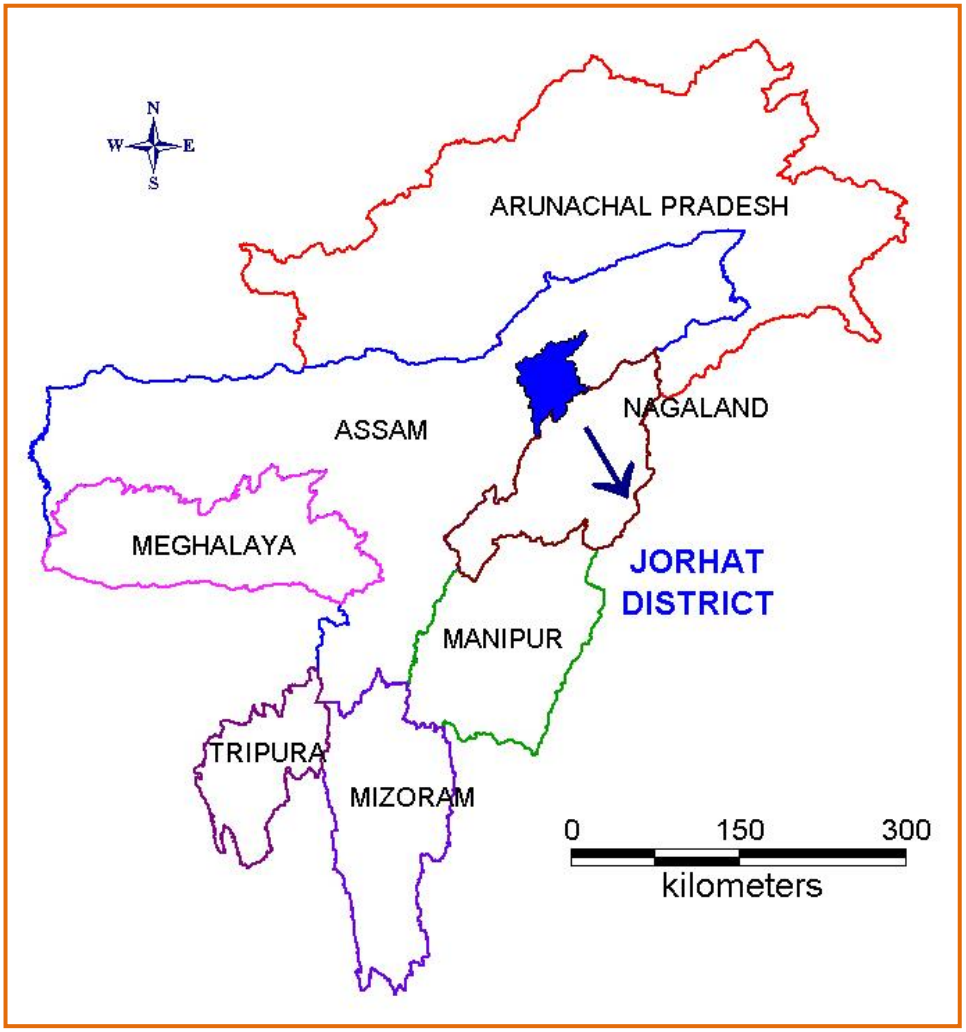
Ground Water Information Booklet
Jorhat District, Assam



Central Ground Water Board

North Eastern Region

Ministry of Water Resources

Guwahati

August 2013

GROUND WATER INFORMATION BOOKLET, JORHAT DISTRICT, ASSAM

DISTRICT AT AGLANCE

Sl No	Items	Statistics
1	GENERAL INFORMATION	
	i) Geographical Area (in sq.km)	2,851
	ii) Population	10,91,295
	iii) Average Annual Rainfall (mm)	1,867
2	GEOMORPHOLOGY	
	i) Major physiographic units	Brahmaputra plain, marshy land and low altitude structural hills in the extreme south.
	ii) Major drainages	River Brahmaputra, Bhogdoi and Kakodonga
3	LAND USE (sq. km.)	
	i) Forest Area	219.04
	ii) Net Area Sown	1202.40
	iii) Total cropped area	1730.75
	iv) Area sown more than once	528.35
4	MAJOR SOIL TYPES	Alluvial and Flood Plains
5	AREA UNDER PRINCIPAL CROPS (sq.km.)	443.00
6	IRRIGATION BY DIFFERENT SOURCES (sq.km.)	4.13
7	NUMBERS OF GROUND WATER MONITORING STATIONS OF CGWB (as on March 2013)	24
8	PREDOMINANT GEOLOGICAL FORMATIONS	Quaternary formation followed by Tertiary deposit.
9	HYDROGEOLOGY	
	i) Major water bearing formations	Vast alluvial formation of river borne deposit
	ii) Pre-monsoon water level during 2007	3.79-8.32 m bgl
	iii) Post monsoon water level during 2007	0.50-4.26 m bgl
	iv) Long term water level trend in 10 years(1997-2007) in m/year	Rising trend
10	GROUND WATER EXPLORATION BY CGWB (as on 28.02.2013)	
	i) No of wells drilled	32 (18 EW, 9 OW, 1 PZ & 4 DW)
	ii) Depth range in meters	69 to 288
	iii) Discharge in lps	4.16 to 58.61

	iv) Transmissivity(m^2/day)	0.86 to 5672
11	GROUND WATER QUALITY i) Presence of chemical constituents more than permissible limit (i.e. EC, F, Fe, As)	EC: 136 to 1,653 micromhos/cm at 25°C (Mariani) F: 0.37 to1.49 ppm Fe: 0.20 to 2.36 ppm As: NA
12	DYANMIC GROUND WATER RESOURCES (2009) in mcm i) Annual replenishable ground water resources i) Net annual ground water draft ii) Projected demand for domestic and industrial use up to 2025 iii) Stage of ground water development	 1340.75 171.09 34.65 13%
13	AWARENESS AND TRAINING ACTIVITY i) Mass awareness programmes organized ii) Date iii) Place	Only one Mass Awareness Programme (MAP) and one Water Management Training Programme (wmtp) were organized. 14th March 2008(MAP), 15th March 2008(WMTP) Jorhat town
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)	Not applicable. No such project has been taken up.
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	As the district is underlain by approximately 30 to 50 meters of clayey formation, construction of shallow tube wells poses problems. Even for the construction of deep tube wells in the extreme southern parts of the district, utmost care should be taken for selection of sites and identification of small alternate beds of fine sand and clay.

GROUND WATER INFORMATION BOOKLET, JORHAT DISTRICT, ASSAM

1.0 Introduction:

Lying on the south bank of the River Brahmaputra, Jorhat is one of the important districts of Assam being the centre of communication for the border areas of Nagaland and Manipur. It is bounded on the south by the Naga-Patkai range, in the west by Golaghat district and in the south east by Wokha and Mokokchung districts of Nagaland. Sibsagar district lies to its northeast (Plate I). The Brahmaputra River forms the northern limit of the district, where world's largest inland island, the Majuli is located which is also a part of the district. The district covers an area of 2,851 sq. km. It has three Sub-divisions namely Jorhat, Titabar and Majuli with head offices at Jorhat. The district has eight development blocks, five revenue circles and seven towns. As per 2001 census, the total population of the district is 10,91,295.

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2.0 Climate and Rainfall

The climate of the district is classified as mesothermal wet climate with forest type of vegetation. January is the coldest month with temperature of 6.1°C. July and August are the hottest period with average monthly temperature of about 29 °C. The average relative humidity in a year is 78.7 per cent. The average annual rainfall for last ten years from 1998 to 2007 has been computed to be 1,867.08 mm. The amount of rainfall increases from southwest to northeast.

3.0 Geomorphologic Features and Landforms

Five geomorphological units are discernible in Jorhat district,

(i) The flood plain of the Brahmaputra River in the north

(ii) The central upland area covering younger alluvial formations

(iii) The central upland area covering older alluvial formations

(iv) The southern undulating hill area running along the Naga-Patkai range covering the piedmont plain

(v) Structural hills.

The elevation of the flood plain area varies from 80 to 90 m while in the central upland area it is 95 to 110 m above Mean Sea Level. The altitude of the hills in the southern and eastern parts of the district is up to 312 m above MSL. The general trend of the hills is NE-SW and at places to N-S.

The mighty River Brahmaputra and its important tributaries like south Dhansiri, Bhogdoi and Kakodonga drain the district. The tributaries originate in Naga-Patkai range and flow northward to join the Brahmaputra River almost at right angles which give rise to sub-parallel type of drainage. These tributaries retain only meager base flow during the dry winter months. The rivers and streams are highly meandering in nature and sudden changes in courses of these rivers possibly due to heavy siltation and epiorogenic movements cause the flood havocs. A total of 109 wetlands with a total area of 21 sq. km. are distributed in the district.

Out of the total geographical area of 2.8 lakh ha, about 1.19 lakh ha is the net cropped area. Forest occupies significant area 0.22 lakh ha. The recent alluvial soils of recent rivers are light grey to dark grey in colour and are confined to the flood plain area adjacent to the Brahmaputra River and its tributaries. The older alluvial soil is sandy loam to silty and clay-loam. It is light yellowish brown to light brown in colour. The p^H is 4.5 to 6.0. Being acidic in nature, these soils are suitable for tea plantation. The soils of the district are characterized by organic matter and available phosphorus and low potash. The soils in the southern parts are residual in origin, derived from the semi-consolidated rocks underlying these areas.

4.0Ground Water Scenario

4.1 Hydrogeology

The area is underlain by unconsolidated alluvial sediments of the Quaternary age, which can be differentiated into i) Older and ii) Younger alluvium. The Older alluvium occupies the upland areas with sediments of oxidized and relatively compact nature, while the Younger alluvium occurs along the low-lying tracts of the area along the river courses (Plate II). The southern part of the area, adjacent to the Naga hill range is covered by surficial

blanket of clay, belonging to Younger alluvium and probably has been derived from the adjacent hills which are composed of the rocks of Tertiary age.

Ground water in the district occurs under water table to semi-confined conditions in the near surface conditions and in the deeper horizon, under semi-confined to confined conditions. Depth to water level in the water table zone varies from 0.41 to 3.07 m bgl in the pre-monsoon period and 0.56 to 3.41 m bgl during post-monsoon period. Panel diagram prepared based on available sub-surface data indicates that in the central parts, three to four prolific aquifer system exist down to explored depth of 300 m(Plate III). In the vicinity of Brahmaputra River, five to six aquifer systems with limited thickness exist within the depth range of 400 m. In the southern parts, the aquifer system fades out due to mixing of finer particles of sand and clay leading to decrease in thickness of aquifer system. The geometry of the aquifer system varies widely. In the northeastern and northwestern parts, the thickness of the aquifer increases and clear sand beds exists. Throughout the district, varied thickness of clay beds overlying and underlying the aquifer system exist. The thickness of the clay beds increases southwards i.e. towards Titabar where it attains a maximum thickness of 103 m.

The predominance of clay formation in the depth of 30 to 50 m poses problem in storage of ground water in the district, however, local variation in the existence of very limited thickness of sand beds mixed with clay performing as conduits of ground water is also observed.

The world's largest inland island 'Majuli' is located in the eastern parts of the district. The area is very much suitable for construction of ground water abstraction structures for discharges ranging from 100 to 300 m^3/hr. Ground water occurs under water table conditions. Water table is shallow and rests within 4 m bgl.

Central Ground Water Board has carried out exploratory drilling activities in various hydrogeological situations by deploying appropriate drilling Rigs in Jorhat district of Assam. The Board has drilled 18 exploratory wells in Jorhat district, out of which, three wells are abandoned and thirteen wells are under operation. The range of drilling depth varies from 79.72 to 457.30 m bgl with the discharge of 8 to 211.44 m^3/ hr. Low duty shallow TWs are also feasible and have been constructed in the district. The yield of the tube wells varies from 30 to 35 m^3/ hr and it irrigates about 3.5 ha. Hydrogeological data of exploratory wells in Jorhat district, Assam is depicted in Table 1.

Table 1: Hydrogeological data of Exploratory wells, Jorhat district, Assam

Sl no	Location	Depth drilled / constructed(m)	Formation tapped (m)	S.W.L m.b.g.l	Discharge M3/hr/Drawdown	T M2/d	P M/d	Storage Coefficient	Geology	Remarks
1	Boisahabi	288.30	-	-	-	-	-	-	Alluvium	Abandoned
2	Brahmingaon	457.30/225.00	72-91 107-132 153-158 168-173 212-222	3.75	211.44/6.076	5672.60	88.63	1.02x10-3	do	
3	Charingia	295.80/173	60-80 130-170	2.065	211.44/2.386	3990	66.5	1.3x103	do	
4	Dekagaon (SH)	292.7								Abandoned
5	Gohaingaon	300.50/169	48-60 94-132 154-166	6.481	211.44/5.628	4383	70.69	1.0x 103	do	
6	Kakojan	311.77/288	88-106 111-114 162-167 177-183 242-254 257-274 276-285	6.61	205.98/5.205	5030	71.86		do	
7	Kakojan(Pz)	89.72/79.72								

5.0 Ground water resources

Ground Water Resource

Methodology adopted for ground water resource estimation of Jorhat District of Assam is as per GEC 1997 Report, i.e. Ground Water Level Fluctuation and Rainfall infiltration factor Method.

The net ground water availability estimated in the year 2009 is 1273.71mcm. The existing gross ground water draft 171.09mcm and the stages of development are 13% only. Future provision for domestic and Industrial use is 34.65mcm and for Irrigation use is 1093.68mcm.

Assessment unit can be categorized into 4 categories as SAFE, SEMI-CRITICAL, CRITICAL, and OVER-EXPLOITED. In Jorhat district stage of ground water development is 13%, which shows under the SAFE category. As long-term water level trend does not show any major change so the whole district may be considered as SAFE.

CHART OF GROUND WATER RESOURCE ESTIMATION

Net Ground Water Availability	= 1273.71mcm
Gross Ground Water Draft	= 171.09mcm
Stage of Ground Water Development	= 13%
Future provision for Domestic & Industrial Use	=34.65mcm
Future Provision for Irrigation Use	= 1093.68mcm

6.0 Ground Water Quality

Chemical analysis of ground water in the district carried out by Regional Chemical Laboratory of Central Ground Water Board, depicts that ground water of the district is potable except high iron content in scattered patches, which is a common factor in the ground water chemistry of the state of Assam.

The content of iron varies from 0.20 to 2.36 ppm. Fluoride content in ground water in the district is found to be within 0.37 to 1.49 ppm. The variation is very much within the permissible limit.

The water quality is found to be well within the permissible limit for drinking, irrigation and industrial purposes except high iron concentration in scattered patches, which can be removed through the process of aeration before use.

7.0 Status of Ground Water Development

Ground water development in the district is still in the nascent stage, as evidenced from the data collected from State Organization. Assam State Agricultural Department has constructed a total of 5,083 shallow tube wells in an area of 124.59 ha and developed 14% of ground water as on March 2005. The construction of shallow tube well down to 50 m depth and dug well are problematic in some parts of the district due to the presence of thick blanket of clay beds. People generally prefer to construct ponds and stores rain water, which dries up during winter period. Though, deep tube wells are feasible in the district, construction of deep tube wells are not common within the mass, which may be due to ignorance and as well as

requirement of high cost involvement. Ground water development has not been geared up in the district, except in the Tea Gardens and in some industries.

8.0 Ground Water Management Strategy

The district is blessed with enormous thickness of aquifer in the central and northern parts comprising medium to coarse sand within the explored depth of 450 m, which is mostly capped in the upper parts by 30 to 50 m of clay beds and varied thickness of clay intercalation in between. These water bearing formations are of moderate to high yielding nature, depending on the nature and size of the sands. In the southern parts of the district, the promising nature of the sediments slowly turns to be poor to very poor, due to mixing of finer sediments and minor thickness of water bearing beds with alternate existence of clay beds. In view of the development strategy of ground water in the district, it needs to be worked out accordingly, considering feasibility of deep tube wells, installation of proper rig and design aspects of deep tube wells.

9.0 Ground Water issues/problem of the area

The district even though having a rich aquifer system down to depth of 300 m witnesses problem in the development of ground water owing chiefly to the fine to very fine nature of the sand. Deep tube wells constructed in the area reportedly undergoes reduction in the yield with time and in some cases, they have to be abandoned. The grain size analysis data was collected during the drilling of exploratory wells in the study area. The results of the analysis indicates that owing to the presence of the fine sand, significant variation occurs in the hydraulic conductivity of the individual aquifer zones within the multi-aquifer system. This points towards the role played by the effective grain size i.e. values in controlling the hydraulic conductivity.

The proper placement of the slotted portion of the pipe against the aquifer zones is of much importance in determining the overall service life of the well. It is noticed that the presence of fines significantly reduce the hydraulic conductivity of the aquifer. Care should be taken while tapping the individual zones and the zone with K value less than 10 m/day should be avoided. This can be done by making use of standard sieve of 0.106 mm. If less than 10% of the representative samples of the aquifer pass through this standard sieve size, it

can be assumed that the hydraulic conductivity of the aquifer zone is more than 10 m/day and the zone may be tapped.

10.0 Recommendations

Ground water development in the district is still in nascent stage. State Organizations like Assam State Minor Irrigation Development Corporation till 1990, Irrigation Department and Agriculture Department have already constructed 5,083 shallow and deep tube wells till March 2004, which are used for irrigation purposes. The draft created by these shallow and deep tube wells is stated to be 132.16 mcm. Based on the balance resource, recommendations is made for construction of shallow/medium duty tube wells within depth range varying from 50 to 70 m along with design aspects and numbers.

Major parts of the district is underlain by sticky clay down to 20 to 50 m with slight variation locally, where clay matters mixes with finer sand grains towards the central and northern parts of the district. Except the extreme southern parts merging with the Naga Hills, feasibility of constructing shallow/ medium duty tube wells exist in the district. Block wise pheasibility of shallow/medium duty tube wells against the resource potential are as follows.

Shallow/medium duty tube wells	
East Jorhat	2467
Central Jorhat	2495
Jorhat Dev.Block	3898
Kaliapani	6866
Titabar	3243
NW Dev.Block	5293
Ujoni Majuli Block	12420
Majuli Dev. Block	16012
Total	52696

Detailed Hydrogeological surveys aided by exploratory drilling by CGWB have revealed the existence of rich aquifer system down to depth of 300 m. The aquifer system of the area is broadly divided into three groups.

i) 0-50 m bgl

ii) 50-200 m bgl

iii) 200-300 m bgl

In the first and the second group, granular zones constitute about 45% and 30% respectively. The granular zones in respect of both shallow and deeper aquifers have

tendencies to become finer grained and decrease in thickness towards the southern part of the area. A great deal of facies variations and lateral intercalations are prevalent.

Hydraulic conductivity as determined through aquifer performance tests and through grain size analysis has enabled the categorization of the deeper aquifer into the following Groups

Group I: Characterized by hydraulic conductivity greater than 20 m/day (in the range of 45-65 m/day). This is characterized by greater thickness of the granular zones and is restricted to areas adjoining the Brahmaputra River. The area is suitable for deep tube wells with discharge of 100-200 m^3/hr for draw down up to 6 m.

Group II: Characterized by hydraulic conductivity greater than 20 m/day (in the range of 30-45 m/day). This occurs in the central portion of the district. This zone is suitable for deep tube wells as above but with higher lifts.

Group III: Characterized by hydraulic conductivity less than 20 m/day. This area occurs in the southern part of the district. The granular zones in this Group especially near the Naga Hills are fine to very fine grained and their demarcation calls for employing precise methods like electrical logging. These areas are suitable for construction of medium tube wells up to 70 m^3/hr for draw down up to 6 m.

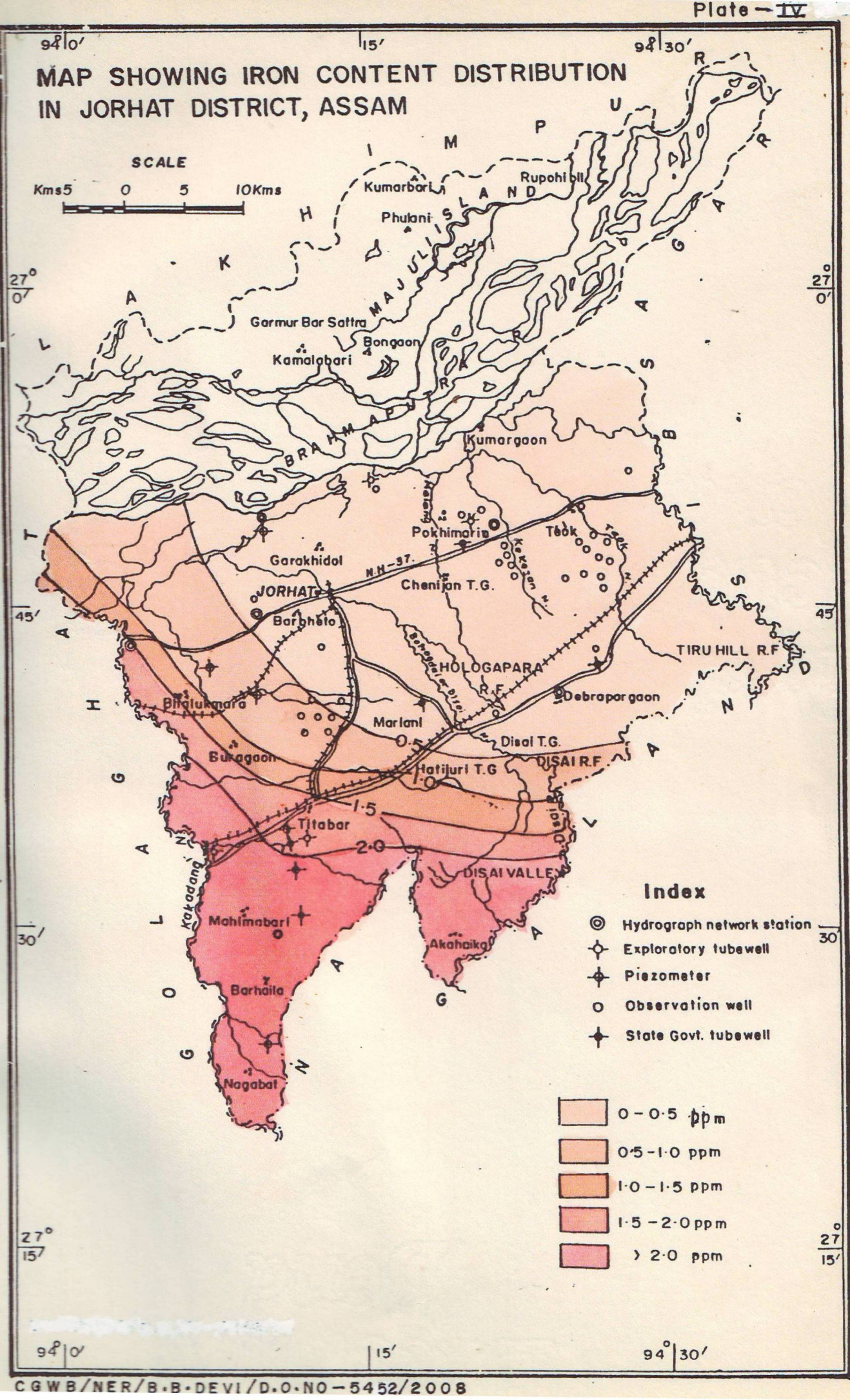
The district has high dependence on ground water to meet the water requirement for domestic uses. However, for irrigation purpose, the ground water development is at low key. There exists enormous potential of ground water development to meet the requirements of the agricultural sector.

To ensure the long service life of the production wells in the district, optimum care should be exercised while placing the screens to tap the aquifer zones The exploration in the study area has revealed the presence of fine to very fine sands in the prominent aquifer zones and have profound impact upon the hydraulic conductivity of the individual aquifer zones.

The pre-monsoon depth to water level in the shallow aquifer of the area varies from 3.79 to 8.32 m bgl. The post-monsoon depth to water level ranges from 0.50 to 4.26 m bgl. The fluctuation (pre-post monsoon) is in the range of 3.29 to 4.06 m.

Agricultural development in the district needs to be given a boost with special emphasis on creation of irrigation schemes particularly by way of constructing 5,26,936 numbers of shallow ground water structures. Ground water development may be stepped up for stabilizing the Rabi irrigation and also for meeting the irrigation demand during the post Rabi period. Ground water abstraction structures that have become sick due to operational hazards and constructional defects should be rejuvenated.

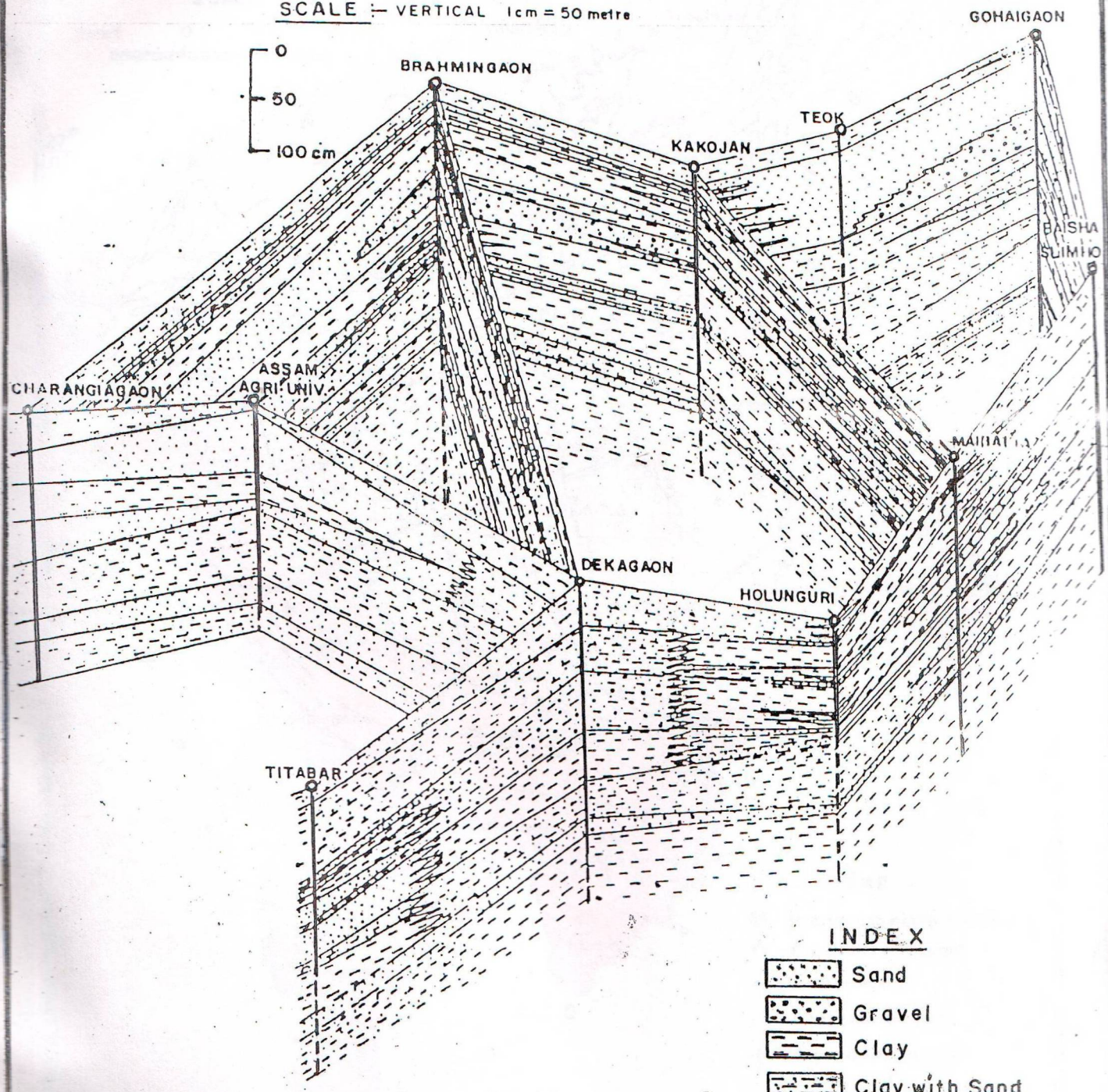
MAP SHOWING IRON CONTENT DISTRIBUTION IN JORHAT DISTRICT, ASSAM



CGWB/NER/B.B.DEVI/D.O.NO–5452/2008

PANEL DIAGRAM OF JORHAT DISTRICT

SCALE :– VERTICAL 1cm = 50 metre



C,G,W.B /NER/B.B.DEVI/D.O.NO–5451/2008

ADMINISTRATIVE DIVISIONS OF JORHAT DISTRICT, ASSAM

SCALE
0 5 10 15 Km

93° 45′ 94° 0′ 94° 15′ 94° 30′

27° 0′ 26° 45′ 26° 30′

LAKHIMPUR DIST.

SUBDIVN

Ratanpur

Jengraimukh

Gadmur

Kamalabari

MAJULI

Sankopara

Tamuligaon

SIBSAGAR DISTRICT

SONITPUR DIST.

MAJAPAR

Nimati

Tiyak

Anhatguri

Kakilamukh

N.H.37

Rakajan

Bhogdoi R.

Rowraya

JORHAT

Lahing

Jonji R.

Tirin Reserve Forest

Bamunmara

DIVN

Kakdonga R.

Mariani

Dichai R.

SUBDIVN

GOLAGHAT DISTRICT

Titabar

JORHATS

Dichai Valley Reserve Forest

Tipmia

Barhola

Kakdonga Reserve Forest

NAGALAND

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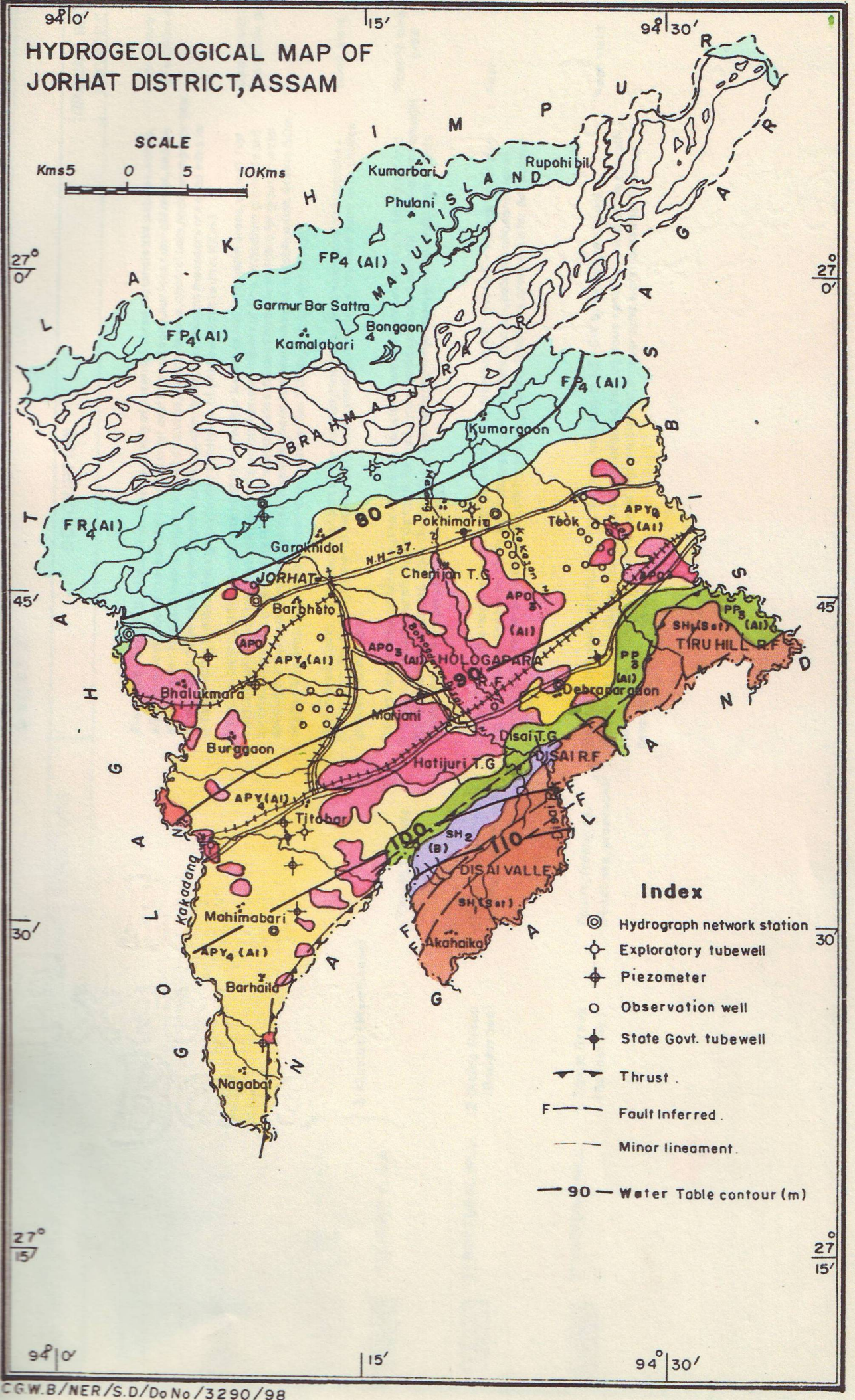
HYDROGEOLOGICAL MAP OF JORHAT DISTRICT, ASSAM



CGWB/NER/S.D/Do No/3290/98

JORHAT DISTRICT, ASSAM.

Legend

MAP UNIT	GEOMORPHIC UNIT	LITHOSTRATIGRAPHIC UNIT	STRUCTURE	DESCRIPTION	GROUND WATER PROSPECT
FP_4 (Al)	FLOOD PLAIN (FP)	4. Alluvium (Recent)		Flood plain of river Brahmaputra consists mainly of unconsolidated materials like pebbles, sands, silts and clays, flooded seasonally when the river overflows its bank, surface run-off areas, shallow groundwater table, old meanders, abandoned channels, natural levees, channel bars, back swamps; ox-bow lakes, water bodies are common, natural levees, abandoned channels, old meanders are good sites for ground water, in other areas groundwater available of shallow depth (within 100m)	Very good yield at shallow depth
APY_4 (Al)	YOUNGER ALLUVIAL PLAIN.			Occupies major parts of the district, slightly at a higher level than the flood plain areas, almost flat surface, gently sloping towards north, materials consist mainly of fine to medium grained sand silt and clay, recharge zone, clay lenses form aquicludes, palaeochannels suitable for ground-water development at shallow depth are less developed, hand tube wells may be suitable within 40m to 50m depth while deep tube wells may be developed within 200m, iron content is high.	Good yield at moderate depth.
APO_3 (Al)	OLDER ALLUVIAL PLAIN.	3. Alluvium (Pleistocene)		Distributed mainly to the southern part of the district, though occur as small scattered patches throughout the district, consist of weathered gravels, sands, silt and clay, rechare zone with shallow ground water table.	Good yield.
FP_3 (Al)	PIEDMONT PLAIN		Thrust, fault, etc.	Occurs are narrow patch along the foot hills, consist mainly of pebbles, gravels, sands, silt and clay, a plain sloping gently towards north formed by the coalescence of several alluvial fans brought by the stream or deposited from the hill slope, partially recharge zone, ground water potentiality is poor due to high percentage of clay.	Poor to moderate yield.
SH_2 (B)	STRUCTURAL HILL	2 Dihing Group (Boulder bed)	Thrust, trendlines, fractures prominent.	Occurs along the northwestern part of the hill sloe trending NE - SW to E - W direction, dipping towards southeast to north, consists mostly of boulders, gravels, pebbles and sandstones, run-off zone, moderately dissected, partial recharge along fractures, ground water developmenet is poor.	Poor
SH_1 (Sst)	STRUCTURAL HILL	1. Tipam Group (Sandstone)	Faults, fractures, trendlines, prominent.	Occurs in the southern part of the district, trending in NE-SW direction, moderately dissected hills, consists mainly of medium grained ferruginous sandstone and shale, run-off zone, partial recharge along fractured and weathered zone, ground water potential through deep tube well is limited.	Poor yield.