Journal of Nepal Geological Society, 2002, Vol. 27 (Special Issue), pp. 53-63

Hydrogeologic and geomorphic settings of the Lower Subansiri Basin, Assam, India

***U. Goswami[1], A. D. Patgiri[2], and J. N. Sarma[1]**
[1]*Department of Applied Geology, Dibrugarh University, Dibrugarh-786 004, India*
*(*Corresponding author, e-mail:u_goswami@rediffmail.com)*
[2]*Department of Geological Sciences, Gauhati University, Guwahati-781 014, India*

ABSTRACT

Geomorphic settings of an area provide valuable supplementary information regarding groundwater recharge, their occurrence and distribution. The geomorphic settings of the Lower Subansiri Basin can broadly be represented by three distinct geomorphic units *viz*., structural hills, piedmont zone and alluvial plain. While the elevation, slope, lithology, drainage pattern and various relevant morphometric parameters vary from one geomorphic unit to another, the conditions of recharge and discharge, occurrence and distribution of groundwater also differ in different units. The structural hills occupying only 4.5% of the area along the north-western boundary represent a high run-off zone characterised by steep slope and fairly dense parallel to sub-parallel drainage. The piedmont zone, built up by the coalescence of alluvial fan deposits, represents 7.7% of the area occurring in a long and narrow NE-SW trending steeply sloping belt along the foothills of Arunachal Pradesh. Owing to high permeability, this zone hardly retains any water and hence forms a high recharge zone with relatively deeper groundwater level. The alluvial plain, covering 87.8% of the basin area and characterised by a gentle slope, serves both as recharge and discharge areas where groundwater occurs relatively close to the ground surface.

Panel diagrams prepared for the Lower Subansiri Basin showing the thickness and extent of granular zones display that the unconsolidated alluvial sediments are primarily composed of sands of various grade and gravel with minor amounts of silt and clay. The sand-gravel isolith maps showing the cumulative thickness of the granular zones down to the depth of 40 m reveal that the subsurface formations in a major part of the alluvial plain of the Lower Subansiri Basin are entirely represented by granular zones. The granular zone in most parts of the area forms one single aquifer system where groundwater mostly occurs under unconfined to semiunconfined conditions. Due to the presence of thin clay and/or sandy clay lenses at shallow depths, however, the single aquifer system gets locally dissipated into multiple aquifer system where, barring the uppermost aquifer, groundwater mostly occur under semiconfined to confined conditions. The overall regional variation of depth to water level, from the piedmont zone in the north and north-west to the alluvial plain of the south and southeast, is controlled by the prevalent geomorphic settings of the area. The disposition of water table contours of the area indicates that the configuration of groundwater table closely conforms to that of general topography of the area. The steeper hydraulic gradient observed to be present in the north and north-east indicates the possible control of the characteristically distinguished geomorphic setting, i.e., topography, relief and lithology.

INTRODUCTION

Geomorphic settings of an area plays an increasingly important role in hydrogeological studies as it can provide valuable supplementary information regarding groundwater recharge and their occurrence and distribution, thus initiating a recent trend in hydrogeomorphological studies. Furthermore, geomorphic settings, to a large extent, control the distribution of rainfall as well as the amount contributed to the surface runoff and groundwater recharge. In the present study the broad geomorphic and hydrogeologic settings of the Lower Subansiri Basin in Assam, India have been demarcated and an attempt has been made to identify the possible relationship between the overall geomorphic and hydrogeologic settings of the area. The study area covering 3,110 km and comprising 55% of the total area of the Dhemaji and Lakhimpur districts of Assam is bounded by North latitudes 27° 00′ 00″ and 27° 40′ 00″ and East longitudes 94° 00′ 00″ and 94° 45′ 00″ (Fig. 1).

The area is characterised by sub-tropical humid climate with an average annual rainfall of 3,283 mm (Goswami 1997). The area is mostly covered by gray to yellowish gray alluvial soil of transported type. Texturally the soils of most parts of the area are of 'sand' to 'loamy sand' type, which are fairly porous and permeable enough allowing infiltration of a substantial amount of rain water to the underlying groundwater storage (Goswami et al. 1999).

SOURCE OF INFORMATION

Survey of India topographic maps prepared during 1969-1970 and published in 1:50,000 scale (2 cm=1 km) provide the basic source of information about the area. A set of IRS LISS II (geocoded) imagery at 1:50,000 scale for November-December, 1990 and a hydrogeomorphological report prepared by Assam Remote Sensing Application Centre (A.R.S.A.C.) (1990) have also been utilized. Reports by

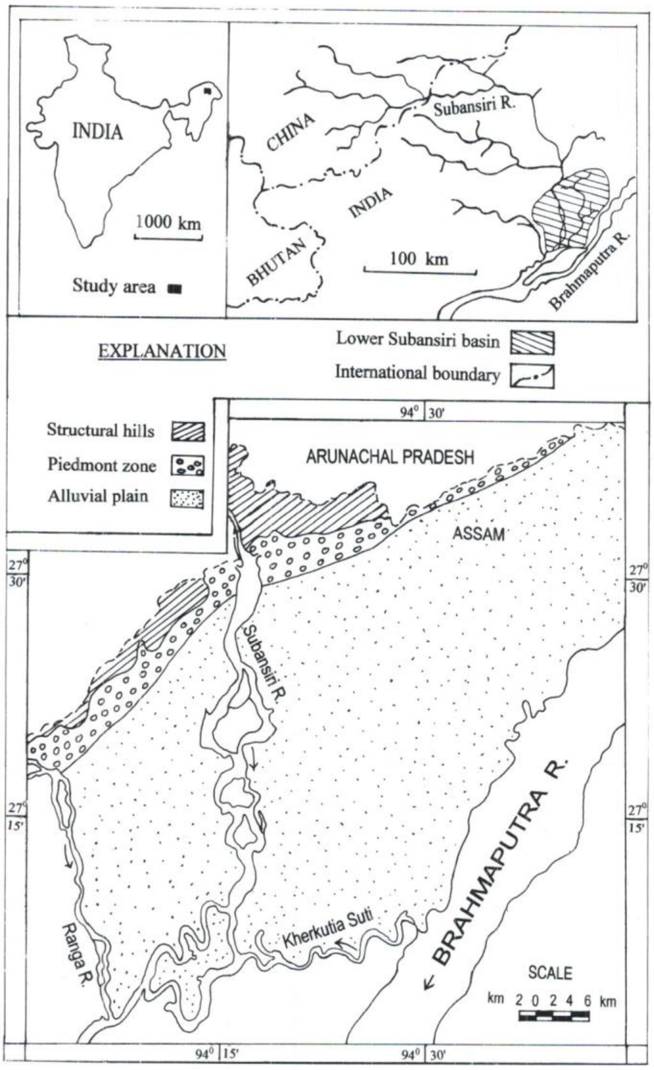

Fig. 1: Location map and geomorphic sub-divisions of the Lower Subansiri Basin.

Duara and Chatterjee (1977) and Dhoolappa (1987) also provide valuable geomorphic and hydrogeologic information about the area.

Subsurface geology of the area is studied on the basis of information obtained from exploratory boreholes drilled by the Directorate of Geology and Mining (D.G.M.), Assam and Central Groundwater Board (C.G.W.B.), North Eastern Region. Subsurface information from shallow to moderately deep tubewells constructed by the Public Health Engineering Department (P.H.E.D.) and Irrigation Department, Government of Assam has also been utilized. Well inventory was done through extensive fieldwork in 1993 and 1994 during which reconnaissance mapping has also been carried out in order to acquire additional information regarding geomorphic settings of the area. The ground elevation data at different well points were collected from the D.G.M. and C.G.W.B. (NER).

METHODOLOGY

In order to decipher the subsurface geology and also to find out the nature and extent of the water bearing zones in the shallow aquifer regime of the area, panel diagrams have been prepared by correlating lithologic logs of shallow to moderately deep boreholes located at different places of the area. Utilizing the same set of data, sand-gravel isolith maps and hydrogeological sections have been prepared. Based on the hydrogeological data collected from 160 numbers of inventory dug wells and bore wells (fitted with hand pumps) in the area, two sets of contour maps, *viz.*, depth to water map and water table contour map of the area have been prepared by following triangulation method. Areas under different depth to water zones have been measured with a digital planimeter.

GEOMORPHIC SETTINGS AND THEIR HYDROGEOLOGIC SIGNIFICANCE

Geomorphic settings of the Lower Subansiri Basin can broadly be represented by three distinct geomorphic units *viz.*, structural hills, piedmont zone and alluvial plain (Fig. 1). Each of these units, being characterised by distinctive hydrogeologic features, also form distinct hydrogeological unit. These major geomorphic and/or hydrogeologic units of the area have been identified and delineated based on existing geological, hydrogeological and hydro-geomorphological maps and IRS LISS II imagery. These units are discussed in the following paragraphs.

Structural Hills

The hilly terrain occurring in the extreme northern and north-western parts of the basin representing only 4.5% of the area and abutting against the southern plains, is composed mainly of moderately hard Siwalik sandstone and conglomerate. At the foothills they are characterised by very high dipping or vertical beds showing a NNE-SSW to NE-SW strike which is in alignment with the strike of the hills (Prasad et al. 1981). The thickly forested hills show steep gradient sloping towards the plains of the south. The average elevation of this unit is more than 210 m above sea level (m.s.l.) and it represents a high runoff zone characterised by the development of fairly dense parallel to sub-parallel drainage.

This unit is of minor hydrogeologic significance due to its unfavourable topography, lithology and structure. However, owing to the favourable factors like high amount of rainfall, low overall permeability of the formation and rugged topography, this unit represents a high runoff zone that contributes significantly to groundwater recharge in the plains.

Piedmont Zone

It is a steeply sloping plain occupying 7.7% of the basin area and occurring in a long and narrow NE-SW trending belt along the foothills of Arunachal Pradesh. It is built up by coalescence of alluvial fan deposits consisting of boulders, cobbles, gravels, sands and silts. These deposits are formed at the points of emergency of rivers into the plains and have a fan shaped configuration in plan view. These deposits are thus a mixture of sediments of various size grades. The coarser fraction comprising boulders and cobbles, with interstices filled up with sands and silts, is deposited within a kilometer of the debauching point while the comparatively finer fraction *viz.*, gravels, sands and silts are carried further down to be deposited progressively. The average elevation of this zone varies from 122 m to 210 m above m.s.l. With a high gradient towards south, the piedmont plain deposits extend from 5 to 8 km from the foothills and quickly disappear below the younger alluvium of the south. This zone is dissected by streams and rivers flowing in general from north to south. These fan deposits are beautifully exposed on the river bed of the Subansiri as well as on the beds of a number of streams flowing across this zone, notably the Geruka and Dirpai on the left bank and the Dulung and Konanadi on the right bank of the Subansiri. Most of the rivers of this area remain generally dry, flow being mostly internal through loose gravel with water oozing out at the base of this zone.

Because of their high permeability attributed by favourable lithologic composition, these fan deposits hardly retain any water at shallow depths. The depth to water level ranges from 2 to 4 m below land surface. With the ground intake of precipitation and surface runoff migrating rapidly down to less permeably zone below, these deposits form a high recharge zone contributing significantly to the groundwater recharge in the alluvial plain of the south.

Alluvial plain

The southern margin of the piedmont zone marks the emergence of the alluvial plain. The alluvial plain, covering 87.8% of the area, is characterised by a gentle slope in the north and north-east and is gradually becoming almost flat while merging with the flood plain of the Brahmaputra river towards the south and south-east. The elevation of this zone ranges from 81 m to 122 m above m.s.l. and the general slope is from north to south. Based on topography, relief, lithology, extent of flood, and associated fluvial geomorphic features, these deposits can be subdivided into three distinct sub-units viz., older alluvial plain, younger alluvial plain and active flood plain.

Older alluvial plain

The gently undulating older alluvial plain occupies the highest topographic position among all the units of alluvial plain and is therefore less susceptible to flood hazard. Older alluvium is mainly found in the northwestern part of the study area girding the foothills where it is well represented by areas occupied by a number of tea estates. This unit is also found to occur as isolated patches of high ground within the younger alluvial plain (e.g., Bardeobam T.E., Ghilamara and North Lakhimpur). These deposits in general fall between the 122 m and 107 m contour levels. The older alluvium, which is 4 m to 5 m above river beds, consists mainly of boulders, pebbles, granules, coarse to fine sands with silts and clay deposited during Pleistocene age.

Younger alluvial plain

The younger alluvial plain occurs in the central part of the Lower Subansiri Basin covering an extensive area along NE-SW direction. Gently sloping towards the south, these deposits occupy an intermediate topographic position between the older alluvium and the active flood plain with the elevation ranging from about 92 m to 107 m above m. s. l. Lithologically this zone consists mainly of gravel, sands, silts and clays mixed in varying proportions. Fluvial geomorphic features like palaeochannels, old meanders, channel-fill deposits etc. are common and as such, this unit from recharge as well as discharge areas with water table resting within 1 to 4 m from ground surface. This unit has moderate to slight flood hazard and agricultural lands of this zone are primarily used for cultivation of paddy.

Active flood plain

This unit comprises low-lying nearly level flood plain deposits, the northern limit of which is roughly demarcated by the 92 m contour. Characterised by severe flood hazards, the average altitude of this zone varies from 81 to 84 m above m.s.l. These deposits consist mainly of unconsolidated materials like gravels, sands, silts and clays deposited up to a certain distance on the banks of rivers like the Subansiri, Ranga, Jiyadhol, Koran, Sisi and of course the Brahmaputra. This zone is characterised by the development of abundant number of natural levees, back swamps and back swamp lakes ('Bils'), cut-off meanders, ox-bow lakes, swamps, abandoned channels, point bars and channel bars. Naturally, active flood plains are the discharge areas with shallow water table condition.

MORPHOMETRIC PARAMETERS IN DIFFERENT GEOMORPHIC SETTINGS

Based on a statistical analysis of various morphometric parameters of 191 third order basins belonging to nine constituent sub-basins of the Lower Subansiri Basin, the trends of various morphometric parameters with respect to three different geomorphic settings were evaluated in an earlier study (Goswami et al. 1998). It was found that different geomorphic settings of the region have significant control over the morphometric parameters of drainage basins. Morphometric parameters found relevant in the present context are stream frequency (number of stream segments per unit area), drainage density (total length of streams per unit area of basins), drainage texture (product of stream frequency and drainage density) and relief ratio (ratio of maximum basin relief and maximum basin length). It has been found that these morphometric parameters have higher values in the structural hills and decrease progressively through piedmont zone and alluvial plain. This distinctive trend in morphometric parameters is manifested by the distinctive lithologic, hydrogeologic and relief characteristic of different geomorphic settings of the region.

HYDROGEOLOGIC SETTINGS

As already mentioned, the three distinct geomorphic units of the Lower Subansiri Basin, being characterised by distinctive hydrogeologic features, also form distinct hydrogeologic units. The subsurface geologic setting, nature and extent of aquifer zones, and the occurrence, distribution and movement of groundwater in the area are largely influenced by these distinct hydrogeologic and/or geomorphic units. Out of the numerous groundwater structure inventoried in the field, 125 dug wells, 35 bored wells (fitted with hand pumps), and 27 shallow to moderately deep tubewells have been selected for collection of relevant hydrogeologic information. This information has been utilized for beginning out a more detailed picture of the hydrogeologic setting.

Subsurface Geologic Setting

Lithologic logs of 27 shallow to moderately deep tubewells have been utilized to prepare panel diagrams (Fig. 2) showing the thickness and extent of the granular zones (mostly sand and gravel) in the shallow aquifer regime of the area. These panel diagrams reveal that the unconsolidated alluvial sediments are primarily composed of sand of various grade and gravel with minor amount of silt and clay. Overlain by a sand horizon of variable thickness at some places also by a mixed zone consisting of sand and gravel, a gravel horizon persistently occurs throughout the levels of the area. Isolated clay lenses of limited vertical and lateral extent are present only locally. Almost the entire eastern part is covered by a thin but persistent surface clay layer which is, however, missing completely towards the northwest and northeast (Fig. 2). A surface clay layer of variable thickness is also present throughout the western part missing locally at some places. With the thickness of upper sand and sand-gravel horizons increasing in general from north to south, the depth of occurrence of the gravel bed in the western part increases progressively towards the south (Fig. 2).

The sand-gravel isolith map (Fig. 3) showing the cumulative thickness of the granular zones within the shallow aquifer regime (down to the depth of 40 m), reveals that the subsurface formation in the eastern part of the basin

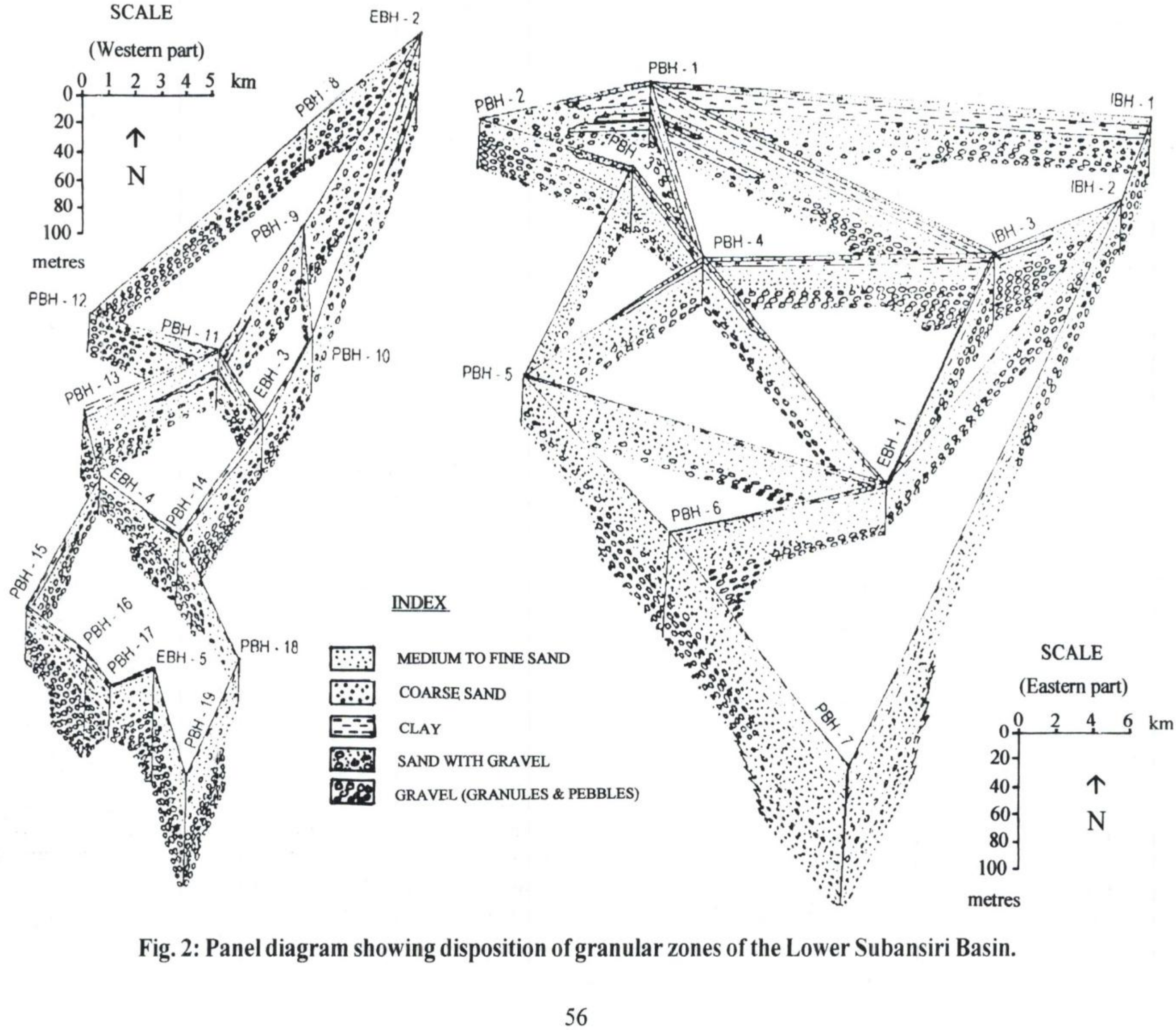

Fig. 2: Panel diagram showing disposition of granular zones of the Lower Subansiri Basin.

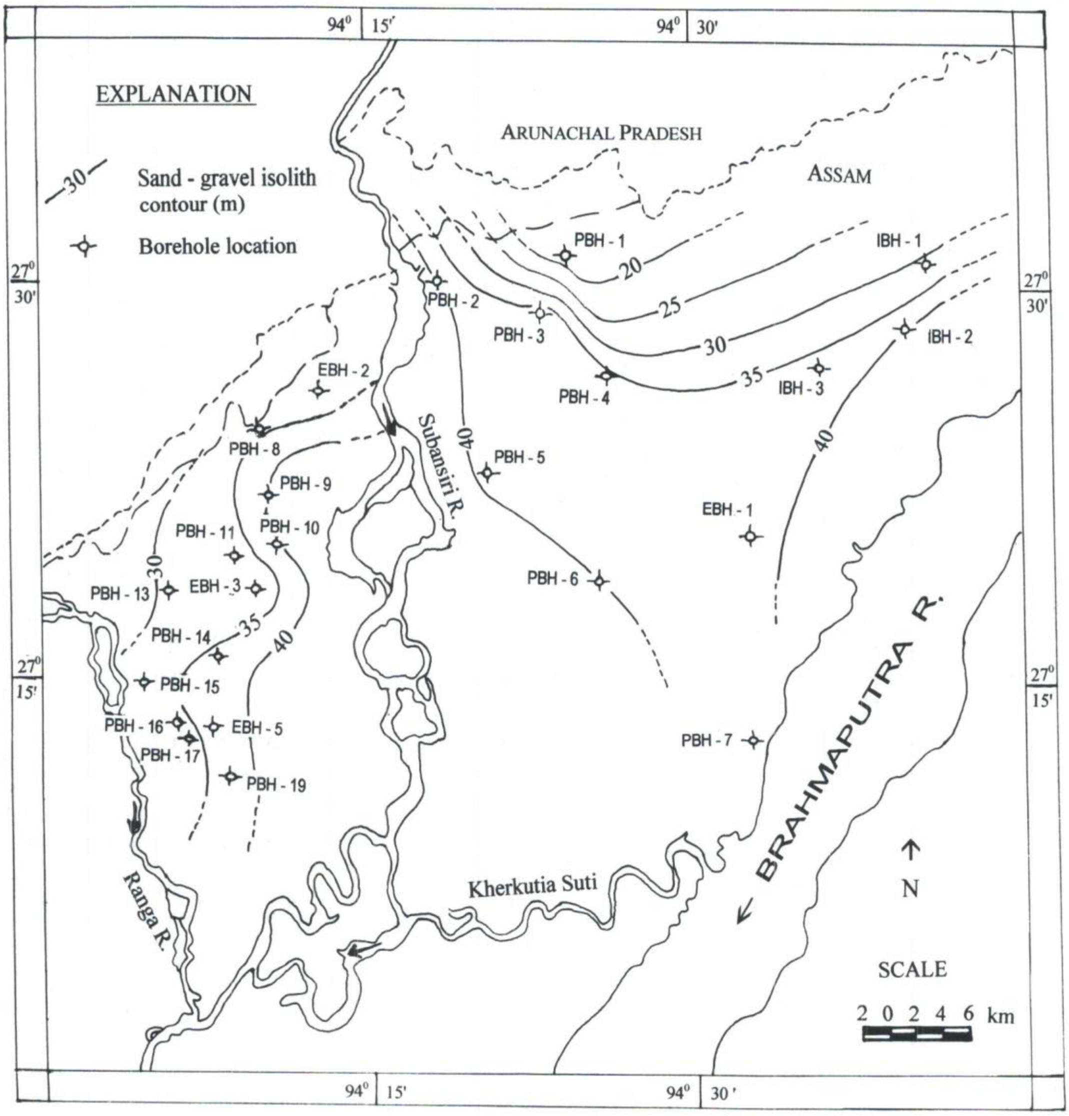

Fig. 3: Sand-gravel isolith map of the Lower Subansiri Basin showing cumulative thickness of granular zones down to the depth of 40 metres.

along the flood plain areas of the Subansiri in the west and the Brahmaputra in the southeast are entirely represented by granular zones. The overall percentage of clay progressively increases towards the north. However, in a major part represented by the entire southern half of the area, the proportion of clay is less than 12.5%. The sand-gravel isolith map for the western part depicts a general increase in the percentage of granular materials progressively from west to east. The overall subsurface lithologic variation is somewhat less compared to that in the eastern part of the area.

The thickness of the granular materials encountered in different boreholes has a definite bearing in the assessment of groundwater potentially of the area as they may serve as the potential aquifer zones. The summarised lithology and the percentage of granular materials (comprising sand and gravel) with respect to different bore holes in the eastern and western parts of the area are given in Table 1 and 2, respectively. It is observed that the granular materials, comprising sands and gravels, constitute the predominant formation occurring in the shallow aquifer zones of the Lower Subansiri Basin.

Nature and Extent of Aquifer Zones

Due to lack of adequate subsurface data pertaining to the deeper aquifer zone, the present study has been confined only to the shallow aquifer zone occurring within the depth of 40 metres. In fact, development of groundwater in the area is at present mostly restricted to the shallow aquifer zone itself. Another practical implication of adhering to the shallow aquifer zone is that it is this zone where most of the dug wells and shallow tubewells of the area are located.

The panel diagrams (Fig. 2) reveal that almost the entire area, except locally around Nalbari in the eastern part and Mari Dirgha and Konanadi in the western part, is characterised by the presence of a single aquifer system

Table 1: Summarised lithology of boreholes in the eastern part of Lower Subansiri Basin.

Well No	Location	Drilled Depth (m)	Up to drilled depth		Per cent of granular zone (sand and gravel)
			Thickness of sand horizons (m)	Thickness of gravel horizons (m)	
1	2	3	4	5	6
IBH-1	Sisibargaon	45.1	21.3	14.6	79.6
IBH-2	Dhunaguri	42.6	31.3	21.3	100.0
IBH-3	Bamgaon	57.0	21.0	33.0	94.7
PBH-1	Nalbari	49.5	26.4	--	53.3
PBH-2	Dirpai	36.9	6.2	30.7	100.0
PBH-3	Dhansiripur	47.0	30.8	12.8	92.8
PBH-4	Deuri Barbam	39.4	20.0	15.2	89.3
PBH-5	Latakgaon	36.6	36.2	--	98.9
PBH-6	Ghilamara	77.1	52.4	-24.7	100.0
PBH-7	Matmara	108.0	105.0	--	97.2
EBH-1	Machkhowa	38.6	30.2	7.5	97.7

Table 2: Summarised lithology of boreholes in the western part of Lower Subansiri Basin.

Well No	Location	Drilled Depth (m)	Up to drilled depth		Per cent of granular zone (sand and gravel)
			Thickness of sand horizons (m)	Thickness of gravel horizons (m)	
1	2	3	4	5	6
EBH-2	Kananadi	67.6	16.2	35.1	75.9
EBH-3	Kadam Balijan	46.3	15.3	21.3	79.0
EBH-4	Ujjalpur	30.8	9.7	21.1	100.0
EBH-5	Bahadurchuk	86.0	39.6	42.7	95.7
PBH-8	Rajgarh Nepaligaon	33.8	11.6	22.2	100.0
PBH-9	Senchowa	58.0	42.8	15.2	100.0
PBH-10	Kulabali	43.0	30.1	12.3	98.6
PBH-11	Mari Dirgha	40.7	33.0	0.0	81.1
PBH-12	Rajgarhgaon	29.6	3.1	26.5	100.0
PBH-13	Balijan	54.9	24.5	21.3	83.4
PBH-14	N. Lakhimpur East	54.9	24.3	27.5	94.4
PBH-15	Bagalijan	40.8	9.1	25.6	85.0
PBH-16	N. Lakhimpur South	76.2	18.3	45.7	84.0
PBH-17	Japisojia	39.6	27.4	6.1	84.6
PBH-18	Garmaragaon	28.4	26.8	0.0	94.4
PBH-19	Bahpaiia	83.2	47.4	35.2	99.3

(1) IBH: Drilled by Irrigation Dept., Assam (2) PBH: Drilled by PHED, Assam (3) EBH: Drilled by DGM, Assam

where water mostly occurs under unconfined to semiunconfined conditions. Due to the increase in the proportion of silt and clay in the form of thin clay and/or sandy clay lenses at shallow depths, this single aquifer system gets locally dissipated into multiple aquifer system where, barring the uppermost aquifer, groundwater mostly occurs under semiconfined to confined conditions.

Perusal of the lithologic logs of boreholes and the panel diagrams reveals that the granular materials of the shallow aquifer zone of the area display a coarsening downward sequence. Presence of these coarse granular clastics contributes positively to the water holding and water yielding capacity of the aquifer zone. The gravel bed occupying the lower levels of the aquifer zone should possess relatively higher permeability as compared to the overlying sand bed, thus making it potentially more favourable aquifer zone.

Occurrence, distribution and movement of groundwater

The water level data collected from 160 numbers of representative dug wells and bored wells have been utilized to prepare a depth to water map and a water table contour map based upon which the occurrence, distribution and movement of groundwater in the area have been studied.

Depth to water level

Water table in the Lower Subansiri Basin rests within 5 m from ground surface. In the alluvial plain areas the depth to water in general ranges from 1 to 4 m from land surface. Apart from the depth of occurrence of water table in the piedmont zone, variation in depth to water level in the eastern and western parts of the area shows more or less similar trend (Fig. 4). In the piedmont zone of the eastern part, water table occurs within the depth range of 2 to 3 m while in the western part it occurs between 3 to 4 m below land surface. In both the areas the depth to water becomes gradually less towards the alluvial plain of the central parts where water table lies between 1 to 2 m from land surface. Depth to water again gradually increases further southeast with water table finally resting within the depth range of 3 to 4 m. Water table in some isolated patches occurs below 4 m of land surface.

The overall regional variation of depth to water level, from the piedmont zone of the north and northwest to the

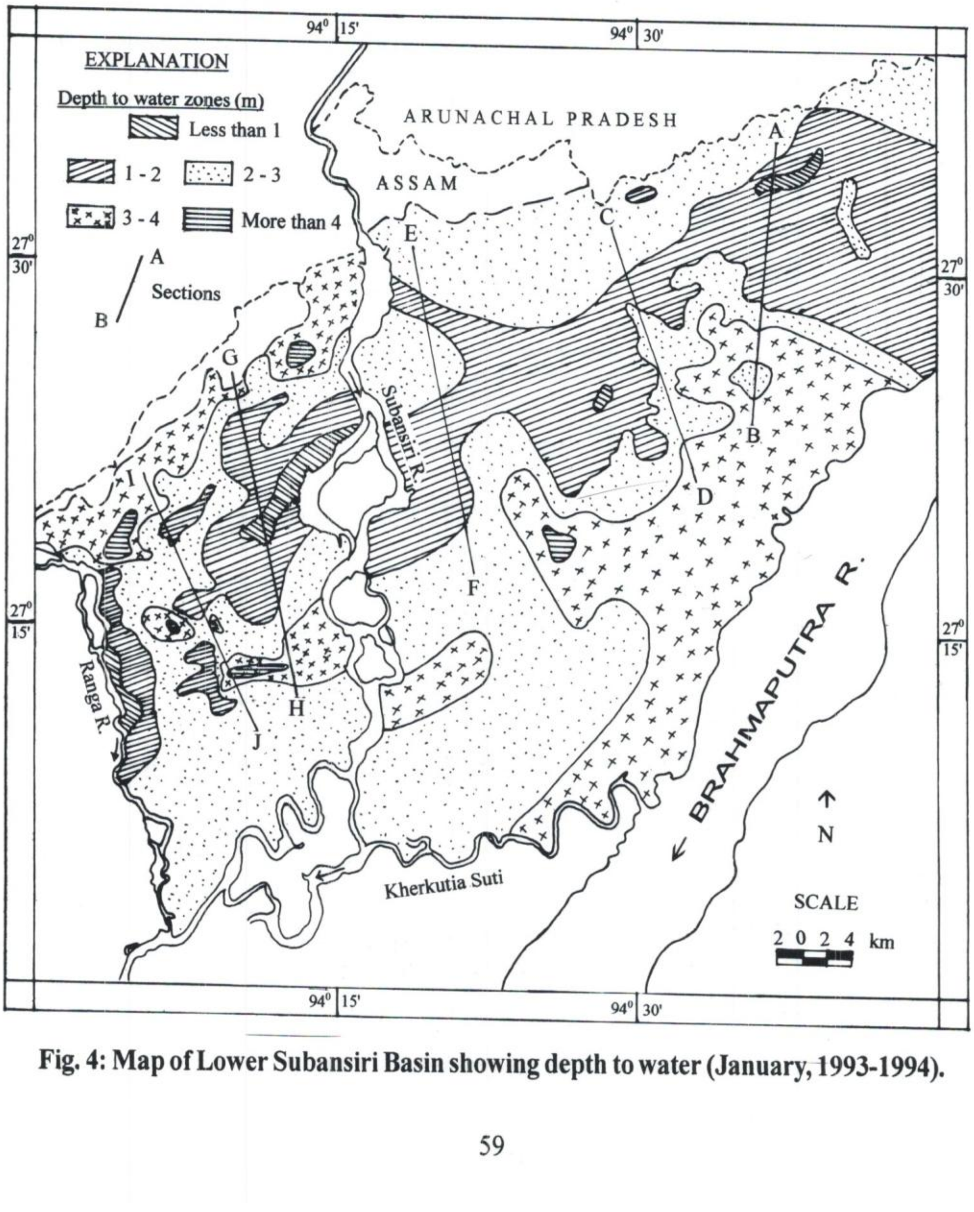

Fig. 4: Map of Lower Subansiri Basin showing depth to water (January, 1993-1994).

alluvial plain of the south and southeast, appears to be controlled by the prevalent geomorphic settings of the area. Owing to its distinctive lithologic and hydrogeologic characteristics, the piedmont zone hardly retains any water as the ground intake of precipitation and most part of the surface runoff migrate rapidly down to the less permeable zone below. As a result the depth to water level in this zone is relatively more with water table resting between 2 to 4 m below land surface. This water which oozes out at the base of the fan deposits and the surface runoff, whatsoever taking place over the relatively steep and uniformly sloping ground, join hands together in the alluvial plain area immediately south of the piedmont zone. This extra water together with the normal ground intake of precipitation of the region are responsible for the shallow water table condition with water table lying within 1 to 2 m of land surface. This shallow water table condition is partly responsible for the development of swampy lands within the NE-SW trending zone in the central part of the area where quite often water table rises above the land surface, particularly during the monsoon and post-monsoon periods. As a result, an area of about 1,524 sq. km in the central part of the basin, where water table normally rests within 1 to 3 m of land surface, has become very much prone to waterlogging (Fig. 4).

Variation of water table depth with respect to land surface, particularly from the foothills in the north to the alluvial plain in the north to the alluvial plain in the south, seems to be largely controlled by the variation in topographic slope as well as formation permeability. A distinct break in slope at the base of the piedmont zone brings the water table very near to the ground surface (Fig. 5). Under favourable conditions groundwater emerges over the ground surface in the form of springs and seepage zone. These features are best exemplified by the reappearance of water flow of a number of rivers flowing across the piedmont zone. Locations of different sections in Fig. 5 are shown in the depth to water map of the area (Fig. 4).

The deepest water levels of 4.25 m and 9.49 m and the shallowest water levels of 0.65 m and 0.37 m below land surface were recorded in the eastern and western parts of the area respectively.

Area-wise distribution of depth to water zones (Table 3) shows that a major part of the Lower Subansiri basin is characterised by 2 to 3 m depth to water zone. In fact, water table in as much as 76% of the total effective area lies within 3 m of ground surface. Depth to water zone of more than 4 m occurs only locally.

Direction and movement of groundwater

The general direction of movement of groundwater in the eastern part of the Lower Subansiri Basin varies between

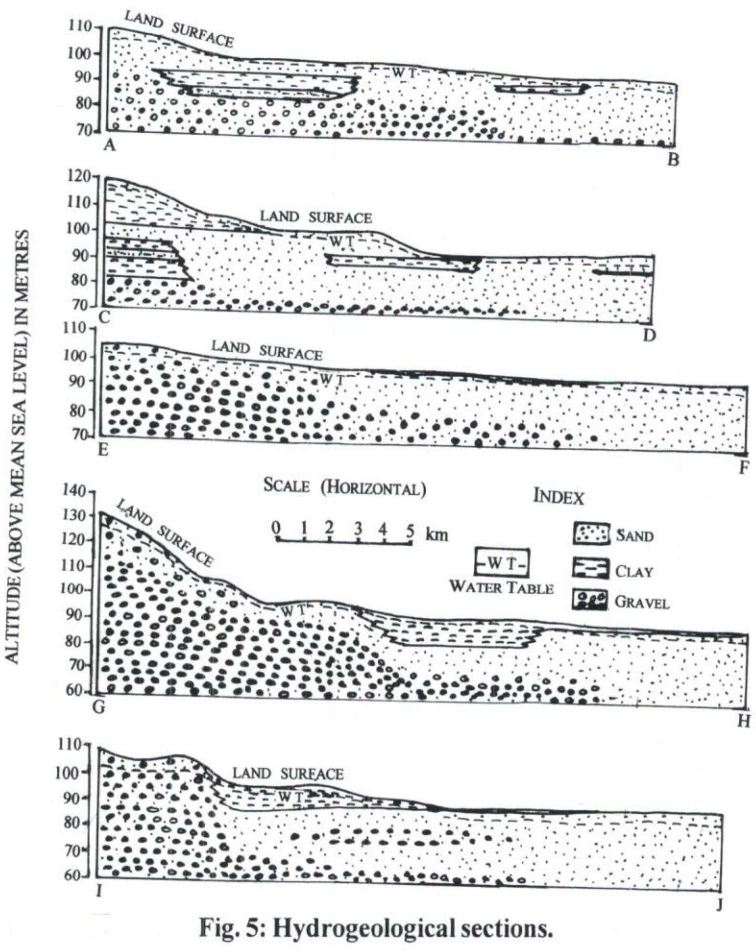

Fig. 5: Hydrogeological sections.

Table 3: Area-wise distribution of depth to water level.

Depth zone (m)	Area (km^2)		Effective area	
	Eastern part	Western part	Net area (km^2)	Per cent of total effective area
<1	11	44	55	1.85
1 – 2	542	177	719	24.21
2 – 3	953	534	1487	50.07
3 – 4	510	178	688	23.16
>4	5	16	21	071
* Total effective area = 2970 km^2				

*Total effective area= (Total basin area)-(Area under structural hills)

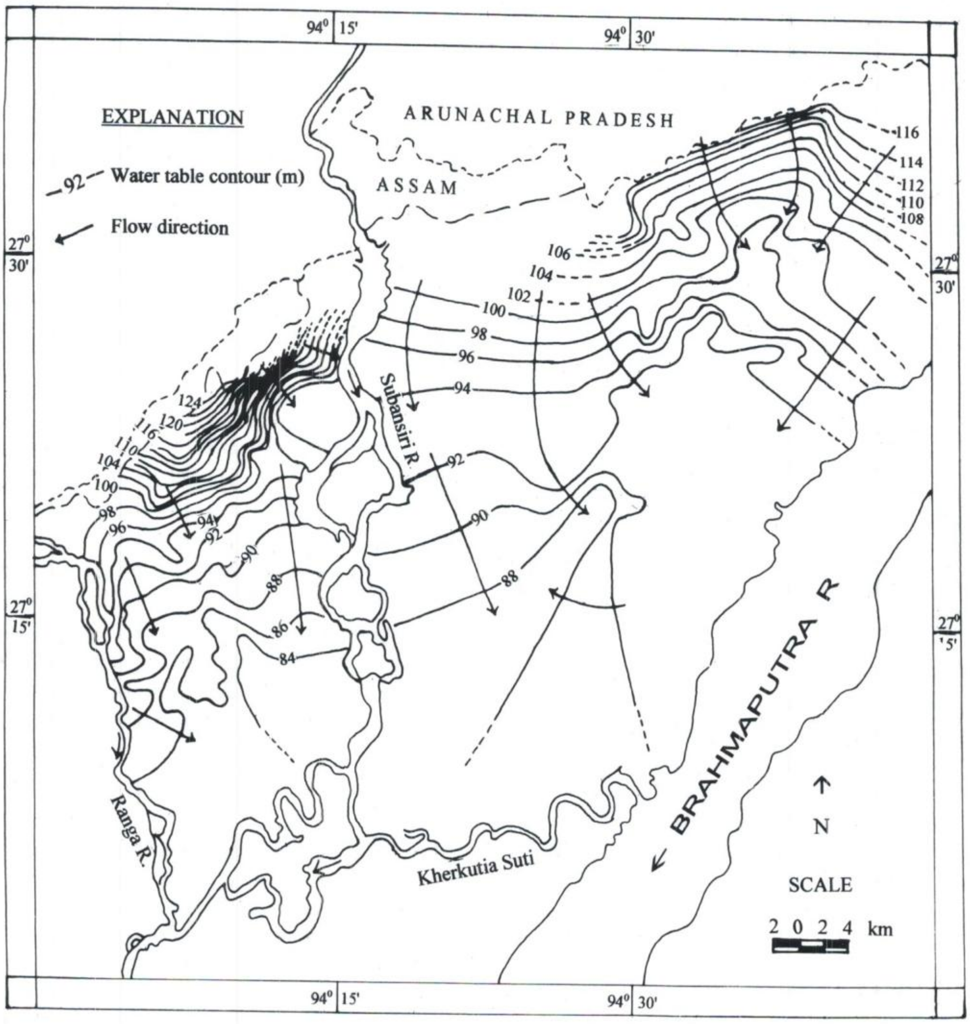

Fig. 6: Map of Lower Subansiri Basin showing water table contours (January, 1993-1994).

N-S and NE-SW directions (Fig. 6). The general trend of water table contours being east to west, the hydraulic gradient is towards south. Water table contours bear a somewhat regular trend and spacing particularly in the northeastern, northern and northwestern parts. Close spacings of the contours in the northeastern part indicate steep hydraulic gradient, the average being 2.545 m/km. Towards the central part, water table slope becomes somewhat gentle with an average hydraulic gradient of 1.136 m/km. Further west, near to the Subansiri, the hydraulic gradient is as flat at 0.347 m/km.

In the western part of the basin, the general trend of water table contours is from NE to SW and the hydraulic gradient is towards SE (Fig. 6). Water table contours display somewhat regular trend and spacing specially in the northern and northeastern parts. Here contours are relatively closely spaced and the average hydraulic gradient is 6.326 m/km. Contours are very closely spaced in a small area around Konanadi in the northeastern part where the local hydraulic gradient is as high as 11.200 m/km. While the same general trend more or less persists, the spacing of contours gets distorted towards the central and southern parts. Gradually becoming somewhat gentler towards the southwest, the average hydraulic gradient in the NE-SW trending upper central part varies between 3.556 m/km and 1.600 m/km. Further south, the average hydraulic gradient becomes relatively flatter and varies between 0.870 m/km and 0.566 m/km.

The disposition of the water table contours in the area indicates that the configuration of groundwater table closely conforms to that of the general topography of the area. The steep hydraulic gradient of north and northeast indicates the possible control of the characteristically distinguished geomorphic settings (i.e. topography, relief and lithology) prevalent in the area. The piedmont zone along the foothills roughly demarcate the recharge area while the flood plain on either side of the southern segment of the Subansiri river mark the discharge area.

In the western part the entire segment of the Subansiri, being mostly fed by groundwater, is effluent in nature whereas only the southern segment of the river in the eastern part is effluent in nature. The northern segment of the river is neither effluent nor influent. The shape and patterns of the water table contours along the active flood plain areas of the Subansiri are, however, temporarily affected on account of recharge through influent seepage during flood periods.

CONCLUSIONS

Geomorphic settings of the Lower Subansiri Basin can broadly be represented by three district geomorphic units viz., structural hills, piedmont zone and alluvial plain. Each of these units has distinct topographic, lithologic, relief and hydrogeologic characteristics. The structural hills unit occupying 4.5% of the area represent a high run-off zone, while the piedmont zone occupying 7.7% of the area represent a high recharge zone. The alluvial plain occupying 87.8% of the basin area marks both recharge and discharge areas. Based on topography, relief, lithology, flood hazard and associated fluvial features – the alluvial plain is sub-divided into older alluvial plain, younger alluvial plain and active flood plain. Different geomorphic settings of the region have significant control over certain relevant morphometric parameters of drainage basins.

Unconsolidated alluvial sediments are primarily composed of sands of various grades and gravel with minor amounts of silt and clay. A gravel bed persistently occurs throughout the lower levels of the shallow aquifer zone. Depth to the gravel bed generally increases from piedmont zone to alluvial plain. Down to a depth of 40 m, the subsurface formations in the flood plain areas are entirely represented by granular zones.

A single aquifer system is present in most parts of the area where groundwater generally occurs under unconfined to semiunconfined conditions. Due to an increase in the percentage of silt and clay, this single aquifer system gets locally dissipated into multiple aquifer system, where groundwater mostly occur under semiconfined to confined conditions.

Water table in the area lies within 5 m from ground surface. In 76% of the total effective area, water table rests within 3 m from ground surface. The overall variation of depth to water level appears to be controlled by the prevalent geomorphic settings of the area.

The general direction of movement of groundwater in the eastern part is broadly from N to S while in the western part it is from NW to SE. Steep hydraulic gradient (2.545 m/km to 6.326 m/km) exists in the piedmont zone indicating possible control of topography, relief and lithology. It gradually becomes gentle towards southern plains. The configuration of groundwater table closely conforms to that of the general topography of the area. The piedmont zone roughly demarcates the recharge areas. Flood plains of the Subansiri in the southern part and that of the Brahmaputra in the southeastern part mark the discharge areas.

REFERENCES

A.R.S.A.C.*, 1990, Report on hydrogeomorphological studies, Lakhimpur district, Assam. Guwahati, 8 p.

Dhoolappa, G., 1987, Groundwater resource potential and development prospects of North Lakhimpur district, Assam. Mins. Water Resour., C.G.W.B. (NER), Guwahati, 36 p.

Duara, B. K. and Chatterjee, B. P., 1977, Subansiri basin : fluvial processes, geomorphology and geology. In M. S. Balasundaram (Ed.) Contributions to geomorphology and geohydrology of the Brahmaputra valley. Geol. Surv. India, Misc. Pub. No.32, pp. 205-227.

Goswami, U., 1997, A study on fluvial processes and groundwater prospect evaluation of the Lower Subansiri basin, Assam. Ph.D. Thesis, Dibrugarh Univ, Dibrugarh, 427 p. (unpubl.)

Goswami, U., Patgiri, A. D., and Sarma, J. N., 1999, Hydrological properties of soil from textural analysis – a case study of Lower Subansiri basin, Assam. Jour. Indian Asso. Sed., v. 18(2), pp. 261-269.

Goswami, U., Sarma, J. N., and Patgiri, A. D., 1998, Geomorphic control on morphometric parameters of drainage basins – a case study in some constituent watersheds of the Lower Subansiri basin, N. E. India. Proc. Reg. Sem. On Dev. Of Geol. Res. in N. E. India, Gauhati Univ., Guwahati, pp. 405-423.

Prasad, K. C., Kakoti, R., and Burman, S. K., 1981, Geology and geomorphology of a part of the Subansiri river valley, Geol. Surv. India, Misc. Pub. No.46, pp. 1-10.

* A.R.S.A.C. – Assam Remote Sensing Application Centre.