1.2.1 Data Compilation & Data Gap Analysis: One of the important aspect of aquifer mapping programme was the synthesis of the large volume of data already collected during specific studies carried out by Central Ground Water Board and various Government organizations with a new data set generated that broadly describe an aquifer system. The data were assembled, analysed, examined, synthesized and interpreted from available sources. These sources were predominantly non computerized data, which was converted into computer based GIS data sets. On the basis of available data, Data Gaps were identified.

1.2.2 Data Generation: There was also a strong need for generating additional data to fill the data gaps to achieve the task of aquifer mapping. This was achieved by multiple activities such as exploratory drilling, geophysical techniques, hydro-geochemical analysis, remote

sensing, besides detailed hydrogeological surveys to delineate multi aquifer system; to bring out the efficacy of various geophysical techniques and a protocol for use of geophysical techniques for aquifer mapping in different hydrogeological environs.

1.2.3. Aquifer Map Preparation: On the basis of integration of data generated from various studies of hydrogeology, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out characterization of Aquifers, which can be termed as Aquifer maps providing spatial variation (lateral & vertical) in reference to aquifer extremities, quality, water level, potential and vulnerability (quality & quantity).

1.2.4. Aquifer Management Plan Formulation: Aquifer Maps and ground water regimescenario are being utilized to identify a suitable strategy for sustainable development of theaquifer in the area.

1.3Approach and Methodology: Aquifer mapping has been carried out by adopting amulti-disciplinary approach:

(i) Geophysical Surveys through Vertical Electrical Sounding (VES)

(ii) Exploratory drilling and construction of tube/bore wells tapping various groups of aquifers

(iii) Ground Water Regime monitoring by establishing monitoring wells tapping different aquifers at different depths for long term monitoring of water level and quality

(iv) Pumping test of bore wells and dug wells, soil infiltration test, specific yield determination, slug tests for determination of ground water recharge scope, intensity and potentials and also to determine the characteristics and performances of existing aquifers at various depths

(v) Collection of various relevant technical data from the field in aquifer mapping area and also from the concerned State Govt. Agencies and other Institutes dealing with ground water and incorporating these data along with CGWB data for final output.

(vi) Preparations of a micro level mapping of existing aquifers, their potentials depth wise and sideways in 2D and 3D forms viewed from different angles by various GIS Layers.

(vii) Formulating a complete sustainable aquifer management plan for ground water development.

1.4 Area details: RiBhoi district lies between E 91˚20’30” to E 92˚17’00” Longitude and N 25˚40’00” to N 26˚20’00” Latitude. The district is having an area of 2448 sq.km. Out of this, 909 sq.km of map able area was covered under NAQUIM programme. The district has three C. &R.D. blocks and the details of the block along with their respective headquarters are given in Table 1.1.

Table 1.1 Administrative setup of Ri Bhoi district

Name of District/C.D. Block/Town	**Total/ Rural/ Urban**	**Area in Km^2**	**Headquarter**	**Total number of villages/wards**	**Number of inhabited villages/wards**	**Number of inhabited villages/wards**
1	2	3	4	5	6	7
Ri Bhoi District	Total	2448.0	Nongpoh	635	579	56
	Rural	2390.02		635	579	56
	Urban	57.98		2	2	0
Umling C.D. Block	Total	599.63	Umling	223	200	23
	Rural	553.63		223	200	23
	Urban	46.0		1	1	0
Jirang C.D. Block	Total	659.40		107	105	2
	Rural	659.40	Jirang	107	105	2
	Urban	0				
Umsning C.D. Block	Total	1188.97	Umsning	305	274	31
	Rural	1176.99		305	274	31
	Urban	11.98	Umroi	1	1	0

This area falls partly or fully in the quadrants of Survey of India Toposheets bearing nos. 78 O/5, 78 O/9, 78 O/10, 78 O/12, 78O/13, 78O/14, 83 B/4, 83 B/8, 83 C/1 and 83 C/2 and is bounded by Kamrup district of Assam in the north, Karbi Anglong district of Assam in the east, East Khasi Hills district in the south and West Khasi Hills district in the west.

1.5 Data availability, data adequacy and data gap analysis:

Aquifer mapping and management plan is carried out through collaborative of different data. The required data on various attributes of the study are collected from the available literatures of Central Ground Water Board, State Water Resources Department of Meghalaya and various Central and State Government agencies. The Data Requirement, Data Availability and Data Gap Analysis are presented in table 1.2.

Table1.2 Data Availability and Data Gap Analysis in Aquifer Mapping Studies

Sl. No.	Items	Data Requirement	Data Availability	Data Gap
1	Ground Water Exploration Data	As per requirement of Advanced Geophysical Studies for Integration of data and Validation of Techniques	17 EW	Entire study area
2	Geophysics	Geophysical data of the Study area	10 VES	Entire study area
3	Ground Water Monitoring Regime	Representative Monitoring Wells well distributed over the Study Area	4 Monitoring Well	Entire study area
4	Ground Water Quality	Representative Monitoring Wells well distributed over the Study Area	Water quality data of 4 monitoring wells	Representative Monitoring key Wells covering the entire study area
5	Specific yield (Shallow and deeper aquifer)	5 in shallow aquifer and 4 in deeper aquifer	Nil	Entire study area
6	Climate	Season-wise Rainfall pattern	Annual Rainfall of 1 Meteorological Station	Time-series data on Rainfall
7	Soil	Soil map and Soil Infiltration Rate	Soil map	Soil Infiltration studies covering the entire study area
8	Land use	Latest Land Use pattern	No Data	Latest data required
9	Geomorphology	Detailed Information on Geomorphology of the area	District level information	
10	Recharge Parameters	Recharge parameters for different soil and aquifer types based on field studies	Recharge parameters given in Ground Water Resources Estimation	Entire study area

1.6 Demography: As per 2011 Census, Ri Bhoi district has a population of 258,840, out of which 132,531 were male and 126,309 were female respectively. Block level population figure as per 2011 census is given in Table 1.3.

Table 1.3 Block level population figure as per 2011 census

Name of the Block		No of Household	Population 2011		
			Total	Male	Female
Umling	Total	15776	87021	43994	43027
	Rural	12616	69966	35458	34508
	Urban	3160	17055	8536	8519
Jirang	Total	5934	30919	15934	14985
	Rural	5934	30919	15934	14985
	Urban	0	0	0	0
Umsning	Total	25162	140900	72603	68297
	Rural	23862	132702	67313	65389
	Urban	1300	8198	5290	2908
Total		46872	258840	135231	126309

Source: *Statistical Handbook Ri Bhoi District, 2016*

1.7 Communication: RiBhoi district forms the northern low portion of East Khasi Hills and the National Highway 40 passes through the heart of the district and serves as the lifeline for the State Capital and other districts of the state. The headquarter of the district is at Nongpoh, which is located at 53 km away from the state capital Shillong and 50 km from Guwahati. All the three development block Headquarters that is Umling, Umsning and Jirang are connected with Nongpoh, the district headquarter by metallic roads.

1.8 Land use: Land utilisation statistics provide detailed information of the land use pattern in the area. Based on the land utilization, the total area is divided into various types of landforms such as forest, cultivable land, fallows lands, crops area etc. which in turn reflects the degree of development of agricultural activities and cultivation potential.The land utilization statistics of the Ri Bhoi district is shown in the following Table1.4 and land use map is shown in Fig. 1.1.

Table 1.4: Land use pattern in Ri Bhoi, 2014-15

Land Classifications	Area in hectares
A. Geogrphical Area	244800
B. Reporting Area	244420
1. Forests (classed & unclassed)	87149
2. Area not available for cultivation a.(i) Area under non-agricultural uses	
b. Barren and uncultivalble lands	
c. Water logged land	
d. Social Forestry	2700
e. Land under still water	2306
f. Other land	10508
TOTAL = (a+b)	
TOTAL (Column a to f)	15514
(ii) Barren and unculturable lands	17683
TOTAL = Col. i& ii	33197
3. Other uncultivable lands a. Permanent pastures and other grazing lands	
b. Land under Misc. tree crops & grooves etc.	30801
c. Cultivable wastelands	55485
TOTAL = (a+b+c)	86286
4. Fallow lands a. Fallow lands other than cerrent fallows	8871
b. Current fallows	6175
TOTAL = (a+b)	15046
5. Net area sown	22742
6. Area sown more than once	2971
7. Total Croped area	25713

Source: Directorate of Economics & Statistics, Shillong, Govt. of Meghalaya.

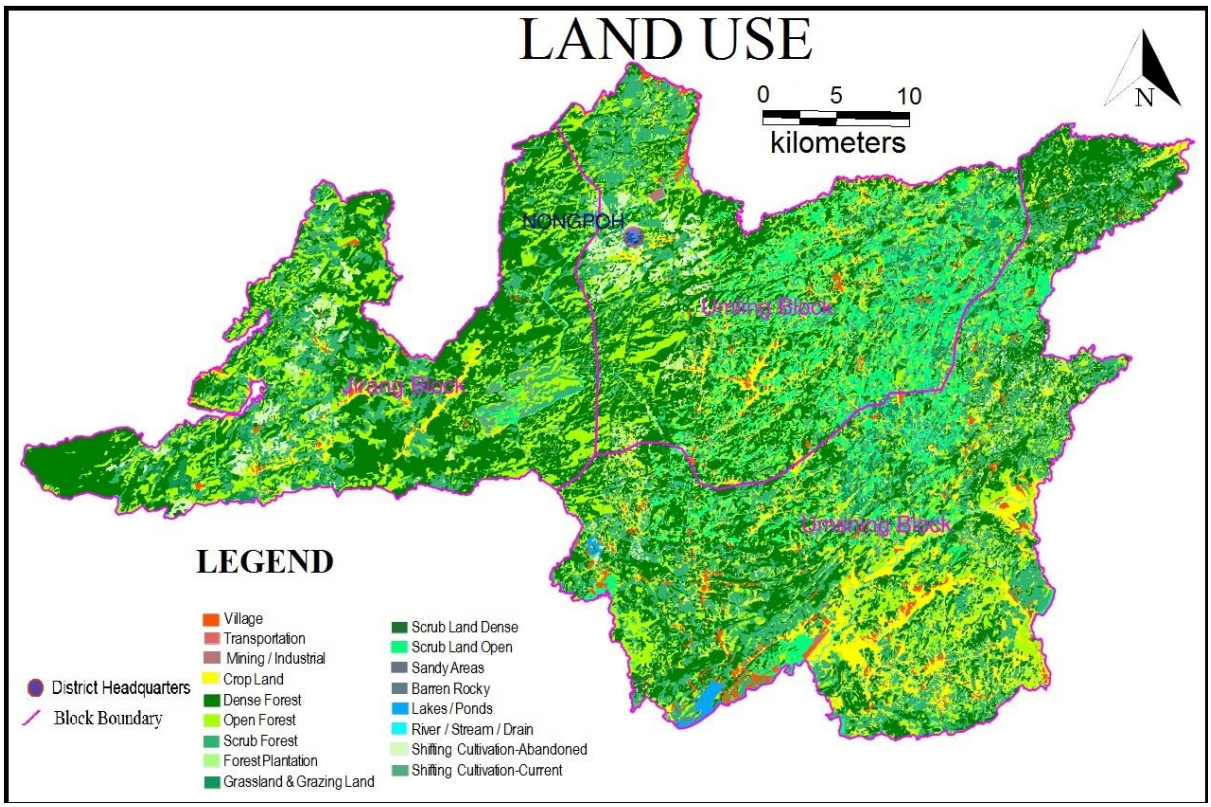


Fig 1.1: Land use map of Ri Bhoi (*Source: NESAC*)

1.9 Soil: High rainfall, humid subtropical climate and favourable topography have resulted in the formation of thick soil profile (5-10 m) in the study area. The soil in the study area is mostly deep brown, silty clay to clay loam, permeable, and acidic in nature. The acidic character is due to leaching of bases caused by high rainfall. The gneisses, quartzite and basic intrusive gave rise to very deep fine texture soils whereas soil developed over granites are coarse loamy and permeable. The soil developed within the intermontane valleys over colluvial and alluvial deposits are light brown to dark grey in colour, poorly drained, strongly acidic clay loams and are used for agriculture.Soil is one of the most important components of the land through which the interaction of all natural factors takes place. The soil classification has been conducted by the Regional Center of National Bureau of Soil Survey and Land Use Planning, for the State of Meghalaya. Accordingly, the soils types are broadly classified into three orders as given below.

- Red loamy soils
- Laterite soils
- Alluvial soils

Red loamy soil: This soil occupies the southern, southeastern and north western part of the study area. It is generally loamy and red in colour. These are the result of weathering of

rocks such as granites, gneisses, diorites and those which are relatively richer in clay forming minerals but poorer in silica. The exposed red loamy soil is rich in organic matter and nitrogen due to humus contains from the litters of tree leaves, grasses etc. These are acidic and suitable for the cultivation of potatoes, rice, fruits in hills slope and terraces.

Laterite soils: This soil is found in the southern fringe of the study area. These are resulted due to the weathering of rocks like granites, quartzite, schist, gneisses, conglomerates etc. This area is rich in iron and aluminum and is yellowish red in colour.

Alluvial Soils: The alluvial soils are found the in northern border of the study area, along Assam border. The soil texture varies from sandy to clayey-loam with varying degree of nitrogen and is acidic in nature. The soil is slightly acidic in nature. It is suitable for cultivation of rich and jute.Soil map of the area is given in Fig 1.2.

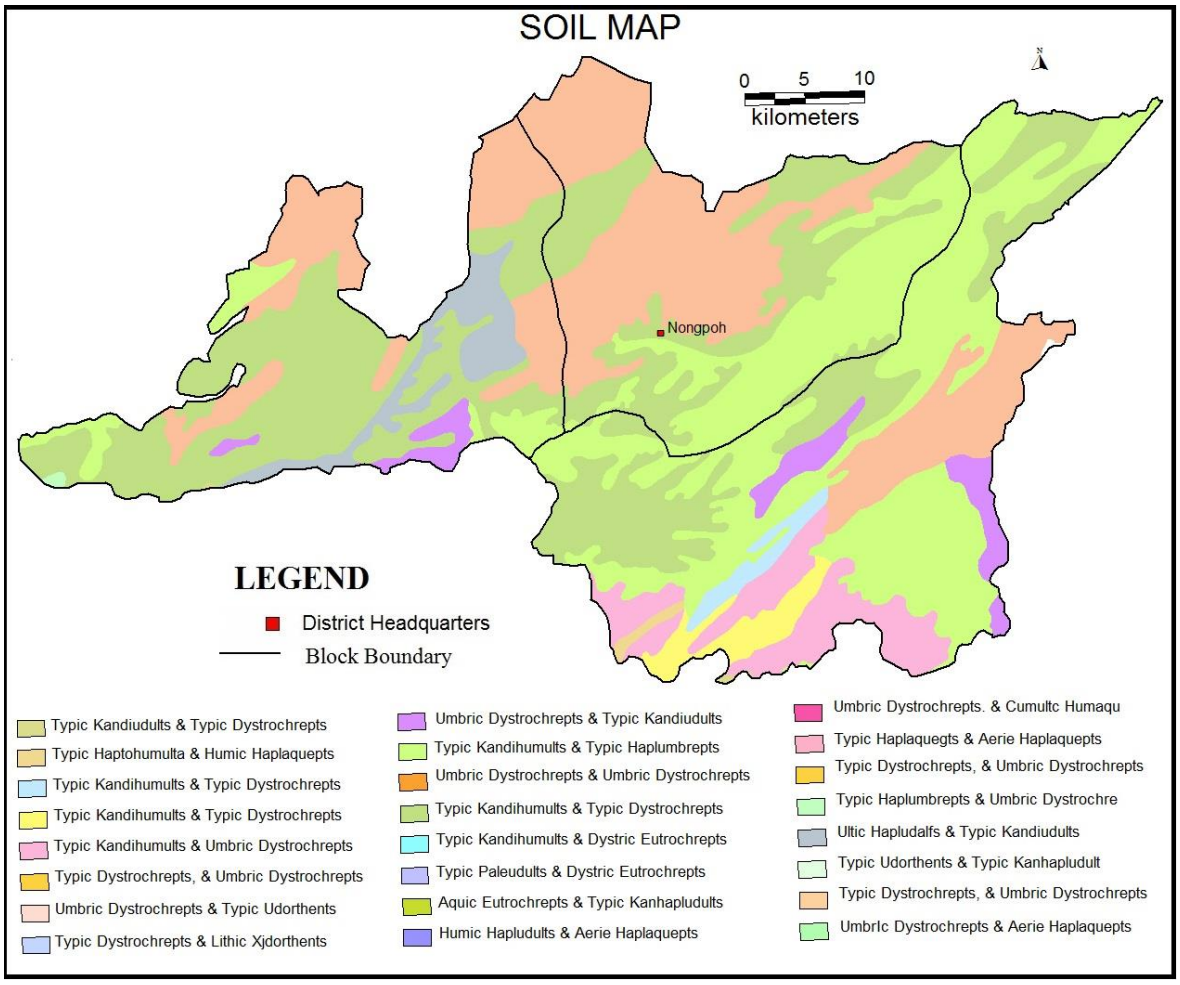


Fig. 1.2: Soil map of Ri Bhoi (*source: Regional Center of National Bureau of Soil Survey and Land Use Planning*).

1.10 Agriculture: Agriculture is the main means of livelihood of the people in the district and about 80 % of the population is dependent on agriculture. The area is endowed with diversified climatic condition thereby offering good scope for cultivation of temperate and subtropical crops. The principal crops of the study area are paddy, maize, potato, ginger, turmeric, pineapple, tapioca, citrus, banana etc. The season wise cropping pattern of RiBhoi district is shown in Table 1.5.

Table 1.5 Season wise cropping pattern of Ri Bhoi district.

Name of the Crop	Kharif (May to Oct)	Rabi (Nov to April)
Paddy	Ploughing, transplanting inter culture nursery operation, sowing	Harvesting
Maize	Sowing, harvesting	Land preparation, inter culture sowing operation,
Tomato, potato, beans etc	-----do----	-----do-----

Source: District Agriculture Office, Nongpoh, Govt. of Meghalaya.

Present area under different crops and their productivity is shown in table 1.6.

Table 1.6: Area under different crops and their productivity, RiBhoi district (2015-16)

Crops	Area (ha)	Avg.Yield (kg/ha)
Autumn rice	160	3263
Winter rice	9286	3378
Spring rice	187	2171
Maize	2358	3193
Millets	29	1241
Pulses	73	1247
Rape and mustard	202	728
Soyabean	244	1307
Citrus fruits	405	5753
Pineapple	3854	11859
Banana	928	17775
Papaya	201	7920
Strawberry	47	10489
Potato	34	6147
Sweet potato	159	6302
Ginger	1027	10674
Turmeric	160	8013
Chillies	115	1904
Black pepper	162	796
Plantation crops	2747	3591
Total	22378	-

Source: Agriculture Department, Govt. of Meghalaya.

1.11 Irrigation: The district does not have any major or medium irrigation projects. Agriculture is dependent mainly on rainfall. There are 32 nos. of minor irrigation schemes available in the district as per 2016. All these minor irrigation schemes are based on surface water sources. Salient features of minor irrigation schemes in Ri Bhoi district are given in Table1.7.

Table 1.7 Salient features of minor irrigation schemes/project in RiBhoi district(Year 2016).

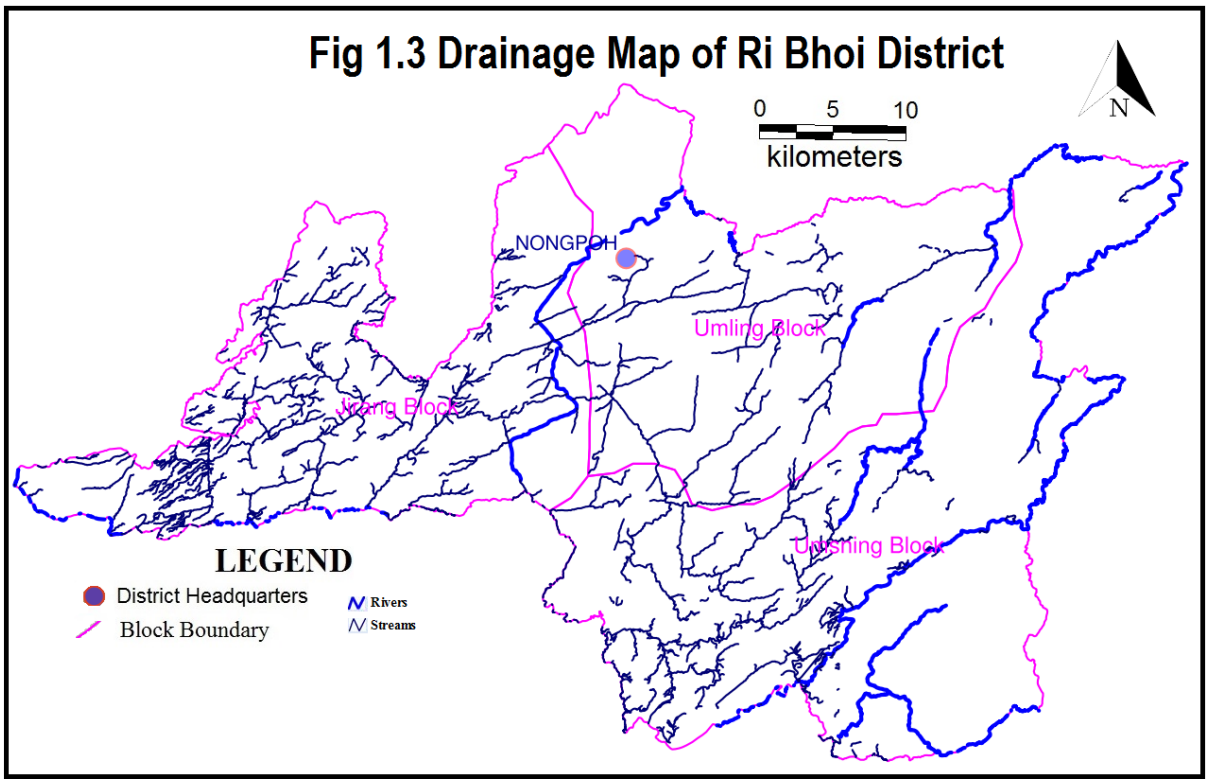
Name of Block	Command area	Name of crops		Cultivable command area	Area Irrigated during kharif	Area irrigated during rabi	Gross irrigated area
		Kharif	Rabi				
Umsning C & RD Block	4301.98	Paddy	Maize, bean, potato, tomato & Cupsecum	3972.61	3648.61	1878.11	5526.72
Umling C & RD Block	985			941	848	481.5	1329.5
Jirang C& RD Block	162			160	160	12	172
Total	**5448.98**			**5073.61**	**4656.61**	**2371.61**	**7028.22**

Source: Office of the Executive Engineer, Water Resource Department, Nongpoh, Govt. of Meghalaya.

1.12 Industries: From industrial point of view, the study area is still underdeveloped as of now. At present, RiBhoi district has one industrial estate i.e., Barapani Industrial Estate and one export promotion industrial park, besides some industrial clusters are in Byrnihat and Jorabat area.

1.13 Forest: As per Forest and Environment Department, Meghalaya, RiBhoi district has a total area of 871.41sq.km (as per 2015-16)under forest (classed & unclassed)and reserved and protected forest of 0.1264 sq.km.

1.14 Drainage: The drainage pattern of annular, trellis, sub-dendritic types are found in the area which indicates both topographic and structural control. The important river in Ri Bhoi district includes the Umtrew, Umsiang, Umran and Umiam rivers.The study area falls under Brahmaputra basin in which the rivers flowing in the north direction areKhri, Umtrew, Umsiang, Umran and Umiam rivers. The drainage map is shown in Fig 1.3.



Brahmaputra Basin:

- Khririver: The Khri River rises near Kyllang rock in West Khasi hills and flows northwards and is joined by Khri Synnia River before it joins Brahmaputra River in Assam.
- Umtrew River: It rises from Nongkhyllem Reserve forest and flows northwards and enters the plains of Assam.
- Umsiang River: It originates from Raitong village in eastern Ri-Bhoi district and flows northerly direction initially and thereafter along Assam – Meghalaya border in EW direction.
- Umran River: It originates from Mawrong village and follows southwest initially and thereafter in north direction.
- Umiam River: It originates from Umiam village and flow northerly direction and finally joins Brahmaputra River.

2. DATA COLLECTION AND GENERATION

One of the main objectives of the study was to collect various relevant technical data from the concerned State Government agencies and other Institutes dealing with ground water and incorporating these data along with CGWB data to generate strong data base. Based on the data availability and data gap analysis, the required sub-surface hydrogeological data, groundwater level data, groundwater quality data and Geophysical data were generated.

2.1 Hydrogeological: Occurrence of ground water in the study area is mainly of weathered and fractured Gneissic, Granite pluton and Quartzite formation. The different hydrogeological data are generated through intensive field data collection and testing.

2.1.1 Water level monitoring: In the study area, there are 4 existing GWM wells and in addition to these 40 dug wells, 17 bore wells and 17 springs were established askey wells to study the water level, quality, spring discharge and its behavior periodically.

Phreatic aquifer: A total of 40 dug well and 4 GMW were established as key wells for periodical monitoring to know the water level trend and its behavior. The key observation wells details are presented in Annexure3A and the pre and post monsoon Depth to Water Level in Fig 3.5 and 3.6. The location of key observation wells is given Annexure 3.

Confined/Semi-confined aquifer: For study of piezometric head in the district, a total of 17 bore wells were monitored periodically. Details of these key observation wells are presented in Annexure 3and the pre and post monsoon Depth to Water Level in Fig 3.7 and 3.8.

Springs:A total of 17 springs were established and monitored to know the type, discharge and their behaviour. The locations of these springs are given in table 2.1.

Table 2.1 Location of springs in Ri Bhoi district

Unique ID	Name of village/site	Latitude in degrees decimal	Longitude in degrees decimal	RL (mamsl)	Aquifer type	Type	Aquifer group	Source /Agency
1	2	3	4	5	6	7	8	9
MEG-8013-27	Lumnongrin zero point road	$25^0$46’25”	$91^0$52’38”	730	Wethered granite gneiss	Spring	I	CGWB
MEG-78013-29	Mowrong	$25^0$50’44”	$91^0$58’7”	922	Wethered granite	Spring	I	CGWB
MEG-78013-31	Umsning market area	$25^0$44’55”	$91^0$53’20”	782	Wethered granite gneiss	Spring	I	CGWB
MEG-7809-34	Jirang	$25^0$54’43”	$91^0$34’54”	414	Wethered granite gneiss	Spring	I	CGWB
MEG-78013-35	Wahsyn-on	$25^0$54’17”	$91^0$35’33”	402	Wethered granite gneiss	Spring	I	CGWB
MEG-7809-37	Lawki	$25^0$54’22”	$91^0$38’23”	346	Fractured granite gneiss	Spring	I	CGWB
MEG-7809-44	Umpyrtha	$25^0$51’35”	$91^0$34’52”	341	Wethered granite gneiss	Spring	I	CGWB
MEG-7809-45	Mawskei	$25^0$51’59”	$91^0$35’6”	344	Wethered granite gneiss	Spring	I	CGWB

1	2	3	4	5	6	7	8	9
MEG-78013-48	Umran Dairy	91º 52'24"	25º 47'9"	699	Wethered granite gneiss	Spring	I	CGWB
MEG-78013-52	Mawkhap	$91^0$53'14"	$25^0$47'13"	732	Wethered granite	Spring	I	CGWB
MEG-78014-53	Nongjiri Umsala	91°54'09"	25°44'45"	877	Fractured Quartzite	Spring	I	CGWB
MEG-78014-54	Umsning 1	91°53'20"	25°44'36"	756	Weathered Quartzite	Spring	I	CGWB
MEG-78014-55	Syadrit	91°53'09"	25°44'17"	759	Weathered Quartzite	Spring	I	CGWB
MEG-78014-56	Umsning 2	91°53'24"	25°43'32.0"	802	Fractured Quartzite	Spring	I	CGWB
MEG-78014-57	Sumer	91°53'20"	25°41'33"	867	Fractured Quartzite	Spring	I	CGWB
MEG-78014-58	Umeit	91°56'51"	25°42'30"	909	Weathered Quartzite	Spring	I	CGWB
MEG-78014-59	Umroi	91°58'27"	25°43'30"	904	Weathered Quartzite	Spring	I	CGWB

2.1.2 Aquifer performance test: A total of 4 Aquifer performance test (APT) were conducted during the course of study to know the various parameters of the wells. The details are show in table 2.2.

Table 2.2 Details of APT results, Ri Bhoi district

Unique ID	Name of village/site	Longitude in degrees decimal	Latitude in degrees decimal	RL (maMSL)	Total depth of Pz/DW (mbgl)	Measuring point (magl)	Transmisivity (m^2/d)	Storativity
MEG-78013-50	Umling	91.85958	25.96583	269	131.9	0.45	7.13	$3x10^1$
MEG-7809-77	Warmawsaw	91.53222	25.83028	313	129	0.5	15.19	$3x10^{-2}$
MEG-78013-79	Purduwa Kharpati	91.94139	25.91500	601	227.98	0.6	1.51	$1x10^{-1}$
MEG-78013-80	Sohpdok	91.96572	25.76500	959	203.46	0.5	151.17	$1x10^{-2}$

2.2.3 Preliminary Yield Test (PYT) and Slug test: A total of 21 preliminary yield testswere carried out during NAQUIM programme in the study area to know the aquifer parameters. And 1 slug test was conducted at Mawshohroh during NAQUIM programme using Ferri's method to ascertain the transmissivity. The details are shown in Annexure 1.

2.1.4 Dug Well Pump Test: A total of 5 dug well pump test were conducted in the study area to know the specific capacity (Slitchers' Method) of shallow aquifers and its suitability for irrigation purposes. The details are shown in the table 2.3.

Table 2.3 Details of Dug well pump test results

Location	Latitude	Longitude	RL (maMSL)	Total depth of DW (mbgl)	Diameter (m)	Measuring Point (m)	Water level (m bgl)	Specific capacity (m^3/min/m of DD)
Nayabanglow	25°44'48"	91°53'13"	861	10.73	1.2	1	9.03	0.065
Pahamwier	25˚59'40"	91˚51'42"	307	1.96	0.8	0.6	0.96	0.0192
Pyllum	25°41'41"	91°55'47"	946	4.5	0.8	0.75	3.53	0.0108
Umbang	25°41'06"	91°54'05"	922	3.95	1	0.6	1.265	0.015
Umsning	25°44'28"	91°53'16"	762	7.05	1.3	0.5	6.41	0.0064

2.1.5Soil Infiltration Studies: Soil infiltration test were conducted using double ring infiltormeter and the constant infiltration rates of different soils were calculated by double ring infiltrometer method. These studies were carried outin different locations to know the infiltration rates at different soil conditions, topography, geology and environment. This will provide a scientific approach of groundwater recharge, its suitability and the amount of water recharging in that area, rainfall infiltration factor and will help in calculating ground water resource estimation. The details are shown in table 2.4.

Table 2.4 Details of Soil Infiltration Test studies results

Sl. No.	Location	Latitude	Longitude	RL (m)	Soil type	Soil thickness (m)	Colour	Infiltration rate (cm/hr)	Date of Test
1	2	3	4	5	6	7	8	9	10
1	Umroi	25˚42'37"	91˚58'48"	883	Typic Kandihumults & Umbric Dystrochrepts	2 to 3	Reddish brown	12.6	13.02.2017
2	Umeit	25˚42'47"	91˚57'19"	903	Typic Kandihumults & Umbric Dystrochrepts	1 to 2	Reddish brown	36.6	15.02.2017
3	Umbir	25˚39'57"	91˚51'42"	1099	Typic Kandihumults & Umbric Dystrochrepts	2 to 2	Reddish brown	7.2	15.022017
4	Umsiak	25˚38'40"	91˚50'07"	958	Typic Haptohumulta & Humic Haplaquepts	1 to 1.5	Reddish brown	3.6	16.02.2017
5	Umnongkrem	25˚39'30"	91˚45'60"	983	Typic Haptohumulta & Humic Haplaquepts	2 to 3	Brown	21.6	16.02.2017
6	Kyrdemkulai	25˚45'0"	91˚50'17"	807	Typic Kandthumults & Typic Dystrochrepts	8 to 10	Red	29.4	17.02.2017
7	Umtham	25˚43'18"	91˚51'23"	721	Typic Kandihumults & Typic Haplumbrepts	2 to 4	Brown	39	18.02.2017
8	Nongmahir	25˚46'40"	91˚47'43"	686	Typic Kandthumults & Typic Dystrochrepts	10 to 15	Red	48.6	20.02.2017

1	2	3	4	5	6	7	8	9	10
9	Mawlein	25˚42’33”	91˚53’45”	887	Typic Kandthumults & Typic Dystrochrepts	8 to 10	Red	54.6	21.03.2016
10	Mawtari Myrdon	25˚48’10”	91˚50’47”	647	Typic Kandthumults & Typic Dystrochrepts	3 to 4	Red	12.3	14.12.2015
11	Tdohumshiaw	25˚ 46’57”	92˚ 01’01”	1124	Typic Kandthumults & Typic Dystrochrepts	7 to 10	Red	1.2	29.10.2015
12	Sohpdok	25˚ 45’16”	91˚ 57’56”	959	Typic Kandihumults & Typic Haplumbrep	8 to 10	Red	12.6	29.10.2015
13	Lumkeni	25˚46’37”	91˚51’21”	649	Typic Kandthumults & Typic Dystrochrepts	6 to 8	Reddish brown	7.5	19.11.2015
14	Umtrew	25˚42’50”	91˚53’17”	803	Typic Kandthumults & Typic Dystrochrepts	7 to 9	Reddish brown	4.8	21.03.2016
15	Pahamri-oh	25˚56’51”	91˚52’21”	305	Typic Kandihumults & Umbric Dystrochrepts	8 to 10	Red	22.2	18.03.2016
16	Umling	25˚57’56”	91˚51’38”	268	Typic Kandihumults & Umbric Dystrochrepts	2 to 4	Red	14.4	18.03.2016
17	Umran Diary	25˚46’48”	91˚52’28”	654	Typic Kandthumults & Typic Dystrochrepts	7 to 9	Reddish brown	25.2	16.03.2016
18	Umran Niangbyrnai	25˚44’41”	91˚53’25”	651	Typic Kandthumults & Typic Dystrochrepts	7 to 9	Reddish brown	38.8	16.03.2016

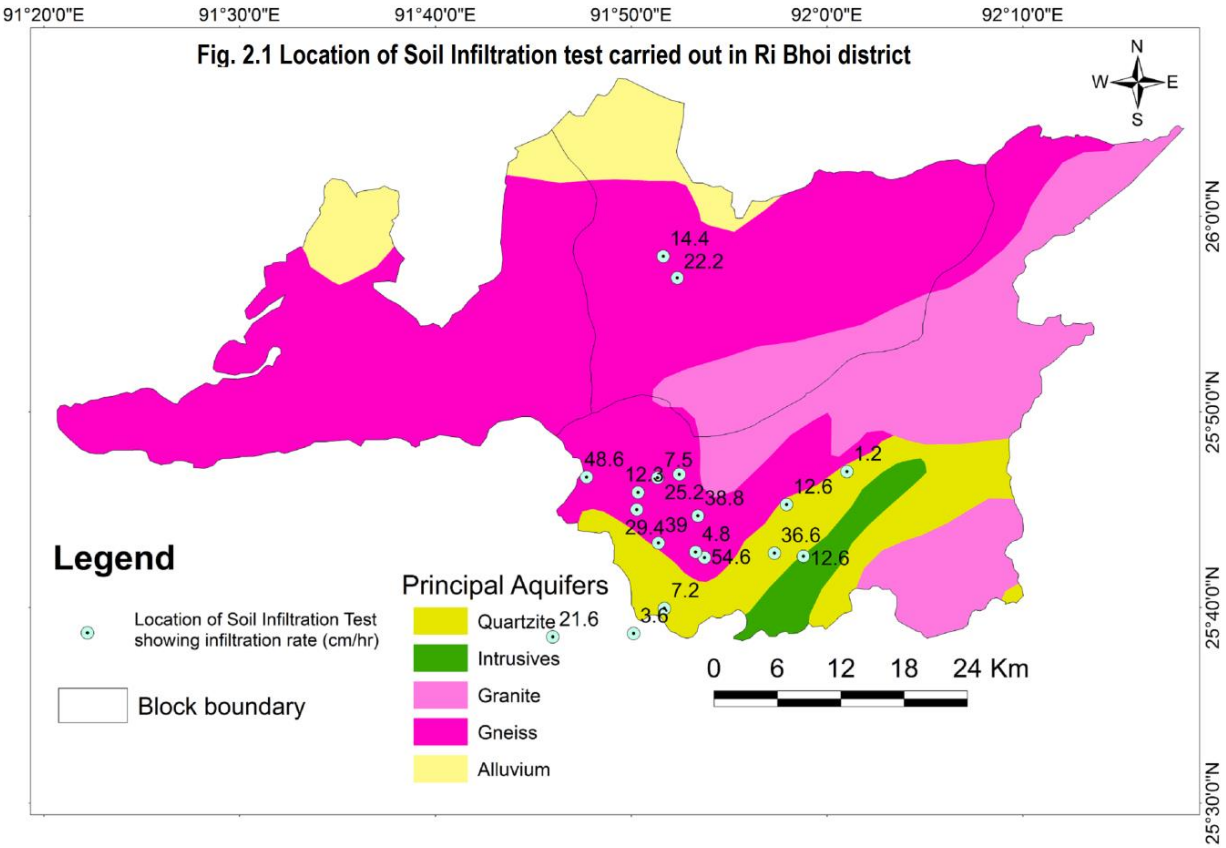


Fig. 2.1 Location of Soil Infiltration test carried out in Ri Bhoi district

2.2 Hydrochemistry: The quality of ground water is as important as that of the quantity. In order to study the chemical quality of ground water in the district, water samples from first aquifer (dug wells and springs) and second aquifer (CGWB Bore well) were collected during the course of field work. Ground water samples were analyzed in the regional chemical laboratory, Central Ground Water Board, North Eastern Region, Guwahati for 14 parameters. The analytical data are given in Annexure 2.

2.3 Geophysical studies: Surface Geophysical studies in the study area were carried out to delineate the subsurface geology as well as supplement the data gap under the assignment of Aquifer Mapping. A total of 20 VES were conducted with maximum available electrode spread (AB) of 250m respectively as part of electrical prospecting. HAK, HK, HKH, HAK, KQ, QH, A, K type VES curves were obtained. The inferences drawn on the basis of interpreted results could not be obtained for deeper formation due to the limitations of unavailability of large and straight stretch for current electrode separation. However, taking into account the interpreted results as well as the apparent resistivity, inferences have been approximated to shallow to deeper depth at fewplaces. The detail results are given in Annexure 6. The locations of the survey carried out are tabulated below;

Table 2.5 Location of VES survey carried out in Ri Bhoi

Sl. No.	Name of village/Location	Latitude	Longitude
1	Patharkhmah	25.87811	91.60706
2	Patharkhmah	25.8785	91.60786
3	Patharkhmah	25.87886	91.60875
4	Barigoan	25.87486	91.59744
5	Barigoan	25.87267	91.59769
6	Patharkhmah	25.88294	91.60742
7	Patharkhmah	25.88403	91.606
8	Patharkhmah	25.88433	91.60525
9	Patharkhmah	25.89061	91.61906
10	Patharkhmah	25.88994	91.61964
11	Patharkhmah	25.88914	91.61972
12	Patharkhmah	25.88822	91.61983
13	Patharkhmah	25.89217	91.61858
14	Patharkhmah	25.8925	91.61844
15	Patharkhmah	25.89331	91.61794
16	Umwang/Marangar	25.90414	91.92986
17	Umwang/Marangar	25.90336	91.929
18	Umwang/Marangar	25.90222	91.92678
19	Mawshohroh	25.663814	91.852067
20	Mawshohroh	25.659833	91.853528

2.4 Ground water Exploration studies: Ground water exploration has been carried out in different parts of the district to delineate the potential aquifers and their geometry and to determine the hydrogeological parameters of the aquifer systems.Before NAQUIM programme was startedin the district, 17 EW were constructed and as a part of data gap generation 17 EW and 9 OW were constructed during the course of study. Details of the exploratory wells are presented below in the table 2.6 and table 2.7.

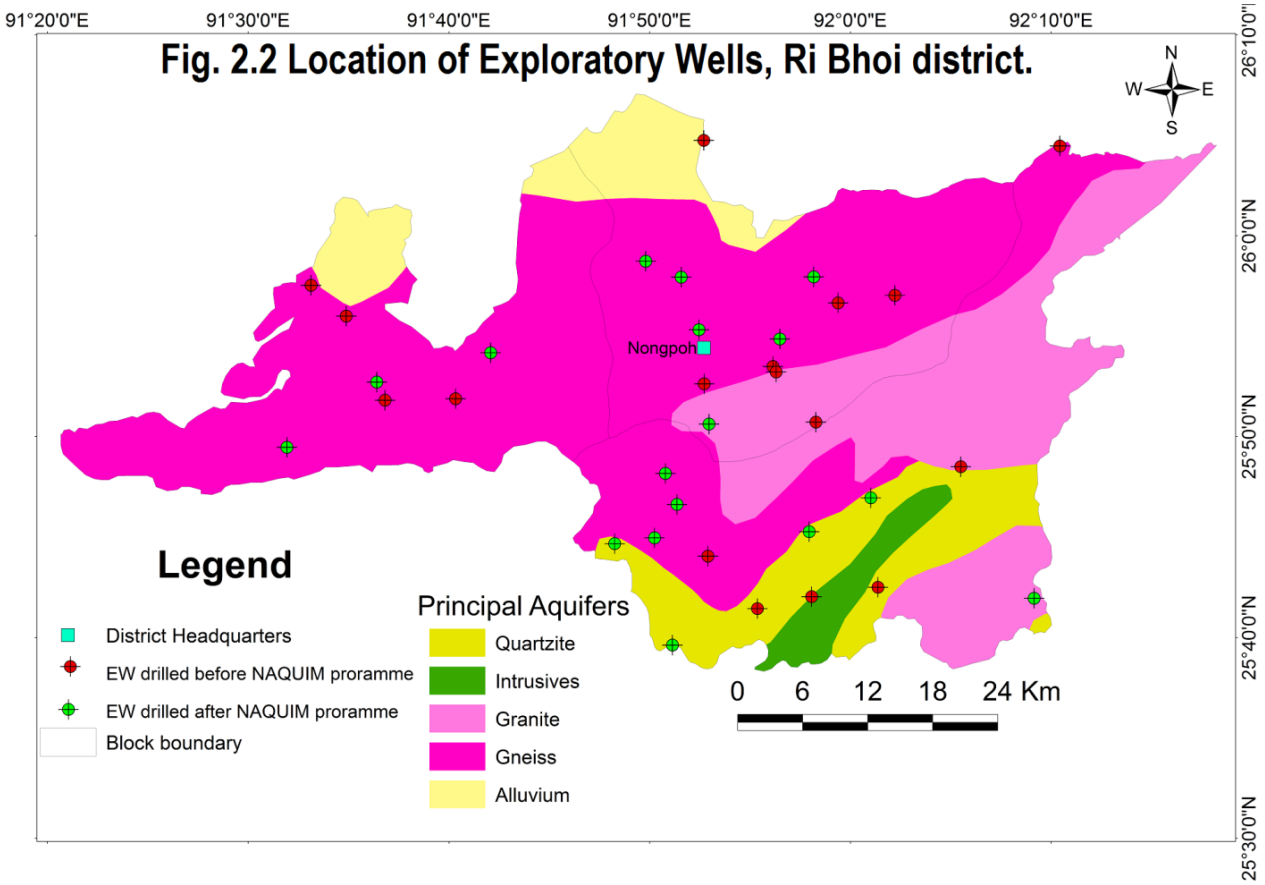
Table 2.6 Exploratory wells constructed before NAQUIM, Ri Bhoi district

Name of site	Longitude	Latitude	Elevation (m)	Totaldepth (m)
Pahan	91°33’08”	25°57’32”	165	154.82
New Jirang	91°34’53”	25°56’00”	400	200.30
Umrit	91°40’20’’	25°51’53’’	380	202.15
Umden	91°59’23”	25°57’52”	550	171.00
Marngar	91°56’09”	25°53’29”	597	180.50
Mawrong	91°58'17"	25°50’43’’	767	201.3
Saiden	91°52’43”	25°52’38”	577	153.9
Mawsyntai	91° 56’ 18”	25° 53’ 13”	606	126.2
Patharkammah	91°36’49”	25°53’19”	329	202.51
Umsning	91° 52’54”	25° 44’03”	773	124.05
ICAR Campus (Plant Pathology)	91° 55’22”	25° 41’26”	954	180.8
Umroi Airodrome	91° 58’04”	25° 42’02”	907	167.4
Umsiang	92°10’26”	26°04’28”	87	124.05
Bhoirymbong	92°01'22”	25°42’30”	882	199
Mawlong	92°02’13”	25°57’02”	663	203.5
Umpher	91°52’42”	26°04’45”	86	200.5
Mawhati	92°05’30”	25°48’30”	1065	171

Table 2.7Exploratory wells constructed during NAQUIM, Ri Bhoi district

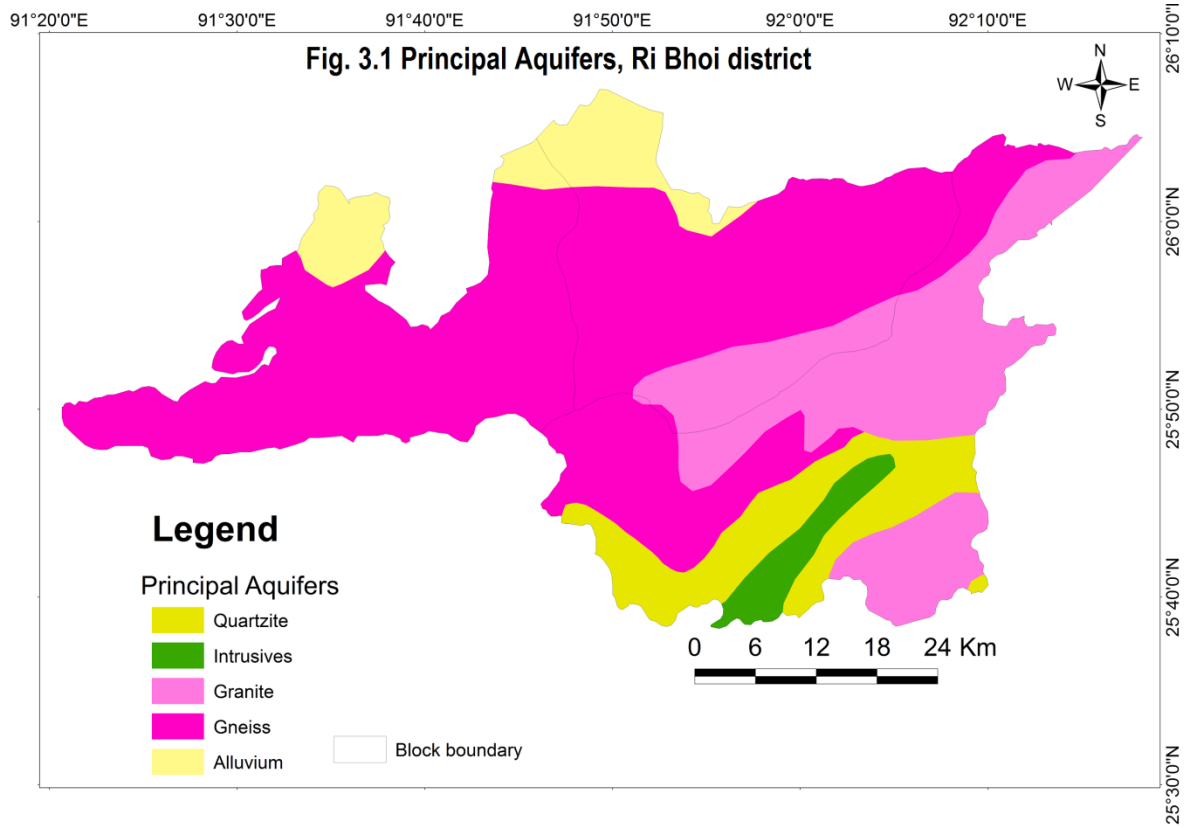
Name of site	Longitude	Latitude	Elevation (m)	Total drilled depth (m bgl)
Warmawsaw	91˚31’56”	25˚49’28”	313	129.00
Nongpoh	91°52’27”	25˚55’19”	561	220.70
Umling	91°51’35”	25˚57’56”	269	131.9
Umdihar	91°52’57”	25˚50’37”	523	239.1
Rongskong	91°58’10”	25°57’57”	533	221.85
Umdu	91°49’48”	25°58’44”	296	203.46
Umsaw	91°36’24”	25°52’43”	338	180.94
Nongladew	91°42’4”	25°54’11”	364	156.77
Kyrdemkulai-Zero point	91°48’16”	25°44’40”	726	203.46
Purduwa	91°56’29”	25°54’52”	601	221.85
Sohpdok	91°57’56”	25°45’16”	959	203.46
Tdohumshiaw	92°1’1”	25°46’57”	1177	172.81
Lumkeni	91°51’22”	25°46’38”	649	191
Mawtari Myrdom	91°50’47”	25°48’10”	647	201.45
Mawshohroh	91°51’08”	25°39’37”	1147	215.72
Thadrang	92°09’09”	25°41’57”	783	200.45
R.P.B.F Kyrdemkulai	91°50'15”	25°44’58”	788	209.67

The exploratory wells which were constructed before and during NAQUIM is shown in fig 2.2


91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°10'0"N
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
Fig. 2.2 Location of Exploratory Wells, Ri Bhoi district.
N
W
E
S
Nongpoh
Legend
District Headquarters
EW drilled before NAQUIM proramme
EW drilled after NAQUIM proramme
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

3. DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

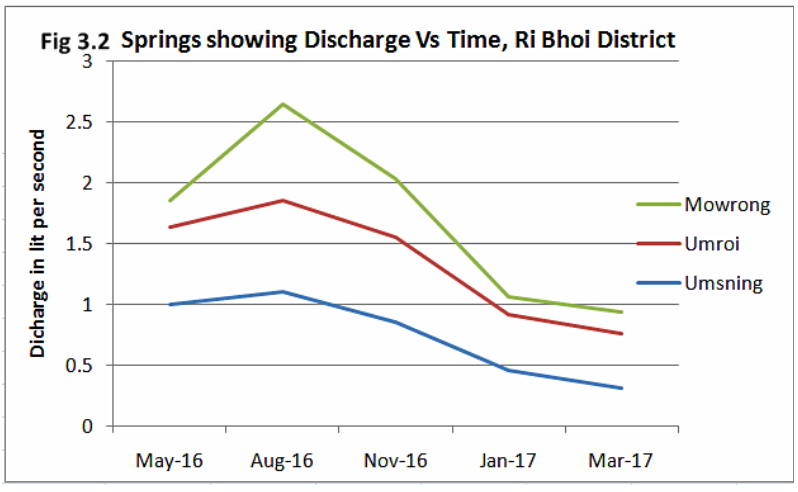
3.1 General hydrogeology and occurrence of ground water: The hydrogeological formation of the study area comprised of Gneissic complex of Arcaean to Proterozoic, Quartzite of Palaeo-Meso-Proterozoic, Khasi Basic- Ultra basic intrusive of Proterozoic, Granite plutons (Kyrdem and Nongpoh Granite pluton) of Neo Proterozoic to Early Proterozoic formation. The presence of weak planes like fractures and joints in these hard rock formation forms the principal aquifer in the area. The ground water in the district occurs under unconfined, semi-confined to confined conditions. Study of dug wells and exploration data reveals the presence of phreatic, shallow and deep fractured aquifers in the district. The principal aquifer of the study area is shown in fig 3.1



3.1.1 Occurrence of ground water in shallow aquifers: The depth of shallow aquifer in the district ranges from 2 to 35 meters. This shallow aquifer occurs under unconfined to semi confined condition. Ground water from shallow aquifer is exploited through different types of ground water extraction structures such as dug wells (Kachha dug wells and ring well). This dug well tapped the unconfined aquifer generally down to 2 to 15 meters. The semi confined aquifer is generally tapped in the zone ranges from 20 to 35 meters which is the weathered portion.

3.1.2 Occurrence of ground water in deeper aquifers: The deeper aquifer occurs as semi-confined to confined condition where ground water is found in the fractured zone of consolidated Quartzite, Gneiss and Granite. The drilled depth of exploratory wells tapping this aquifer ranges from 124.05 to 220.70 m bgl. The number of fractures and its zones encountered varies in all the places which show the complexity of the hydrogeology of consolidated hard rock formation. Two artesian wells were found in the study area, one was at ICAR campus where the discharge is 66.78 m^3/hr and the other one is at Sohpdok where the discharge is 36.43 m^3/hr.

3.1.3 Springs: Spring is defined as a localized natural discharge of ground water appearing at the ground surface as a current of flowing water through well-defined outlets. The discharge may vary from a trickle to a stream. Groundwater flow from springs is governed mainly by three inter-related factors: geology (type, distribution and permeability characteristics of geologic units), topography (landforms and relief), and climate (timing and amount of precipitation). Topography drives the groundwater flow downhill and largely dictates the occurrence of the spring itself. Climate would influence the timing and amount of recharge to the flow system and the volume and variability of discharge. Groundwater obtained from springs is similar to water pumped from shallow wells. The study of spring has been carried out in the aquifer mapping area and it was found that the location of the spring is mainly restricted to foothills and intermontane valleys.Most of the villagers are highly depended on the springs for their drinking and domestic purposes. A total of 17 springs were established and monitored periodically during the course of study. Most of these springs are depression and topographic or fractured springs. It is observed that the discharge of springs in this area ranges from 0.576 to 81 litre/minute during pre-monsoon and 0.6 to 102.84 litre/minute during post-monsoon season and is show in fig 3.3 and fig 3.4. It has also been observed that the discharge of springs have been increased during monsoon season and graudually decreases in post-monsoon and pre-monsoon as shown in fig. 3.2.



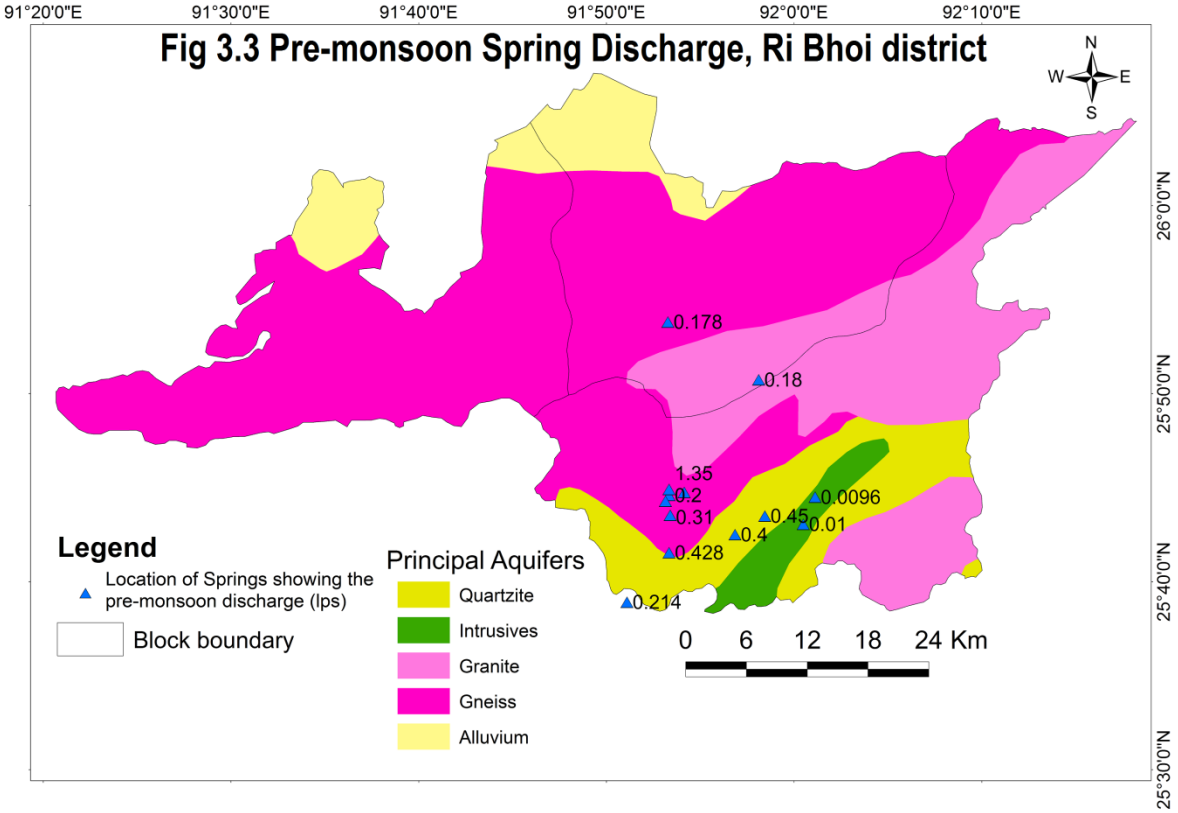


Fig 3.3 Pre-monsoon Spring Discharge, Ri Bhoi district
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
0.178
0.18
1.35
0.2
0.31
0.45
0.0096
0.01
0.4
0.428
0.214
Legend
Location of Springs showing the pre-monsoon discharge (lps)
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

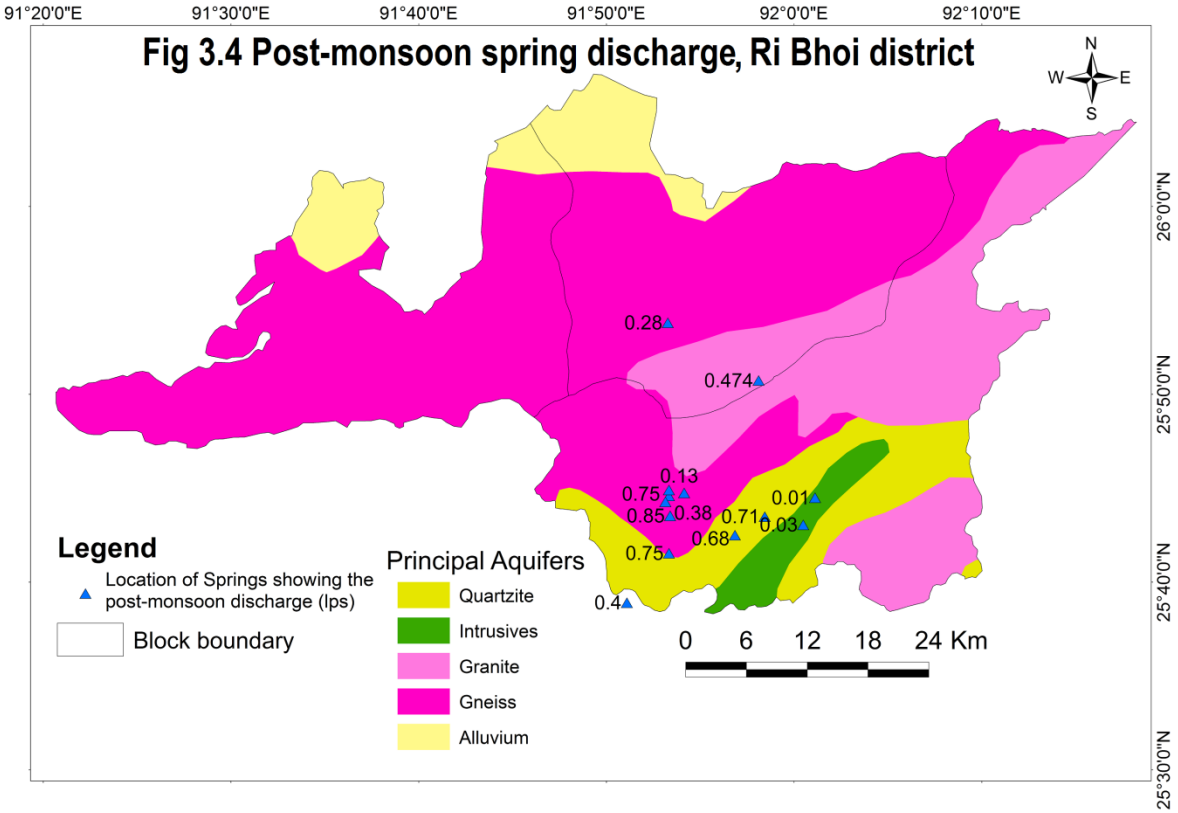
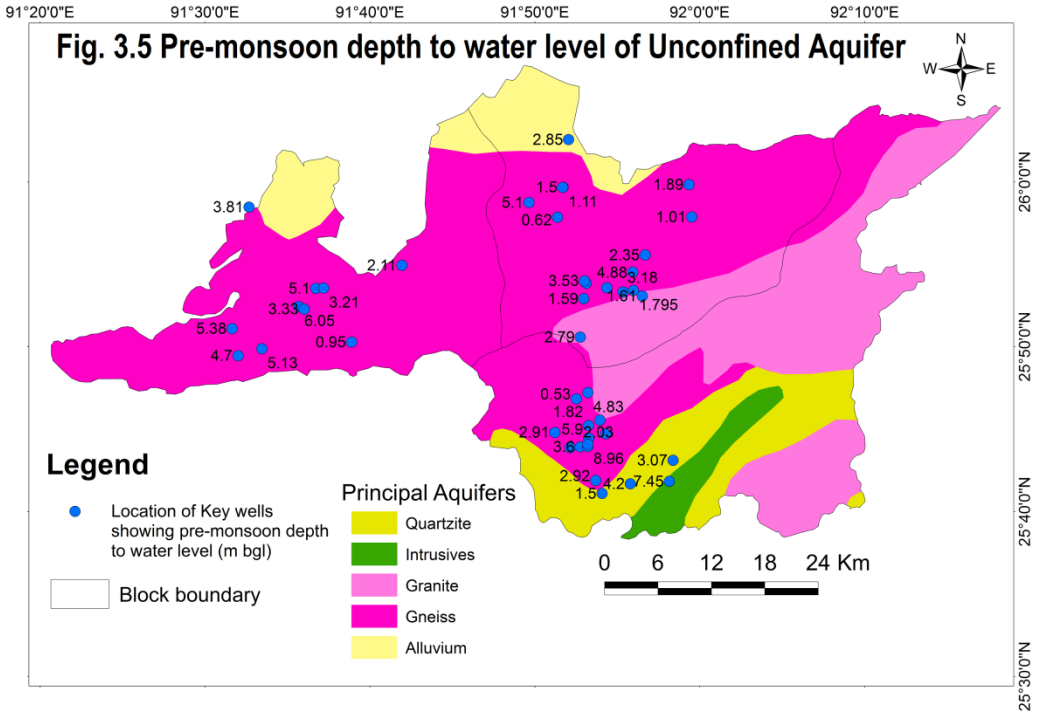
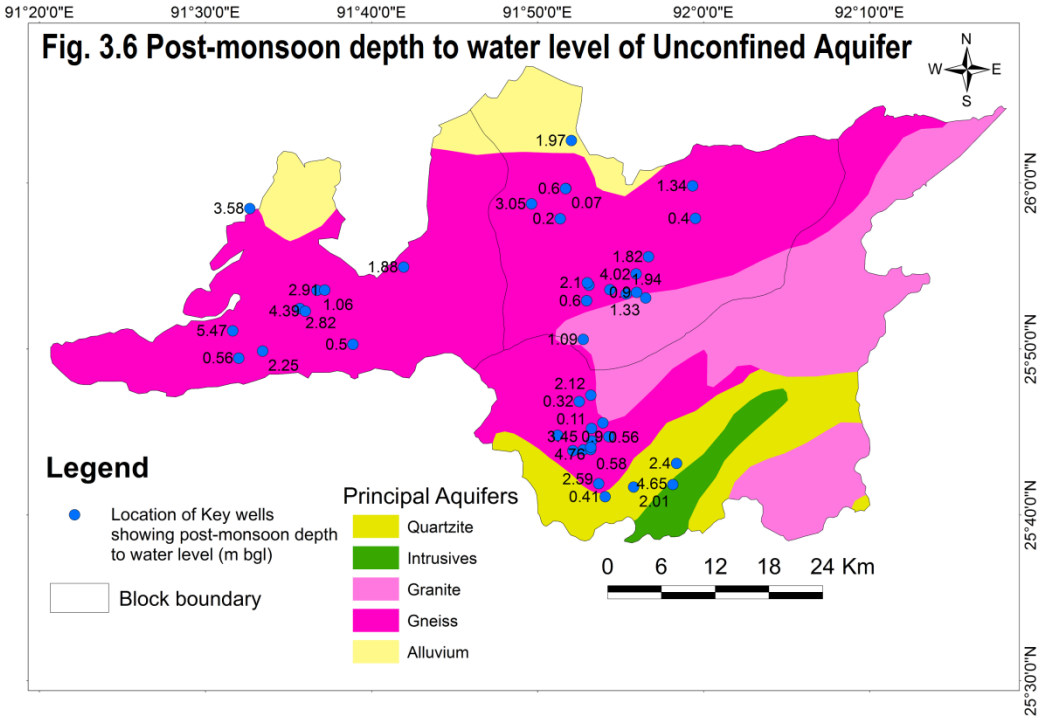


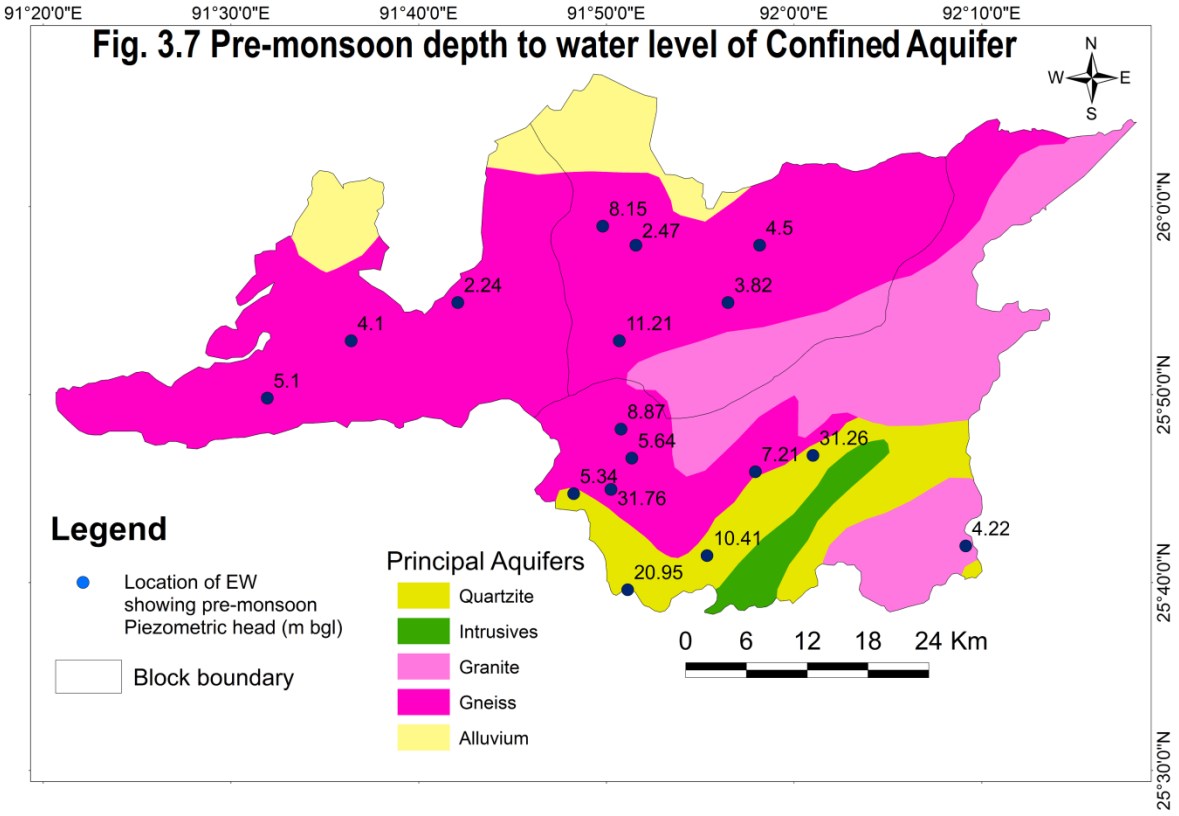
Fig 3.4 Post-monsoon spring discharge, Ri Bhoi district
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
0.28
0.474
0.13
0.75
0.85
0.38
0.71
0.01
0.03
0.68
0.75
0.4
Legend
Location of Springs showing the post-monsoon discharge (lps)
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

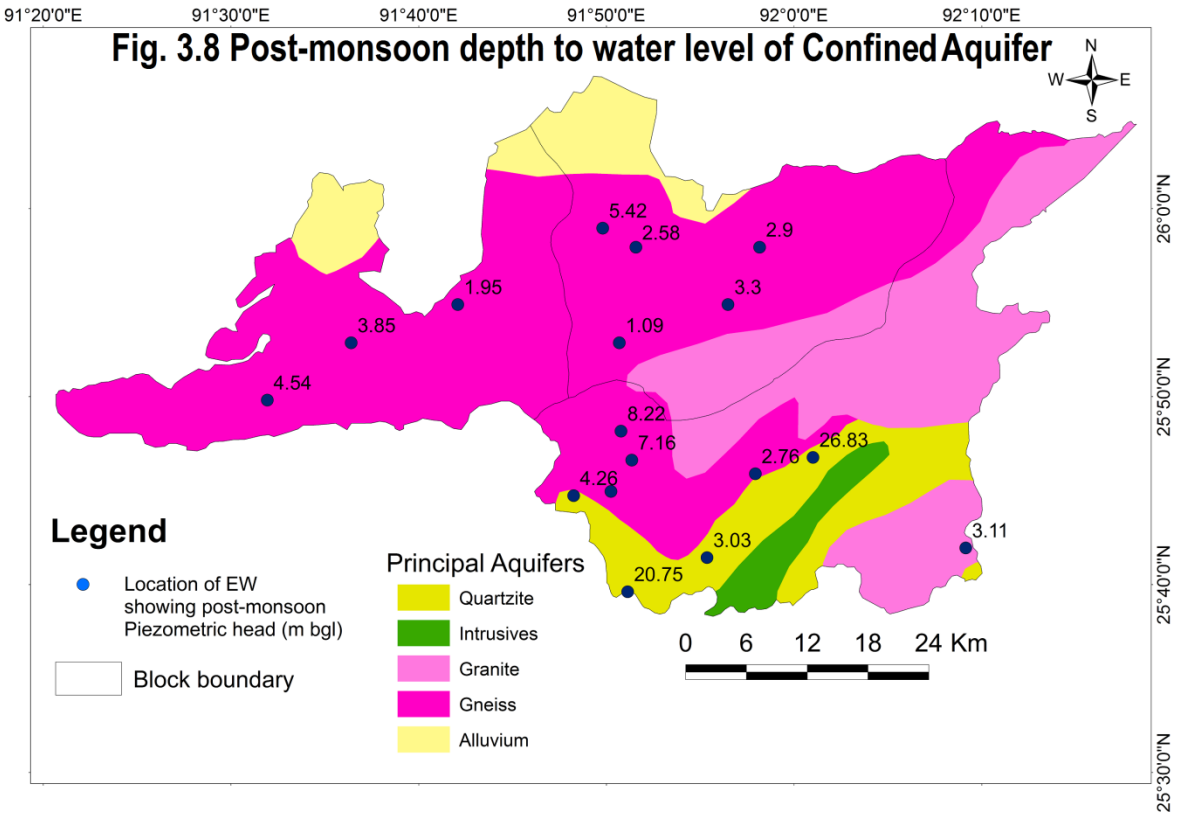
3.2 Depth to Water Level: Study of water level and its behaviour both in phreatic and confined condition were carried out in the aquifer mapping area. A total of 44 Dug wells were established as key wells for periodical monitoring to know the water level trend and its behaviour in phreatic condition. The depth to water level in these dug wells ranges from 0.55 to 7.6 m bgl during pre-monsoon and 0.41 to 4.76 m bgl during post-monsoon season and is shown in fig 3.5 and fig. 3.6 and the average water level fluctuation is 1.14 m.





To study the piezometric head, 17 bore wells were monitored periodically. The piezometric head ranges from 1.01 to 31.76 m bgl during pre-monsoon and 0.40 to 25.64 m bgl during post-monsoon season and is shown in fig 3.7 and fig. 3.8.





Further, long term water level data of 44 years were collected in one of the GWM (Nongpoh) to know the water level trend and its behaviour over the years. Based on depth to water level data collected from this ground water monitoring station at Nongpoh, the hydrographs of this well shows no significant rise or fall in the water level trend and is shown in fig. 3.9.

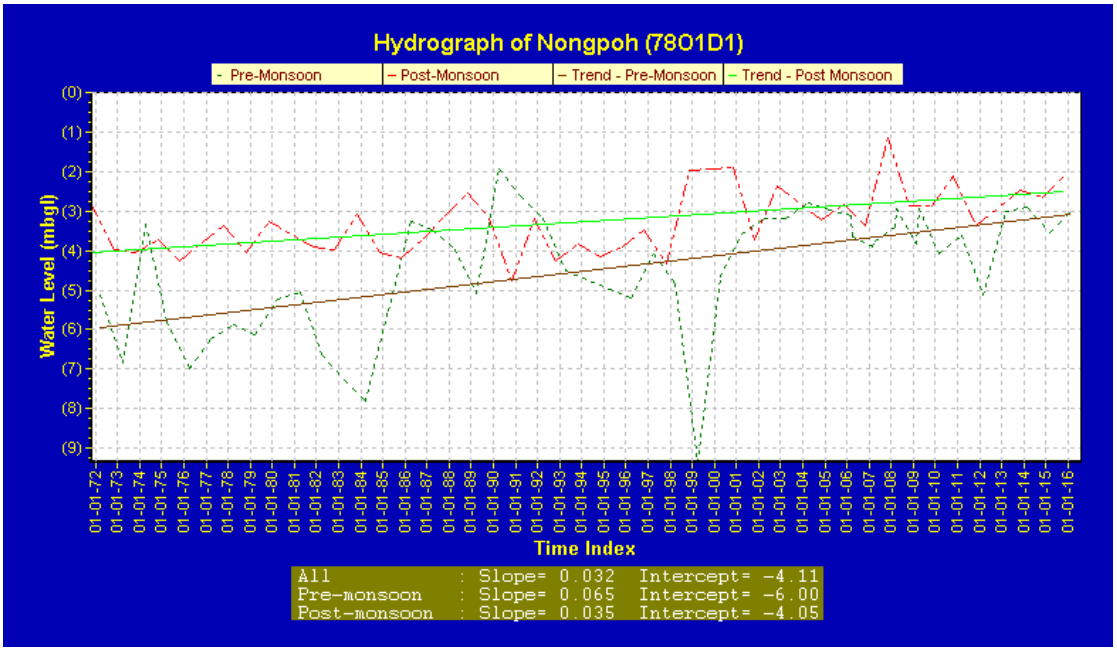


Fig. 3.9 Hydrograph of Nongpoh from 1972 -2016.

3.3 Aquifer system: The entire study area is underlain by consolidated rocks like Archaean Gneissic complex, Granite pluton and Quartzite with a small patch of unconsolidated Tertiary alluvium in isolated patches of limited areal extent in North-West part. The aquifer system exists in all the rock formations. It also exists in both weathered formation as well as fractured system down to the explored depth of 213.59 m bgl. The depth of weathered zone varies from 4 to as high as 35 m below ground level. Thus, hydrogeologically, the study area can be categorized into two groupsi.e. (i) Granitic gneissic complex aquifer of Archaean (ii) Quartzite aquifer of Shillong Group. The aquifer system in these hard rock terrain is a complex one as during construction of exploratory and observation bore wells under ground water exploration programme, it is found that there is no uniformity between depth and thickness of fractures encountered in exploratory bore hole and nearby observation bore hole. Two exploratory wells were constructed at Nongpoh area which was separated by an arial distance of 200 m showed completely different result. One well encountered 4 to 5 fractures and yielded 5.5 lps while the other bore holes did not encountered any fracture and remained

dry even though both the wells were drilled upto 200 m. Likewise, in Umling area one exploratory bore hole (147 m depth) and one observation bore hole (135 m bgl) were drilled. In the observation bore hole, one fracture was encountered between 22 to 25 m bgl and during washing the bore hole was collapsed and filled up to 35 m bgl. While in exploratory bore hole, six fractures were encountered and due to high discharge /water pressure it was not possible to drill farther down below. This type of variation in number, depth and thickness of fractures were observed not only in different geological formations but also in same geological formation. In fig.3.11, disposition of fractures were shown but were not connected because of huge vertical variation and lateral extension of fractures.

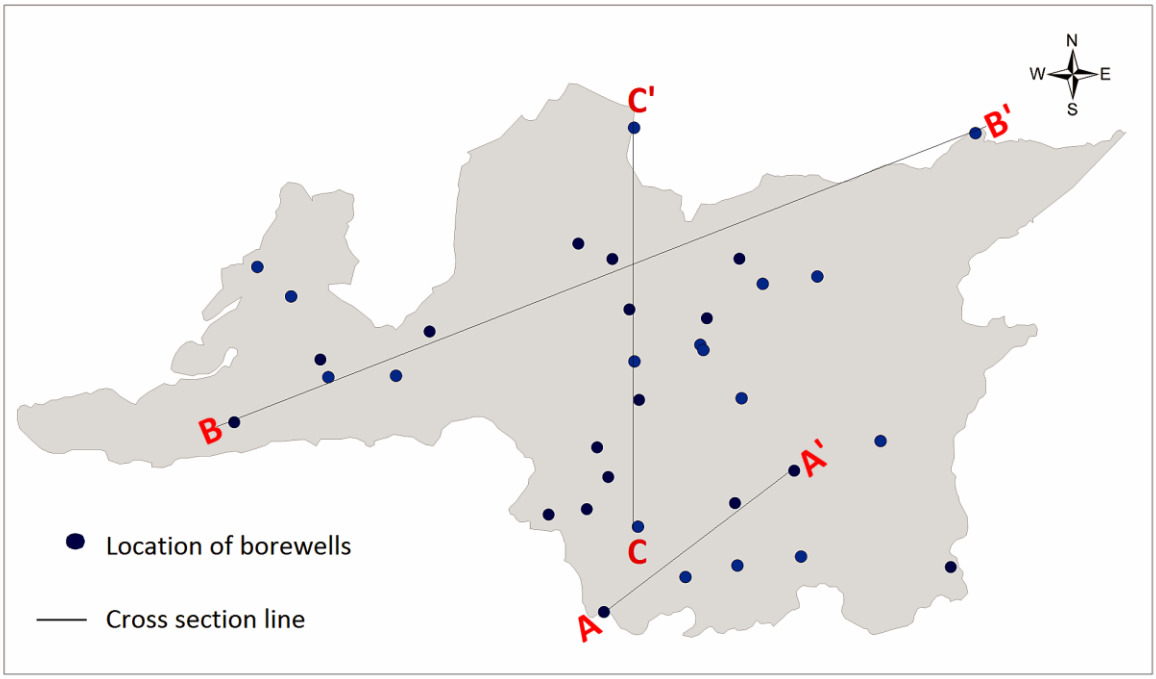
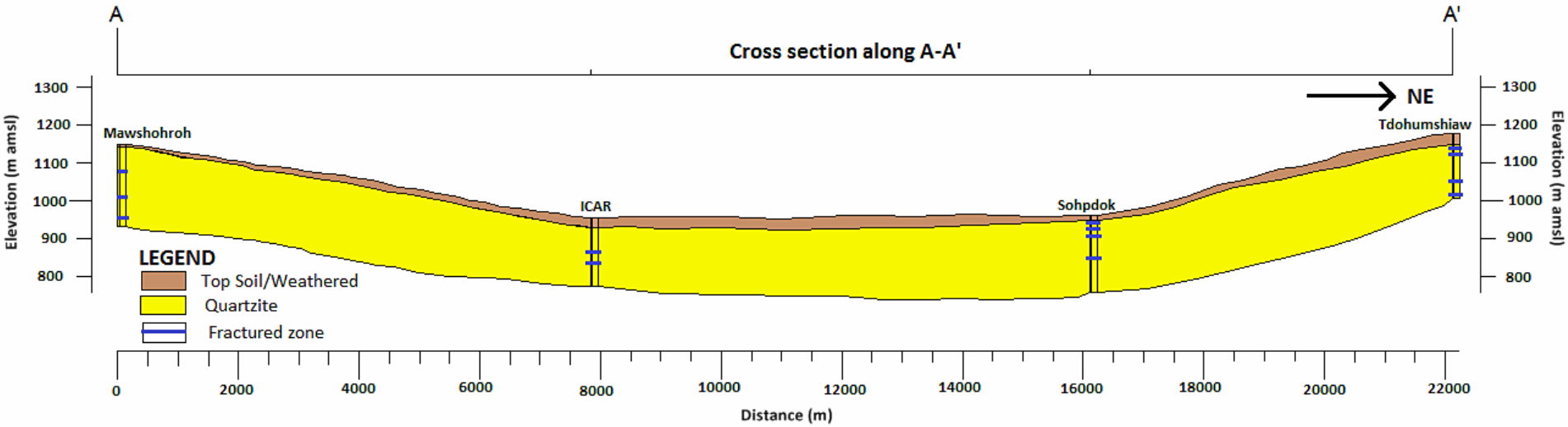
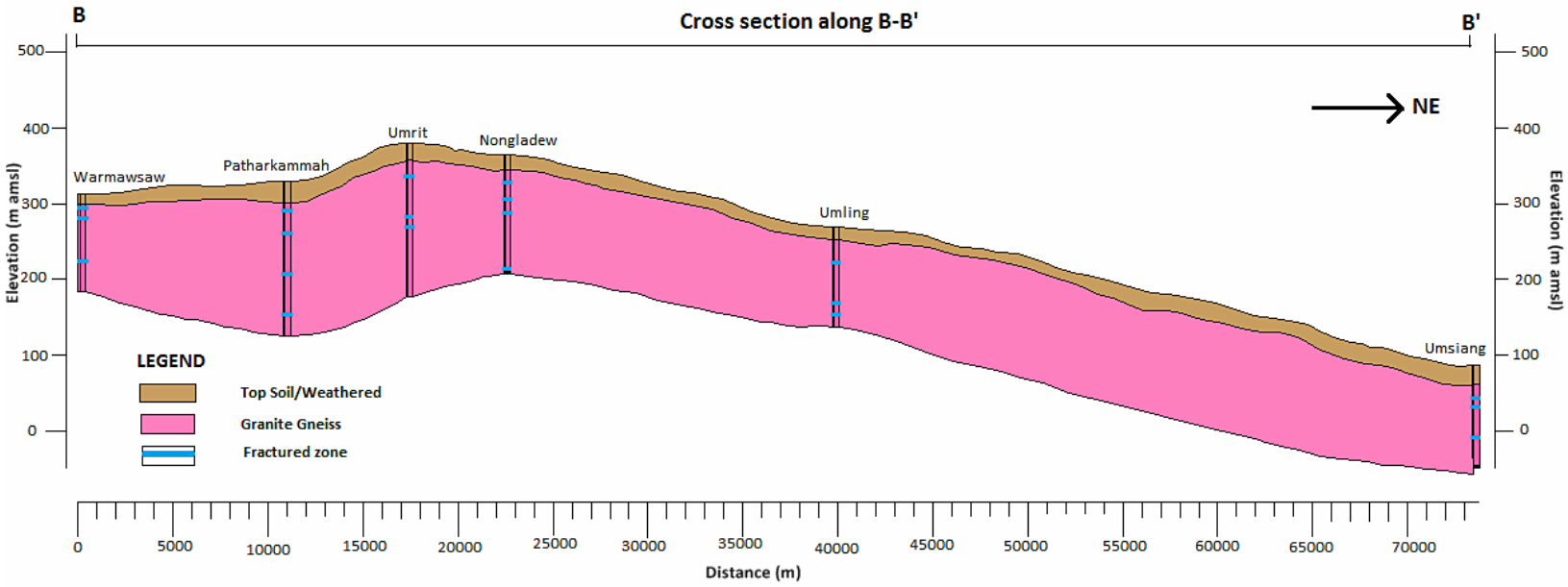


Fig.3.10 Hydrogeological section lines in Ri Bhoi


A
A'
Cross section along A-A'
NE
Mawshohroh
ICAR
Sohpdok
Tdohumshiaw
Elevation (m amsl)
1300
1200
1100
1000
900
800
LEGEND
Top Soil/Weathered
Quartzite
Fractured zone
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
Distance (m)


B
B'
Cross section along B-B'
NE
Warmawsaw
Patharkammah
Umrit
Nongladew
Umling
Umsiang
Elevation (m amsl)
500
400
300
200
100
0
LEGEND
Top Soil/Weathered
Granite Gneiss
Fractured zone
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
55000
60000
65000
70000
Distance (m)

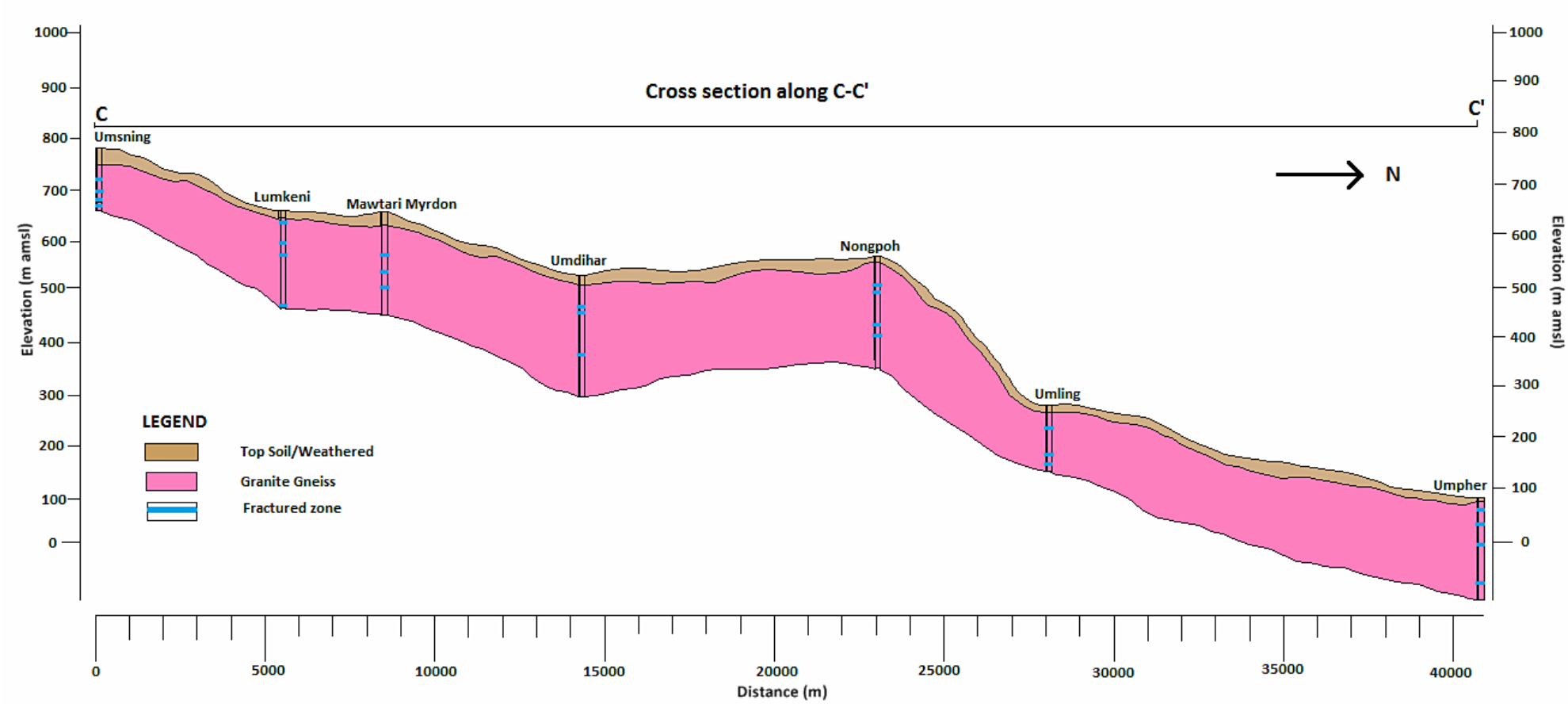


Fig. 3.11 Cross sectionsalong A-A', B-B' and C-C'

Formation wise hydrogelogical behaviours in the district are discussed below:

3.3.1 Granitic gneissic complex: The gneissic rocks are exposed in the north, central and western parts of the district.The occurrence of ground water in this formation are largely controlled either by weathering and or by fractures patterns. In fractured rocks, ground water movement mainly takes place along the fracture and their openings. Groundwater in these formations occurs under phreatic conditions in weathered mantle and under semi-confined to confine conditions in the fractured rocks, which is governed by topography and drainage. In this gneissic complex, depth of first aquifer ranges from 6 to 35 m bgl and the second aquifer ranges from 35 to 210 mbgl. Discharge of the exploratory wells ranges from 0.43 to 12.56 lps Transmissivity ranges from1.22 to 29 m^2/day.In general discharge in this gneissic complex is greater than the discharge found in the Nongpoh Granite. Distribution of fractures at various depth and cumulative discharge is tabulated in table 3.1.

Table 3.1 Location wise details of fracture encountered in Archaean gneissic complex

Location	Depth drilled in m bgl	Number of fractures encountered					Discharge (in lps)
		0 to 50 m	50 to 100 m	100 to 150 m	150 to 200 m	200 to 250 m	
Warmawsaw	129	2	1	0	-	-	10.775
Paham	154.82	1	2	1	-	-	6.04
New Jirang	200.3	2	1	2	0	-	4.26
Umrit	202.15	1	1	1	0	-	4.8
Mawrong	201.3	1	1	2	2		10.5826
Mawpat-Dongkiingding	61.8	1	-	-	-	-	0.43
Umling	131.9	1	2	1	-	-	2.45
Mawhati	171	0	0	2	0	-	1.9
Patharkammah	202.51	1	2	1	1	-	2.44
Umdu	203.46	1	1	1	1	-	1.03
Umsaw	180.94	1	0	0	1	-	1.85
Nongladew	156.77	1	2	1	1		12.56
Lumkeni	191	1	2	0	0	-	10.119
Marangar	180.5	2	0	1	0	-	0.8293
Mawtari Myrdon	201.45	0	1	2	0	-	2.25
R.P.B.F Kyrdemkulai	209.67	0	2	1	0	-	1.9

The above table reveals that in most of the places, 1 to 3 numbers of fractures were encountered within 100 m depth.

Granite Pluton: The Granite pluton is found on the central and Eastern part of the district and has been classified into twotype of major granitic plutoni.e., Nongpoh granite and Kyrdem granite. Ground water occurs in these formations under unconfined and semi-confined to confine conditions. In this Granite pluton, depth of first aquifer occurs within 35m bgl. Depth to water level in shallow aquifer during pre-monsoon and post-monsoon period ranges from 0.59 to 4.85 m bgl and 0.15 to 3.2 m bgl respectively.Exploratory bore holes were constructed in this formation within a depth range of 131.9 to 239.1 m bgl. Discharge in the wells ranges from 0.63 to 9.9 lps. Transmissivity ranges from 1.59 m^2/day (at Purduwa Kharpati village) to 18.936 m^2/day (at Umling village). Two bore holes are constructed at Nonpoh GAD area and at Saiden village in the western border of the Nongpoh valley, runs in north – south direction, at a higher elevation comparative to the valley (at an elevation difference of 20 to 30 m) revels that there is no productive fracture zone upto the explored depth of 200 m. Distribution of fractures at various depth and cumulative discharge is tabulated in table 3.2.

Table 3.2 Location wise details of fracture encountered in Granite pluton

Location	Depth drilled in m bgl	Number of fractures encountered					Discharge (in lps)
		0 to 50 m	50 to 100 m	100 to 150 m	150 to 200 m	200 to 250 m	
Nongpoh	204.6	2	2	4	2	-	5.5
Nongpoh GAD	220.70	0	2	2	1	-	< 0.0294
Umden	171	0	3	2	0	-	0.87
Purduwa	221.85	2	2	1	2	0	3.298
Umdihar	239.1	0	0	1	-	-	1.55
Mawsyntai	126.2	1	2	1	-	-	8.3889
Saiden	153.9	0	0	0	0	-	0
Rongskong	221.85	0	0	0	0	1	0.63
Thadrang	200.45	1	1	0	0	-	3.2

The above table reveals that most of the fractures were encountered within 50 to 150 m bgl.

3.3.2 Quartzite of Shillong Group: The quartzite and phyllites are exposed trending NE-SW in the southern part of the study area.Ground water occurs in the area under watertable conditions in the top weathered quartzite and in semi-confined to confined condition in the interconnected joints and fractures of the underlying hard quartzite.Exploratory bore wellswere constructed in this formation within a depth range of 167.04 to 215.71 m bgl. Discharge in the wells ranges from 0.2 to 18.55 lps. Transmissivity ranges from 0.06 m^2/day (at Mawshohroh) to 151.17 m^2/day (at Sohpdok) under Umsning block. Two artesian wells which are at ICAR campus and Sohpdok were found in this terrain during ground water exploration programme. Distribution of fractures at various depth and cumulative discharge is tabulated in table 3.3.

Table 3.3 Location wise details of fracture encountered in Quartzite

Location	Depth drilled in m bgl	Number of fractures encountered					Discharge (in lps)
		0 to 50 m	50 to 100 m	100 to 150 m	150 to 200 m	200 to 250 m	
Kyrdemkulai-Zero point	203.46	1	1	1	2	1	2.53
Sohpdok	203.46	2	1	1	0	-	10.12
Tdohumshiaw	172.81	0	1	1	-	-	4.04
Mawrong	201.3	1	1	1	0	-	3.28
ICAR campus (Plant Pathology)	180.80	0	1	1	0	-	18.55
Umroi Airdrome	167.04	1	1	1	0	-	15.70
Mawshohroh	215.71	0	2	1	0	0	0.2

In quartzite terrain, the fractures zones are mainly encountered within 150 meters depth and has higher yield than granitic gneissic complex terrain.

3.4 Aquifer geometry: The aquifer system in this district can be dividedas a two aquifer systemviz., first aquifer (shallow) and second aquifer (deeper).Shallow or first aquifer consists of weathered residuum where ground water occurs under water table condition and is mainly developed by construction of dug wells or shallow bore wells as hand pump. The second aquifer is the deeper aquifer which tapped the fractured zone. Based on the study of litholog and analysis of depth of construction of dug wells and shallow bore wells, it is found that the first aquifer occur within 2 to 35 m bgl. Ground water in the second aquifer occurs under semi-confined to confined condition in the fractures upto the maximum depth of 213.59 m bgl. The disposition of these aquifers is shown in fig.3.12.

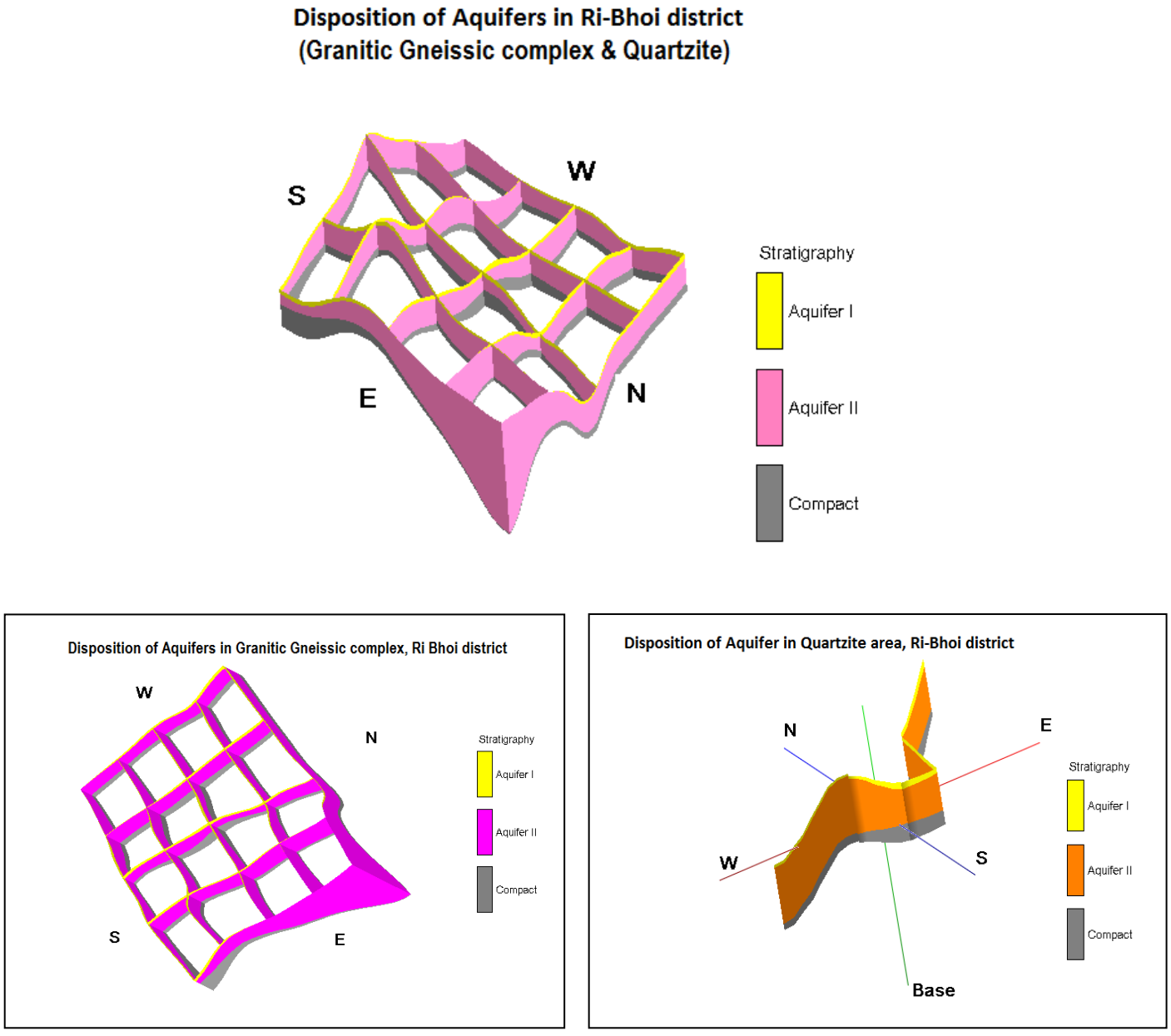


Fig. 3.12 Disposition of aquifers in Ri Bhoi district, Meghalaya

3.5 Aquifer properties:

Aquifer I: It is the unconfined aquifer where the tapping of aquifer zone ranges within 2 to 35 m depth and generally exhibits unconfined nature of the aquifer. Pumping tests in dug wells show specific capacity varies from 0.0064 to 0.065 m^3/min/m of drawdown (Slitcher's method).

Aquifer II: This is the deeper aquifer which occurs as semi confine to confine condition where ground water is found in the fractured zone of consolidated Quartzite, Gneiss and Granite. The drilled depth of exploratory wells tapping this aquifer ranges from 124.05 to 220.70 m bgl. The number of fractures and zones of encountering fractures varies widely which show the complexity of the hydrogeology of consolidated hard rock formation. The piezometric head ranges from 0.40 to 31.76 bgl. Through PYT, Slug test and Aquifer performance test it was found that transmissivity values vary from 0.06 to 151.17 m^2/day and the storativity ranges from $3x10^{-1}$ to $1x10^{-2}$. The discharge in these wells ranges from 0.2 to 18.55 lps.

3.6 Hydrochemistry:

The quality of ground water is as important as that of the quantity. In order to study the chemical quality of ground water in the district, water samples fromsprings, exploratory bore wells and dug wells were collected during the course of field work. The parameters analyzed are pH, EC, Turbidity, TDS, CO_3, Cl, SO_4, Na, K, HCO_3, NO_3, F, Ca, Mg, TH and Fe. The details of chemical analysis were given in the Annexure 2.

3.6.1 Ground water quality of unconfined aquifer:

A total of 44 ground water samples from dug well were collected during pre-monsoon studies and therange of concentrations of different chemical constituents present in the ground water samples are given in table 3.4.

Table 3.4: Chemical quality/ water samples from dug well, Ri Bhoi district

Sl.No.	Chemical constituents (Concentrations in mg/l except pH)	Range	
		Min	Max
1	pH	6.03	8.7
2	E.C. in micromhos/cm at 25º C	14.1	662
3	Turbidity(NTU)	BDL	29
4	TDS	7	385
5	TH	18	180
6	Ca	3.20	48
7	Mg	0.50	18.20

8	Na	0.60	74
9	K	0.60	33.80
10	CO_3	BDL	40
11	HCO_3	BDL	120
12	SO_4	BDL	75.26
13	NO_3	BDL	9.30
14	Fe	BDL	4.43

It is deciphered from table 3.4 that other than iron and turbidity, rest of the chemical parameters are within permissible limit for all uses. Out of 44 samples, 5 samples are having Fe concentration of more than 1 mg/l, 8 samples have Fe conc. of 0.3 to 1 mg/l and 31 samples have Fe conc. of less than 0.3 mg/l and 1 sample have turbidity of 29 NTU which is above permissible limit. The EC values are shown in fig 3.13, pH values in fig 3.14 and Fe conc. in fig. 3.15.

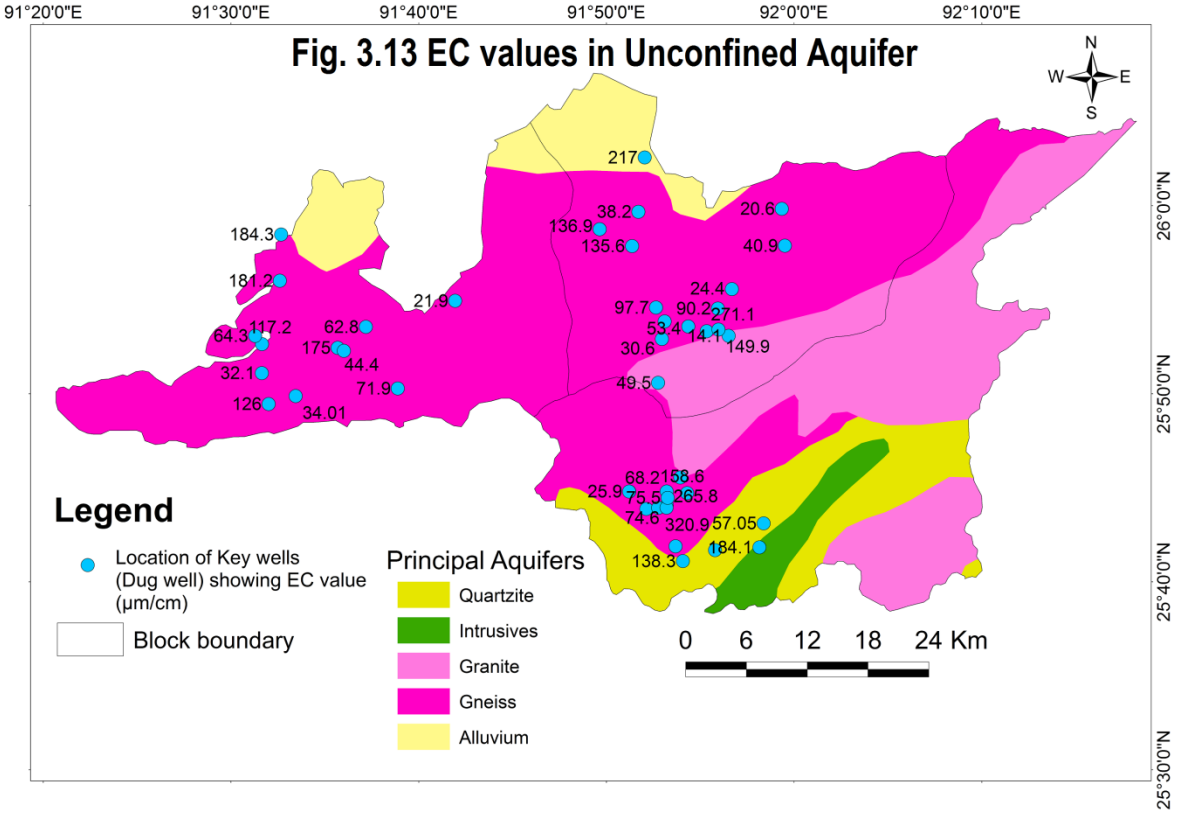


Fig. 3.13 EC values in Unconfined Aquifer

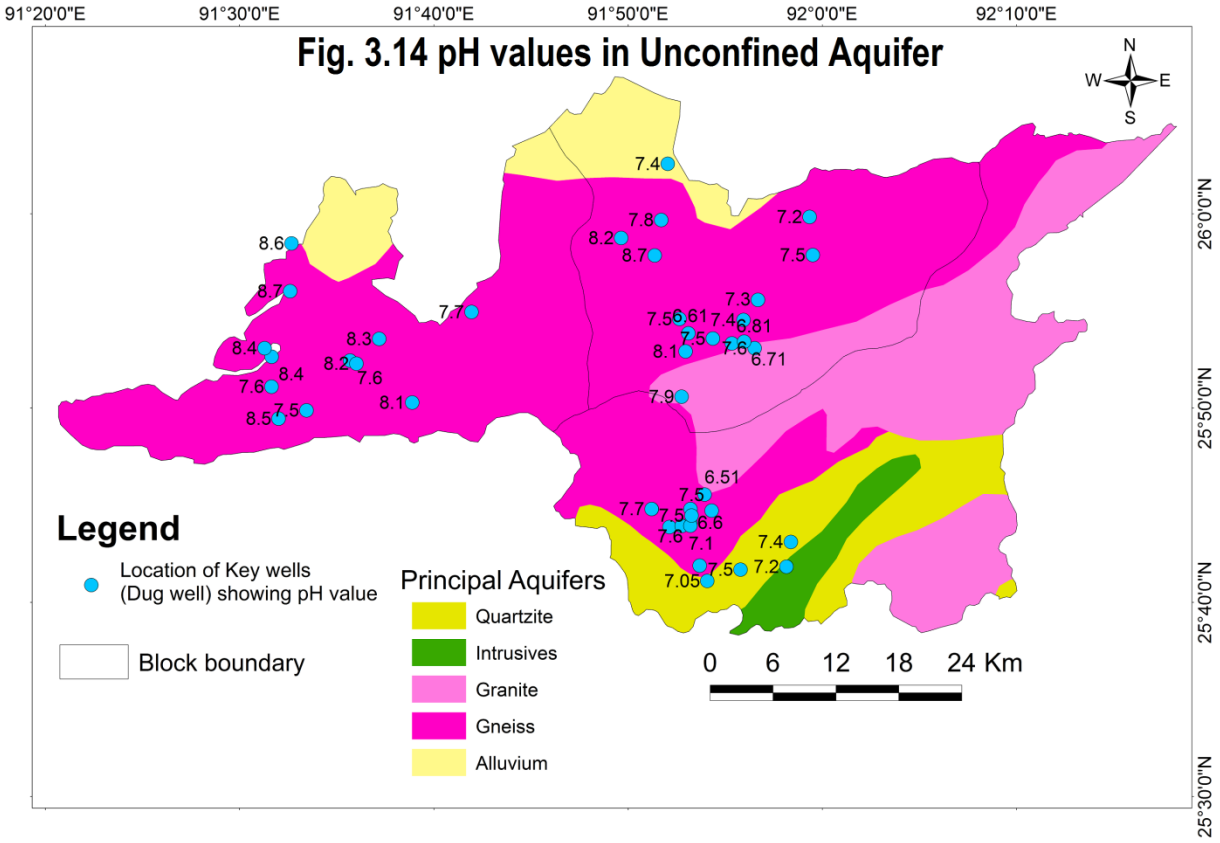


Fig. 3.14 pH values in Unconfined Aquifer
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
Legend
Location of Key wells (Dug well) showing pH value
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

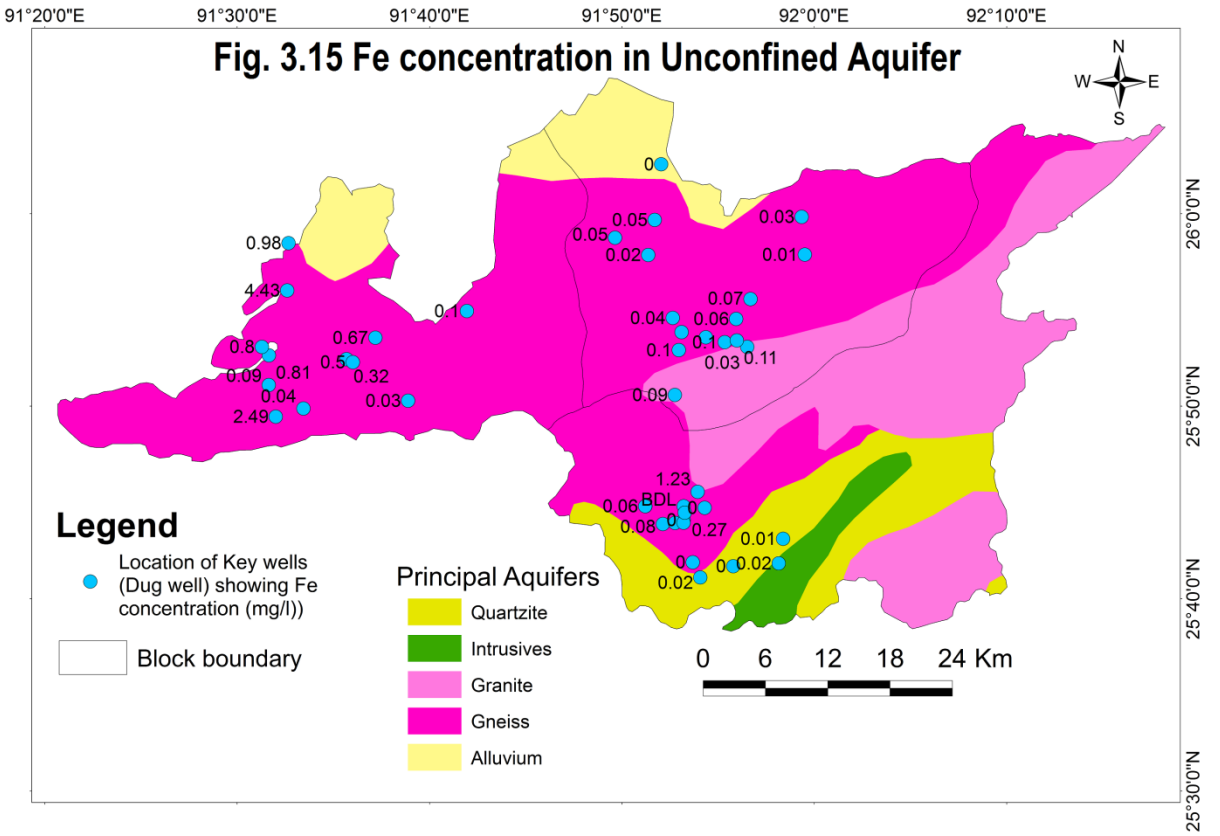


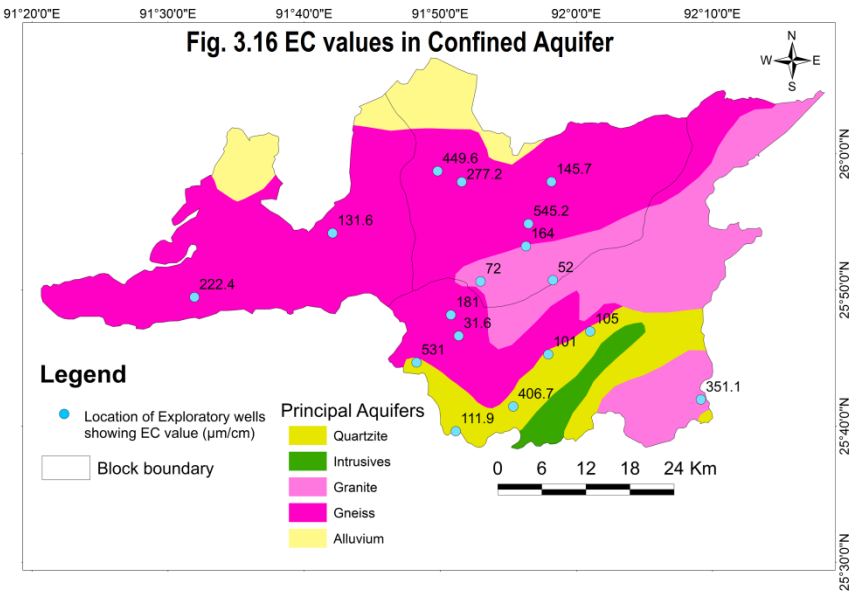
Fig. 3.15 Fe concentration in Unconfined Aquifer
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
Legend
Location of Key wells (Dug well) showing Fe concentration (mg/l))
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

3.6.2 Ground water quality in confined aquifer: A total of 18 water samples were collected during exploratory drilling programme and monitoring during the course of studies. Based on chemical analysis data therange of concentrations of different chemical constituents present in the deeper aquifer samples is given in table 3.5.

Table 3.5: Chemical quality of ground water in deeper aquifer

Sl.No.	**Chemical constituents (Concentrations in mg/l except pH)**	**Range**	
		Min	**Max**
1	pH	6.86	8.80
2	E.C. in micromhos/cm at 25° C	31.60	545.20
3	Turbidity(NTU)	BDL	4.90
4	TDS	21.47	283.20
5	TH	15	136
6	Ca	2	41.60
7	Mg	1.20	32
8	Na	1.41	54.24
9	K	1.90	33.82
10	CO_3	BDL	60
11	HCO_3	5	100
12	SO_4	BDL	61.26
13	NO_3	BDL	3.90
14	Fe	BDL	12.88

It can be inferred from table 3.5that except iron, the other parameters are within the permissible limit. pH of 8.8 was found in one well and out of 18 samples analyzed, 9 samples content Fe conc. of more than 1 mg/l, 2 samples have Fe conc. of 0.3 to 1 mg/l and 7 samples have Fe conc. of less than 0.3 mg/l. The EC values are shown in fig 3.16, pH values in fig 3.17 and Fe conc. in fig. 3.18.



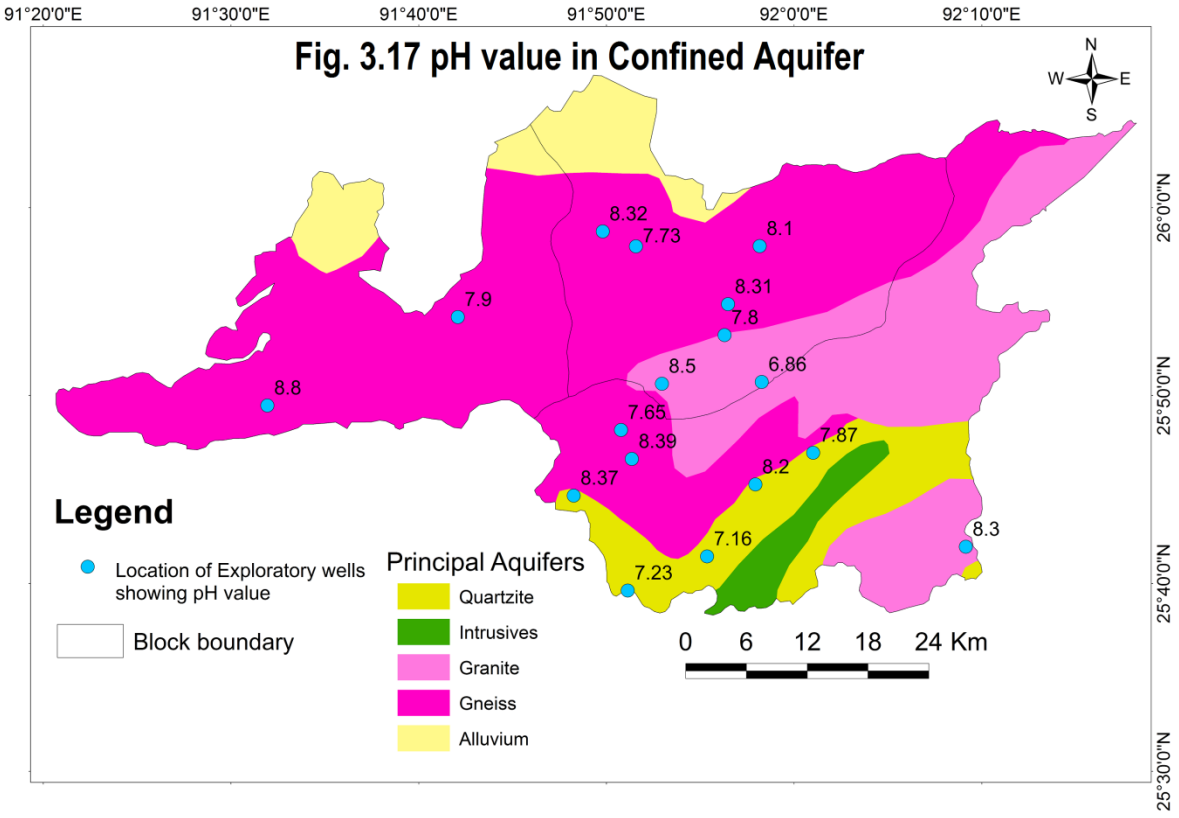


Fig. 3.17 pH value in Confined Aquifer
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
8.32
7.73
8.1
7.9
8.31
7.8
8.5
6.86
8.8
7.65
8.39
7.87
8.2
8.37
7.16
8.3
7.23
Legend
Location of Exploratory wells showing pH value
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

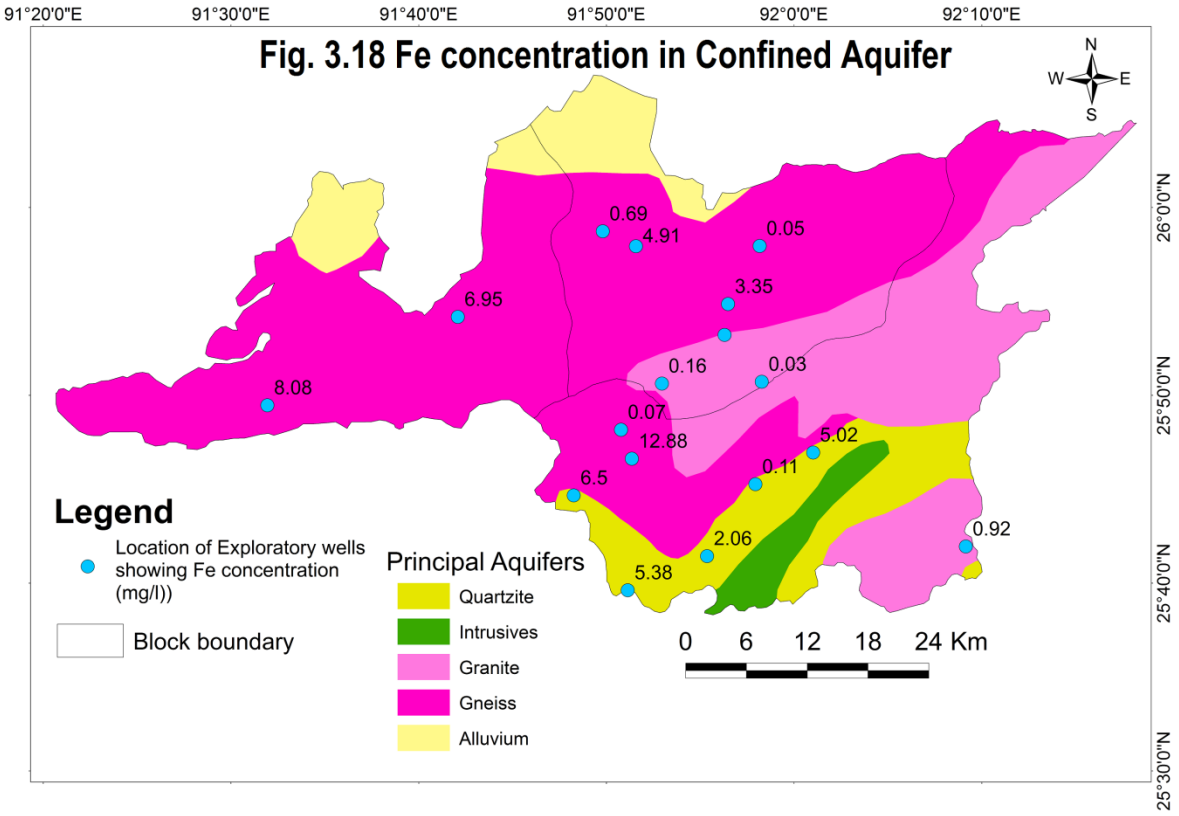


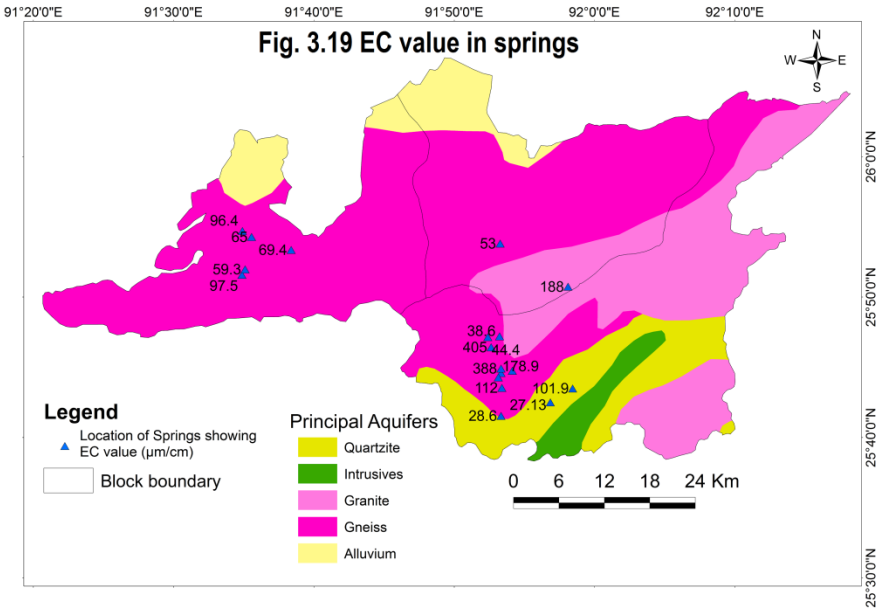
Fig. 3.18 Fe concentration in Confined Aquifer
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
0.69
4.91
0.05
6.95
3.35
0.16
0.03
8.08
0.07
12.88
5.02
0.11
6.5
2.06
0.92
5.38
Legend
Location of Exploratory wells showing Fe concentration (mg/l))
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

3.6.3 Water quality of springs: A total of 18 water samples from spring were collected during pre-monsoon studies and therange of concentrations of different chemical constituents present in the spring samples is shown in table 3.6

Table 3.6: Chemical quality of spring water, Ri Bhoi district

Sl.No.	Chemical constituents (Concentrations in mg/l except pH)	Range	
		Min	Max
1	pH	6	8.8
2	E.C. in micromhos/cm at 25° C	405	27.1
3	Turbidity(NTU)	BDL	1.2
4	TDS	14.4	236
5	TH	15	132
6	Ca	4	36.8
7	Mg	0.5	9.7
8	Na	1.95	37.1
9	K	1.3	21.8
10	CO_3	BDL	40
11	HCO_3	5	180
12	SO_4	BDL	29.4
13	NO_3	BDL	6.5
14	Fe	BDL	2.4

Itcan be inferred from table 3.6that except iron and pH,the other parameters are within the permissible limit. Out of 17 samples, 2 samples are having Fe concentration of more than 1 mg/l, 5 samples have Fe conc. of 0.3 to 1 mg/l and 10 samples have Fe conc. of less than 0.3 mg/l and 1 sample have pH of 8.8 which is above permissible limit. The EC values are shown in fig 3.19, pH values in fig 3.20 and Fe conc. in fig. 3.21.



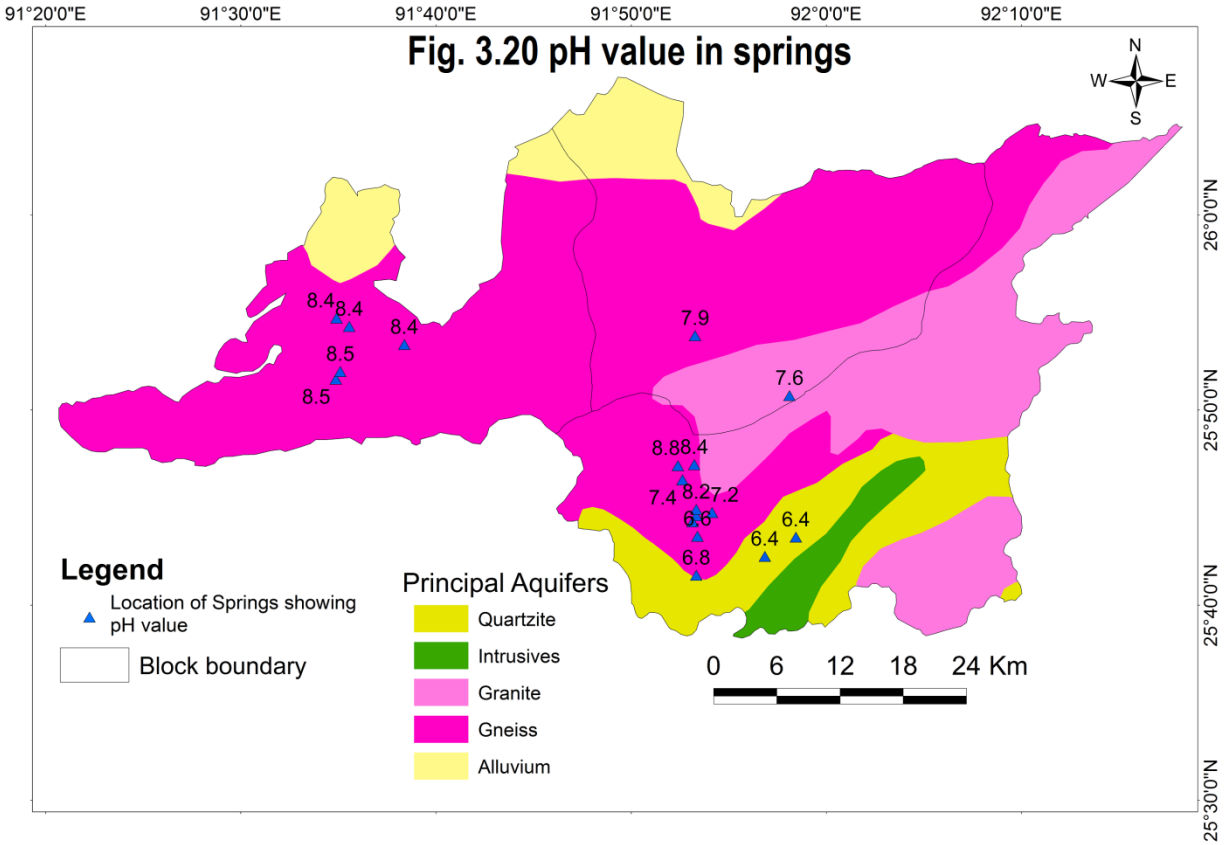


Fig. 3.20 pH value in springs
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
8.4
8.4
8.4
8.5
8.5
7.9
7.6
8.8
8.4
7.4
8.2
7.2
6.6
6.4
6.4
6.8
Legend
Location of Springs showing pH value
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

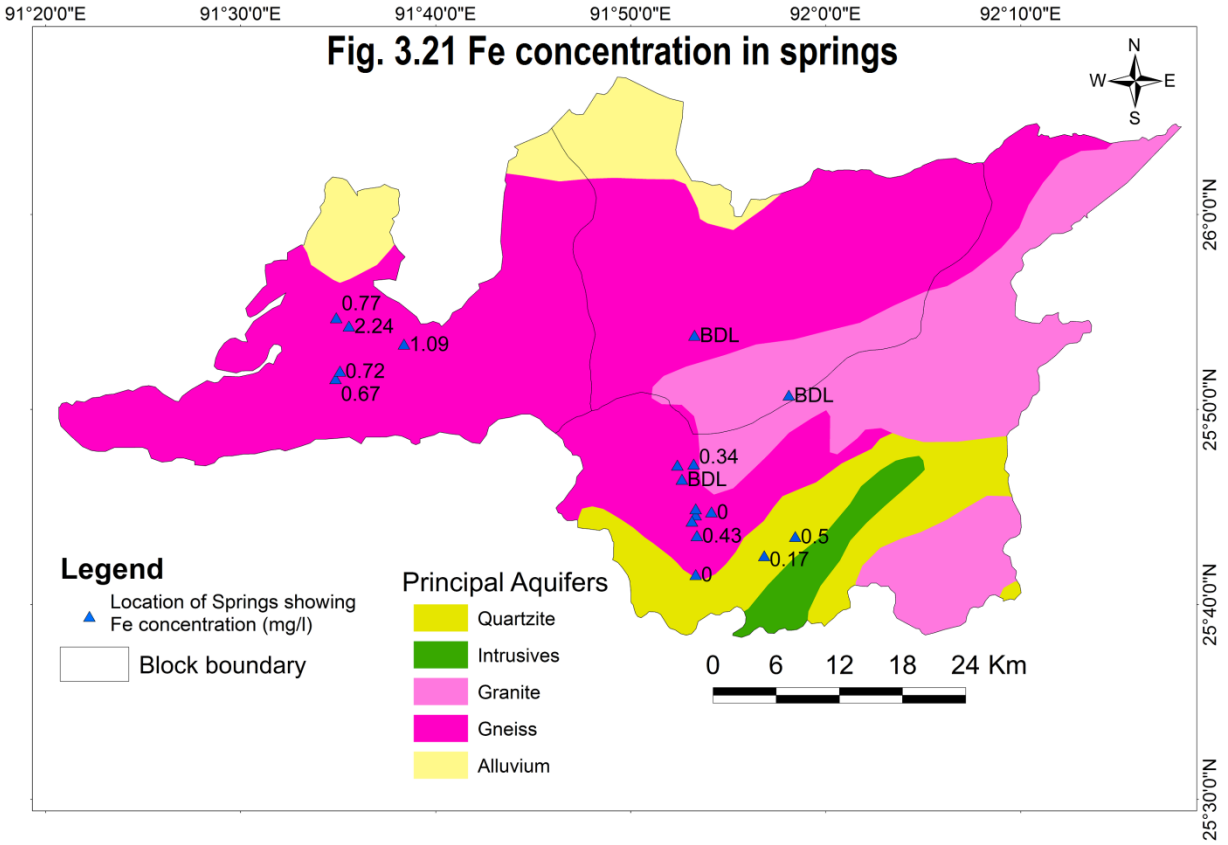


Fig. 3.21 Fe concentration in springs
91°20'0"E
91°30'0"E
91°40'0"E
91°50'0"E
92°0'0"E
92°10'0"E
26°0'0"N
25°50'0"N
25°40'0"N
25°30'0"N
N
W
E
S
0.77
2.24
1.09
0.72
0.67
BDL
BDL
0.34
BDL
0
0.43
0.5
0.17
0
Legend
Location of Springs showing Fe concentration (mg/l)
Block boundary
Principal Aquifers
Quartzite
Intrusives
Granite
Gneiss
Alluvium
0 6 12 18 24 Km

4. GROUNDWATER RESOURCES

Dynamic Groundwater Resources of RiBhoi district has been estimated based on the methodology recommended by Groundwater Estimation Committee (GEC'97). The resources computed for the groundwater year 2015-16. In the present resource estimation, the smallest administrative unit considered for resource estimation is district since block-wise data is not available. The following sub-units are recommended for the computation of various figures in the methodology and these are considered in details below:

Hilly Area: Area with more than 20% slope has been excluded for the recharge computation. As per NESAC, total recharge worthy area in the district is 90915 ha.

Poor Groundwater Quality Area: In the district, there is no mappable area, which can be demarcated as poor groundwater quality and hence not considered.

Command and Non-Command Area: The methodology envisages computation of various figures separately for command & non-command area. In the district, there is no major or medium canal irrigation scheme and thus the entire rechargeable area has been considered as a non-command area.

Lithological sub-units: The entire district is underlain by consolidated rocks like Archaean Gneissic complex, Granite pluton and Quartzite with a small patch of unconsolidated Quaternary alluvium in Northern part. Different units considered for computation of recharge are Granitic- Gneissic complex, Quartzites, valley fills and alluvium.

4.1 Groundwater Resources – Recharge for Various Seasons: The rainfall infiltration factor recommended by GEC'97 for Granitic- Gneissic complex and Quartzites are 0.05, for alluvium it is 0.20. During fieldworks 18 nos. of Infiltration studies were carried out, mostly in valley fills and alluvium areas. Rainfall recharge factor (RRF) calculated from these studies show that average RRF is 0.13.

For calculating recharge from return flow from irrigation, an average water requirement of 1.5 m & 0.1 m for paddy & non-paddy has been considered (as per discussion with Agriculture department, Govt. of Meghalaya). Computation factor for return flow from surface water irrigation is taken as 0.30 – 0.50 as per GEC'97 methodology. Return flow from surface water irrigation has not been considered for monsoon season, as there is enough rainfall during monsoon and irrigation is not practiced.

The aquifer remains fully saturated during the periods of intensive rainfall, additional recharge from ponds & tanks during this period is negligible. Recharge from ponds and tanks during non-monsoon period are considered for 100 days.

The district is mainly underlain by hard rocks and the specific yield value considered for them is 0.03 (from GEC'97 Methodology).

Recharge from Rainfall has been computed separately for monsoon and non-monsoon periods for the entire district. The recharge from rainfall during monsoon season has been computed using both water level fluctuation method (WLFM) and rainfall infiltration method (RIFM). The results from the above two methods (WLFM & RIFM) have been compared using Percent Deviation (PD). After the computation of the percent deviation (PD) it is found that the district shows PD value less than (–) 20. Monsoon recharge to groundwater is then estimated as per recommendations of GEC'97 methodology. The rainfall recharge estimated for non-command area of the entire district and the details are shown in annexure 9.

Recharge from All Sources: Total recharge to groundwater has several components, rainfall being the major one. The other components include seepage from canals, return flow from surface water irrigation, return flow from groundwater irrigation, seepage from tanks/ ponds etc. Recharge from various sources has been calculated for monsoon as well as non-monsoon periods and details have been shown in table 4.1.

Table 4.1: Recharge from various sources (ham).

District	Recharge from Rainfall	Return Flow from Surface water Irrigation	Recharge from ponds & tanks	Total recharge from other sources	Total Annual Recharge
RiBhoi	7772	43	111	154	7926

Recharge from rainfall in the district is 7772 ham whereas recharge from other sources is 154ham. Comparison of monsoon & non-monsoon rainfall recharge shows that monsoon recharge accounts for 91%. In Comparison to recharge from rainfall, recharge from sources other than rainfall shows that the later accounts for less than 2% of the total recharge.

4.2 Groundwater Draft for Various Purposes: Groundwater draft for domestic use has been estimated based on number of households using groundwater (Census 2011 data) and on number of structures used in different industrial units. Groundwater draft for irrigation is nil. It was found that groundwater draft for all uses in the district is only 27 ham.

4.3 Stage of Groundwater Development &Categorisation of the Blocks: The district falls under SAFE category. The stage of development is 0.38%. Summary of groundwater resources, stages of development and categorization are given in annexure 9.

4.4 Comparison with groundwater resource over the years: In table 4.2, a comparison amongst the total annual groundwater recharge, total groundwater resources available, net annual draft and balance groundwater resources available for future development estimated during 2012-13 and 2015-16 has been presented.

Table 4.2: Comparison between Groundwater Resources Estimatedduring 2012-13 and 2015-16. (Ground water resources in ham)

Sl. No.	Item	Year of Assessment 2012-13	Year of Assessment 2015-16
1	Areal extent of GW assessment unit (ha)	90915	90915
2	Rainfall recharge during monsoon	10559	7065
3	Rainfall recharge during non-monsoon	585	707
4	Recharge from other sources	2249	154
5	Annual GW recharge	13393	7926
5	Net GW availability	12723	7133
6	GW draft for irrigation	0	0
7	Gross GW draft	27	27
8	Annual Allocation of ground water for domestic & industrial water supply upto 2025	2027	270
9	Balance GW for future irrigation development	10696	6863
10	Stage of development	0.21	0.38

The reasons behind the differences between the groundwater resources estimated during 2012-13 and during 2015-16 are as follows;

(1) Difference in Rainfall recharge – (a)Rainfall not computed as per groundwater year. (b)Rainfall infiltration factor (RIF) considered for valley fills and alluvium during 2012-13 was 20% (GEC'97 norm) while during 2015-16 RIF taken was 13% (after field studies).

(2) Difference in recharge from other sources – mainly difference arises from recharge from surface water irrigation because data considered during 2012-13 was doubtful.

(3) Annual Allocation of ground water for domestic & industrial water supply upto 2025 was calculated as per GEC'97 methodology during 2012-13 but it is too high in comparison to present ground water draft. During 2015-16, this figure was considered as 10 times of present draft.

(4) Difference in Balance groundwater available for future irrigation and stage of development – due to above reasons these figures show changes.

5. GROUND WATER RELATED ISSUES

There are two major ground water related issues found in the study area.

5.1 Low stage of ground water development: As per ground water resource estimation 2016, the stage of ground water development is just 0.38 % and there is no utilization of ground water for irrigation in this area. All the irrigation schemes in the district are dependent upon the surface water resources. Therefore, there is enough scope for future development of ground water in the study area to bring more area under irrigation practice. At present the irrigation practice by utilising ground water (constructing bore well) is not accepted by villagers due to small land holding, high cost for construction and running of a well compared to production outcome. Another major obstacle in accelerating ground water irrigation is the absence of power lines in most of the cultivated/cultivable area.

5.2 Ground water quality: As per water quality analysis data, it is found that there is a high concentration of iron in both shallow aquifer and deeper aquifer. A moderately high concentration of iron is also found in springs. The comparison of iron content in shallow and deeper aquifer gives that there is more concentration of iron in deeper aquifer which is needed to be filtered before using it. Apart from iron, the other parameters are within the permissible limit.

6. MANAGEMENT STRATEGIES

As per dynamic ground water resource estimation of Ri Bhoi district for 2015-16, net ground water availability is 7133 ham and stage of development is only 0.38%. The district is having balance net ground water availability for future irrigation use in the tune of 6863 ham. If an irrigation plan is made to develop 60% of the balance dynamic ground water resources available, then 4117 ham of groundwater resources is available in the district for the future irrigation uses. From this available resource (planned for future development) 3400 nos. of shallow tube wells (considering a unit draft of 1.2 ham/year) can be constructed. Therefore, there is enough scope for future development of ground water in the study area to bring more area under irrigation practice.

Present land under irrigation during kharif season is 4656 ha, during rabi season it is 2371 ha. Present minor irrigation schemes are using surface water sources only. Present irrigation from ground water sources is almost nil. Hence, there is ample scope for ground water development for irrigation purpose which will bring prosperity to the society and help the district in achieving self-reliance on food grain. To use the groundwater for irrigation purpose a cropping plan has been designed for the district by using CROPWAT model developed by FAO. A suitable cropping plan for the district was prepared in consultation with Water Management Division of ICAR, Umiam and scientists of Assam Agricultural University, Jorhat. Cropping pattern data for the district is presented in Table 6.1.

During 2015-16, net sown area in the district is 22751 ha and cropping intensity is 113%. The net sown area included field crops as well as horticulture and plantation crops cultivated on hills and their slopes. Cropping intensity is calculated generally from field crops, which are of short duration whereas horticulture (like citrus, bananaand pineapple) and plantation crops like spices are long duration crops. Again crops grown on Ri Bhoi hills like pineapple, turmeric and ginger are having negligible or nil irrigation requirements. During kharif season, paddy is cultivated in 9286 ha and land under Maize cultivation is 2358 ha. After Kharif crops are over major portion of this area remains fallow during Rabi season. The intention of this plan is to utilize this fallow land (total kharif crops area is 11644 ha and total rabi crops area is 1647 ha) of about 10000 ha under assured irrigation during Rabi season which will help to increase gross cropped area to 23288 ha and thereby increase cropping intensity up to 200%. In rice fallow, potato, mustard and rabi vegetables and in maize fallow, soybean, pulses and vegetables can be grown with the support of irrigation. Present cropping

pattern, proposed cropping pattern, targeted increase in cropping intensity were shown in Table 6.2a and 6.2b.

Crop-wise and month-wise irrigation water requirement (Precipitation deficit) has been estimated from CROPWAT after giving necessary meteorological, soil, crop plan inputs and the same has been shown in Table 6.3. Crop-wise and month-wise Irrigation water requirement in ham has been further calculated in Table 6.4.

Table 6.1: CROPPING PATTERN DATA Ri Bhoi District

Cropping pattern name: Ri Bhoi CGWB Shlg

No.	Crop file	Crop name	Planting date	Harvest date	Area %
1	...Data\CROPWAT\data	Rice	04/06	01/10	10
2	...Data\CROPWAT\data	Rice	11/06	08/10	10
3	...Data\CROPWAT\data	Rice	25/06	22/10	10
4	...Data\CROPWAT\data	Rice	02/07	29/10	10
5	...\CROPWAT\data\cro	Potato	25/11	03/04	8
6	rape___mustard.CRO	Mustard	15/10	26/02	8
7	...ata\CROPWAT\data\	MAIZE (Grain)	16/04	18/08	10
8	...\CROPWAT\data\cro	Soybean	15/07	07/10	4
9	...CROPWAT\data\crop	Small Vegetables	05/02	10/05	12
10	...CROPWAT\data\crop	Small Vegetables	15/02	20/05	12
11	...a\CROPWAT\data\cr	Pulses	12/08	29/11	1
12	...CROPWAT\data\crop	Small Vegetables	23/09	26/12	5

Source: CROPWAT

Table 6.2 a. Cropping pattern, proposed cropping pattern, intended cropping intensity, Ri Bhoi district.

Cropping pattern (s)				
Rice based cropping pattern				
1. Rice-Potato 2. Rice-Mustard 3. Rice-Vegetables	Present Cultivated area (**ha**)	Area to be cultivated (**%**)	Area to be cultivated (**ha**)	Irrigation requirement (**ha m**)
	1	2	3(= % of 1)	4
Rice (main crop)	9286	9286		1639
Potato	34	1857	20	331
Mustard	202	1857	20	227
Vegetables	617	5572	60	448
Net cultivated area	9286	**9286**		
Gross cultivated area (1+potato/+mustard/+Veg)	10139	**18572**		
Total irrigation requirement				2645
Cropping intensity	**109% (Present)**	**200% (Intended)**		
Maize based cropping pattern				
4. Maize-soybean 5. Maize-pulses 6. Maize- vegetable				
Maize (main crop)	2358	2358		0
Soybean	244	943	40	0
Pulses	73	235	10	6
Vegetables	477	1180	50	85
Net cultivated area	2358	**2358**		
Gross cultivated area (Maize+soybean/+pulses/+Veg)	3152	**4716**		
Total irrigation requirement				91
Cropping intensity	**134 % (Present)**	**200% (Intended)**		
Total (Ri Bhoi district)				2736

Table 6.2 b. Proposed cropping pattern with water deficit months and IWR, Ri Bhoi district

Rice based cropping pattern			
Crop	**Growing period (Months)**	**Periods/months of water deficit**	**Irrigation requirement (ha m)**
Rice	4	1 – 2	1614
Potato	5	5	312
Mustard	6	6	353
Vegetables	3	3	417
Maize based cropping pattern			
Maize	4	0	0
Soybean	3	0	0
Pulses	4	1	6
Vegetables	3	2	80

The total area of rice cultivation is comprised of (9286 ha) 40 % of the targeted cultivated area of (23288 ha). During kharif season, rice is cultivated from June to mid-July. Since this huge area cannot be cultivated in a single day (one planting date), so it is considered/ planned to cultivate rice in four stages (each stage covering 10%) during this period.

Maize is cultivated during Aril to August. Soybean is cultivated from July to October. Potato and mustard cultivation are done in the month of October-November to February-March, pulses are cultivated during August to November. Vegetables are cultivated from September to December and again from February to April.

It is planned to utilize rice fallow of 9286 ha for the cultivation of potato, mustard and vegetables. It is considered to cultivate potato and mustard in 1857 ha each and vegetable in 5552 ha, including present cultivation area for these crops.

The peak water requirement for irrigation for rice is in the month of June, for potato it is in the month of March, for mustard it is in the month of December, for pulses it is in the month of November and for vegetables it is during November and March.

It is planned to utilize maize fallow of 2358 ha for the cultivation of soybean, pulses and vegetables. It is considered to cultivate soybean in 943 ha, pulses in 235 ha and vegetable in 1180 ha, including present cultivation area for these crops.

Irrigation requirement for Maize and Soybean is nil. While peak water requirement for irrigation for vegetables are during November.

Table 6.3: Crop-wise and month-wise precipitation deficit (mm) using CROPWAT 8 for Ri Bhoi District.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation deficit												
1. Rice	0	0	0	0	147	61.1	0	0	0	2.5	0	0
2. Rice	0	0	0	0	49.3	98	0	0	0	0	0	0
3. Rice	0	0	0	0	0	146.9	0	0	0	4.6	0	0
4. Rice	0	0	0	0	0	194.5	0	0	0	0	0	0
5. Potato	44.3	51.7	56.4	0	0	0	0	0	0	0	4	21.3
6. Mustard	37.7	19.8	0	0	0	0	0	0	0	0	25	39.1
7. MAIZE (Grain)	0	0	0	0	0	0	0	0	0	0	0	0
8. Soybean	0	0	0	0	0	0	0	0	0	0	0	0
9. Small Vegetables	0	23.5	53.7	13.3	0	0	0	0	0	0	0	0
10. Small Vegetables	0	13.3	43.8	12.9	0	0	0	0	0	0	0	0
11. Pulses	0	0	0	0	0	0	0	0	0	0	26.7	0
12. Small Vegetables	0	0	0	0	0	0	0	0	0	0	36.5	36.1

Table 6.4: Irrigation water requirement (ham) of Ri Bhoi district

Crop	% of total area of 23288 ha	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual**
1. Rice	10	0.0	0.0	0.0	0.0	342.3	142.3	0.0	0.0	0.0	5.8	0.0	0.0	490.4
2. Rice	15	0.0	0.0	0.0	0.0	114.8	228.2	0.0	0.0	0.0	0.0	0.0	0.0	343.0
3. Rice	7	0.0	0.0	0.0	0.0	0.0	342.1	0.0	0.0	0.0	10.7	0.0	0.0	352.8
4. Rice	8	0.0	0.0	0.0	0.0	0.0	453.0	0.0	0.0	0.0	0.0	0.0	0.0	453.0
5. Potato	8	82.5	96.3	105.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	39.7	331.1
6. Mustard	8	70.2	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.6	72.8	226.5
7. MAIZE (Grain)	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8. Soybean	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9. Small Vegetables	12	0.0	65.7	150.1	37.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	252.9
10. Small Vegetables	12	0.0	37.2	122.4	36.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	195.6
11. Pulses	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.0	6.2
12. Small Vegetables	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.5	42.0	84.5
Total	100	152.8	236.0	377.5	73.2	457.1	1165.6	0.0	0.0	0.0	16.5	102.7	154.6	2736.1

Under ground water exploration programme, CGWB has constructed 30 bore wells in this area and has established that the aquifer in most part of the district is having low potentiality, having an average discharge of about 10 m^3/hr but can be sustainably developed and use for irrigation purpose.

The ground water potentiality of the area is low to moderate, especially in the low-lying valley areas which are feasible for sustainable ground water development. Therefore, those areas can be brought under irrigation by developing ground water through bore wells or large diameter dug wells. Pumping tests of a few dug wells show that specific capacity values vary from 0.01 to 0.07 m^3/min/ m of drawdown. This type of dug wells can be used to irrigate 0.1 to 0.3 ha of land especially under Rabi vegetables. However, majority of the farmers in the district are marginal to small and their average land holding is 0.5ha. To irrigate 0.5 ha land especially for Rabi vegetables (maximum demand of 20 mm/month for March after CROPWAT) 150 m^3/month water is required (for October to March). Considering 70% of irrigation efficiency the demand will rise to 180m^3/month. This amount of water can be extracted if large diameter dug wells of size 2 to 3 m (dia) X 10 to 15 m (depth) can be constructed.

A bore well in the area is expected to yield 10 m^3/hr. If such a bore well runs for 10 hrs/day for 120 days, then it will create a draft of 1.2 ham. Bore wells can be designed within a depth of 100m, expected to encounter 2 – 3 fractures. Bore wells can be constructed by using 8$^{//}$ dia. casing pipe down to 30 m.

In considered net sown area of 11644 ha, 2900 nos. of shallow bore wells can be constructed (considering 200m distance between any two shallow bore well). 2900 nos. of bore wells can extract 3480 ham of water annually.

Annual irrigation water requirement is 2736 ham while irrigation water requirement during dry season spanning from October to March it is 1040 ham. However, proportionate dynamic groundwater resources available for future irrigation use in 11644 ha in Ri Bhoi district is 879 ham. Hence, there will be a shortage / gap of 161 ham of water during Rabi season.

State Govt. has already constructed 13 nos. of gravity flow irrigation projects (minor irrigation schemes) based on about 20 nos. of perennial rivers and streams. Minimum average discharge of these streams is 0.30 cumec and together they can supply 5.1 cumec of water. The existing schemes can irrigate 2371 ha during dry months. A few more gravity irrigation

schemes can be easily taken up to cover at least 7000 ha in the district as it is having many more perennial streams. Rest of the area [proposed double cropping land of 11644 ha – 7000 ha land under existing and future surface water irrigation projects] i.e., 4644 ha can be covered from ground water sources by constructing bore wells and dug wells. To cover 4644 ha during Rabi season, 483 ham of groundwater resources will be required. This amount of groundwater resources can be harnessed by constructing 400 bore wells. Even at possible places water harvesting structures should be employed.

Groundwater in the area is infested with iron, therefore before consumption aeration/ filtering/ installation of Iron Removal Plant is necessary.

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Annexure 1: Hydrogeological details of bore wells constructed by CGWB in Aquifer mapping area.

Unique ID	Village/ Location	Taluka/ Block	District	Toposheet No.	Lat	Long	Type of well (DW/BW/TW)	Depth	Dia	Date of pumping Test	Draw down (m)	Transmissivity (m^2/day)	Storativity/ S.Yield	Specific Capacity (lpm/m of dd)	Source/ Agency
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MEG-7809-1	Warmawsaw	Jirang	Ri-Bhoi	78 O/9	25^{0}49'28"N	91^{0}31'56"E	BW	129	7"/ 6½"						CGWB
MEG-7809-2	Paham	Jirang	Ri-Bhoi	78 O/9	25^{0}57'32"N	91^{0}33'08"E	BW	154.82	7"/ 6½"			27			CGWB
MEG-7809-3	New Jirang	Jirang	Ri-Bhoi	78 O/9	25^{0}56'00"N	91^{0}34'53"E	BW	200.3	7"/ 6½"			29			CGWB
MEG-7809-4	Umrit	Jirang	Ri-Bhoi	78 O/9	25^{0}51'53''N	91^0 40'20''E	BW	202.15	7"/ 6½"			13			CGWB
MEG-78013-5	Nongpoh	Umling	Ri-Bhoi	78 O/13	25^{0}56'24" N	91^{0}52'25" E	BW	204.6	8"/ 6½"		29.46	18.5			CGWB
MEG-78013-6	Umden	Umling	Ri-Bhoi	78 O/13	25^{0}57'52" N	91^{0}59'23" E	BW	171	7"/ 6½"						CGWB
MEG-78013-7	Marngar	Umling	Ri-Bhoi	78 O/13	25^{0}53'30" N	91^{0}56'9" E	BW	201.7	7"/ 6½"						CGWB
MEG-78013-8	Mawrong	Umsning	Ri-Bhoi	78 O/13	25^{0}50'43'' N	91^{0}58'17'' E	BW	201.3	8"/ 6½"		4.33	11.22			CGWB
MEG-83C2-9	Bhoirymbong	Umsning	Ri-Bhoi	83 C/2	25^{0}42'30" N	92^{0}01'22" E	BW	199	7"/ 6½"		43.98	0.27			CGWB
MEG-78013-10	Saiden	Umling	Ri-Bhoi	78 O/13	25^{0}52'38" N	91^{0}52'43" E	BW	153.9	7"/ 6½"		Dry				CGWB
MEG-78013-11	Mawsyntai	Umling	Ri-Bhoi	78 O/13	25°53'13" N	91°53'13" E	BW	126.2	7"/ 6½"	10.7.2013	6.63	21.52	$3x10^1$		CGWB
MEG-78013-12	Umling	Umling	Ri-Bhoi	78 O/13	25°57'56" N	91°51'35" E	BW	131.9	7"/ 6½"	30.12.2014	2.632	18.936	$3x10^{-2}$		CGWB
MEG-78013-13	Umdihar	Umling	Ri-Bhoi	78 O/13	25°50'37"N	91°52'57"E	BW	239.1	7"/ 6½"	3.1.2015	40	6.89			CGWB
MEG-78013-14	Rongskong	Umling	Ri-Bhoi	78 O/13	25°57'57" N	91°58'10" E	BW	221.85	7"/ 6½"	30.12.2014	2.632	1.82			CGWB
MEG-78013-15	Nongpoh GAD	Umling	Ri-Bhoi	78 O/13	25°55'19" N	91°52'27" E	BW	220.7	7"/ 6½"		Dry				CGWB
MEG-7809-16	Patharkammah	Jirang	Ri-Bhoi	78 O/9	25^{0}53'02" N	91^{0}37'07" E	BW	202.51	7"/ 6½"		19.02	3			CGWB
MEG-7809-17	Umdu	Umling	Ri-Bhoi	78 O/9	25°57'56" N	91°51'35" E	BW	203.46	7"/ 6½"	5.2.2015	21.37	4.07			CGWB
MEG-7809-18	Umsaw	Jirang	Ri-Bhoi	78 O/9	25°52'43" N	91°36'24" E	BW	203.46	7"/6½"	18.2.2015	24.865	1.22			CGWB

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MEG-7809-19	Nongladew	Jirang	Ri-Bhoi	78 O/9	25°54'11" N	91°42'5" E	BW	156.77	7"/ 6½"	23.2.2015	7.87	2.109			CGWB
MEG-7809-20	Warmawsaw II	Jirang	Ri-Bhoi	78 O/9	25°49'42" N	91°31'50" E	BW	80.86	7"/ 6½"		Dry				CGWB
MEG-78013-21	Kyrdemkulai-Zero point	Umsning	Ri-Bhoi	78 O/13	25°44'40" N	91°48'16" E	BW	203.46	7"/ 6½"	1.4.2015	15.47	4.82			CGWB
MEG-78013-22	Purduwa	Umling	Ri-Bhoi	78 O/13	25°54'51" N	91°56'29" E	BW	221.85	7"/ 6½"	19.6.2015	40.957	1.59	$1x10^{-1}$		CGWB
MEG-78013-23	Sohpdok	Umsning	Ri-Bhoi	78 O/13	25°45'16" N	91°57'56" E	BW	203.46	7"/ 6½"	30.7.2015	1.39	12.12	$1x10^{-2}$		CGWB
MEG-78013-24	Tdoumsaw	Umsning	Ri-Bhoi	78 O/13	25°46'57" N	92°1'01" E	BW	172.81	7"/ 6½"	29.9.2015	7.95	38.827			CGWB
MEG-78013-25	Lumkeni	Umsning	Ri-Bhoi	78 O/13	25°46'38" N	91°51'22" E	BW	191.2	7"/ 6½"	19.11.2015	21	9.02			CGWB
MEG-78013-26	Mawtari Myrdom	Umsning	Ri-Bhoi	78 O/13	25°48'10" N	91°50'47" E	BW	201.45	7"/ 6½"		43.05	6.25			CGWB
MEG-78014-27	ICAR Campus (Plant Pathology)	Umsning	Ri-Bhoi	78 O/14	25°41'26" N	91°55'22" E	BW	180.8	7"/ 6½"						CGWB
MEG-78014-28	Umroi Airodrome	Umsning	Ri-Bhoi	78 O/14	25°42'02" N	91°58'04" E	BW	167.4	7"/ 6½"						CGWB
MEG-83C1-29	Mawhati	Umsning	Ri-Bhoi	83 C/1	25°48'30" N	92°05'30" E	BW	171	7"/ 6½"						CGWB
MEG-83B4-30	Umsiang	Umsning	Ri-Bhoi	83 B/4	26°04'28" N	92°10'26" E	BW	135.1	7"/ 6½"						CGWB
MEG-78N16-31	Umpher	Umling	Ri-Bhoi	78 N/16	26°04'45" N	91°52'42" E	BW	200.5	7"/ 6½"						CGWB
MEG-83C1-32	Mawlong	Umling	Ri-Bhoi	83 C/1	25°57'02" N	92°02'13" E	BW	203.5	7"/ 6½"						CGWB
MEG-78014-33	Mawshohroh	Umsning	Ri-Bhoi	78 O/14	25°39'37" N	91°51'08" E	BW	215.72	7"/ 6½"	08.07.2016		0.06			CGWB
MEG-83C2-34	Thadrang	Umsning	Ri-Bhoi	83 C/2	25°41'57" N	92°09'09" E	BW	200.45	7"/ 6½"	04.08.2016	14.46	6.18			CGWB
MEG-78014-35	R.P.B.F. Kyrdemkulai	Umsning	Ri-Bhoi	78 O/14	25°44'58" N	91°50'15" E	BW	209.67	7"/ 6½"	30.03.2017	9.79	5.48	$3.3x10^{-4}$		CGWB

Annexure 2: Aquifer wise water quality data of Aquifer mapping area

Village/ Location	Taluka/ Block	District	Lat	Long	Aquifer Type	pH	EC (mS/cm)	Turbidity(NTU)	TDS (mg/L)	TH (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	NO_3 (mg/L)	Fe (mg/L)
Spring																			
Lumnongrin zero point road	Umsning	Ri-Bhoi	25^{0}46’25”	91^{0}52’38”	Wethered granite gneiss	7.4	405	BDL	236	112	30.4	8.73	37.1	2.59	BDL	88	6.94	1	BDL
Jirang	Jirang	Ri-Bhoi	25^{0}54’43”	91^{0}34’54”	Wethered granite gneiss	8.4	96.4	BDL	48.5	34	8.8	2.9	6.5	1.7	BDL	40	1.3	6.5	0.77
Lawki	Jirang	Ri-Bhoi	25^{0}54’22”	91^{0}38’23”	Fractured granite gneiss	8.4	69.4	BDL	34.5	34	8.8	2.9	4.7	1.5	BDL	60	BDL	1.7	1.09
Mawkhap	Umsning	Ri-Bhoi	25^{0}47’13”	91^{0}53’14”	Wethered granite	8.4	38.6	1	19.3	60	9.6	8.7	3.5	3.1	0	40	1.46	0.1	0.34
Mawrong	Umsning	Ri-Bhoi	25°50'44"	91°58’07”	Weathered Granite	7.29	143.90	0.30	75.26	30.00	6.00	3.64	17.82	7.92	0.00	25.00	19.36	3.10	0.09
Mawskei	Jirang	Ri-Bhoi	25°51’59”	91^{0}35’6”	Wethered granite gneiss	8.5	59.3	BDL	29.7	20	4	2.4	7.8	1.7	BDL	40	1.15	2.5	0.72
Mowrong	Umling	Ri-Bhoi	25°50’45”	91^{0}58’7”	Wethered granite	7.6	188	BDL	108	88	33.6	0.97	2.11	6.69	40	180	3.18	BDL	BDL
Nongjiri Umsala	Umsning	Ri-Bhoi	25°44'45"	91°54'09"	Fractured Quartzite	7.20	51.16	1.20	27.20	25.00	8.00	1.21	10.76	2.23	0.00	20.00	6.25	0.70	0.00
Sumer	Umsning	Ri-Bhoi	25°41'33"	91°53'20"	Fractured Quartzite	6.80	28.60	BDL	15.19	20.00	4.00	2.43	15.44	6.20	0.00	15.00	23.36	0.50	0.00
Syadrit	Umsning	Ri-Bhoi	25°44'17"	91°53'09"	Weathered Quartzite	6.80	178.90	BDL	79.40	25.00	6.00	2.43	30.20	6.18	0.00	30.00	25.36	3.90	0.13
Umeit	Umsning	Ri-Bhoi	25°42'30"	91°56'51"	Weathered Quartzite	6.40	27.13	BDL	14.44	15.00	4.00	1.21	18.88	9.19	0.00	25.00	16.36	0.40	0.17
Umpyrtha	Jirang	Ri-Bhoi	25°51’35”	91^{0}34’52”	Wethered granite gneiss	8.5	97.5	BDL	48.7	38	9.6	3.4	6.8	4.5	40	5	BDL	1.6	0.67
Umran Dairy	Umsning	Ri-Bhoi	25º 47’9”	91°52’24”	Wethered granite gneiss	8.8	44.4	1	22.2	44	11.2	3.9	6.7	4.7	0	32	2.09	3.1	0.08
Umroi	Umsning	Ri-Bhoi	25°43'30"	91°58'27"	Weathered Quartzite	6.40	101.90	BDL	53.70	20.00	6.00	1.21	10.34	21.84	0.00	20.00	20.31	3.10	0.50
Umsning 2	Umsning	Ri-Bhoi	25°43'32"	91°53'24"	Fractured Quartzite	6.60	112.00	BDL	59.04	20.00	6.00	1.21	23.64	3.22	0.00	20.00	29.36	1.50	0.43
Umsning I	Umsning	Ri-Bhoi	25°44'36"	91°53'20"	Weathered Quartzite	6.80	87.06	BDL	46.16	30.00	6.00	3.64	9.47	2.12	0.00	10.00	17.23	2.70	0.11
Umsning market area	Umsning	Ri-Bhoi	25^{0}44’55”	91^{0}53’20”	Wethered granite gneiss	8.2	388	BDL	225	132	36.8	9.7	21.7	10.6	16	104	17.91	BDL	0.01
Wahsyn-on	Jirang	Ri-Bhoi	25^{0}54’17”	91^{0}35’33”	Wethered granite gneiss	8.4	65	BDL	32.5	32	12	0.5	1.95	1.3	BDL	55	1.77	3.1	2.24

Village/ Location	Taluka/ Block	District	Lat	Long	Aquifer Type	Depth	pH	EC (mS/cm)	Turbidity(NTU)	TDS (mg/L)	TH (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	NO_3 (mg/L)	Fe (mg/L)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Shallow Aquifer																				
2 Kilo	Umsning	Ri-Bhoi	25°45' 33"	91° 53' 56"	Weathered granite	4.4	6.51	123.60	BDL	62.56	40.00	12.00	2.43	50.04	12.72	0.00	80.00	60.13	1.40	1.23
20 Mile	Umling	Ri-Bhoi	$25^0$59’41”	$91^0$51’42”	Wethered granite	4	7.8	38.2	1	19.1	52	6.4	8.7	7.4	4.9	0	48	1.46	BDL	0.05
20 Mile	Umling	Ri-Bhoi	25° 59' 41"	91° 51' 42"	Weathered granite	4	7.56	173.30	BDL	92.30	50.00	16.00	2.43	34.51	2.99	0.00	85.00	23.37	0.70	0.23
Bakhalapara	Jirang	Ri-Bhoi	$25^0$52’38”	$91^0$31’39”	Fractured granite gneiss	5.2	8.4	117.2	1	57.1	44	13.6	2.4	3.9	1.62	BDL	60	2.4	2.2	0.81
Barigaon	Jirang	Ri-Bhoi	$25^0$52’27”	$91^0$36’01”	Wethered granite gneiss	7.67	8.3	148	BDL	73.4	44	16	1	2.3	8.6	BDL	75	BDL	5.6	0.75
Barigaon	Jirang	Ri-Bhoi	$25^0$52’27”	$91^0$35’41”	Wethered granite gneiss	7.67	7.6	44.4	0.9	22.1	40	6.4	5.8	5.4	14.48	0	36	3.65	3	0.02
Breeze Dale Resort	Umsning	Ri-Bhoi	25° 44' 48"	91° 51' 13"	Weathered granite	11.97	7.57	182.10	BDL	95.82	55.00	18.00	2.43	37.41	10.30	0.00	110.00	22.26	0.90	0.39
Breeze Dale Resort II	Umsning	Ri-Bhoi	$25^0$44’48”	$91^0$53’13”	Wethered granite gneiss	5.7	6.6	68.2		39.4	40	8	4.85	3.89	3.34	BDL	32	2.71	0.9	BDL
Byrnihat	Umling	Ri-Bhoi	26°2’20”	91°52’72”	Weathered granite	3.82	7.40	217.00	BDL	102.50	75.00	20.00	6.07	6.23	5.90	0.00	45.00	10.44	1.40	0.00
Charikuchi Marangar	Umling	Ri-Bhoi	$25^0$53’20”	$91^0$55’21”	Wethered granite	5.31	7.6	92.6	1	46.4	64	16	5.8	10.9	13.6	0	8	2.56	4.8	0.04
Charikuchi Marangar	Umling	Ri-Bhoi	25° 53' 20"	91° 55' 21"	Weathered granite	5.31	6.81	271.10	BDL	138.20	40.00	14.00	1.21	23.37	17.79	0.00	45.00	19.17	7.90	0.10
Iewmawlong	Umling	Ri-Bhoi	25° 53' 51"	91° 53' 6"	Weathered granite	4.56	6.61	280.80	BDL	148.70	55.00	14.00	4.85	41.99	14.61	0.00	70.00	42.27	7.70	0.45
Iew-Mawroh(Sukurbaria)	Jirang	Ri-Bhoi	$25^0$58’29”	$91^0$32’40”	Fractured granite gneiss	10.36	8.6	184.3	BDL	90.7	66	18.4	4.9	10	1.8	BDL	75	1.15	3.5	0.98
Lyngkhung	Jirang	Ri-Bhoi	$25^0$53’5”	$91^0$31’17”	Fractured granite gneiss	2.73	8.4	64.3	BDL	39.2	26	9.6	0.5	2.9	1.03	BDL	50	BDL	3.7	0.8
Mawsyntai	Umling	Ri-Bhoi	$25^0$53’5”	$91^0$56’31”	Wethered granite	4.013	8	37.2	1	18.6	56	11.2	6.8	4.03	1.3	0	24	2.09	0.3	0.03
Mawsyntai	Umling	Ri-Bhoi	$25^0$53’25”	$91^0$55’59”	Wethered granite	4.36	7.6	14.1	1	7	48	4.8	8.7	3.2	1.9	0	20	2.71	0.1	0.03

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Mawsyntai	Umling	Ri-Bhoi	25° 53' 5"	91° 56' 31"	Weathered granite	4.013	6.71	149.90	BDL	78.56	25.00	4.00	3.64	53.32	2.40	0.00	45.00	52.34	2.60	0.11
Nayabunglow	Umsning	Ri-Bhoi	25°44’48”	91°53’13”	Weathered gneiss	9	7.03	265.80	BDL	142.20	40.00	4.00	7.28	32.58	4.18	0.00	25.00	35.65	6.10	0.00
Nayabunglow	Umsning	Ri-Bhoi	25°44’48”	91°53’13”	Weathered gneiss	9	8.00	516.70	BDL	242.80	175.00	42.00	16.99	4.91	3.38	0.00	80.00	44.00	0.00	0.00
Nongjiri Umsala	Umsning	Ri-Bhoi	25°44'43"	91°54'18"	Weathered Quartzite	3.6	7.50	158.60	BDL	82.50	65.00	14.00	7.28	21.19	9.80	0.00	65.00	41.26	1.20	0.00
Nongladew	Jirang	Ri-Bhoi	$25^0$54’28”	$91^0$41’56”	Wethered granite gneiss	3.3	7.7	21.9	2.2	10.9	36	4.8	5.8	8.8	4.2	0	20	3.06	0.6	0.1
Nongpoh	Umling	Ri-Bhoi	$25^0$54’0”	$91^0$53’0”	Wethered granite	5.52	7.5	97.7	1.9	49.03	36	8	3.9	20.03	33.8	0	32	3.17	7.8	0.04
Nongpoh	Umling	Ri-Bhoi	25°53’60”	91°53’0”	Weathered granite	5.52	7.20	159.20	BDL	73.73	50.00	12.00	4.85	11.16	1.99	0.00	30.00	10.48	0.00	0.00
Pahamjiri	Umling	Ri-Bhoi	$25^0$59’50”	$91^0$59’21”	Wethered granite gneiss	2.61	7.2	20.6	1.1	10.3	44	4.8	7.8	3.04	3.4	0	60	3.03	1.4	0.03
Patharkhamma	Jirang	Ri-Bhoi	$25^0$53’32”	$91^0$36’43”	Wethered granite gneiss	6.28	8.3	62.8	BDL	31.1	40	8.8	4.4	1.47	0.9	BDL	40	5.69	1.8	0.67
Patharkhamma	Jirang	Ri-Bhoi	$25^0$53’34”	$91^0$37’11”	Wethered granite gneiss	6.88	8.3	98.9	BDL	48.7	40	8.8	4.4	5.2	2.7	BDL	45	1.15	5.2	1.28
Patharkhamma	Jirang	Ri-Bhoi	25° 53' 33"	91° 37' 11"	Weathered gneiss	6.88	6.43	104.00	BDL	55.05	30.00	10.00	1.21	17.79	6.56	0.00	35.00	32.33	1.20	0.17
Patharkhamma Barigaon	Jirang	Ri-Bhoi	25° 52' 17"	91° 36' 01"	Weathered gneiss	5.6	6.56	175.00	BDL	91.70	45.00	10.00	4.85	37.21	16.84	0.00	70.00	39.19	4.90	0.32
Patharkhamma Barigaon-3	Jirang	Ri-Bhoi	$25^0$52’17”	$91^0$35’41”	Wethered granite gneiss	5.6	8.2	120.5	BDL	59.8	40	10.4	3.4	3.9	3.6	BDL	55	BDL	9.3	0.5
Puyllun	Umsning	Ri-Bhoi	25°41'41"	91°55'47"	Weathered Quartzite	5.3	7.50	173.40	BDL	96.72	80.00	12.00	12.14	24.09	9.75	0.00	90.00	41.26	1.00	0.00
Saiden	Umling	Ri-Bhoi	$25^0$52’55”	$91^0$52’58”	Wethered granite	2.62	8.1	30.6	1.3	15.3	52	11.2	5.8	4.7	3.2	0	24	3.18	1.3	0.1
Sumer	Umsning	Ri-Bhoi	25°41'54"	91°53'41"	Wethered granite gneiss	4.2	6.03	58.92	BDL	32.36	30.00	8.00	2.43	33.43	3.78	0.00	65.00	32.26	1.30	0.00
Tamanpahlong	Umling	Ri-Bhoi	$25^0$55’34”	$91^0$56’41”	Wethered granite	3.94	7.3	24.4	0.9	12	52	6.4	8.7	2.8	1.7	0	16	2.56	1.1	0.07

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Tamanpahlong	Umling	Ri-Bhoi	25° 55' 34"	91° 56' 41"	Weathered granite	3.94	6.45	86.70	0.20	45.73	25.00	8.00	1.21	12.80	21.41	0.00	45.00	17.25	2.10	0.27
Umbang	Umsning	Ri-Bhoi	25°41'06"	91°54'05"	Weathered Quartzite	4.6	7.05	138.30	BDL	73.90	65.00	16.00	6.07	3.03	1.41	0.00	50.00	13.37	2.10	0.02
Umden	Umling	Ri-Bhoi	$25^0$57’53”	$91^0$59’31”	Wethered granite gneiss	4	7.5	40.9	1	20.4	48	6.4	7.8	8.4	2.1	0	20	2.87	0.3	0.01
Umden	Umling	Ri-Bhoi	25° 57' 53"	91° 59' 31"	Weathered granite	4	6.81	155.30	BDL	80.96	45.00	8.00	6.07	21.49	4.83	0.00	55.00	8.25	4.30	0.47
Umden Mission	Umsning	Ri-Bhoi	25°41'50"	91°58'09"	Weathered Quartzite	12.2	7.20	184.10	BDL	106.70	85.00	16.00	10.92	33.04	11.87	0.00	85.00	75.26	1.80	0.02
Umdew	Umling	Ri-Bhoi	$25^0$58’45”	$91^0$49’39”	Wethered granite gneiss	5.96	8.2	136.9	1.5	68.3	156	46.4	9.7	9.2	5.8	40	88	3.79	0.3	0.05
Umdihar	Umling	Ri-Bhoi	$25^0$50’35”	$91^0$52’45”	Wethered granite	5.77	7.9	49.5	1.2	24.7	80	16	9.7	6.6	4.8	16	32	1.46	0.4	0.09
Umdihar	Umsning	Ri-Bhoi	25° 50' 35"	91° 52' 45"	Weathered granite	5.77	7.27	164.90	BDL	85.50	70.00	20.00	4.85	38.16	7.55	0.00	120.00	24.27	1.30	0.04
Umjarong	Umsning	Ri-Bhoi	25°43'53"	91°52'08"	Weathered gneiss	12.2	7.40	162.20	0.50	82.50	70.00	18.00	6.07	18.91	4.24	0.00	70.00	32.26	1.40	0.08
Umkaliar	Umsning	Ri-Bhoi	25°43'56"	91°52'46"	Weathered gneiss	6.2	7.10	320.90	BDL	172.10	170.00	38.00	18.20	2.37	3.98	0.00	105.00	51.34	5.20	0.24
Umling	Umling	Ri-Bhoi	$25^0$57’52”	$91^0$51’22”	Wethered granite	3	8.7	135.6	1	67.8	140	48	4.9	11.5	6.4	24	48	6	1.1	0.02
Umling	Umling	Ri-Bhoi	$25^0$53’51”	$91^0$53’6”	Wethered granite gneiss	4.56	8.2	103	1.4	51.5	124	38.4	6.8	25.5	10.7	40	76	3.03	1.4	2.25
Umroi Maidan	Umsning	Ri-Bhoi	25°43'07"	91°58'23"	Weathered Quartzite	9.14	7.40	57.05	BDL	32.10	30.00	6.00	3.64	29.87	2.46	0.00	25.00	52.00	1.30	0.01
Umsahbar	Jirang	Ri-Bhoi	$25^0$51’6”	$91^0$31’39”	Wethered granite gneiss	3.46	7.6	32.1	2.1	16.08	44	8	5.8	7.5	1.1	0	40	3.12	BDL	0.09
Umsaitsning	Umsning	Ri-Bhoi			Wethered granite gneiss	4	8.3	662		385	180	48	14.5	74	2.67	BDL	64	14.93	BDL	0.14
Umsning	Umsning	Ri-Bhoi	$25^0$44’48”	$91^0$53’13”	Wethered granite	11.97	7.7	25.9	1.4	12.9	48	12.8	3.9	0.6	0.6	0	40	2.71	BDL	0.06
Umsning (IO petrol pump)	Umsning	Ri-Bhoi	25°44'28"	91°53'16"	Weathered gneiss	7.5	7.60	74.60	BDL	39.90	20.00	4.00	2.43	15.26	10.69	0.00	25.00	15.24	1.70	0.21

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Umsning (Meg Tea Garden)	Umsning	Ri-Bhoi	25°43'56"	91°53'12"	Weathered gneiss	9.1	7.50	75.50	BDL	40.60	25.00	4.00	3.64	15.86	3.61	0.00	25.00	15.34	0.50	0.27
Umsopri	Jirang	Ri-Bhoi	$25^0$50’17”	$91^0$38’53”	Wethered granite gneiss	2.9	8.1	71.9	1	35.9	88	25.6	5.8	4.5	3.3	12	48	3.03	0.7	0.03
Umsur	Jirang	Ri-Bhoi	$25^0$56’01”	$91^0$32’36”	Wethered granite gneiss	4.71	7.4	152.3	29	58.7	18	6.4	0.5	4.1	7.9	BDL	55	8.2	5	1.11
Umsur	Jirang	Ri-Bhoi	$25^0$56’01”	$91^0$32’35”	Wethered granite gneiss	7.62	8.7	181.2	BDL	90.9	82	14.4	11.2	10	2.7	BDL	75	1.46	3.2	4.43
Umtang	Jirang	Ri-Bhoi	$25^0$49’53”	$91^0$33’27”	Wethered granite gneiss	6.48	7.5	34.01	1.7	16.9	72	16	7.8	3.58	1.06	0	36	3.25	1.7	0.04
Umtang	Jirang	Ri-Bhoi	25° 49' 53"	91° 33' 26"	Weathered gneiss	6.48	7.64	116.40	BDL	61.10	35.00	8.00	3.64	32.33	29.31	0.00	90.00	30.27	3.40	0.24
Umtham Marangar	Umling	Ri-Bhoi	$25^0$53’35”	$91^0$54’22”	Wethered granite	5.01	7.5	53.4	1.1	26.6	60	12.8	6.8	5.3	4.8	0	44	2.87	3	0.01
Umtham Marangar	Umling	Ri-Bhoi	25° 53' 35"	91° 54' 22"	Weathered granite	5.01	6.82	130.70	BDL	68.67	30.00	6.00	3.64	30.30	7.99	0.00	50.00	16.27	3.60	0.19
Umwang	Umling	Ri-Bhoi	$25^0$54’32”	$91^0$56’56”	Wethered granite	7.16	7.4	90.2	0.9	42	20	3.2	2.9	12.2	8.5	0	24	2.87	1.2	0.06
Umwang	Umling	Ri-Bhoi	25° 54' 32"	91° 55' 56 "	Weathered granite	7.16	6.77	93.86	BDL	49.53	25.00	4.00	3.64	32.61	4.38	0.00	40.00	38.27	2.50	0.03
Warmawsaw	Jirang	Ri-Bhoi	$25^0$49’27”	$91^0$32’0”	Wethered granite gneiss	1.88	8.5	126	BDL	64.4	46	12	3.9	12.5	4.23	BDL	60	BDL	4.3	2.49
Warmawsaw	Jirang	Ri-Bhoi	25° 49' 27 "	91° 32' 0"	Weathered gneiss	1.88	7.36	115.50	BDL	63.10	30.00	6.00	3.64	20.56	8.83	0.00	35.00	25.36	3.10	0.47

Village/ Location	Taluka / Block	District	Lat	Long	Aquifer Type	Depth	pH	EC (mS/cm)	Turbidity(NTU)	TDS (mg/L)	TH (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	NO_3 (mg/L)	Fe (mg/L)
Deeper Aquifer																				
ICAR	Umsning	Ri-Bhoi	25º 1'26.3"	91º55'22"	Fractured quartzite	180.8	7.16	40.67	BDL	21.47	25.00	4.00	3.64	9.59	4.35	0.00	5.00	26.33	2.20	2.06
Mawrong	Umsning	Ri-Bhoi	$25^0$50'41"	91º58'17"	Fractured granite gneiss	201.7	6.86	52	BDL	34	25	8	1.2			0	24	BDL		0.03
Mawshoroh	Umsning	Ri-Bhoi	25º39'37"	91º 51'08"	Fractured quartzite	215.72	7.23	111.90	0.10	57.80	15.00	2.00	2.43	21.75	4.73	0.00	50.00	11.24	0.40	5.38
Mawsyntai (PYT- I)	Umling	Ri-Bhoi	25º53'13"	91º53'13"	Granite, fractured	123.2	7.8	164		95.3	76	19.2	6.79	9.79	4.08	16	80	3.18	BDL	BDL
Mawsyntai (PYT- II)	Umling	Ri-Bhoi	25º 53' 13"	91º 53' 13"	Granite, fractured	126.2	7.8	135		78.8	48	11.2	4.85	9.27	4.15	16	72	3.34	BDL	BDL
Purduwa	Umling	Ri-Bhoi	25º 54'51"	91º 56'29"	Fractured granite	227.98	8.31	545.20	BDL	283.20	135.00	28.00	15.78	27.32	12.72	60.00	75.00	42.36	0.00	3.35
Rongskong	Umling	Ri-Bhoi	25º 57'57"	91º58'10"	Fractured granite gneiss	221.85	8.1	145.7	1.8	72.9	120	41.6	3.9	13.4	3.7	24	80	3.56	0.1	0.05
Thadrang	Umsning	Ri-Bhoi	25º 41'57"	92º 09'09"	Fractured granite	200.45	8.30	351.10	BDL	183.90	70.00	24.00	2.43	54.24	33.82	50.00	100.00	61.26	0.00	0.92
Umdihar	Umling	Ri-Bhoi	25º 52'59"	91º 50'41"	Fractured granite	239.1	8.5	72	2.9	36.02	120	22.4	15.5	33.3	15.2	24	72	27.14	BDL	0.16
Umling	Umling	Ri-Bhoi	25º 57'56"	91º 51'35"	Fractured granite gneiss	131.9	8.1	95.1	4.6	47.4	60	16	4.9	14.8	5.1	16	56	2.92	BDL	0.23
Umling	Umling	Ri-Bhoi	25º 57'56"	91º 51'35"	Fractured granite	131.9	7.73	277.20	BDL	145.90	70.00	16.00	7.28	27.00	2.89	0.00	75.00	27.27	0.00	4.91
Warmawsaw	Jirang	Ri-Bhoi	25^0 49'42"	$91^0$31'49"	Fractured granite gneiss	7.3	8.8	222.4	BDL	106.5	88	30.4	2.9	13	10.8	40	50	3.5	2.2	8.08
Sohpdok	Umsning	Ri-Bhoi	25.76500	91.96572	Fractured quartzite	203.46	8.2	101	0.1	51.8	36	9.6	2.9	17.43	2.29	BDL	32	4.0	2.7	0.11
Tdoumsaw	Umsning	Ri-Bhoi	25.77944	92.01692	Fractured quartzite	178.81	7.87	105	0.2	55.6	52	11.2	5.8	1.41	7.72	BDL	64	1.0	BDL	5.02
Lumkeni	Umsning	Ri-Bhoi	25.77711	91.85597	Fractured granite gneiss	191	8.39	31.6	0.2	165.7	128	40	6.8	8.55	5.11	48	88	3.2	3.9	12.88
Mawtari Myrdon	Umsning	Ri-Bhoi	25.80272	91.84639	Fractured granite gneiss	201.45	7.65	181	BDL	95.2	48	16	1.9	2.5	1.9	BDL	31	1.2	0.2	0.07
Zero point Kyrdemkulai	Umsning	Ri-Bhoi	25.74556	91.80431	Fractured quartzite	203.46	8.37	531	0.8	278.5	52	18	32	16.3	5.03	48	88	13	2.2	6.5
Umdu	Jirang	Ri-Bhoi	25.98278	91.83008	Fractured gneiss	203.46	8.32	449.6	0.3	236.4	136	24	19.2	5.23	2.46	24	88	1.7	3.5	0.69
Nongladew	Jirang	Ri-Bhoi	25.91500	91.70136	Fractured gneiss	156.77	7.9	131.6	4.9	69.6	28	4.8	17.6	10.86	2.46	BDL	64	2.6	3.2	6.95

Annexure 3: Water level monitoring data compilation

Unique ID	Name of village/site	Longitude in degrees decimal	Latitude in degrees decimal	RL (mamsl)	Total depth of Pz/DW (mbgl)	Type (DW/Pz/Spring)	Aquifer group	Measuring point (magl)	Source /Agency
Shallow Aquifer									
MEG-78013-68	Umdew	91.82739	25.97922	286	5.96	Dug	I	0.75	CGWB
MEG-7809-67	Nongladew	91.69900	25.91567	355	3.3	Dug	I	0	CGWB
MEG-7809-36	Patharkhamma	91.61203	25.89228	348	6.28	Dug	I	0.75	CGWB
MEG-7809-38	Patharkhamma	91.61969	25.89264	338	6.88	Dug	I	0.78	CGWB
MEG-7809-47	Barigaon	91.59475	25.87406	350	7.67	Dug	I	0.88	CGWB
MEG-7809-46	Patharkhamma Barigaon 3	91.60017	25.87144	330	5.6	Dug	I	0.91	CGWB
MEG-7809-63	Umsopri	91.64806	25.83800	342	2.9	Dug	I	0.73	CGWB
MEG-78013-71	2 Kilo	91.89897	25.75917	768	4.4	Dug	I	0.74	CGWB
MEG-78013-72	Iewmawlong	91.88508	25.89750	514	4.56	Dug	I	0.62	CGWB
MEG-78013-55	Umtham Marangar	91.90603	25.89300	597	5.01	Dug	I	0.85	CGWB
MEG-78013-58	Charikuchi Marangar	91.92242	25.88875	585	5.31	Dug	I	0.41	CGWB
MEG-78013-56	Mawsyntai	91.94189	25.88464	598	4.013	Dug	I	0	CGWB
MEG-78013-57	Mawsyntai	91.93292	25.89019	600	4.36	Dug	I	0.57	CGWB
MEG-78013-59	Umwang	91.93231	25.90892	601	7.16	Dug	I	0	CGWB
MEG-78013-60	Tamanpahlong	91.94475	25.92611	577	3.94	Dug	I	0.75	CGWB
MEG-78013-61	Umden	91.99183	25.96461	550	4	Dug	I	0	CGWB
MEG-78013-69	Nongpoh	91.88333	25.90000	540	5.52	Dug	I	0.66	CGWB
MEG-78013-50	Umling	91.85611	25.96431	254	3	Dug	I	0.71	CGWB
MEG-78013-51	20 Mile	91.86175	25.99467	313	4	Dug	I	0.8	CGWB
MEG-78013-53	Umsning	91.85356	25.74672	787	11.97	Dug	I	0.9	CGWB
MEG-78013-52	Mawkhap	91.88686	25.78697	720	7	Dug	I	0.8	CGWB
MEG-78013-13	Umdihar	91.87922	25.84306	523	5.77	Dug	I	0.66	CGWB
MEG-78013-54	Saiden	91.88269	25.88186	592	2.62	Dug	I	0.47	CGWB
MEG-78013-48	Umran Dairy	91.87525	25.78064	653	3.7	Dug	I	0.64	CGWB
MEG-78013-62	Pahamjiri	91.98908	25.99728	333	2.61	Dug	I	0.37	CGWB
MEG-7809-65	Umtang	91.55736	25.83136	326	6.48	Dug	I	0.73	CGWB
MEG-7809-43	Warmawsaw	91.53344	25.82425	321	1.88	Dug	I	0.46	CGWB
MEG-78013-82	Umsahbar	91.52736	25.85167	293	3.46	Dug	I	0.83	CGWB
MEG-7809-39	Iew-Mawroh (Sukurbaria)	91.54450	25.97458	68	10.36	Dug	I	0.7	CGWB
MEG-78013-73	Umsning Nongthymi	91.88761	25.75361	767	4.84	Dug	I	0.8	CGWB
MEG-78014-1	Sumer	92.56833	26.57500	853	4.2	Dug	I	0.75	CGWB
MEG-78014-2	Umden Mission	92.11833	26.51667	902	12.2	Dug	I	0.8	CGWB
MEG-78014-3	Umroi Maidan	92.34667	25.82833	904	9.14	Dug	I	0.3	CGWB
MEG-78014-4	Pyllun	92.70500	26.36833	949	5.3	Dug	I	0.75	CGWB
MEG-78014-5	Nongjiri Umsala	92.20167	26.45167	880	3.6	Dug	I	0.1	CGWB
MEG-78014-6	Umsning	92.14833	26.20000	762	7.5	Dug	I	0.5	CGWB
MEG-78014-7	Umjarong	91.99667	26.59167	757	12.2	Dug	I	0.5	CGWB
MEG-78014-8	Umkaliar	92.62500	26.64500	774	6.2	Dug	I	0.2	CGWB
MEG-78014-9	Umsning	92.08667	26.66167	780	9.1	Dug	I	0.55	CGWB
MEG-78014-10	Umbang	91.975	25.78167	922	4.6	Dug	I	0.6	CGWB
MLRB04	Byrnihat	91.86739	26.04283	89	3.82	Dug	I	0.93	CGWB
MLRB05	Nayabunglow	91.88692	25.73472	861	9	Dug	I	0.94	CGWB
MLRB03	Nongpoh	91.87744	25.90973	540	5.52	Dug	I	0.58	CGWB
MLRB06	Pahanmawlier	91.86157	25.99454	322	2.66	Dug	I	0.6	CGWB

Unique ID	Name of village/site	Longitude in degrees decimal	Latitude in degrees decimal	RL (mamsl)	Total depth of Pz/DW (mbgl)	Type (DW/Pz/Spring)	Aquifer group	Measuring point (magl)	Source /Agency
Deeper Aquifer									
MEG-78013-13	Umdihar	91.84481	25.88111	523	239.1	EW	II	0.3	CGWB
MEG-78013-14	Rongskong	91.96950	25.96583	533	221.85	EW	II	0.7	CGWB
MEG-78013-50	Umling	91.85958	25.96583	269	131.9	PZ	II	0.45	CGWB
MEG-7809-74	Umsaw	91.60678	25.88111	530	180.84	PZ	II	0.5	CGWB
MEG-7809-75	Umdu	91.83008	25.98278	296	203.46	PZ	II	1	CGWB
MEG-7809-76	Nongladew	91.70136	25.91500	364	156.77	PZ	II	0.6	CGWB
MEG-7809-77	Warmawsaw	91.53222	25.83028	313	129	BW	II	0.5	CGWB
MEG-78013-78	Zero point Kyrdemkulai	91.80431	25.74556	726	203.46	BW	II	0.5	CGWB
MEG-78013-79	Purduwa Kharpati	91.94139	25.91500	601	227.98	PZ	II	0.6	CGWB
MEG-78013-80	Sohpdok	91.96572	25.76500	959	203.46	PZ	II	0.5	CGWB
MEG-78013-81	Tdoumsaw	92.01692	25.77944	1124	178.81	PZ	II	0.6	CGWB
MEG-78013-82	Lumkeni	91.85597	25.77711	649	191	PZ	II	0.6	CGWB
MEG-78013-83	Mawtari Myrdon	91.84639	25.80272	647	201.45	PZ	II	0.75	CGWB
MEG-78014-20	ICAR Plant Pathology	91.92278	25.69064	954	180.8	EW	II	0.85	CGWB
MEG-78014-21	Mawshohroh	91.85228	25.66036	1147	215.72	EW	II	0.65	CGWB
MEG-83C2-30	Thadrang	92.15253	25.69922	783	200.45	EW	II	0.75	CGWB
MEG-78014-22	R.P.B.F. Kyrdemkulai	91.83742	25.74931	788	203.3	PZ	II	0.6	CGWB

Annexure 3 A: Dynamic water level data

Unique ID	Location	DTWL (mbgl) April13	DTWL (mbgl) Aug 13	DTWL (mbgl) Nov 13	DTWL (mbgl) Jan 14	DTWL (mbgl) Mar14	DTWL (mbgl) Aug 14	DTWL (mbgl) Nov 14	DTWL (mbgl) Jan 15	DTWL (mbgl) Mar15	DTWL (mbgl) Aug 15	DTWL (mbgl) Nov 15	DTWL (mbgl) Jan 16	DTWL (mbgl) Mar16	DTWL (mbgl) Aug 16	DTWL (mbgl) Nov 16	DTWL (mbgl) Jan 17	DTWL(mbgl)Mar 17
Shallow Aquifer																		
MEG-78013-68	Umdew	3.30	2.21	3.10	3.45	4.12	2.23	0.80	3.21	5.10	2.26	3.05	3.16	4.87	2.28	2.96		
MEG-7809-67	Nongladew	2.45	0.65	1.84	0.99	2.14	0.89	0.74	2.06	2.11	0.70	1.88	2.21	2.87	0.84	1.23		
MEG-7809-36	Patharkhamma	3.20	0.74	1.10	3.56	4.28	1.00	0.79	3.17	5.10	0.70	1.06	3.58	4.67	1.18	3.02		
MEG-7809-38	Patharkhamma	1.00	2.58	2.91	1.56	2.92	2.71	2.41	1.11	3.21	2.66	2.91	2.14	2.86	2.58	2.69		
MEG-7809-47	Barigaon	5.85	1.67	2.85	3.11	6.68	1.89	1.80	3.17	6.05	1.83	2.82	3.1	6.21	2.34	2.91		
MEG-7809-46	Patharkhamma Barigaon 3	3.21	2.20	2.95	2.99	5.21	3.10	2.00	3.09	3.33	2.40	4.39	3.58	3.2	2.78	2.94		
MEG-7809-63	Umsopri	0.86	0.35	0.78	1.68	2.79	0.39	0.29	1.68	0.95	0.30	0.50	1.11	1.85	0.38	0.66		
MEG-78013-71	2 Kilo	0.99	0.68	0.77	1.58	2.05	0.52	0.72	1.00	1.11	0.07	0.56	1.63	1.07	0.84	0.61		
MEG-78013-72	Iewmawlong	1.12	0.20	0.99	1.32	1.28	0.15	0.19	1.15	1.24	0.17	0.18	1.35	1.08	0.21	0.39		
MEG-78013-55	Umtham Marangar	3.19	1.23	1.21	1.60	3.70	1.85	2.00	1.40	2.92	1.95	2.36	1.52	3.68	2.41	3.21		
MEG-78013-58	Charikuchi Marangar	3.24	2.85	2.10	2.70	3.50	1.43	1.10	2.72	3.18	1.04	1.94	2.65	2.74	1.52	2.19		
MEG-78013-56	Mawsyntai	1.65	1.00	1.01	1.21	1.98	0.95	0.95	1.04	1.61	0.92	1.33	1.33	1.69	1.08	1.15		
MEG-78013-57	Mawsyntai	1.70	0.89	1.50	2.58	3.56	0.91	0.15	2.68	1.80	0.13	0.90	2.56	2.99	0.64	1.13		
MEG-78013-59	Umwang	4.80	3.40	2.31	2.69	4.85	3.70	3.20	2.79	4.88	3.10	4.02	2.75	4.26	2.94	3.8		
MEG-78013-60	Tamanpahlong	2.60	1.10	1.79	4.10	4.32	1.54	1.12	4.69	2.35	1.07	1.82	3.87	3.25	1.46	1.98		
MEG-78013-61	Umden	1.20	0.67	0.45	1.48	1.50	0.35	0.40	2.08	1.01	0.30	0.40	1.98	1.86	0.35	0.58		
MEG-78013-50	Umling	0.58	0.43	0.31	0.48	0.59	0.21	0.24	0.50	0.62	0.19	0.20	0.42	0.61	0.38	0.6		
MEG-78013-51	20 Mile	3.15	0.68	0.10	3.68	5.76	0.35	0.28	3.30	1.50	0.25	0.07	3.54	4.78	0.62	1.78		
MEG-78013-53	Umsning	2.96	1.70	2.21	2.98	3.76	1.45	2.00	2.72	2.91	1.85	2.33	2.88	3.11	2.08	2.78		
MEG-78013-52	Mawkhap	4.71	3.82	2.32	3.34	4.40		2.68	3.29	4.83		2.12	3.47	4.51	2.97	3.12		
MEG-78013-13	Umdihar	2.75	0.24	1.10	2.31	3.43	0.11	0.15	2.11	2.79	0.12	1.09	2.29	2.71	0.34	1.29		
MEG-78013-54	Saiden	1.60	0.83	0.68	1.40	1.96	0.60	0.69	1.43	1.59	0.74	0.60	1.28	1.56	0.66	0.95		
MEG-78013-48	Umran Dairy	0.51	0.30	0.35	0.66	0.85	0.32	0.38	0.65	0.53	0.31	0.32	1.2	0.71	0.72	0.4		
MEG-78013-62	Pahamjiri	1.79	1.23	1.23	1.23	1.96	1.11	1.31	1.10	1.89	1.24	1.34	1.74	1.84	1.31	1.69		
MEG-7809-65	Umtang	5.20	1.90	2.28	3.63	5.70	1.85	2.10	3.09	5.13	1.95	2.25	3.78	4.92	3.11	3.82		
MEG-7809-43	Warmawsaw	4.60	2.10	0.54	4.13	4.80	0.11	0.16	4.60	4.70	0.01	0.56	3.34	4.78	2.25	0.09		
MEG-78013-82	Umsahbar	5.27	4.73	5.29	0.28	2.88	4.65	2.12	0.24	5.38	4.82	5.47	4.96	5.22	3.56	2.97		
MEG-7809-39	Iew-Mawroh (Sukurbaria)	5.11	3.70	2.90	3.67	4.11	3.20	3.58	3.77	3.81	3.60	Filled & abandoned						
MEG-78013-73	Umsning Nongthymi	0.20	0.18	0.11	1.10	1.82			0.28	Abandoned								

Unique ID	Location	DTWL (mbgl) April 13	DTWL (mbgl) Aug 13	DTWL (mbgl) Nov 13	DTWL (mbgl) Jan 14	DTWL (mbgl) Mar 14	DTWL (mbgl) Aug 14	DTWL (mbgl) Nov 14	DTWL (mbgl) Jan 15	DTWL (mbgl) Mar 15	DTWL (mbgl) Aug 15	DTWL (mbgl) Nov 15	DTWL (mbgl) Jan 16	DTWL (mbgl) Mar 16	DTWL (mbgl) Aug 16	DTWL (mbgl) Nov 16	DTWL (mbgl) Jan 17	DTWL(mbgl)Mar 17
MEG-78014-1	Sumer	Not established												2.85	2.62	2.59	2.85	2.92
MEG-78014-2	Umden Mission													7.8	3.83	4.65	6.3	7.45
MEG-78014-3	Umroi Maidan													2.8	1.94	2.4	2.15	3.07
MEG-78014-4	Pyllun													3.55	2.65	2.01	4.05	4.2
MEG-78014-5	Nongjiri Umsala													2.05	0.78	0.9	1.1	1.92
MEG-78014-6	Umsning													5.05	1.75	2.37	4.3	5.9
MEG-78014-7	Umjarong													1.9	1.75	3.26	3.2	4.15
MEG-78014-8	Umkaliar													4.85	2.81	3.45	4.3	3.6
MEG-78014-9	Umsning													3.6	0.25	0.58	0.76	2.03
MEG-78014-10	Umbang													0.55	0.65	0.41	1.73	1.5
MLRB04	Byrnihat	3.20	1.51	1.95	2.54	2.75	1.05	1.70	2.60	2.85	1.11	1.54	2.35	2.67	1.67	1.97	2.48	2.85
MLRB05	Nayabunglow	NA									2.06	6.9	5.24	7.06	4.01	4.76	5.31	8.96
MLRB03	Nongpoh	3.01	2.11	2.46	2.41	2.90	1.50	2.65	2.82	3.53	0.85	2.1	2.67	3.02	2	Abandoned		
MLRB06	Pahanmawlier	NA									0.25	0.07	0.20	0.69	0.86	0.6	0.96	1.11

Unique ID	Name of village/site	DTWL (mbgl) Jan 15	DTWL (mbgl) Mar 15	DTWL (mbgl) Aug 15	DTWL (mbgl) Nov 15	DTWL (mbgl) Jan 16	DTWL (mbgl) Mar 16	DTWL (mbgl) Aug 16	DTWL (mbgl) Nov 16	DTWL (mbgl) Jan 17	DTWL(mbgl)Mar 17
Deeper Aquifer											
MEG-78013-13	Umdihar	10.84	11.21	9.92	1.09	NA					
MEG-78013-14	Rongskong	3.67	4.50	3.1	2.9						
MEG-78013-50	Umling	4.12	4.83	1.18	1.675	2.67	2.71	1.87	2.58	2.37	2.47
MEG-7809-74	Umsaw		4.30	3.01	3.735	3.78	4.12	3.25	3.85	3.88	4.1
MEG-7809-75	Umdu		8.15	5.62	5.42						
MEG-7809-76	Nongladew		2.35	1.56	2.03	2.08	2.28	1.64	1.95	2.12	2.24
MEG-7809-77	Warmawsaw		5.10	4.05	4.54	NA					
MEG-78013-78	Zero point Kyrdemkulai	Not constructed	6.75	3.8	3.36	4.97	5.77	4.4	4.26	4.94	5.34
MEG-78013-79	Purduwa Kharpati	Not constructed		2.29	2.82	3.54	3.81	2.35	3.3	3.61	3.82
MEG-78013-80	Sohpdok	Not constructed		4.89	2.77	4.92	7.15	4.66	2.76	4.68	7.21
MEG-78013-81	Tdoumsaw	Not constructed			25.646	28.97	31.18	24.21	26.83	29.5	31.26
MEG-78013-82	Lumkeni	Not constructed			5.55	5.78	6.87	5.49	7.16	5.51	5.64
MEG-78013-83	Mawtari Myrdon	Not constructed				8.97	9.11	8.04	8.22	8.58	8.87
MEG-78014-20	ICAR Plant Pathology	Not constructed						2.65	3.03	1.25	10.41
MEG-78014-21	Mawshohroh	Not constructed					20.95	21.65	Sealed		
MEG-83C2-30	Thadrang	Not constructed						3.27	3.11	3.87	4.22
MEG-78014-22	R.P.B.F. Kyrdemkulai	Not constructed									31.76

Annexure 4: Spring discharge data collected during 2016-17

Location	Longitude	Latitude	RL (m)	Type	Lithology	Discharge (LPS) MAY-2016*	Discharge (LPS) AUGUST-2016*	Discharge (LPS) NOVEMBER-2016*	Discharge (LPS) JANUARY-2017*	Discharge (LPS) MARCH-2017*
Nongjiri Umsala	91°54'09"	25°44'45.0"	877	Fractured	Quartzite	0.1	0.15	0.13	0.21	0.07
Umsning 1	91°53'20"	25°44'36"	756	Depression	Gneiss	0.2	0.4	0.38	___	___
Syadrit	91°53'09"	25°44'17"	759	Depression	Quartzite	0.32	0.1	0.75	0.85	0.23
Umsning 2	91°53'24"	25°43'32"	802	Fractured	Gneiss	1	1.1	0.85	0.46	0.31
Sumer	91°53'20"	25°41'33"	867	Fractured	Quartzite	0.412	0.53	0.75	0.44	0.428
Umeit	91°56'51"	25°42'30"	909	Depression	Quartzite	0.46	0.85	0.68	0.6	0.4
Umroi	91°58'26"	25°43'30"	904	Depression	Quartzite	0.64	0.76	0.71	0.46	0.45
Mowrong	91˚58’7”	25˚50’44”	903	Fractured	Granite	0.21	0.785	0.474	0.142	0.18
Umsning market area	91˚53’20”	25˚44’54”	759	Depression	Gneiss	1.46	1.812	1.714	1.21	1.35
Mynsain	92°01'07"	25°44'30"	862	Depression	Gneiss	0.018	0.24	0.01	0.008	0.0096
Khapmara	92°00'29"	25°43'03"	882	Fractured	Granite	0.163	0.26	0.03	0.011	0.01
Mawlyndep	91°51'03"	25°38'52"	882	Depression	Quartzite	0.187	0.5	0.4	0.25	0.214
Lewmawlong	91°53'16"	25°53'49"	572	Fractured	Granite	0.217	0.32	0.28	0.147	0.178

Annexure 5: Litholog of exploratory wells

Unique ID	MEG-7809-1
Village	Warmawsaw
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	$25^0$49’28” N
Longitude	$91^0$31’56” E
RL (m amsl)	313
Drilled Depth	129
Casing	21.25
SWL (mbgl)	4.01
Discharge (lps)	10.775
Date/year	2005

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	13.2	13.2	Red soil, reddish, medium grain
13.2	19	5.8	Gneiss, grey, weathered, fine to Medium
19	21.3	2.3	Gneiss, fractured zone with broken chip of mainly quartz, weathered
21.3	31	9.7	Gneiss, brownish, weathered medium grain consisting mainly of quartz grain.
31	37	6	Mica schist, fine grain, melanocractic
37	43.6	6.6	Gneiss, fine grain, fractured zone with broken chip of quartzalong with fe-mg minerals.
43.6	87.2	43.6	Gneiss, fine grain with quartz and mica as assential minerals.
87.2	92.4	5.2	Gneiss, medium grain, moderately fractured zone with broken chip of quartz, feldspar & mica flakes.
92.4	129	36.6	Gneiss, medium to coarse with mainly fe-mg minerals along with minor quartz grain.

Unique ID	MEG-7809-2
Village	Paham
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	$25^0$57’32” N
Longitude	$91^0$33’08” E
RL (m amsl)	165
Drilled Depth	154.82
Casing	14.4
SWL (mbgl)	2.954
Discharge (lps)	6.04
Date/year	2006

Depth range (mbgl)		Thickness (m)	Litholog
From	To	0.9	
0	0.9	58	Top soil, red, fine grain
0.9	58.9	2.1	Fine grain, brownish, weathered with mica flakes
58.9	61	7	Gneiss, fine to medium, pink, minor fractured zone with broken chips of quartz grain
61	68	5.6	Gneiss, fine grain of quartz, pink
68	73.6	26.6	Gneiss, fine to medium, grey,highly fractured zone consisting broken chips of quartz & biotite
73.6	100.2	4.4	Gneiss, fine to medium with grain of quartz & feldspar, mica flakes present as assosories
100.2	104.6	50.22	Gneiss, fine to medium, minor fractured zone with quartz as essential minerals
104.6	154.82	0.9	Gneiss, fine to medium grain of quartz &mica

Unique ID	MEG-7809-3
Village	New Jirang
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	$25^0$56’00” N
Longitude	$91^0$34’53” E
RL (m amsl)	400
Drilled Depth	200.3
Casing	13.96
SWL (mbgl)	2.61
Discharge (lps)	4.26
Date/year	2006

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.1	7.1	Top soil, reddish, medium to coarse
7.1	11.5	4.4	Gneiss, brownish red, medium to coarse
11.5	15	3.5	Gneiss, highly fractured zone consisting of broken chips of weathered quartz, & minor biotite, medium to coarse
15	27.95	12.95	Gneiss, fine to medium with grain of quartz, feldspar & mica
27.95	31.05	3.1	Granitic gneiss, fine to medium with grain of quartz & feldspar, hard & compact
31.05	101	69.95	Granitic gneiss, fine to medium with grain of quartz & feldspar, hard & compact
101	104.25	3.25	Biotite hornblende gneiss, light green, coarse grain, highly fractured zone consisting broken chips of
104.25	133.5	29.25	Biotite Gneiss, medium to coarse, mica dominant
133.5	135	1.5	Biotite hornblende gneiss, highly fractured zone consisting broken chips of Quartz & mica, coarse
135	200.3	65.3	Gneiss, medium to coarse grain with quartz as essential mineral.

Unique ID	MEG-7809-4
Village	Umrit
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	25051’45” N
Longitude	91035’5” E
RL (m amsl)	
Drilled Depth	202.15
Casing	23.1
SWL (mbgl)	5.61
Discharge (lps)	4.8
Date/year	2006

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	0.85	0.85	Top soil, brownish, fine grain
0.85	43.95	43.1	Fine to medium, brownish, Sandy with grain of quartz and minor mica flakes, weathered,
43.95	48	4.05	Gneiss, fine to medium, highly fractured zone consisting of broken chips of quartz, feldspar & mica
48	98.5	50.5	Mica gneiss, fine to medium, melanocractic due to the presence of Biotite, few quartz grain seen.
98.5	103.5	5	Gneiss, fine to coarse, moderately fractured zone with broken chip of quartz, feldspar & mica flakes.
103.5	110	6.5	Mica gneiss, fine to medium, melanocractic due to the presence of Biotite, few quartz grain seen.
110	116	4	Gneiss, fine to coarse, moderately fractured zone with broken chip of quartz, feldspar & mica flakes.
116	202.15	86.15	Gneiss, fine to coarse, moderately fractured zone with broken chip of quartz, feldspar & mica flakes.

Unique ID	MEG-78013-5
Village	Nongpoh
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	$25^0$56’23.665” N
Longitude	$91^0$52’24.618” E
RL (m amsl)	540
Drilled Depth	204.6
Casing	13.6
SWL (mbgl)	12
Discharge (lps)	5.5
Date/year	

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	20.6	20.6	Surface Soil
20.6	24.6	4	Granite, fractured
24.6	48	23.4	Granite, compact
48	66.3	18.3	Granite, fractured
66.3	96.8	30.5	Granite, compact
96.8	109	12.2	Granite, fractured
109	115.1	6.1	Granite, compact
115.1	124.3	9.2	Granite, fractured
124.3	130.4	6.1	Granite, compact
130.4	142.6	12.2	Granite, fractured
142.6	154.8	12.2	Granite, compact
154.8	167	12.2	Granite, fractured
167	179.2	12.2	Granite, compact
179.2	188.3	9.1	Granite, fractured
188.3	204.6	16.3	Granite, compact

Unique ID	MEG-78013-6
Village	Umden
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	$25^0$57’52” N
Longitude	$91^0$59’23” E
RL (m amsl)	550
Drilled Depth	171
Casing	45.77
SWL (mbgl)	3
Discharge (lps)	0.87
Date/year	

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	20	20	Top Soil
20	51	31	Granite, compact
51	70	19	Granite, fractured
70	73	3	Granite, compact
73	77	4	Granite, fractured
77	92	15	Granite, compact
92	106	14	Granite, fractured
106	120	14	Granite, compact
120	122	2	Granite, fractured
122	171	49	Granite, compact

Unique ID	MEG-78013-7
Village	Marngar
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	$25^0$53’29.44” N
Longitude	$91^0$56’8.59” E
RL (m amsl)	597
Drilled Depth	180.05
Casing	25.35
SWL (mbgl)	10.68

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	19	19	Top Soil
19	41	22	Granite, compact
41	43.85	2.85	Granite, fractured
43.85	151	107.15	Granite, compact
151	154	3	Granite, fractured
154	180.5	26.5	Granite, compact

Discharge (lps)	9.9
Date/year	

Unique ID	MEG-78013-8
Village	Mawrong
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	$25^0$50’43.14’’ N
Longitude	91°58'16.77'' E
RL (m amsl)	767
Drilled Depth	201.3
Casing	29.9
SWL (mbgl)	5.5
Discharge (lps)	10.1193
Date/year	

0	7	54.7	Top Soil, yellowish brown
7	30.7	6.1	Quartzite, weathered
30.7	85.4	30.5	Quartzite, semi-fractured
85.4	91.5	12.2	Phyllite, compact
91.5	122	30.5	Quartzite, fractured
122	140.3	18.3	Quartzite, massive
140.3	189.1	48.8	Quartzite, fractured

Unique ID	MEG-83C2-9
Village	Bhoirymbong
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	83 C/2
Latitude	$25^0$42’30” N
Longitude	$92^0$01'22.3” E
RL (m amsl)	882
Drilled Depth	199
Casing	25.3

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	22.2	22.2	Top soil/Weathered
22.2	54.5	32.3	Granite gneiss, compact
54.5	55.5	1	Fractured
55.5	71	15.5	Granite gneiss, compact
71	72	1	Fractured
72	136	64	Granite gneiss, compact
136	137	1	Fractured
137	167	30	Granite gneiss, compact

SWL (mbgl)	5.97
Discharge (lps)	1.47
Date/year	2007

167	168	1	Fractured
168	199	31	Granite gneiss, compact

Unique ID	MEG-78013-10
Village	Saiden
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	$25^0$52’37.5” N
Longitude	$91^0$52’43.1” E
RL (m amsl)	577
Drilled Depth	153.9
Casing	7.6
SWL (mbgl)	Dry
Discharge (lps)	Dry
Date/year	2013

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.6	7.6	Surface Soil, dark yellowish in colour.
7.6	153.9	146.3	Granite, massive, off white in colour, sample cuttings are powdery.

Unique ID	MEG-78013-11
Village	Mawsyntai
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 53’ 13.4” E
Longitude	91º 53’ 13.4” N
RL (m amsl)	606
Drilled Depth	126.2
Casing	46
SWL (mbgl)	13.4
Discharge (lps)	8.3889

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	4	4	Top Soil, Red lateritic loam.
4	46	42	Highly weathered and altered material.
46	57	11	Quartz vein, Highly fractured.
57	76	19	Granite, massive
76	76.5	0.5	Quartz vein fractured
76.5	122	45.5	Granite, massive
122	123	1	Porphyritic Granite, highly fractured, light grey
123	126.2	3.2	Porphyritic Granite, massive, light grey

Date/year	2013

Unique ID	MEG-78013-12
Village	Umling
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 57’56.3”
Longitude	91º 51’34.50”
RL (m amsl)	269
Drilled Depth	131.9
Casing	18.94
SWL (mbgl)	3.29
Discharge (lps)	2.45
Date/year	2014

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	13.43	13.43	Top Soil, Reddish silty
13.43	44.08	30.65	Granite, fractured, sample cuttings shows pieces of quartz. Water stucked.
44.08	53.21	9.13	Granite, moderately fractured, grey in colour.
53.21	98.25	45.04	Granite, compact, sample cuttings are grey in colour.
98.25	107.38	9.13	Granite, moderately fractured, grey in colour.
107.38	113.51	6.13	Granite, compact, sample cuttings are grey in colour.
113.51	131.9	18.39	Granite, highly fractured, grey in colour.

Unique ID	MEG-78013-13
Village	Umdihar
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 50’37.4604”
Longitude	91º 52’57.4428”
RL (m amsl)	523

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	13.43	7.3	Top Soil, Reddish silty
13.43	44.08	6.1	Granite, fractured, sample cuttings shows pieces of quartz. Water stucked.
44.08	53.21	49.6	Granite, moderately fractured, grey in colour.
53.21	98.25	1	Granite, compact, sample cuttings are grey in colour.
98.25	107.38	8	Granite, moderately fractured, grey in colour.
107.38	113.51	6	Granite, compact, sample cuttings are grey in colour.

Drilled Depth	239.1
Casing	7.5
SWL (mbgl)	10.84
Discharge (lps)	1.55
Date/year	2014

Unique ID	MEG-78013-14
Village	Rongskong
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 57’57.10” N
Longitude	91º 58’10.20” E
RL (m amsl)	533
Drilled Depth	221.85
Casing	33.08
SWL (mbgl)	3.29
Discharge (lps)	0.63
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.3	7.3	Top Soil, mixture of sand, silt and clay, reddish brown in colour.
7.3	212.59	205.29	Granite, highly compact, sample cuttings are powdery, yellowish in colour.
212.59	215.72	3.13	Granite, little fractured, sample cuttings are 10 to 15 mm size, grey in colour.
215.72	221.85	6.13	Granite, compact, sample cuttings are grey in colour.

113.51	131.9	75.7	Granite, highly fractured, grey in colour.

Unique ID	MEG-78013-15
Village	Nongpog GAD
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 55’19.20” N
Longitude	91º 52’27.40” E
RL (m amsl)	561
Drilled Depth	220.7
Casing	6.1
SWL (mbgl)	>100
Discharge (lps)	<0.0294
Date/year	2014

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.2	7.2	Top Soil, mixture of sand, silt and clay, brown in colour.
7.2	59	51.8	Granite chips (fracture ?), grey in colour
59	62.1	3.1	Granite, fractured, sample cuttings are grey in colour.
62.1	68.2	6.1	Granite, compact, sample cuttings are grey in colour.
68.2	71.2	3	Granite, fractured, sample cuttings are grey in colour.
72.1	135.8	63.7	Granite, compact, sample cuttings are grey in colour.
135.8	141.4	5.6	Granite, fractured, sample cuttings are grey in colour.
141.4	202.4	61	Granite, compact, sample cuttings are grey in colour
202.4	208.5	6.1	Granite, fractured, sample cuttings are pinkish grey in colour.
208.5	220.7	12.2	Granite, compact, sample cuttings are pinkish grey in colour

Unique ID	MEG-7809-16
Village	Patharkammah
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	$25^0$53’02” N
Longitude	$91^0$37’07” E
RL (m amsl)	329
Drilled Depth	202.51
Casing	21.09
SWL (mbgl)	1.18
Discharge (lps)	2.44
Date/year	2006

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	10.31	10.31	Top soil, reddish, medium to coarse
10.31	37.8	27.49	Gneiss, dark brown, weathered, friable, fine to medium
37.8	41.5	3.7	Granitic gneiss, medium, moderately fractured zone with broken chips of quartz, feldspar, & few mica flakes
41.5	68.1	26.6	Gneiss, fine to medium grain of quartz & Biotite
68.1	71.5	3.4	Gneiss, medium to coarse, moderately fractured zone with broken chips of quartz & fe-mg minerals
71.5	120.21	48.71	Gneiss, fine to medium, grain of quartz & minor mica seen
120.21	123	2.79	Biotite gneiss, medium to coarse, moderately fractured zone with broken chips of quartz &mica flakes
123	175	52	Gneiss, fine grain, quartz & feldspar dominant, few mica present
175	179	4	Biotite gneiss, medium to coarse, moderately fractured zone.
179	202.51	23.51	Granitic gneiss, coarse to medium, grain of quartz, feldspar, & few mica flakes

Unique ID	MEG-7809-17
Village	Umdu
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	25º 57’56.3” N
Longitude	91º 51’34.50” E
RL (m amsl)	296
Drilled Depth	203.46
Casing	28.1
SWL (mbgl)	8.15
Discharge (lps)	1.03
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	27.98	27.98	Top Soil, Reddish upto 4 m and thereafter yellowish in colour.
27.95	44.08	16.13	Granite gneiss, highly compact, sample cuttings are powdery, grey in colour.
44.08	53.21	9.13	Granite gneiss, fractured, sample cuttings are 1 to 5 cm in size, grey in colour.
53.21	132.9	79.69	Granite gneiss, compact
132.9	148.29	15.39	Granite gneiss, fractured, sample cuttings are 1 to 5 cm in size, grey in colour.
148.29	172.81	24.52	Granite gneiss, compact
172.81	178.94	6.13	Granite gneiss, fractured, sample cuttings are 1 to 5 cm in size, grey in colour.
178.94	203.46	24.52	Granite gneiss, compact, grey in colour.

Unique ID	MEG-7809-18
Village	Umsaw
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	25º 52’43” N
Longitude	91º 36’24.4” E
RL (m amsl)	338
Drilled Depth	203.46
Casing	20
SWL (mbgl)	4.795
Discharge (lps)	1.85
Date/year	2014

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.3	7.3	Top Soil, Reddish silty
7.3	28.69	21.39	Weathered granite gneiss upto 19.56 m,compact from 19.56 m to 28.69 m, grey in colour
28.69	31.82	3.13	Granite gneiss, little fractured, sample cuttings are coarse sand size with pieces of quartzite
31.82	178.94	147.12	Granite gneiss, compact, sample cuttings are powdery and some time medium to fine grained
178.94	181.94	3	Granite gneiss, little fractured, sample cuttings are coarse sand size with pieces of quartzite
181.94	203.46	21.52	Granite gneiss, compact, sample cuttings are powdery and some time medium to fine grained

Unique ID	MEG-7809-19
Village	Nongladew
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	25º 54’10.5” N
Longitude	91º 42’4.9” E
RL (m amsl)	364
Drilled Depth	156.77
Casing	6.1
SWL (mbgl)	2.25
Discharge (lps)	12.56
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	4.2	4.2	Top Soil, yellowish in colour
4.2	34.7	30.5	Granite gneiss, weathered upto 7.30 m after compact
34.7	37.8	3.1	Granite gneiss, little fractured
37.8	56.1	18.3	Granite gneiss, compact
56.1	59.1	3	Granite gneiss, little fractured
59.1	74.4	15.3	Granite gneiss, compact
74.4	77.4	3	Granite gneiss, little fractured
77.4	147.6	70.2	Granite gneiss, compact
147.4	150.6	3.2	Granite gneiss, little fractured
150.6	153.7	3.1	Granite gneiss, compact
153.7	156.77	3.07	Granite gneiss, little fractured

Unique ID	MEG-7809-20
Village	Warmawsaw II
Taluka/Block	Jirang
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	25º 49’41.5”
Longitude	91º 31’49.6”
RL (m amsl)	313
Drilled Depth	80.86
Casing	39.7
SWL (mbgl)	10.1

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	13.43	13.43	Top Soil, Reddish silty
13.43	59.34	45.91	Weathered Granite gneiss upto 44.08, thereafter compact
59.34	62.47	3.13	Granite gneiss, little fractured
62.47	80.86	18.39	Granite gneiss, high biotite content

Discharge (lps)	Not measurable, almost dry
Date/year	2014

Unique ID	MEG-78013-21
Village	Kyrdemkulai-Zero point
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 44’40.30”
Longitude	91º 48’15.50”
RL (m amsl)	726
Drilled Depth	203.46
Casing	23.09
SWL (mbgl)	6.75
Discharge (lps)	2.53
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.3	7.3	Top Soil, Reddish
7.3	28.69	21.39	Quartzite, compact
28.69	31.82	3.13	Quartzite, little fractured
31.82	60.47	28.65	Quartzite, compact
60.47	68.6	8.13	Quartzite, little fractured
68.6	108.38	39.78	Quartzite, compact
108.38	111.51	3.13	Quartzite, little fractured
111.51	185.07	73.56	Quartzite, compact
185.07	188.07	3	Quartzite, little fractured
188.07	194.07	6	Quartzite, compact
194.07	203.46	9.39	Quartzite, little fractured

Unique ID	MEG-78013-22
Village	Purduwa
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 54’51” N
Longitude	91º 56’29” E
RL (m amsl)	601
Drilled Depth	221.85
Casing	18.43
SWL (mbgl)	4.085
Discharge (lps)	3.298
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.3	7.3	Top Soil, yellowish in colour
7.3	10.3	3	Pebbles mixed with weathered granitic material
10.3	37.95	27.65	Granite, weathered upto 19.56 m thereafter, compact
37.95	44.08	6.13	Granite, fractured (thin zone)
44.08	50.21	6.13	Granite, compact
50.21	53.21	3	Granite, fractured (thin zone)
53.21	68.6	15.39	Granite, compact
68.6	71.6	3	Granite, fractured (thin zone)
71.6	74.73	3.13	Granite, dry fracture (thin zone) (?), sample cuttings are fine grained in size, grey in colour.
74.73	160.55	85.82	Granite, compact, sample cuttings are fine to medium grained size, pinkish grey in colour.
160.55	166.68	6.13	Granite, fractured (thin zone), coarse grained sample cuttings are mixed with pieces of rock cuttings of 2-3 cm size, pinkish grey in colour.
166.68	221.85	55.17	Granite, compact, sample cuttings are fine to medium grained size, pinkish grey in colour.

Unique ID	MEG-78013-23
Village	Sohpdok
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25˚ 45’16” N
Longitude	91˚ 57’56.2” E
RL (m amsl)	959
Drilled Depth	203.46
Casing	18.65
SWL (mbgl)	3.765
Discharge (lps)	10.12
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	4	4	Top Soil, reddish brown in colour
4	16.43	12.43	Quartzite, weathered upto 10.30 m , thereafter compact
16.43	19.56	3.13	Quartzite, fractured
19.56	34.82	15.26	Quartzite, compact
34.82	37.95	3.13	Quartzite, fractured
37.95	53.21	15.26	Quartzite, compact
53.21	56.34	3.13	Quartzite, fractured
56.34	108.38	52.04	Quartzite, compact
108.38	111.51	3.13	Quartzite, fractured
111.51	203.46	91.95	Quartzite, compact

Unique ID	MEG-78013-24
Village	Tdoumsaw
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25º 46’57.2” N
Longitude	92º 1’0.9” E
RL (m amsl)	1177
Drilled Depth	172.81
Casing	34.82
SWL (mbgl)	28.69
Discharge (lps)	4.04

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	4	4	Top Soil, reddish in colour
4	34.82	30.82	Quartzite, highly weathered upto 28.69 m, thereafter compact
34.82	56.34	21.52	Phyllite, compact
56.34	59.34	3	Phyllite, fractured (thin zone)
59.34	123	63.66	Phyllite, compact
123	163.55	40.55	Quartzite, compact
163.55	166.68	3.13	Quartzite, fractured
166.68	172.81	6.13	Quartzite, compact

Date/year	2015

Unique ID	MEG-78013-25
Village	Lumkeni
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/9
Latitude	25º 46’37.6” N
Longitude	91º 51’21.5” E
RL (m amsl)	
Drilled Depth	191.2
Casing	16.65
SWL (mbgl)	7.5
Discharge (lps)	10.119
Date/year	2015

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	4	4	Top Soil, reddish in colour
4	19.56	15.56	Granite gneiss, compact
19.56	62.47	42.91	Granite gneiss, little fractured
62.47	83.86	21.39	Granite gneiss, compact
83.86	86.99	3.13	Granite gneiss, little fractured
86.99	191	104.01	Granite gneiss, compact

Unique ID	MEG-78013-26
Village	Mawtari Myrdom
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/13
Latitude	25˚ 48’9.8” N
Longitude	91˚ 50’47” E
RL (m amsl)	647
Drilled Depth	201.45
Casing	25.45
SWL (mbgl)	9.6

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	25.69	25.69	Top soil/Weathered
25.69	80.98	55.29	Granite gneiss, compact
80.98	83.86	2.88	Granite gneiss, Fractured
83.86	114	30.14	Granite gneiss, compact
114	117	3	Granite gneiss, Fractured
117	145	28	Granite gneiss, compact
145	148	3	Granite gneiss, Fractured
148	201.45	53.45	Granite gneiss, compact

Discharge (lps)	2.3
Date/year	2015

Unique ID	MEG-78014-27
Village	ICAR Campus (Plant Pathology)
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/14
Latitude	25˚ 41’26.3” N
Longitude	91˚ 55’22” E
RL (m amsl)	954
Drilled Depth	180.8
Casing	21.97
SWL (mbgl)	Auto well
Discharge (lps)	18.55
Date/year	2007

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	25.3	25.3	Top soil/Weathered
25.3	89.3	64	Quartzite, compact
89.3	93.8	4.5	Quartzite, Fractured
93.8	116.8	23	Quartzite, compact
116.8	119	2.2	Quartzite, Fractured
119	180.8	61.8	Quartzite, compact

Unique ID	MEG-78014-28
Village	Umroi Airodrome
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/14
Latitude	25˚42’02” N
Longitude	91˚58’04” E
RL (m amsl)	907
Drilled Depth	167.4
Casing	10
SWL (mbgl)	3
Discharge (lps)	15.73
Date/year	

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0.00	12.30	12.30	Top soil/Weathered
12.30	15.43	3.13	Quartzite, Fractured
15.43	93.87	78.44	Quartzite, compact
93.87	98.90	5.03	Quartzite, Fractured
98.90	130.47	31.57	Quartzite, compact
130.47	133.6	3.13	Quartzite, Fractured
133.6	167.04	33.44	Quartzite, compact

Unique ID	MEG-83C1-29
Village	Mawhati
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	83 C/1
Latitude	25˚48’30” N
Longitude	92˚05’30” E
RL (m amsl)	1065
Drilled Depth	171
Casing	35.7
SWL (mbgl)	7.34
Discharge (lps)	1.96
Date/year	

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	22	22	Top soil/Weathered
22	108	86	Granite gneiss, compact
108	111	3	Granite gneiss, Fractured
111	140	29	Granite gneiss, compact
140	143	3	Granite gneiss, Fractured
143	171	28	Granite gneiss, compact

Unique ID	MEG-83B4-30
Village	Umsiang
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	83 B/4
Latitude	26˚04’28” N
Longitude	92˚10’26” E
RL (m amsl)	87
Drilled Depth	135.1
Casing	25.3
SWL (mbgl)	8.52
Discharge (lps)	5.6
Date/year	2007

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	25.3	25.3	Top soil/Weathered
25.3	41.6	16.3	Granite gneiss, compact
41.6	42.6	1	Fractured
42.6	52.8	10.2	Granite gneiss, compact
52.8	53.8	1	Fractured
53.8	93.5	39.7	Granite gneiss, compact
93.5	94.5	1	Fractured
94.5	132	37.5	Granite gneiss, compact
132	133	1	Fractured
133	135	2	Granite gneiss, compact

Unique ID	MEG-78N16-31
Village	Umpher
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	78 N/16
Latitude	26˚04’45” N
Longitude	91˚52’42” E
RL (m amsl)	86
Drilled Depth	200.5
Casing	8.56
SWL (mbgl)	13.72
Discharge (lps)	0.9
Date/year	2011

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	8	8	Top soil/Weathered
8	25.5	17.5	Granite, compact
25.5	26.25	0.75	Granite, Fractured
26.25	49	22.75	Granite, compact
49	50	1	Granite, Fractured
50	89	39	Granite, compact
89	90	1	Granite, Fractured
90	166	76	Granite, compact
166	167	1	Granite, Fractured
167	200.5	33.5	Granite, compact

Unique ID	MEG-83C1-32
Village	Mawlong
Taluka/Block	Umling
District	Ri-Bhoi
Toposheet No	83 C/1
Latitude	25˚57’02” N
Longitude	92˚02’13” E
RL (m amsl)	663
Drilled Depth	203.5
Casing	12
SWL (mbgl)	8.66
Discharge (lps)	3.28
Date/year	

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	8	8	Top soil/Weathered
8	17.4	9.4	Granite gneiss, compact
17.4	20.4	3	Granite gneiss, Fractured
20.4	72.3	51.9	Granite gneiss, compact
72.3	75.4	3.1	Granite gneiss, Fractured
75.4	197	121.6	Granite gneiss, compact
197	200	3	Granite gneiss, Fractured
200	203.5	3.5	Granite gneiss, compact

Unique ID	MEG-78014-33
Village	Mawshohroh
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/14
Latitude	25˚39’37.3” N
Longitude	91˚51’08.2” E
RL (m amsl)	1147
Drilled Depth	215.72
Casing	13.96
SWL (mbgl)	26.755
Discharge (lps)	0.2
Date/year	2016

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	4	4	Top soil/Weathered
4	68.6	64.6	Quartzite, compact
68.6	71.6	3	Quartzite, Fractured
71.6	136.03	64.43	Quartzite, compact
136.03	139.03	3	Quartzite, Fractured
139.03	191.2	52.17	Quartzite, compact
191.2	194.2	3	Quartzite, Fractured
194.2	215.72	21.52	Quartzite, compact

Unique ID	MEG-83C2-34
Village	Thadrang
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	83 C/2
Latitude	25˚41’57.2” N
Longitude	92˚09’09.1” E
RL (m amsl)	783
Drilled Depth	200.45
Casing	20.34
SWL (mbgl)	3.27
Discharge (lps)	3.29
Date/year	2016

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	25.69	25.69	Top soil/Weathered
25.69	28.69	3	Fractured
28.69	53.21	24.52	Granite, compact
53.21	56.34	3.13	Fractured
56.34	200.45	144.11	Granite, compact

Unique ID	MEG-78014-35
Village	R.P.B.F. Kyrdemkulai
Taluka/Block	Umsning
District	Ri-Bhoi
Toposheet No	78 O/14
Latitude	25˚ 44’57.5” N
Longitude	91˚ 50’14.7” E
RL (m amsl)	788
Drilled Depth	209.67
Casing	30.2
SWL (mbgl)	33.64
Discharge (lps)	1.73
Date/year	2017

Depth range (mbgl)		Thickness (m)	Litholog
From	To		
0	7.3	7.3	Top soil
7.3	22.56	15.26	Schist, weathered
22.56	31.82	9.26	Schist, Compact
31.82	62.47	30.65	Gneiss, compact
62.47	63.47	1	Gneiss, fractured
63.47	86.99	23.52	Gneiss, compact
86.99	87.99	1	Gneiss, fractured
87.99	142.16	54.17	Gneiss, compact
142.16	143.16	1	Gneiss, fractured
143.16	209.67	66.51	Gneiss, compact

Annexure 6: Geophysical data

Unique ID	MEG-7809-85	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	3.8	600	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		3.8		400	
Toposheet No.	78 O/9	Depth drilled					
Lattitudes	25.879	Discharge (lps)					
Longitudes	91.60731	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-86	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	0.8	270	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		0.8	4.7	450	
Toposheet No.	78 O/9	Depth drilled		4.7	11	125	
Lattitudes	25.87811	Discharge (lps)		11		1000	
Longitudes	91.60706	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-87	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To	1800	
Talluka/block	Jirang	Yield/Discharge		0	1	450	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	5	160	
Toposheet No.	78 O/9	Depth drilled		5	18	700	
Lattitudes	25.8785	Discharge (lps)					

Longitudes	91.60786	Transmissivity (m^2/day)	
RL(m amsl)		Storativity	

Unique ID	MEG-7809-88	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1	160	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	6.5	270	
Toposheet No.	78 O/9	Depth drilled		6.5	17	100	
Lattitudes	25.87886	Discharge (lps)		17		650	
Longitudes	91.60875	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-89	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Barigoan	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1	970	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	4	850	
Toposheet No.	78 O/9	Depth drilled		4		155	
Lattitudes	25.87486	Discharge (lps)					
Longitudes	91.59744	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-90	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Barigoan	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	0.9	110	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		0.9	5.5	250	
Toposheet No.	78 O/9	Depth drilled		5.5	14	50	
Lattitudes	25.87267	Discharge (lps)		14		800	
Longitudes	91.59769	Transmissivity (m^2/day)					

RL(m amsl)		Storativity	

Unique ID	MEG-7809-91	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1.2	60	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1.2	7	70	
Toposheet No.	78 O/9	Depth drilled		7	16	180	
Lattitudes	25.88294	Discharge (lps)		16		450	
Longitudes	91.60742	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-92	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	6.5	160	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		6.5	22	375	
Toposheet No.	78 O/9	Depth drilled		22	44	180	
Lattitudes	25.88403	Discharge (lps)		44		1000	
Longitudes	91.606	Transmissivity (m^2/day)					

RL(m amsl)		Storativity	

Unique ID	MEG-7809-93	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1	180	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	2.8	65	
Toposheet No.	78 O/9	Depth drilled		2.8	22	300	
Lattitudes	25.88433	Discharge (lps)		22		600	
Longitudes	91.60525	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-94	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	0.8	190	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		0.8	2.5	450	
Toposheet No.	78 O/9	Depth drilled		2.5	20	350	
Lattitudes	25.89061	Discharge (lps)		20	31	100	

Longitudes	91.61906	Transmissivity (m^2/day)		31		1000	
RL(m amsl)		Storativity					

Unique ID	MEG-7809-95	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1	180	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	5	450	
Toposheet No.	78 O/9	Depth drilled		5	20	150	
Lattitudes	25.88994	Discharge (lps)		20		7500	
Longitudes	91.61964	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-96	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1.5	130	
District	Ri-Bhoi	Whether BH was drilled		1.5	16	200	

		at this point? If Yes,					
Toposheet No.	78 O/9	Depth drilled		16	45	450	
Lattitudes	25.88914	Discharge (lps)		45		750	
Longitudes	91.61972	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-97	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	0.9	50	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		0.9	9	240	
Toposheet No.	78 O/9	Depth drilled		9	23	80	
Lattitudes	25.88822	Discharge (lps)		23		4000	
Longitudes	91.61983	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-98	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW		From	To		

		Depth					
Talluka/block	Jirang	Yield/Discharge		0	5	210	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		5	32	150	
Toposheet No.	78 O/9	Depth drilled		32		350	
Lattitudes	25.89217	Discharge (lps)					
Longitudes	91.61858	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-99	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1	225	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	10	250	
Toposheet No.	78 O/9	Depth drilled		10	20	300	
Lattitudes	25.8925	Discharge (lps)		20		800	
Longitudes	91.61844	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-7809-100	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Patharkhmah	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Jirang	Yield/Discharge		0	1	275	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	10	140	
Toposheet No.	78 O/9	Depth drilled		10	20	250	
Lattitudes	25.89331	Discharge (lps)		20		1500	
Longitudes	91.61794	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-78013-101	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Umwang/Marangar	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Umling	Yield/Discharge		0	0.8	75	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		0.8	22.6	125	
Toposheet No.	78 O/13	Depth drilled		22.6		700	
Lattitudes	25.90414	Discharge (lps)					
Longitudes	91.92986	Transmissivity (m^2/day)					

RL(m amsl)		Storativity	

Unique ID	MEG-78013-102	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Umwang/Marangar	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Umling	Yield/Discharge		0	1	150	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	7.5	35	
Toposheet No.	78 O/13	Depth drilled		7.5	45	300	
Lattitudes	25.90336	Discharge (lps)		45		700	
Longitudes	91.929	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	MEG-78013-103	Date/year		Depth range (mbgl)		Layer Resistivity in Ohm m	Inferred subsurface geology
Village	Umwang/Marangar	Nearby DW/DCBW/BW Depth		From	To		
Talluka/block	Umling	Yield/Discharge		0	1	125	
District	Ri-Bhoi	Whether BH was drilled at this point? If Yes,		1	5	35	
Toposheet No.	78 O/13	Depth drilled		5	45	80	
Lattitudes	25.90222	Discharge (lps)		45		15000	
Longitudes	91.92678	Transmissivity (m^2/day)					
RL(m amsl)		Storativity					

Unique ID	VES 1 Ri-Bhoi	Date/Year	26/10/2016
Village	Mawshohroh	Nearby DW/DCBW/BW Depth	
Taluka/Block	Umsing	Yield/discharge	
District	Ri-Bhoi	Whether borehole was drilled at this point ? if yes,	
Toposheet No.		Depth Drilled	
Lat	25°39'49.73"	Discharge(lps)	
Long	91°51'7.44"	Transmissivity(m^2/day)	
RL(m amsl)		Storativity	
Spreads (AB/2 (m))	250		

Unique ID: VES 1 Ri-Bhoi				
Depth range(m bgl)		Thickness(m)	Resistivity(ohm-m)	Inferred Lithology
From	To			
0	0.777	0.777	1.6E+5	Top Soils
0.777	1.86	1.08	9455	Quartzite
1.86	33.9	32.1	20762	Quartzite ,Medium Grained
33.9	65.4	31.5	4.8E+5	Hard formation
Below **65.4**		-	1202	Quartzite

Unique ID	VES 2 Ri-Bhoi	Date/Year	26/10/16
Village	Mawshohroh	Nearby DW/DCBW/BW Depth	
Taluka/Block	Umsing	Yield/discharge	
District	Ri-Bhoi	Whether borehole was drilled at this point ? if yes,	
Toposheet No.		Depth Drilled	
Lat	25°39'35.4"	Discharge(lps)	
Long	91°51'12.7"	Transmissivity(m^2/day)	
RL(m amsl)		Storativity	
Spreads (AB/2 (m))	200		

Unique ID: VES 2 Ri-Bhoi				
Depth range(m bgl)		Thickness(m)	Resistivity(ohm-m)	Inferred Lithology
From	To			
0	0.871	0.871	3031	Top Soils
0.871	2.56	1.69	636	Quartzite
2.56	12.3	9.74	84564	Quartzite , Medium Grained
Below **12.3**			43.1	Quartzite

Annexure 7: Dug well pump test data

Test	Dug Well
Location	Nayabanglow
Owner	SBI
SWL	10.03 m bmp
Depth	11.73 m bmp
Dia	1.20 m
MP	1 m
Motor	1HP
Q =m3/hr	0.936
Duration	15 min
DD	0.19 m
Date of Test	25.03.2017
Latitude	91°53'12.8"
Longitude	25°44'48.2"
RL (m)	861

Drawdown data:

Time (min)	DTW (m bmp)	DD (m)
1	10.05	0.02
2	10.07	0.04
3	10.08	0.05
4	10.095	0.065
5	10.1	0.07
6	10.115	0.085
7	10.126	0.096
8	10.14	0.11
9	10.15	0.12
10	10.16	0.13
11	10.17	0.14
12	10.182	0.152
13	10.2	0.17
14	10.21	0.18
15	10.22	0.19

Recovery data:

Time (Min)	DTW (m bmp)	RDD (m)	S1/S2	Time (min)	Recovery %
0	10.22	0.19	1.000	0	0.00
1	10.22	0.19	1.000	1	0.00
2	10.22	0.19	1.000	2	0.00
3	10.22	0.19	1.000	3	0.00
4	10.219	0.189	1.005	4	0.53
5	10.218	0.188	1.011	5	1.05
6	10.217	0.187	1.016	6	1.58
7	10.216	0.186	1.022	7	2.11
8	10.215	0.185	1.027	8	2.63
9	10.214	0.184	1.033	9	3.16
10	10.214	0.184	1.033	10	3.16
15	10.21	0.18	1.056	15	5.26
20	10.205	0.175	1.086	20	7.89
25	10.2	0.17	1.118	25	10.53
30	10.195	0.165	1.152	30	13.16
40	10.185	0.155	1.226	40	18.42
50	10.175	0.145	1.310	50	23.68
60	10.165	0.135	1.407	60	28.95
80	10.14	0.11	1.727	80	42.11
100	10.12	0.09	2.111	100	52.63
120	10.105	0.075	2.533	120	60.53
160	10.065	0.035	5.429	160	81.58
200	10.035	0.005	38.000	200	97.37

Test	Dug Well
Location	Pahamwier
Owner	Petrol Pump
SWL	1.59 m bmp
Depth	2.56 m bmp
Dia	0.80 m
MP	0.60 m
Motor	1HP
Q =m3/hr	1.62
Duration	15 min
DD	0.75 m
Date of Test	24.03.2017
Latitude	91˚51'41.6"
Longitude	25˚59'40.3
RL (m)	307

Drawdown data:

Time (min)	DTW (m bmp)	DD
1	1.67	0.08
2	1.72	0.13
3	1.78	0.19
4	1.83	0.24
5	1.88	0.29
6	1.93	0.34
7	1.98	0.39
8	2.03	0.44
9	2.08	0.49
10	2.12	0.53
11	2.17	0.58
12	2.21	0.62
13	2.25	0.66
14	2.29	0.7
15	2.34	0.75

Recovery data:

Time (min)	DTW (m bmp)	RDD (m)	S1/S2	Time (Min)	Recovery %
0	2.34	0.75	1.000	0	0.00
1	2.33	0.74	1.014	1	1.33
2	2.325	0.735	1.020	2	2.00
3	2.32	0.73	1.027	3	2.67
4	2.315	0.725	1.034	4	3.33
5	2.31	0.72	1.042	5	4.00
6	2.305	0.715	1.049	6	4.67
7	2.298	0.708	1.059	7	5.60
8	2.29	0.7	1.071	8	6.67
9	2.283	0.693	1.082	9	7.60
10	2.278	0.688	1.090	10	8.27
15	2.25	0.66	1.136	15	12.00
20	2.225	0.635	1.181	20	15.33
25	2.202	0.612	1.225	25	18.40
30	2.179	0.589	1.273	30	21.47
40	2.156	0.566	1.325	40	24.53
50	2.133	0.543	1.381	50	27.60
60	2.11	0.52	1.442	60	30.67
80	2.064	0.474	1.582	80	36.80
100	2.019	0.429	1.748	100	42.80
120	1.974	0.384	1.953	120	48.80
180	1.839	0.249	3.012	180	66.80
240	1.704	0.114	6.579	240	84.80

Test	Dug Well
Location	Pyllum
Owner	Petrol Pump
SWL	4.28 m bmp
Depth	5.25 m bmp
Dia	0.80 m
MP	0.75 m
Motor	1HP
Q =m3/hr	1.224
Duration	20 min
DD	0.75 m
Date of Test	23.03.2017
Latitude	91°55'47.3"
Longitude	25°41'41.0"
RL (m)	946

Drawdown data

Time (min)	DTW (m bmp)	DD (m)
1	4.29	0.01
2	4.29	0.01
3	4.29	0.01
4	4.29	0.01
5	4.29	0.01
6	4.32	0.04
7	4.37	0.09
8	4.43	0.15
9	4.48	0.2
10	4.53	0.25
11	4.58	0.3
12	4.62	0.34
13	4.68	0.4
14	4.73	0.45
15	4.77	0.49
16	4.82	0.54
17	4.88	0.6
18	4.93	0.65
19	4.98	0.7
20	5.03	0.75

Recovery data:

Time (min)	DTW (m bmp)	RDD (m)	S1/S2	Time (min)	Recovery %
0	5.03	0.75	1.000	0	0.00
1	5.025	0.745	1.007	1	0.67
2	5.02	0.74	1.014	2	1.33
3	5.018	0.738	1.016	3	1.60
4	5.016	0.736	1.019	4	1.87
5	5.015	0.735	1.020	5	2.00
6	5.012	0.732	1.025	6	2.40
7	5.01	0.73	1.027	7	2.67
8	5.008	0.728	1.030	8	2.93
9	5.005	0.725	1.034	9	3.33
10	5.002	0.722	1.039	10	3.73
15	4.995	0.715	1.049	15	4.67
20	4.985	0.705	1.064	20	6.00
25	4.975	0.695	1.079	25	7.33
30	4.965	0.685	1.095	30	8.67
35	4.955	0.675	1.111	35	10.00
40	4.945	0.665	1.128	40	11.33
50	4.92	0.64	1.172	50	14.67
60	4.9	0.62	1.210	60	17.33
80	4.865	0.585	1.282	80	22.00
100	4.825	0.545	1.376	100	27.33
120	4.79	0.51	1.471	120	32.00
140	4.76	0.48	1.563	140	36.00
180	4.7	0.42	1.786	180	44.00
240	4.61	0.33	2.273	240	56.00

300	4.52	0.24	3.125	300	68.00
360	4.43	0.15	5.000	360	80.00

Test	Dug Well
Location	Umbang
Owner	Petrol Pump
SWL	1.865 m bmp
Depth	4.55 m bmp
Dia	1 m
MP	0.60 m
Motor	1HP
Q =m3/hr	0.9
Duration	30 min
DD	0.531 m
Date of Test	25.03.2017
Latitude	91°54'04.5"
Longitude	25°41'05.8"
RL (m)	922

Drawdown data

Time (min)	DTW (m bmp)	DD (m)
1	1.881	0.016
2	1.889	0.024
3	1.916	0.051
4	1.933	0.068
5	1.95	0.085
6	1.967	0.102
7	1.985	0.12
8	2	0.135
9	2.02	0.155
10	2.035	0.17
12	2.069	0.204
14	2.103	0.238
18	2.137	0.272
20	2.171	0.306
25	2.284	0.419
30	2.396	0.531

Recovery data:

Time (min)	DTW (m bmp)	RDD (m)	S1/S2	Time (min)	Recovery %
0	2.396	0.531	1.000	0	0.00
1	2.394	0.529	1.004	1	0.38
2	2.392	0.527	1.008	2	0.75
3	2.39	0.525	1.011	3	1.13
4	2.388	0.523	1.015	4	1.51
5	2.386	0.521	1.019	5	1.88
6	2.384	0.519	1.023	6	2.26
7	2.383	0.518	1.025	7	2.45
8	2.382	0.517	1.027	8	2.64
9	2.381	0.516	1.029	9	2.82
10	2.38	0.515	1.031	10	3.01
15	2.373	0.508	1.045	15	4.33
20	2.366	0.501	1.060	20	5.65
25	2.36	0.495	1.073	25	6.78
30	2.354	0.489	1.086	30	7.91
40	2.342	0.477	1.113	40	10.17
50	2.33	0.465	1.142	50	12.43
60	2.318	0.453	1.172	60	14.69
80	2.294	0.429	1.238	80	19.21
100	2.27	0.405	1.311	100	23.73
120	2.246	0.381	1.394	120	28.25
180	2.174	0.309	1.718	180	41.81
240	2.102	0.237	2.241	240	55.37
300	2.03	0.165	3.218	300	68.93
360	1.958	0.093	5.710	360	82.49

Test	Dug Well
Location	Umsning
Owner	Petrol Pump
SWL	6.91 m bmp
Depth	7.55 m bmp
Dia	1.30 m
MP	0.50 m
Motor	0.5HP
Q =m3/hr	0.612
Duration	20 min
DD	0.14 m
Date of Test	23.03.2017
Latitude	91°53'15.9"
Longitude	25°44'28.0"
RL (m)	762

Drawdown data

Time	DTW (m bmp)	DD (m)
1	6.92	0.01
2	6.925	0.015
3	6.93	0.02
4	6.935	0.025
5	6.94	0.03
6	6.95	0.04
7	6.96	0.05
8	6.97	0.06
9	6.98	0.07
10	6.984	0.074
11	6.99	0.08
12	6.995	0.085
13	7	0.09
14	7.01	0.1
15	7.015	0.105
16	7.02	0.11
17	7.025	0.115
18	7.03	0.12
19	7.04	0.13
20	7.05	0.14

Recovery data:

Time (min)	DTW (m bmp)	RDD (m)	S1/S2	Time (min)	Recovery %
0	7.05	0.14	1.000	0	0.00
1	7.05	0.14	1.000	1	0.00
2	7.05	0.14	1.000	2	0.00
3	7.05	0.14	1.000	3	0.00
4	7.05	0.14	1.000	4	0.00
5	7.05	0.14	1.000	5	0.00
6	7.048	0.138	1.014	6	1.43
7	7.047	0.137	1.022	7	2.14
8	7.046	0.136	1.029	8	2.86
9	7.045	0.135	1.037	9	3.57
10	7.045	0.135	1.037	10	3.57
15	7.043	0.133	1.053	15	5.00
20	7.04	0.13	1.077	20	7.14
25	7.038	0.128	1.094	25	8.57
30	7.036	0.126	1.111	30	10.00
40	7.033	0.123	1.138	40	12.14
50	7.03	0.12	1.167	50	14.29
60	7.027	0.117	1.197	60	16.43
80	7.021	0.111	1.261	80	20.71
100	7.015	0.105	1.333	100	25.00
120	6.999	0.089	1.573	120	36.43
140	6.992	0.082	1.707	140	41.43
180	6.978	0.068	2.059	180	51.43
240	6.96	0.05	2.800	240	64.29
300	6.942	0.032	4.375	300	77.14

Annexure 8: Soil Infiltration Test data

1. Location – Umroi

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		25		0	0	f0 = 12.6 from the curve	ft	
1	1	25	21.9	3.1	3.1	186	173.4	Refilled
2	1	25	23.1	1.9	5	114	101.4	Refilled
3	1	25	23.4	1.6	6.6	96	83.4	Refilled
4	1	25	23.6	1.4	8	84	71.4	Refilled
5	1	25	23.9	1.1	9.1	66	53.4	Refilled
6	1	25	23.7	1.3	10.4	78	65.4	Refilled
7	1	25	24	1	11.4	60	47.4	Refilled
8	1	25	24	1	12.4	60	47.4	Refilled
9	1	25	24	1	13.4	60	47.4	Refilled
10	1	25	24	1	14.4	60	47.4	Refilled
12	2	25	23.4	1.6	16	48	35.4	Refilled
14	2	25	23.2	1.8	17.8	54	41.4	Refilled
16	2	25	23.5	1.5	19.3	45	32.4	Refilled
18	2	25	23.6	1.4	20.7	42	29.4	Refilled
20	2	25	23.8	1.2	21.9	36	23.4	Refilled
25	5	25	22.8	2.2	24.1	26.4	13.8	Refilled
30	5	25	21.2	3.8	27.9	45.6	33	Refilled
35	5	25	23	2	29.9	24	11.4	Refilled
40	5	25	23	2	31.9	24	11.4	Refilled
45	5	25	23.5	1.5	33.4	18	5.4	Refilled
50	5	25	23.9	1.1	34.5	13.2	0.6	Refilled
55	5	25	23.8	1.2	35.7	14.4	1.8	Refilled
60	5	25	24	1.2	36.9	14.4	1.8	Refilled
70	10	25	21	4	40.9	24	11.4	Refilled
80	10	25	21.4	3.6	44.5	21.6	9	Refilled
90	10	25	21.8	3.2	47.7	19.2	6.6	Refilled
100	10	25	22	3	50.7	18	5.4	Refilled
110	10	25	22.6	2.4	53.1	14.4	1.8	Refilled
120	10	25	22.6	2.4	55.5	14.4	1.8	Refilled
130	10	25	22.7	2.3	57.8	13.8	1.2	Refilled
140	10	25	22.8	2.2	60	13.2	0.6	Refilled
160	20	25	20.7	4.3	64.3	12.9	0.3	Refilled
180	20	25	20.8	4.2	68.5	12.6	0	Refilled
200	20	25	20.8	4.2	72.7	12.6	0	Refilled
220	20	25	20.8	4.2	76.9	12.6	0	Refilled

2. Location – Umeit

Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	cm	cm	cm	cm	cm/hr	f0	
	25		0	0	f0 = 36.6 from the curve	ft	
1	25	23	2	2	120	83.4	Refilled
1	25	23.6	1.4	3.4	84	47.4	Refilled
1	25	23.7	1.3	4.7	78	41.4	Refilled
1	25	23.8	1.2	5.9	72	35.4	Refilled
1	25	23.9	1.1	7	66	29.4	Refilled
1	25	24	1	8	60	23.4	Refilled
1	25	24.1	0.9	8.9	54	17.4	Refilled
1	25	24.1	0.9	9.8	54	17.4	Refilled
1	25	24.2	0.8	10.6	48	11.4	Refilled
1	25	24.2	0.8	11.4	48	11.4	Refilled
2	25	23.2	1.8	13.2	54	17.4	Refilled
2	25	23.1	1.9	15.1	57	20.4	Refilled
2	25	23.2	1.8	16.9	54	17.4	Refilled
2	25	23.5	1.5	18.4	45	8.4	Refilled
2	25	23.5	1.5	19.9	45	8.4	Refilled
5	25	21	4	23.9	48	11.4	Refilled
5	25	21.3	3.7	27.6	44.4	7.8	Refilled
5	25	21.5	3.5	31.1	42	5.4	Refilled
5	25	21.5	3.5	34.6	42	5.4	Refilled
5	25	21.6	3.4	38	40.8	4.2	Refilled
5	25	21.8	3.2	41.2	38.4	1.8	Refilled
5	25	21.9	3.1	44.3	37.2	0.6	Refilled
5	25	21.9	3.1	47.4	37.2	0.6	Refilled
10	25	18.8	6.2	53.6	37.2	0.6	Refilled
10	25	18.8	6.2	59.8	37.2	0.6	Refilled
10	25	18.9	6.1	65.9	36.6	0	Refilled
10	25	18.9	6.1	72	36.6	0	Refilled
20	25	12.8	12.2	84.2	36.6	0	Refilled
20	25	12.8	12.2	96.4	36.6	0	Refilled
20	25	12.8	12.2	108.6	36.6	0	Refilled

3. Location-Umbir

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		23.9		0	0	f0 = 2.4 from the curve	ft	
1	1		22	1.9	1.9	114	106.8	
2	1		21	1	2.9	60	52.8	
3	1		20	1	3.9	60	52.8	
4	1		19.1	0.9	4.8	54	46.8	
5	1		18.5	0.6	5.4	36	28.8	
6	1		18	0.5	5.9	30	22.8	
7	1		17.5	0.5	6.4	30	22.8	
8	1		17	0.5	6.9	30	22.8	
9	1		16.5	0.5	7.4	30	22.8	
10	1		16.1	0.4	7.8	24	16.8	
12	2	23.9	23	0.9	8.7	27	19.8	Refilled
14	2	23.9	23	0.9	9.6	27	19.8	Refilled
16	2	23.9	23.1	0.8	10.4	24	16.8	Refilled
18	2	23.9	23.1	0.8	11.2	24	16.8	Refilled
20	2	23.9	23.2	0.7	11.9	21	13.8	Refilled
25	5	23.9	22.4	1.5	13.4	18	10.8	Refilled
30	5	23.9	22.5	1.4	14.8	16.8	9.6	Refilled
35	5	23.9	22.7	1.2	16	14.4	7.2	Refilled
40	5	23.9	22.9	1	17	12	4.8	Refilled
45	5	23.9	23	0.9	17.9	10.8	3.6	Refilled
50	5	23.9	23.1	0.8	18.7	9.6	2.4	Refilled
55	5	23.9	23.2	0.7	19.4	8.4	1.2	Refilled
60	5	23.9	23.2	0.7	20.1	8.4	1.2	Refilled
70	10	23.9	22.5	1.4	21.5	8.4	1.2	Refilled
80	10	23.9	22.6	1.3	22.8	7.8	0.6	Refilled
90	10	23.9	22.6	1.3	24.1	7.8	0.6	Refilled
100	10	23.9	22.7	1.2	25.3	7.2	0	Refilled
120	20	23.9	21.5	2.4	27.7	7.2	0	Refilled
140	20	23.9	21.5	2.4	30.1	7.2	0	Refilled
160	20	23.9	21.5	2.4	32.5	7.2	0	Refilled

4. Location-Umsiak

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		26		0	0	f0 = 3.6 from the curve	ft	
1	1		25.5	0.5	0.5	30	26.4	
2	1		25	0.5	1	30	26.4	
3	1		24.7	0.3	1.3	18	14.4	
4	1		24.4	0.3	1.6	18	14.4	
5	1		24.1	0.3	1.9	18	14.4	
6	1		23.9	0.2	2.1	12	8.4	
7	1		23.8	0.1	2.2	6	2.4	
8	1		23.7	0.1	2.3	6	2.4	
9	1		23.5	0.2	2.5	12	8.4	
10	1		23.3	0.2	2.7	12	8.4	
12	2	26	25.9	0.1	2.8	3	-0.6	Refilled
14	2		25.7	0.2	3	6	2.4	
16	2		25.4	0.4	3.4	12	8.4	
18	2		25.1	0.3	3.7	9	5.4	
20	2		25	0.1	3.8	3	-0.6	
25	5	26	25.7	0.3	4.1	3.6	0	Refilled
30	5		25.3	0.4	4.5	4.8	1.2	
35	5		24.9	0.4	4.9	4.8	1.2	
40	5		24.5	0.4	5.3	4.8	1.2	
45	5		24.1	0.3	5.6	3.6	0	
50	5		23	0.3	5.9	3.6	0	
55	5		22.7	0.3	6.2	3.6	0	
60	5		22.4	0.3	6.5	3.6	0	
70	10	26	25.4	0.6	7.1	3.6	0	Refilled
80	10		24.8	0.6	7.7	3.6	0	
90	10		24.2	0.6	8.3	3.6	0	
100	10		23.6	0.6	8.9	3.6	0	
120	20	26	24.8	1.2	10.1	3.6	0	Refilled
140	20		23.6	1.2	11.3	3.6	0	
160	20		22.4	1.2	12.5	3.6	0	

5. Location-Umnongkrem

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		20.5		0	0	f0 = 21.6 from the curve	ft	
1	1		19.6	0.9	0.9	54	32.4	
2	1		19	0.6	1.5	36	14.4	
3	1		18.6	0.4	1.9	24	2.4	
4	1		18.1	0.4	2.3	24	2.4	
5	1		17.7	0.4	2.7	24	2.4	
6	1		17.3	0.4	3.1	24	2.4	
7	1		16.9	0.4	3.5	24	2.4	
8	1		16.5	0.4	3.9	24	2.4	
9	1		16.1	0.4	4.3	24	2.4	
10	1		15.7	0.4	4.7	24	2.4	
12	2	20.5	19.9	0.6	5.3	18	-3.6	Refilled
14	2	20.5	19.5	1	6.3	30	8.4	Refilled
16	2	20.5	19.5	1	7.3	30	8.4	Refilled
18	2	20.5	19.6	0.9	8.2	27	5.4	Refilled
20	2	20.5	19.6	0.9	9.1	27	5.4	Refilled
25	5	20.5	18.3	2.2	11.3	26.4	4.8	Refilled
30	5	20.5	18.4	2.1	13.4	25.2	3.6	Refilled
35	5	20.5	18.5	2	15.4	24	2.4	Refilled
40	5	20.5	18.6	1.9	17.3	22.8	1.2	Refilled
45	5	20.5	18.6	1.9	19.2	22.8	1.2	Refilled
50	5	20.5	18.7	1.8	21	21.6	0	Refilled
55	5	20.5	18.7	1.8	22.8	21.6	0	Refilled
60	5	20.5	18.7	1.8	24.6	21.6	0	Refilled
70	10	20.5	16.9	3.6	28.2	21.6	0	Refilled
80	10	20.5	16.9	3.6	31.8	21.6	0	Refilled
90	10	20.5	16.9	3.6	35.4	21.6	0	Refilled
100	10	20.5	16.9	3.6	39	21.6	0	Refilled
120	20	20.5	13.2	7.3	46.3	21.9	0.3	Refilled
140	20	20.5	13.3	7.2	53.5	21.6	0	Refilled
160	20	20.5	13.3	7.2	60.7	21.6	0	Refilled

6. Location-Kyrdemkulai

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		27.8		0	0	f0 = 29.4 from the curve	ft	
1	1		24.3	3.5	3.5	210	180.6	
2	1		21.8	2.5	6	150	120.6	
3	1		20	1.8	7.8	108	78.6	
4	1		18.5	1.5	9.3	90	60.6	
5	1		17.4	1.1	10.4	66	36.6	
6	1		16.4	1	11.4	60	30.6	
7	1		15.4	1	12.4	60	30.6	
8	1		14.5	0.9	13.3	54	24.6	
9	1		13.9	0.6	13.9	36	6.6	
10	1		13.3	0.6	14.5	36	6.6	
12	2	27.8	25.4	2.4	16.9	72	42.6	Refilled
14	2	27.8	26.1	1.7	18.6	51	21.6	Refilled
16	2	27.8	25.5	2.3	20.9	69	39.6	Refilled
18	2	27.8	26.2	1.6	22.5	48	18.6	Refilled
20	2	27.8	26.2	1.6	24.1	48	18.6	Refilled
25	5	27.8	23.1	4.7	28.8	56.4	27	Refilled
30	5	27.8	23.3	4.5	33.3	54	24.6	Refilled
35	5	27.8	23.3	4.5	37.8	54	24.6	Refilled
40	5	27.8	23.6	4.2	42	50.4	21	Refilled
45	5	27.8	23.6	4.2	46.2	50.4	21	Refilled
50	5	27.8	23.8	4	50.2	48	18.6	Refilled
55	5	27.8	24	3.8	54	45.6	16.2	Refilled
60	5	27.8	24.4	3.4	57.4	40.8	11.4	Refilled
70	10	27.8	21.3	6.5	63.9	39	9.6	Refilled
80	10	27.8	21.5	6.3	70.2	37.8	8.4	Refilled
90	10	27.8	21.6	6.2	76.4	37.2	7.8	Refilled
100	10	27.8	22.3	5.5	81.9	33	3.6	Refilled
120	20	27.8	17.8	10	91.9	30	0.6	Refilled
140	20	27.8	17.9	9.9	101.8	29.7	0.3	Refilled
160	20	27.8	18	9.8	111.6	29.4	0	Refilled
180	20	27.8	18	9.8	121.4	29.4	0	Refilled
200	20	27.8	18	9.8	131.2	29.4	0	Refilled

7. Location – Umtham

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		28.5		0	0	f0 =39 from the curve	ft	
1	1		26.8	1.7	1.7	102	63	
2	1		25.3	1.5	3.2	90	51	
3	1		24.1	1.2	4.4	72	33	
4	1		23.1	1	5.4	60	21	
5	1		22.3	0.8	6.2	48	9	
6	1		21.5	0.8	7	48	9	
7	1		20.8	0.7	7.7	42	3	
8	1		20.1	0.7	8.4	42	3	
9	1		19.4	0.7	9.1	42	3	
10	1		18.8	0.6	9.7	36	-3	
12	2		26.9	1.9	11.6	57	18	
14	2		25	1.6	13.2	48	9	
16	2		23.4	1.6	14.8	48	9	
18	2		22	1.4	16.2	42	3	
20	2		20.6	1.4	17.6	42	3	
25	5	28.5	24.7	3.8	21.4	45.6	6.6	Refilled
30	5	28.5	24.7	3.8	25.2	45.6	6.6	Refilled
35	5	28.5	24.9	3.6	28.8	43.2	4.2	Refilled
40	5	28.5	25	3.5	32.3	42	3	Refilled
45	5	28.5	25	3.5	35.8	42	3	Refilled
50	5	28.5	25	3.5	39.3	42	3	Refilled
55	5	28.5	25.1	3.4	42.7	40.8	1.8	Refilled
60	5	28.5	25.1	3.4	46.1	40.8	1.8	Refilled
70	10	28.5	21.9	6.6	52.7	39.6	0.6	Refilled
80	10	28.5	21.9	6.6	59.3	39.6	0.6	Refilled
90	10	28.5	22	6.5	65.8	39	0	Refilled
100	10	28.5	22	6.5	72.3	39	0	Refilled
120	20	28.5	15.5	13	85.3	39	0	Refilled
140	20	28.5	15.5	13	98.3	39	0	Refilled
160	20	28.5	15.5	13	111.3	39	0	Refilled

8. Location – Nongmahir

Time (t)	Time difference	After filling	Before filling	Depth of Infiltration	Cummulative Infiltration	Infiltration rate	f-fc	Remarks
min	min	cm	cm	cm	cm	cm/hr	f0	
0		26.5		0	0	f0 =48.6 from the curve	ft	
1	1		23	3.5	3.5	210	161.4	
2	1		20.5	2.5	6	150	101.4	
3	1		18.9	1.6	7.6	96	47.4	
4	1		17.2	1.7	9.3	102	53.4	
5	1		15.8	1.4	10.7	84	35.4	
6	1		14.5	1.3	12	78	29.4	
7	1		13.6	0.9	12.9	54	5.4	
8	1		12.9	0.7	13.6	42	-6.6	
9	1		12.4	0.5	14.1	30	-18.6	
10	1		11.8	0.6	14.7	36	-12.6	
12	2	26.5	23.8	2.7	17.4	81	32.4	Refilled
14	2	26.5	24	2.5	19.9	75	26.4	Refilled
16	2	26.5	24.3	2.2	22.1	66	17.4	Refilled
18	2	26.5	24.4	2.1	24.2	63	14.4	Refilled
20	2	26.5	24.5	2	26.2	60	11.4	Refilled
25	5	26.5	21.7	4.8	31	57.6	9	Refilled
30	5	26.5	21.7	4.8	35.8	57.6	9	Refilled
35	5	26.5	21.8	4.7	40.5	56.4	7.8	Refilled
40	5	26.5	21.9	4.6	45.1	55.2	6.6	Refilled
45	5	26.5	22.1	4.4	49.5	52.8	4.2	Refilled
50	5	26.5	22.1	4.4	53.9	52.8	4.2	Refilled
55	5	26.5	22.2	4.3	58.2	51.6	3	Refilled
60	5	26.5	22.2	4.3	62.5	51.6	3	Refilled
70	10	26.5	18.3	8.2	70.7	49.2	0.6	Refilled
80	10	26.5	18.4	8.1	78.8	48.6	0	Refilled
90	10	26.5	18.4	8.1	86.9	48.6	0	Refilled
100	10	26.5	18.4	8.1	95	48.6	0	Refilled
120	20	26.5	10.3	16.2	111.2	48.6	0	Refilled
140	20	26.5	10.3	16.2	127.4	48.6	0	Refilled

9. Location - Umran Diary

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
2	2	7.8	14.1	6.3	6.3	189	163.8
4	2	7.8	12.6	4.8	11.1	144	118.8
10	6	7.8	13.7	5.9	17	59	33.8
15	5	7.8	11.8	4	21	48	22.8
20	5	7.8	11.5	3.7	24.7	44.4	19.2
25	5	7.8	11.3	3.5	28.2	42	16.8
30	5	7.8	11.2	3.4	31.6	40.8	15.6
40	10	7.8	14.6	6.8	38.4	40.8	15.6
50	10	7.8	13.5	5.7	44.1	34.2	9
60	10	7.8	13.2	5.4	49.5	32.4	7.2
70	10	7.2	12.4	5.2	54.7	31.2	6
80	10	7.5	12.2	4.7	59.4	28.2	3
90	10	7.2	11.9	4.7	64.1	28.2	3
100	10	7	11.7	4.7	68.8	28.2	3
110	10	7	11.4	4.4	73.2	26.4	1.2
120	10	7	11.2	4.2	77.4	25.2	0
130	10	7.2	11.4	4.2	81.6	25.2	0

10. Location - Mawlein

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	Min	cm	cm	cm	cm	cm/hr	
2	2	4	13.6	9.6	9.6	288	233.4
7	5	5.5	17.8	12.3	21.9	147.6	93
10	3	16	21.5	5.5	27.4	110	55.4
15	5	16	24	8	35.4	96	41.4
20	5	18	25.6	7.6	43	91.2	36.6
25	5	13.5	21	7.5	50.5	90	35.4
30	5	12	19.33	7.33	57.83	87.96	33.36
40	10	11.5	25.1	13.6	71.43	81.6	27
50	10	12.5	25.2	12.7	84.13	76.2	21.6
60	10	12	23.3	11.3	95.43	67.8	13.2
70	10	11	21.5	10.5	105.93	63	8.4
80	10	11.6	21.2	9.6	115.53	57.6	3
90	10	10.5	19.8	9.3	124.83	55.8	1.2
100	10	10.8	19.9	9.1	133.93	54.6	0
110	10	10	19.1	9.1	143.03	54.6	0

11. Location - Mawtari Myrdon

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	Min	cm	cm	cm	cm	cm/hr	
2	2	20.75	19.15	1.6	1.6	48	35.7
5	3	20.72	19.25	1.47	3.07	29.4	17.1
10	5	20.75	18.58	2.17	5.24	26.04	13.74
15	5	20.8	18.75	2.05	7.29	24.6	12.3
20	5	20.8	18.9	1.9	9.19	22.8	10.5
30	10	20.65	17.2	3.45	12.64	20.7	8.4
40	10	20.5	17.42	3.08	15.72	18.48	6.18
50	10	20.5	17.82	2.68	18.4	16.08	3.78
60	10	20.87	18.5	2.37	20.77	14.22	1.92
70	10	20.6	18.38	2.22	22.99	13.32	1.02
80	10	20.6	18.42	2.18	25.17	13.08	0.78
90	10	20.62	18.45	2.17	27.34	13.02	0.72
100	10	20.55	18.5	2.05	29.39	12.3	0
110	10	20.75	18.7	2.05	31.44	12.3	0
120	10	20.3	18.25	2.05	33.49	12.3	0
143	22	18.25	13.74	4.51	38	12.3	0

12. Location -Tdohumshiaw

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
10	10	20	19.2	0.8	0.8	4.8	3.6
20	10	20	19.5	0.5	1.3	3	1.8
30	10	20	19.65	0.35	1.65	2.1	0.9
40	10	20	19.7	0.3	1.95	1.8	0.6
50	10	20	19.72	0.28	2.23	1.68	0.48
60	10	20	19.75	0.25	2.48	1.5	0.3
70	10	20	19.78	0.22	2.7	1.32	0.12
80	10	20	19.8	0.2	2.9	1.2	0
90	10	20	19.8	0.2	3.1	1.2	0
100	10	20	19.8	0.2	3.3	1.2	0

13. Location - Lumkeni

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
5	5	19.8	17.8	2	2	24	16.5
10	5	20	18.75	1.25	3.25	15	7.5
15	5	19.9	18.79	1.11	4.36	13.32	5.82
20	5	19.9	18.95	0.95	5.31	11.4	3.9
25	5	20	19.13	0.87	6.18	10.44	2.94
30	5	20	19.2	0.8	6.98	9.6	2.1
35	5	20.1	19.33	0.77	7.75	9.24	1.74
40	5	20.1	19.35	0.75	8.5	9	1.5
50	10	20.1	18.65	1.45	9.95	8.7	1.2
60	10	20.1	18.7	1.4	11.35	8.4	0.9
70	10	20.1	18.75	1.35	12.7	8.1	0.6
80	10	20.1	18.8	1.3	14	7.8	0.3
90	10	20.1	18.82	1.28	15.28	7.68	0.18
100	10	20.1	18.85	1.25	16.53	7.5	0
110	10	20.1	18.85	1.25	17.78	7.5	0

14. Location - Sohpdok

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
10	10	20	19.2	0.8	0.8	4.8	3.6
20	10	20	19.5	0.5	1.3	3	1.8
30	10	20	19.65	0.35	1.65	2.1	0.9
40	10	20	19.7	0.3	1.95	1.8	0.6
50	10	20	19.72	0.28	2.23	1.68	0.48
60	10	20	19.75	0.25	2.48	1.5	0.3
70	10	20	19.78	0.22	2.7	1.32	0.12
80	10	20	19.8	0.2	2.9	1.2	0
90	10	20	19.8	0.2	3.1	1.2	0
100	10	20	19.8	0.2	3.3	1.2	0

15. Location - Umtrew

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
2	2	5.4	5.9	0.5	0.5	15	10.2
5	3	4.4	4.9	0.5	1	10	5.2
10	5	4.9	5.5	0.6	1.6	7.2	2.4
15	5	5.5	6	0.5	2.1	6	1.2
20	5	6.1	6.6	0.5	2.6	6	1.2
25	5	5.6	6.1	0.5	3.1	6	1.2
30	5	4.8	5.3	0.5	3.6	6	1.2
35	5	5.3	5.8	0.5	4.1	6	1.2
40	5	5.8	6.3	0.5	4.6	6	1.2
50	15	6	7.1	1.1	5.2	4.4	0
60	10	7.1	7.9	0.8	6	4.8	0
70	10	8	8.7	0.7	6.7	4.2	0
80	10	5.5	6.2	0.7	7.4	4.2	0
90	10	6.2	7	0.8	8.2	4.8	0
100	10	7	7.8	0.8	9	4.8	0
110	10	7	7.8	0.8	9.8	4.8	0

16. Location - Pahamri-oh

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
2	2	9	11.2	2.2	2.2	66	43.8
4	2	11.2	13	1.8	4	54	31.8
7	3	13	15.3	2.3	6.3	46	23.8
10	3	14.8	16.7	1.9	8.2	38	15.8
15	5	11	13.8	2.8	11	33.6	11.4
20	5	13.8	16.3	2.5	13.5	30	7.8
25	5	10	12.3	2.3	15.8	27.6	5.4
30	5	9.2	11.4	2.2	18	26.4	4.2
40	10	9.9	14	4.1	22.1	24.6	2.4
50	10	8	11.8	3.8	25.9	22.8	0.6
60	10	12.3	16	3.7	29.6	22.2	0
70	10	8.3	12	3.7	33.3	22.2	0
80	10	8.6	12.3	3.7	37	22.2	0
90	10	8.1	11.8	3.7	40.7	22.2	0
100	10	11.8	15.5	3.7	44.4	22.2	0
110	10	8	11.7	3.7	48.1	22.2	0

17. Location - Umling

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
2	2	4.5	8	3.5	3.5	105	90.6
5	3	8	11.5	3.5	7	70	55.6
10	5	4.5	7.8	3.3	10.3	39.6	25.2
15	5	4.5	7.4	2.9	13.2	34.8	20.4
20	5	7.4	10	2.6	15.8	31.2	16.8
25	5	10	12.4	2.4	18.2	28.8	14.4
30	5	4.5	6.9	2.4	20.6	28.8	14.4
40	10	6.9	11.2	4.3	24.9	25.8	11.4
50	10	11.2	15.4	4.2	29.1	25.2	10.8
60	10	4.3	8.3	4	33.1	24	9.6
70	10	8.3	11.6	3.3	36.4	19.8	5.4
80	10	9	12.2	3.2	39.6	19.2	4.8
90	10	12.2	15	2.8	42.4	16.8	2.4
100	10	9	11.7	2.7	45.1	16.2	1.8
110	10	9.2	11.8	2.6	47.7	15.6	1.2
120	10	9.1	11.6	2.5	50.2	15	0.6
130	10	9	11.4	2.4	52.6	14.4	0
140	10	11.8	14.2	2.4	55	14.4	0

18. Location -Umran Niangbyrnai

Time t	Time diff	Before filling	After filling	Depth of Infiltration	Cummulative Infiltration	Infiltation rate	f-fc
min	min	cm	cm	cm	cm	cm/hr	
2	2	22.5	18.5	4	4	120	85.2
4	2	22.5	19.6	2.9	6.9	87	52.2
6	2	22.4	19.8	2.6	9.5	78	43.2
10	4	22.5	17.5	5	14.5	75	40.2
15	5	22.5	17.5	5	19.5	60	25.2
20	5	22	17.1	4.9	24.4	58.8	24
25	5	22	17.5	4.5	28.9	54	19.2
30	5	22.7	18.2	4.5	33.4	54	19.2
35	5	22	17.5	4.5	37.9	54	19.2
40	5	22.3	18.2	4.1	42	49.2	14.4
50	10	22.6	14.8	7.8	49.8	46.8	12
60	10	22.6	14.4	8.2	58	49.2	14.4
70	10	22	13.8	8.2	66.2	49.2	14.4
80	10	22.5	14.7	7.8	74	46.8	12
90	10	22.5	15	7.5	81.5	45	10.2
100	10	22	16.2	5.8	87.3	34.8	0
110	10	22	16.2	5.8	93.1	34.8	0
120	10	23	17.2	5.8	98.9	34.8	0

Annexure 9: Ground water Resources data

a) General Description of Ground Water Assessment in Ri Bhoi district for 2015-16 (area in ha)

Name of Ground Water Assessment Unit	Ri Bhoi
Type of Ground Water Assessment Unit	District
Type of rock formation	Granitic-Gneissic complex, Quartzites, Valley fills and Alluvium
Total area of Groundwater Assessment Unit	244800
Hilly area	153885
Command area	0
Non-command area	90915
Poor ground water quality area	0
Area considered for groundwater recharge	90915

b) Ground Water Resource Potential in Ri Bhoi district during 2015-16

Assessment Unit / District	Ri Bhoi
Command/ Non-Command/ Total	Total
Recharge from rainfall during monsoon season	7065 ham
Recharge from other sources during monsoon season	0 ham
Recharge from rainfall during non-monsoon season	707 ham
Recharge from other sources during non-monsoon season	154 ham
Total Ground Water Recharge	7926 ham
Natural discharge during non-monsoon season	793 ham
Net Annual Ground Water Availability	7133 ham

c) Ground Water Draft for All Uses in Ri Bhoi district

District	Ri Bhoi
Total draft for domestic and industrial purpose (as per households)	27 ham
Total draft for irrigation	0 ham
Total groundwater draft	27 ham

d) Balance Ground Water Resources Available and Stage of Groundwater Development in the Study Area as On 31st March 2008

Assessment Unit / District	Ri Bhoi
Command/ Non-Command/ Total	Total
Net Annual Ground Water Availability	7133 ham
Existing Gross Ground Water Draft for Irrigation	0 ham
Existing Gross Ground Water Draft for domestic and industrial water supply	27 ham
Existing Gross Ground Water Draft for All Uses	27 ham
Allocation for domestic and industrial requirement supply upto next 25 years	270 ham
Net Annual Ground Water Availability for future irrigation development	6863 ham
Stage of ground water development	0.38

e) Categorization for Ground Water Development of Ri Bhoi district during 2015-16

Assessment Unit/ District	Ri Bhoi
Stage Of Ground Water Development (%)	0.38
Is there a significant decline of pre-monsoon water table levels (Yes / No)	No
Is there a significant decline of post-monsoon water table levels (Yes / No)	No
Categorization For Future Ground Water Development (Safe / Semi-Critical/ Critical/ Over-Exploited)	Safe

FIELD PHOTOGRAPHS

Ground Water Exploration at Thadrang

Ground Water Exploration at Sohpdok

Ground water exploration at Lumkeni



Soil Infiltration Test studies



Dug well pump test



Springs in Ri Bhoi district