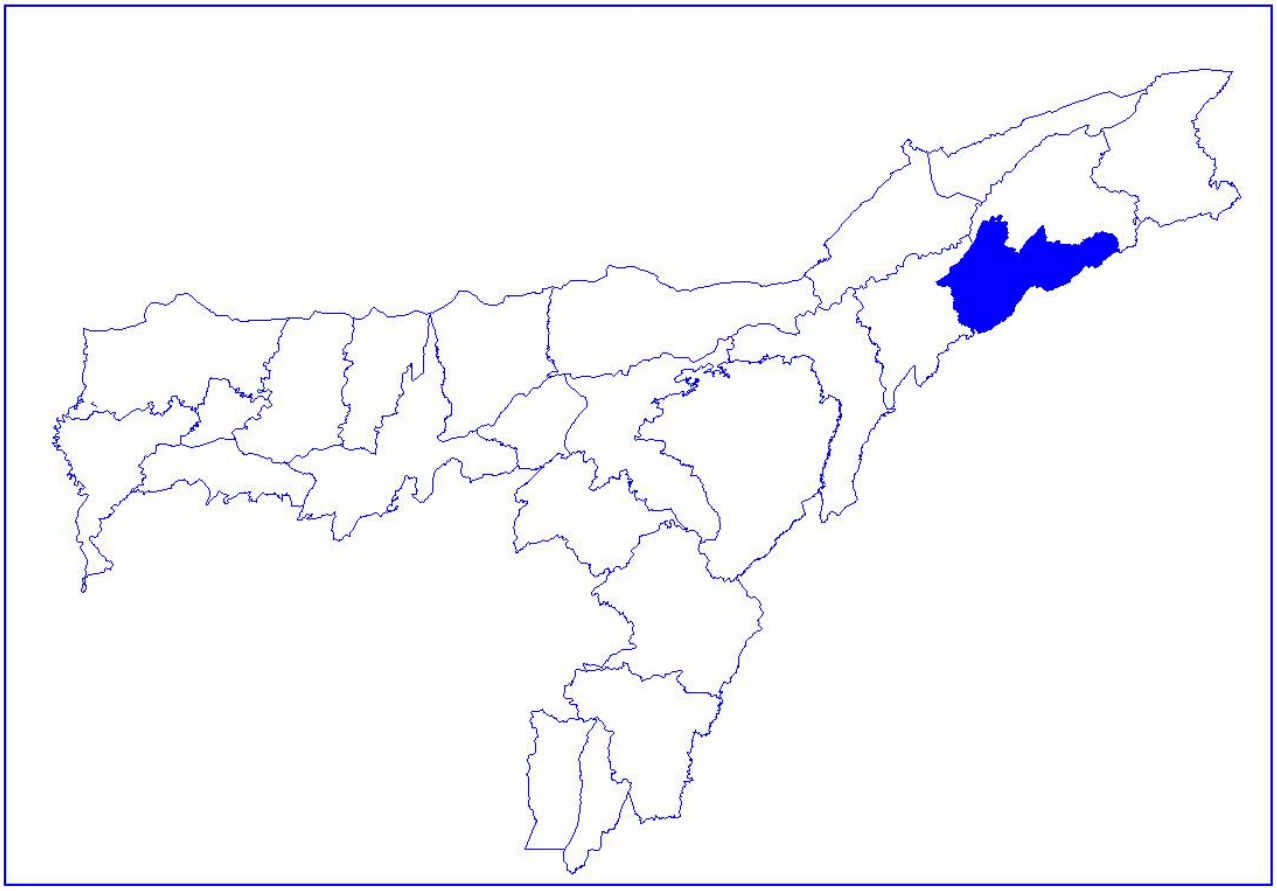
Technical Report Series: D

No:

Ground Water Information Booklet
Sibsagar District, Assam



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Guwahati
September 2013

GROUND WATER INFORMATION BOOKLET
SIVASAGAR DISTRICT, ASSAM
DISTRICT AT A GLANCE

Sl No	Items	Statistics
1	**General information**	
	i) Geographical area (sq.km.)	2,668
	ii) Administrative Divisions as on 2011	
	Number of Sub-division	3
	Number of Blocks	9
	Number of Panchayat/Village	118/875
	iii) Population as SHB of Assam 2011	1,150,253
	iv) Average annual rainfall in mm	2,400
2	**Geomorphology**	
	i) Major physiographic units	Flood plain, marshy land, younger and older alluvium, low altitude structural hills in the southeast.
	ii) Major drainages	Brahmaputra, Janji, Dikhow, Disang, Namdang, Mitong, Dorika Rivers.
3	**Land use in ha**	
	i) Forest area	30,465
	ii) Water logged land	3,111
	iii) Land under still water	4575
	iv) Cultivable waste land	1,820
4	**Major soil types**	Alluvial and flood plain soils
7	**Numbers of monitoring wells of CGWB as on 31.03.13**	13
8	**Predominant geological formations**	Quaternary formation followed by Tertiary deposits
9	**Hydrogeology**	
	i) Major water bearing formations	Vast alluvial formation of river borne deposit
	ii) Pre-monsoon water level during 2009	0.017 - 0.156 m bgl 0.155 - 0.245 m bgl
	iii) Post monsoon water level during 2009	Rising
	iv) Long term water level trend in 10 years(1998-2007) in m/year	
10	Ground water exploration by CGWB as on 31.03.2013	
	i) No of wells drilled	17EW,13OW,2PZ,1 SH
	ii) Depth range (meters)	Up to 287.10
	iii) Discharge (m^3/hr)	Up to 177
	iv) Transmissivity (m^2/day)	375 - 3,390
	v) Storativity	1.25 x 10^{-3} --- 2.25x 10^{-4}
11	**Ground water quality** i) Presence of chemical constituents more	Sporadic occurrence of iron

	than permissible limit (mg/l) (i.e.,EC,F,Fe,As)	
12	**Dynamic ground water resources in mcm (2009)** i) Net Annual ground water availibility ii)Net annual ground water draft iii)Projected demand for domestic and industrial use up to 2025 iv)Stage of ground water development	 1,316.33 187.04 36.23 14%
13	**Awareness and training activity** i) Mass awareness programmes organized ii) Date iii) Place	Nil
14	**Efforts of artificial recharge and rainwater harvesting** i) Projects completed by CGWB(no and amount spent) ii) Projects under technical guidance of CGWB(numbers)	Nil
15	**Ground water control and regulation** i) Numbers of OE blocks ii)Numbers of critical blocks iii)Numbers of blocks notified	 Nil Nil Nil
16	**Major ground water problems and issues**	Not emerged so far except higher concentration of Iron in some places..

GROUND WATER INFORMATION BOOKLET, SIVASAGAR DISTRICT, ASSAM

1.0 INTRODUCTION

Historical district Sivasagar known for its very rich and versatile culture & heritage, diverse flora and fauna, its lush green tea gardens as well as prolific oil fields, red rivers and the blue hills has always been the centre of attraction of all communities of the world since time immemorial. The district is bounded by longitude 94.25 and 95.25E & latitude 21.45 and 27.15N. The district head quarter Sivasagar earlier known as Rangpur during the Ahom Era is situated at adistance of 363 km east of Guwahati

The present district of Sivasagar covers an area of 2,668 sq km. The district is delimited on its North by the mighty river Brahmaputra; the south is surrounded by the states of Nagaland and Arunachal Pradesh. The East is surrounded by Dibrugarh district and the West byJorhat district of Assam.

Physiographically, the district represents a more or less flat country excepting some low undulating hummocks in the southern part which are generally covered by tea estates or reserved forests. Disang and Dikhow are two major rivers which originate in Naga Patkai range and drain the district. They are joined by numerous streams in the southern part. Dikhow River has a highly meandering course. A number of Physiographic features like ox-bow lakes, cut off chutes, meander scrolls, point bars etc are found in the area. The general slope of the area is from southeast to northwest to which the drainage pattern also conforms. The general elevation of the plain area varies from 85 to 100m above mean sea level which gradually rises to 128 to 150 m towards south and southeast.

Being a high rainfall area, the district is characterised by thick and luxurious growth of vegetation. Out of the total area of 2.66 lakh hectares, the net sown area is 1.26 lakh ha (about 52%) and the gross cropped area is 1.42 lakh ha. Forest occupies about 33.9 thousand hectares of land. Rice is the dominant crop covering over 80% of the cultivated areas. Other

important crops grown are pulses, sugarcane, mustard and wheat. The soils are generally sandy loam in the northern flood plain and silty to clayey loam in the southern part. These soils are characteristically different in colours also, being grey in case of sandy loam and yellowish brown in case of silty and clayey type.

1.1 Administrative Divisions and Population

The present administrative divisions and population pattern as per Statistical Hand Book of Assam 2011 of the district is given on Table - 1 and 2. Adminstrative divisions of the district has been depicted in **Plate-I.**

Table-1. Administrative Divisions and Population of Sivasagar district

Sl.No.	District	Area (sq.km)	Sub-division	Block	Town	No. of Gaon	No. of villages
1	**2**	**3**	**4**	**5**	**6**	**8**	9
1	Sivasagar	2668	3	9	7	118	875

Table-2. Progress in urban and rural population of Sivasagar districts during 1991-2011

Sl. No	Nameof state/district	Urban and Rural Population			Percentage decadal growth
		1991	2001	2011	
1	Assam/ Sivasagar	65,689/955,701	97,101/842,294	109,877/1,040,376	+16.93/+09.37

1.2 Pedological characteristics and Land use Pattern

The alluvial soil developed in the vast areas of Brahmaputra river system is practically unaltered alluvium generally, light to dark grey in colour and represented by a broad spectrum of sand, silt and humus rich bog clay depending on the land from component. Weathering and geochemical changes are minimal, but incipient changes in the top layer have been noticed due to biological activity. Soil P^H is generally feebly alkaline excepting bog soils.

Table 3. Total Land area and classification of Sivasagar district (in hectares)

District	Total Geographical area	Forest	Not availabe for cultivation					Permanent pastures and other graging Land	Other uncultivated land excluding fallow land	
			Land put to non-	Baren and un-	total	Water logged land	Land under still water		Land under Misc trees groves pot	Cultivable waste land
Sivasagar	266800	30465	1217503	1408042	2625545	3111	7067	7330	20061	1820

1.3 Agriculture

Agriculture is the mainstay of the people of the district

Table-4. Area under high yeilding variety of paddy in the district **(**Area in hactre)

Sl. No.	District	Autumn paddy	Winter paddy	Summer paddy	Total
1	Sivasagar	264	60917	12	61193

1.4 Irrigation

Prior to Independence irrigation was not practiced in Assam and most of the people use to depend on monsoon rains for agriculture. Many of the farmers who realised the necessity of irrigation for an assured rice crop during kharif period managed to construct small inundation channels for the purpose. Prior to the First Five Year Plan, a few minor irrigation schemes were taken up with a view to benefiting 810 hectares only. But increase in population, resulting in pressure on land and the annual flood havoc led to serious thinking on the urgency of irrigation development. Moreover, the advent of green revolution in other parts of the country in mid-sixties due to adoption of the new technology of High Yielding Variety (HYV) seeds and application of optimal fertilizer brought about a sea of change in the outlook of the farmers. The success of the new technology depended solely on water because HYV seeds were found to respond well under irrigated conditions only. From the Fourth Plan

onwards, the emphasis was on increasing the coverage under HYV which meant bringing more area under irrigation.

Irrigation programme in the district is now taken up under two broad head viz. (i) Major & Medium Projects and (ii) Minor Irrigation. The irrigation schemes are of three categories viz. (a) flow irrigation, (b) low lift irrigation and (c) ground water irrigation. Irrigation potential created upto 2010-11 is given in table-5.

Table-5. Irrigation potential created, 2010-11**(**Area in hactre)

Sl.No	District	Minor	Major and Medium	Total
1	Sivasagar	16026	-	16026

Ground water development in Assam remained at a low key primarily due to lack of adequate ground water data and non-availability of energy. However, with creation of the Directorate of Central Ground Water Board at Guwahati in 1974 and as a result of their surveys and explorations, hydrogeological conditions of the district could be deciphered and the potential of ground water resources is well established.

Chapter-2

CLIMATE & RAINFALL

2.1 Climate

The climate of the district is humid and sub-tropical with maximum temperature ranging from 27° to 38°C in the summer and minimum winter temperature varying between 3.4° and 11°C. Humidity is very high ranging from 74 to 87 per cent. The extreme humidity causes swealtering conditions during June to September.

2.2 Rainfall

The district experiences predominant influence of southwest tropical monsoon which persists from April to October with occasional winter showers. The low clouds of the southwest monsoon after being intercepted by the North Cachar Hills and Naga-Patkai range, cause heavy rainfall in the southern part of Assam and the clouds which pass over this 1800 m ridge, precipitate in the Brahmaputra valley, their intensity increasing towards the foothills of the Himalayas. The approach of the monsoon is marked by strong winds, overcast skies and occasional thunder showers, hailstorm and cyclones during April and May. It starts its full play of heavy showers from June.

Distribution of rainfall pattern reveals that it is negligible during the period January to March and November to December. On an average the total rainfall during these winter months hardly exceeds 100 mm. Otherwise, the average annual rainfall of the district is of the order of 2400mm.

Chapter 3

GEOMORPHOLOGY

3.1 Physiographic Features

The district lies in the Brahmaputra valley evolved during Quaternary period in between the Himalayan orogenic belt and crystalline massif of the Shillong plateau and owes its origin and development to phases of uplift, glaciation and erosion of the Himalayas, basement tectonics affecting the Shillong massif and eustatic changes of sea level during the glacial and inter-glacial phases.

3.2 Drainage Basins

Brahmaputra is the major drainage basin which is confined by the Eastern Himalayas on the North and East, the Naga-Patkai range on the southeast and Mikir Hills and Shillong

plateau on the southern and southwestern side. The present master slope of this basin finds a gap between the Shillong plateau and the Eastern Himalayas to open in Bangladesh. The Brahmaputra River is one of the largest rivers of the world and discharges about 30 per cent of the total water resources of the country.

Chapter 4

GEOLOGY

Geologically, the district is a part of the Brahmaputra valley covered by Recent alluvial deposits showing wide variations from place to place. Approximate thickness of this formation is 200 to 300 m.

In the flood plain areas of Brahmaputra valley, the coarse clastics dominate over finer sediments. While on the North bank the thickness is generally more than 300m, in the South bank it is variable. On the South bank, sand horizons dominate in major part of these areas but in the extreme southern fringes adjoining the Naga-Patkai range, the sub surface geology gets complicated. As per GSI (1974) the sub-surface geology of the Upper Assam Oilfields indicate that the Tertiary sediments overlying the basement are gently folded into domes and anticlines with low to moderately dipping limbs affected by numerous faults giving rise to a mosaic in which individual blocks lie at different levels at places being warped and tilted. The Moran field is dissected by major NE-SW reverse fault. Rudrasagar field, a gentle dome and Lakwa field, a large ENE-WSW anticline are affected by several criss-cross faults. The faulting continued intermittently throughout the sedimentation from Eocene to Pleistocene, some of the faults affected only the Oligocene rocks and others extend upto the younger group of rocks.

As a result of the structural disturbances, the granular sandy zones also get affected and they become discontinuous. In Jorhat district, therefore lateral variations in lithofacies are so common in Melamati, Titabor and Maibalia areas that the entire sediment down to the explored depth of about 300 m is predominantly clayey with very thin sandy clay.

Chapter 5

HYDROGEOLOGY

The geology of Upper Assam as a whole is quite interesting and can be clearly visualised only if we know the geological history of Assam which has been discussed in detail by many workers of the Geological Survey of India, Oil India and the Oil and Natural Gas Commission. References are found in the publications of G.S.I. & O.N.G.C. Without going into the details of the geological history, it can be stated that the sedimentation in Upper Assam particularly covering parts of Jorhat, Sivasagar, Dibrugarh and Tinsukia districts has been affected by the Naga Patkai range. The Naga-Patkai range consists of a series of complex over thrusts with an imbricate pattern, one thrust overlapping the other. The outer most boundary thrust of the "belt of schuppen" known as the Naga thrust closely follows the boundary of the Assam valley alluvium for about 350 km and continues southwestward for another 50 km upto Haflong.

The southern foot hills of Sivasagar district falls in the upthrust block of Naga thrust. The various rocks exposed in this strip belong to Barail Group, Tipam Group and post Tipam sediments, oriented in NE-SW to ENE-WSW direction dipping 40-50° in southerly direction.

Exploratory drillings carried out down to the depth of 287.10 m by the CGWB has not touched the basement rocks of Archaean age. However, the sediments penetrated are largely soft sandstone, shale and clay and sandy clay belonging to the Tertiary Group of rocks. The sandy horizons whch form the principal aquifers in the district are generally fine to medium grained, occasionally coarse and gritty with typical grey colour. In a few boreholes, carbonised or petrified fossil- wood has also been found. The clay is dark grey, bluish to black which is typical of Tertiary age. Hydrogeology of the district is given in **Plate-II.**

Large number of drilling has been carried out in the district by the CGWB and other State Government agencies like Irrigation, Agriculture and Public Health Engineering departments. The salient features of CGWB tubewells are given in table 25 A critical

appraisals of the lithological logs of existing tube wells reveals that the top few metres blanket of sediments is ferruginous, reddish or yellowish silty clay mixed with sand underlain by thick grey sand and clay sequence.

Ground water occurs under unconfined and confined conditions saturating the fine to coarse sandy horizons mostly belonging to Tertiaries. Water table generally rests at depth of 4 m below land surface. In the southern part, it varies from 4 to 6 m below land surface. Water table movement conforms to the topography of the area and moves in northwesterly directions. The hydraulic gradient is steep in the undulating tracts of the southern part gradually becoming gentle in the flood plain areas of the Brahmaputra.

Deep tubewells constructed down to the depth of 68 to 196 m have generally tapped 45 to 54 m of saturated granular zones. The yields of these tubewells vary from 100 to 177 m^3/hr for drawdown of upto 8 m. Sufficient thickness of fine to coarse grained sands are found within 50 m depth in some parts particularly southern and southeastern parts. Broadly covering parts of Nazira, Sapekhati and Sonari blocks, the sands are fine grained and mixed with clay/shale. The finer nature of the sediments gives low permeability to the aquifer which often results in heavy drawdown. The yields of shallow tubewells vary from 20 to 35 m^3/hr depending upon the nature and thickness of aquifer tapped. The details of the exploratory wells so far constructed in Sibsagar district is given in **ANNEXURE-I.**

Chapter 6
GROUND WATER RESOURCE

Dynamic ground water resources are estimated basd on the methodologyadopted as per GEC 1997 following Water Level Fluctuation and Rainfall Infiltration Factor Method. The total annual dynamic ground water recharges are calculated to be 1462.81mcm while the net annual grtound water draft is 187.04 mcm. The stage of ground water developmentis 14%. The projected demand for domestic and industrial uses upto 2025 is estimate to be

about 36.23mcm. The district is under category and sufficient resources are available for development.

Chapter 7
GROUND WATER QUALITY

Analysis of ground water samples collected from DGWMSs and EWs in the district reveals thatground water is fresh, potable and is suitable for both domestic and irrigation purposes.Ground water is coming under $C_1S_{1,}C_2S_2$ classes and excellent to good categories in US salinity and Wilcox Classifications of irrigation. Sporadic occurrence of high content of iron in both deeper as wellas shallow aquifers requires suitable treatment before being used for drinking purposes.

Chapter 8
GROUND WATER MANAGEMENT STRATEGY

Thick and extensive alluvial deposits with rich aquifer system covering major part of the district are suitable for ground water development through ground water structures like open wells, shallow tube wells and deep tube wells. For meeting water requirements of limited individual households, open wells and filter point wells are feasible almost in all parts of the district. Ring wells having 0.80 to 1.20m dia with the depth of 5 to 10m bgl are likely to hold sufficient amount of water to meet the water requirement of the households. Filter point wells with the depth of about 15 to 20 m bgl are also suitable for extractioin of ground water. For agricultural purposes, shallow tube wells may be constructed in the areas occupied by flood plains and younger alluvial formation. A centrifugal pump may be used to irrigate about 2-3 ha of land at an average annual draft of 0.03mcm.

Chapter 9

GROUND WATER RELATED ISSUES AND PROBLEMS

A sizeable portion of district is inundated by flood every year during monsoon. Large part of the area is under water logging condition and for lowering of waer levels, shallow tube wells may be constructed.

Sporadic occurrence of high iron content in ground water may be treated prior to domestic consumption.

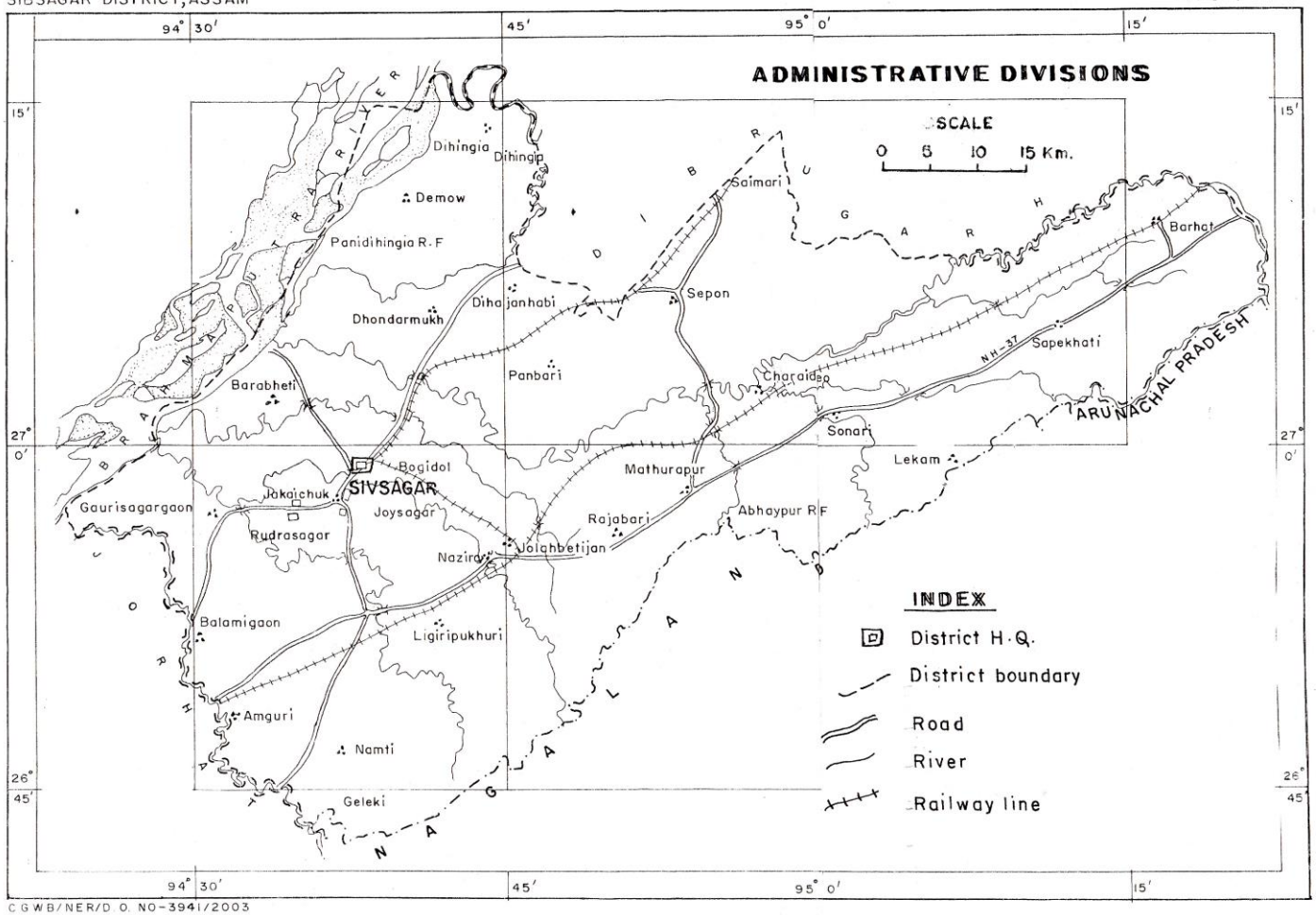
Chapter 10

CONCLUSION AND RECOMMENDATION

Hydrogeological conditions prevailing in the district aptly ensure that there is ample scope for development of ground water in Sivasagar district. Detail hydrogeological surveys aided by exploratory drilling carried out by CGWB has revealed existance of rich aquifer system down to a depth of 287.10m comprising Recent to Sub-Recent unconsolidated alluvial formations and semi consolidated formation of Upper Tertiary age. Deep tubewells are feasible in most parts of the district. Such tubewells can be constructed within 100 to 170 m and high yields upto 150 m^3/hr can be obtained. The permeability is relatively lower in case of semi-consolidated sandstones compared to alluvial formations. This results in greater drawdown upto 12 m for a discharge of 150 m^3/hr in case of semi-consolidated formation. Low-duty shallow tubewells can also be constructed in large parts of the area particularly Dimow, Sivasagar and Amguri blocks. However development of ground water should be always done in a planned and sustainable manner.

SIBSAGAR DISTRICT, ASSAM

Plate-I



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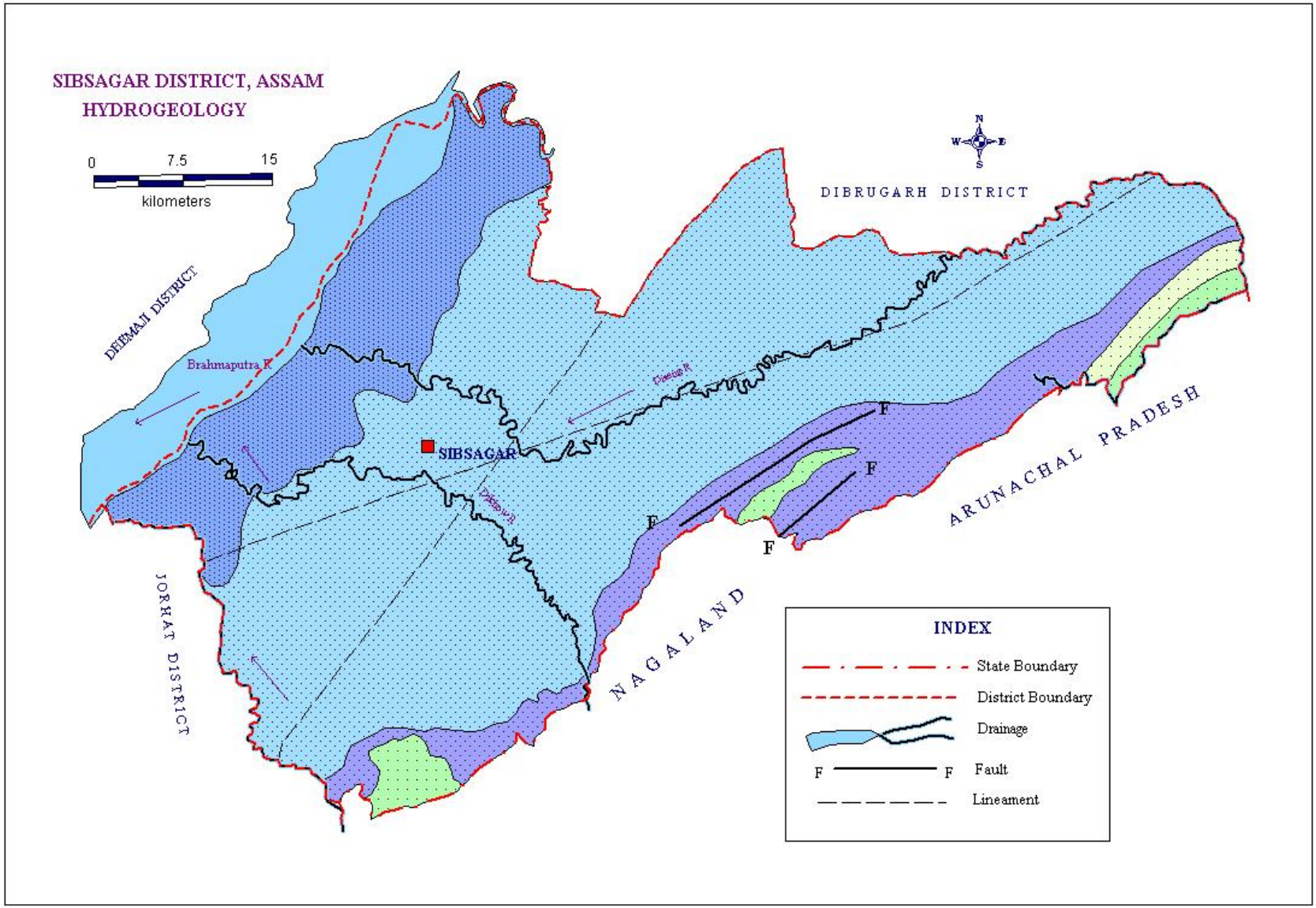
SIBSAGAR DISTRICT, ASSAM
HYDROGEOLOGY
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DEHMAJI DISTRICT
Brahmaputra R
Dikhow R
SIBSAGAR
Dikhow R
F
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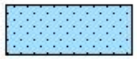
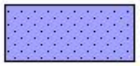
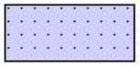
F
F
ARUNACHAL PRADESH
NAGALAND
JORHAT DISTRICT
INDEX
State Boundary
District Boundary
Drainage
F
F
Fault
Lineament

SIBSAGAR DISTRICT, ASSAM
HYDROGEOLOGY

LEGEND

MAP UNIT	FORMATION	LITHOLOGY	AQUIFER DISPOSITION	PROSPECTS OF GROUND WATER DEVELOPMENT
	FLOOD PLAIN	Silt, clay, fine to medium grained sand, grey in colour	Discontinious aquifer zones	Moderate yield of 20-50m3/hr. from shallow tube wells. Suitable for bamboo structures and shallow tube wells
	YOUNGER & OLDER ALLUVIUM	Younger - Grey coloured sand, medium to coarse, clay and silt with gravel	Limited areal extent, discontinious, 2-4 zones down to50m. Unconfined to semi-confined.	Suitable for shallow tube wells. Deep tube wells not preferrable. Yield range 30-50m3/hr
		Older - Yellow coloured sand, mediumto coarse,silt, clay with gravel & pebble	Areally extensive deep aquifers, 3-7 zones in the depth rage of 50-250m. Semi-confined to confined	Moderate to high yield, suitable for deep heavy duty tube wells of 100--250m deep, yield range 120-210m3/hr. at drawdown 1-9m.
	PIEDMONT PLAIN	Boulder, pebble, gravel,& sand mixed with silt and clay	Limited areal extent.Unconfined to confined.	Suitable for shallow and deep tube wells. Yield range 30-100m3/hr
	TIPAM	Fine to medium grained sand-stone with clay & shales	Multilayered, interbedded,. Semi-confined to confined.	Suitable for deep tube wells of low to moderate yield
	BARAIL	Fine tomedium grained sandstones with carbonaceous clays, shales and siltstones	Multilayered, interbedded & intercaleted. Semi-confined to confined	

ANNEXURE-I

Hydrogeological data of exploratory wells in Sibsagar District, Assam

Year of construction	Location	Depth Drilled (m)	Aquifer zones tapped (m)	SWL (m bgl)	Discharge (m^3/hr) DD(m)	Transmissivity (m^2d)	Hydraulic Conduct-ivity (m/d)	Specific Capacity (lpm/m)	Storage Coefficient (S)	Geology	Sub Basin Sub-sub basin
82-83	Dihajan Habi EW+OW 27°07'22": 94°45'16"	281.90 167	59-71, 95-116,130-140, 160-164	1.602	177.36 7.55	3118.01	66.34	391.52	$2.2x10^{-4}$	Alluvium Sand f,m,c, gravel,	Disang Disang
82-83	Bogidol EW+OW 26° 57'16": 94°46'03"	181.86 178	70.5-76.5, 96-104, 120-126, 136-146, 151-175	5.152	140.82 5.513	915	16.94	425.72	$8.25x10^{-3}$	Do	Disang Dikhow
82-83	Charaideo EW + OW 26° 25'00": 94° 46'03"	287.44 135	74-96, 123-125, 130-132	11.44	140.64 7.70	1237.53	45.83	304.42	$1.2x10^{-3}$	Do	Disang Disang
82-83	Jokaichuk EW + OW 26°57'16': 94° 33'30"	287.10 94.5	15-40,46-51, 65-85	2.95	174.36 4.20	263.40	51.65	703.81	$10.3x10^{-4}$	Do	Do
82-83	Namti EW + OW 26° 51'08": 94°38'15"	288.20 187.50	49-55, 64-82, 116-120, 129-135, 166-184	3.32	123.36 4.50	3390	65.19	449.89	$2.5x10^{-3}$	Do	Do

82-83	Ligiripukhuri Pz 26^{o} 52’35” :94^{O}42-40	69 68	63-65	5.64	7.74					Do	Do
82-83	Dimow Pz 27^{o} 09’00” :94^{O}44’57”	47.55 43.50	41.5-42.5	3.13	89.25 1.72	374.5	41	865	-	Do	Do
97-98	Sonari EW 95^{o}01’23”: 27^{o}01’53”	212 167	44-56, 62-74, 86-98, 124-133, 152-164	5.90	44.76 2.08	-	-	358.65	-	Do	Do
97-98	Jalahbetijan EW+OW 27^{o} 03’35”: 95^{o} 06’46”	201.03 196	43-49, 94-97, 106-118, 124-130, 163-169, 181-193	2.45	44.70 3.79			196.47		Do	Do
98-99	Nakhana Hudupara I & II EW + OW 26^{o}51’47”: 94^{o}42’12”	100.90 Abandoned 204.48 198	45-48, 76-82, 122-125,136-141, 160-161, 187-190	4.30	428.94	1846	12.39	78.30		Do	Do
98-99	Mohmara Konwargaon EW + OW 27^{o}04’23” 94^{o}59’24”	245.56 190	73-79, 85-94, 136-139, 145-151, 157-160, 169-178, 184-187	5.71	37.8 5.6	1347	29	112.5		Do	Do
00-01	Abhayapuria EW + OW	201.10 133	63-75, 118-130	2.04						Do	Do

	26°55'32": 94°47'28"				70.38 3.30	2577.5	32.63	355.45	$8.75x10^{-14}$		
00-01	Talatal Ghar EW + OW 26°57'55" :94°37'35"	210 129	42-54, 112-124	1.82	42.46 3.56			198.78	Do	Do	Disang Dikhow
06-07	Maduri Gohain Gaon EW + OW 26°06'00" 94°42'06"	200.10 142	47-53, 75-81, 88-94, 132-138	4.30					Do	Do	
06-07	Nagaon (Santak) EW 26°52'45": 94	155 106	76-88, 100-103	11.00	38.70 5.6			115.18	Do	Do	
06-07	Athkhel Grant EW 26°46'52" :94°40'49"	200.70 92	76.5-88.50	2.04						Do	
11-12	Sonari EW+OW E 26°58′30″ N 94° 54′ 25″	96.05 69	30-36;57-66								
11-12	Garbhaga EW+OW E 27° 11′ 56″;	150.20 86	51-66;74-83								

	N 94^0 $45^/$ $00^{//}$										
11-12	Gargaon EW+OW E 26^0 $33^/$ $40^{//}$; N 94^0 $04^/$ $27^{//}$	96.05 95	56-62;68-74;86-92								