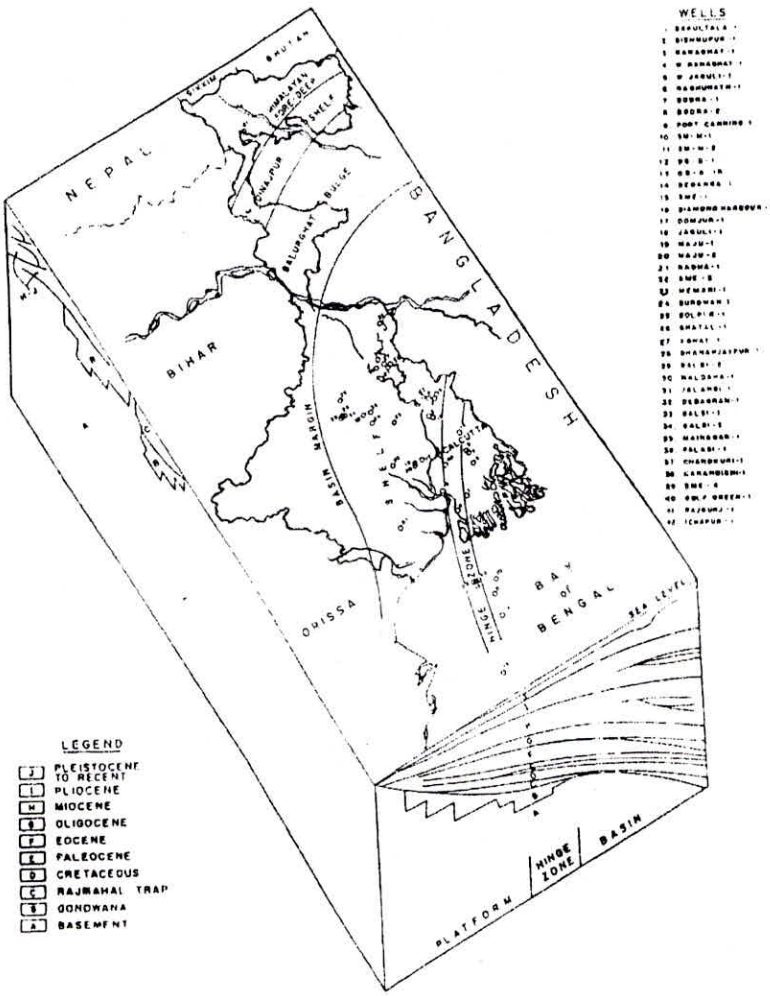
Hydrogeology of West Bengal



By

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Lecture note on "Hydrogeology of West Bengal, Problems and Prospects.

By; Tapan. K. Ray

This lecture note is divided into three parts. It is felt that before discussing about hydrogeology of West Bengal it is imperative to give an overview of the geological set up of the state. So, in the first part of the lecture the geology of the West Bengal will be discussed very briefly, which will be followed up by the discussion on hydro geological condition of the state, obviously in the context of the diverse geological set up of the state, and in the third part the discussion will be concluded to highlight the prevailing problems related to ground water development, prospective as well as proactive planning for sustainable development of this vulnerable resource.

Part: I. GEOLOGY OF WEST BENGAL - AN OVERVIEW.

The state of west Bengal is situated within latitudes 21^0 31′ N to 27^0 30′ N and longitude 85^0 30′ E to 89°45′ E. The total area of the state is 88, 75200 hectare. West Bengal is only state in India, where the Himalayas are in the north and sea is at south with vast stretching river flood plain and plateau table land covering the state. From north to south the ***major physiographic divisions of the state are:***

- Extra peninsular mountainous region,(high slope> 20%) of Darjeeling Himalayas
- Piedmont plain of North Bengal, comprising Bhabar & Terai belt at the foot hills of Darjeeling Himalayas.
- Alluvial plains of Teesta - Torsa – Mahananda sub- basins of Brahmaputra Basin.
- The Gangetic alluvial plains south of Terai region, merging to lower Ganga paleo deltaic plain of Sunder ban delta front.
- Coastal plains and sub-aerial deltaic plains of active delta front.
- Eastern extension of Chottanagpur plateau within the state of West Bengal, bordering the western districts of the state. The north eastern triangular part of great Indian peninsular shield west of basin marginal faults with intracratonic Gondwana basins of Ranigunj Coalfield .

Two important major drainage basin of the state are i) The Brahmaputra basin ii) the Ganga basin iii) a small part of Medinipur falls in Subarnarekha basin.

The major land forms of West Bengal are:

a) Darjeeling Himalayan hill region
b) Terai Region .
c) North Bengal Plains & Barind Region.
d) Rurh Region of South Bengal (74 administrative blocks of the state)
e) Coastal Plains drained by innumerable tributaries.

f) Sunderban Delta front with largest mangrove forest (4000 km^2 within the state of W.B.)with wide biodiversity,

g) Western Plateau and high lands (around 2000 Km^2)

h) Ganga delta area with tributaries & distributaries

The Agro- Climatic Regions of West Bengal are:

a) **The Hill region** in the north

b) **The Terai and Teesta alluvium** region of North Bengal.

c) **The Laterite and red soil soil** gravelly undulating region in the western Rurh Bhumi.

d) **The Coastal Alluvium** Region in the south.

e) **The Gangetic Alluvial region** in the west.

f) **The Vindhya Alluvial** Region in the centre.

Geology of Bengal Basin

The geological history of West Bengal is by and large the history of sedimentation in the Bengal Basin. The Bengal basin is a pericratonic asymmetrical basin on the north eastern part of Indian peninsula(*Archean metasediments with granitic, granophyric and doleritic intrusions*) forming the western part of the Assam – Arakan geosynclinal's province flanked by Indian shield and Shillong massif to the west and north respectively. Geographically the Bengal Basin is a surface unit ,comprising entire low land bounded by The Chottanagpur Plateau and Rajmahal Hills in the west , The Himalayas Foot hills in the north , The Meghalaya Plateau in the north east and Manipur – Tripura hills in the East. The average height of the basin above Mean Sea Level(MSL) increases from 2m . near sea surface to over 100m near the northern hilly region. Most of the basin is between 5m to 10m above MSL and is therefore lowest plaion in the world vulnerable to any sea rise. The basin area comprises 57.000 Km^2 on land and 33,700Km^2 offshore up to 200m bathymetry. The basin has a long depositional history from geological age Permian (23 crores yrs B.P.) to Recent – Pleistocene(0 to 1 crore yrs B.P.) in varying environment of deposition such as continental, estuarine, brackish marshy – lagoon to littoral, brackish to deltaic, shallow marine, deeper neretic to inner Neretic. The Bengal basin emerged on the Precambrian floor and the sedimentation initiated during Permo- Carboniferous time with Gondwana sediments (23 to 25 crores yrs B.P.). After prolonged hiatus, a colossal spasmodic outpour of basalt – andesite lava during early cretaceous time formed thick trap cover of the underlying Gondwanas. Differential subsidence took place during Middle- Upper Cretaceous (7 to 13 crores yrs B.P.) time and the Bengal basin started taking its shape. These episodes were the depositional history of the sub aerial clastics and its facieses variations. After wide marine transgression during Late Eocene, facieses variant formations were developed under the interplay of brackish, marshy, littoral and shallow marine conditions and continued during Oligocene time and extended up to Mio- Pliocene. During early Pleistocene time ,shallow marine conditions prevailed only in the deeper parts of the Bengal Basin.

Possibly only very late in the Pleistocene did the sea finally recede completely from the Bengal basin area. Erosion then occurred , followed by peneplanation of the whole Tertiary (1 to 7 crores yrs B.P.) basin area of Bengal. Finally the older sediments are were covered by completely by a thick mantle of river borne sediments of **Holocene** (0 to 50 lakhs yrs B.P., the age of man end of ice age) **alluvium**.

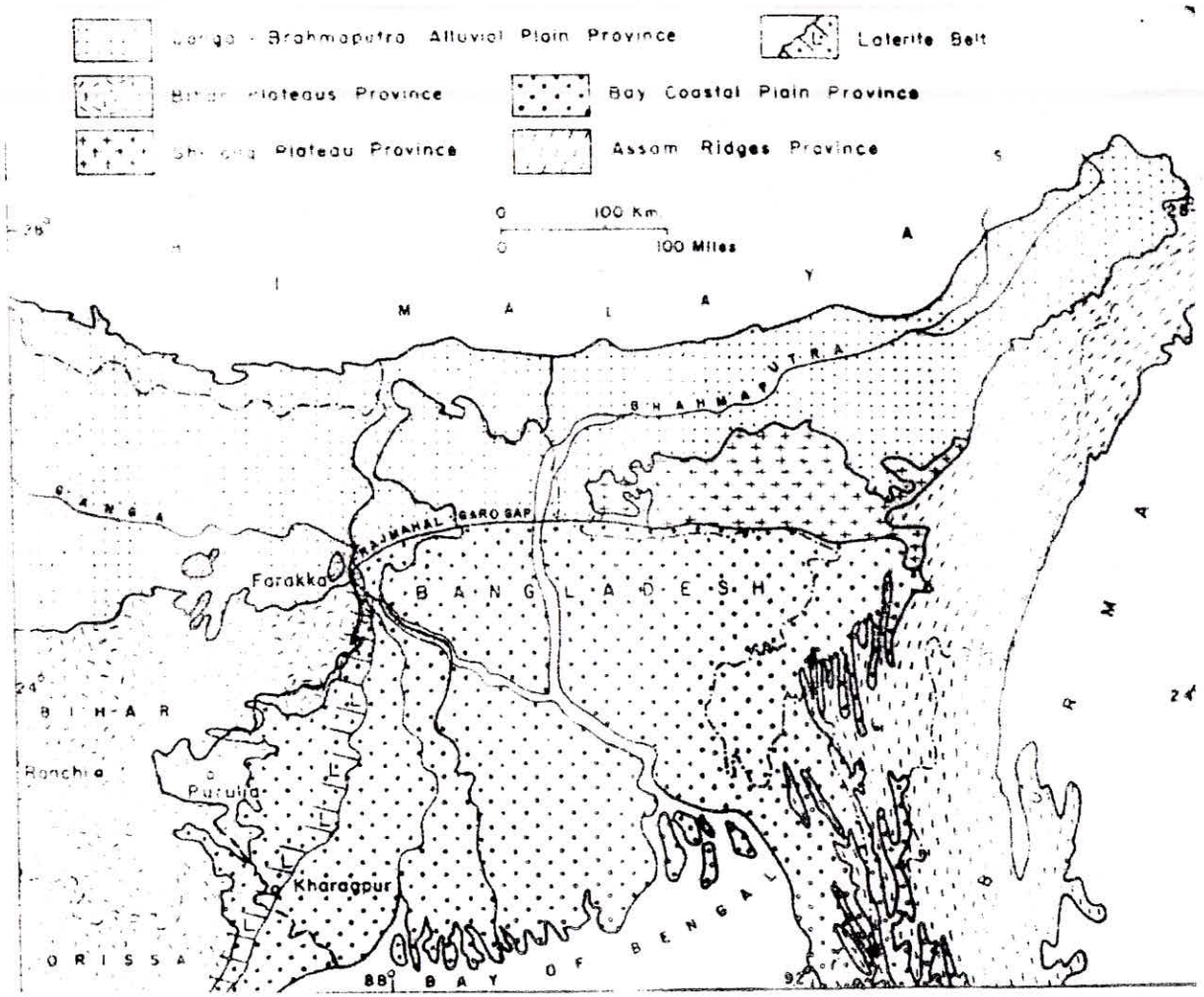
On the eastern margin of the shield area is the Ranigunj Coal Field, wherein the itracratonic block faulted grabens are filled up by continental facies sediments - characterized by alterations of sand-shale- coal known as lower Gondwana Group of rocks. The type for the surface exposures of these rocks are in the blocks of Ranigunj Coal Field.

Another notable feature in the shield area bordering the north western part of the Bengal basin is a thick (1500 – 2000 feet) horizontal to sub horizontal basaltic lava flows with intercalated thin layers of shale and clay – known as *Rajmahal Trap of basaltic rocks.* The type area for surface exposures of this rock type is located at western part of the Birbhum district.

The sedimentation history of the litho logical formations may be looked into the background four paleo – environmental conditions and provenance history of the depositional cycles. These are :

- Sedimentation in Himalayan fore deep region – ***Bhabar*** and ***Terai*** belt within Brahmaputra basin
- Sedimentation in Garo Rajmahal Gap (***Barind Upland*** – low sheep back ridge, undulating surface which generally shows a thick and uniform brownish layer of Lateritic Mottled Clay with ***moorum*** or ferruginous concretions.
- Sedimentation in Mahananda – Tangan river valleys
- Sedimentation in foreland shelf area, simultaneous with basalt flows (late Jurassic to early Cretaceous geologic age.
- Sedimentation in Bengal basin – from shelf area to active delta front.

BROAD GEOMORPHIC PROVINCES IN & AROUND GANGA- MEGHNA- BRAHMAPUTRA BASIN



GEOLOGY IN & AROUND GANGA- MEGHNA- BRAHMAPUTRA BASIN

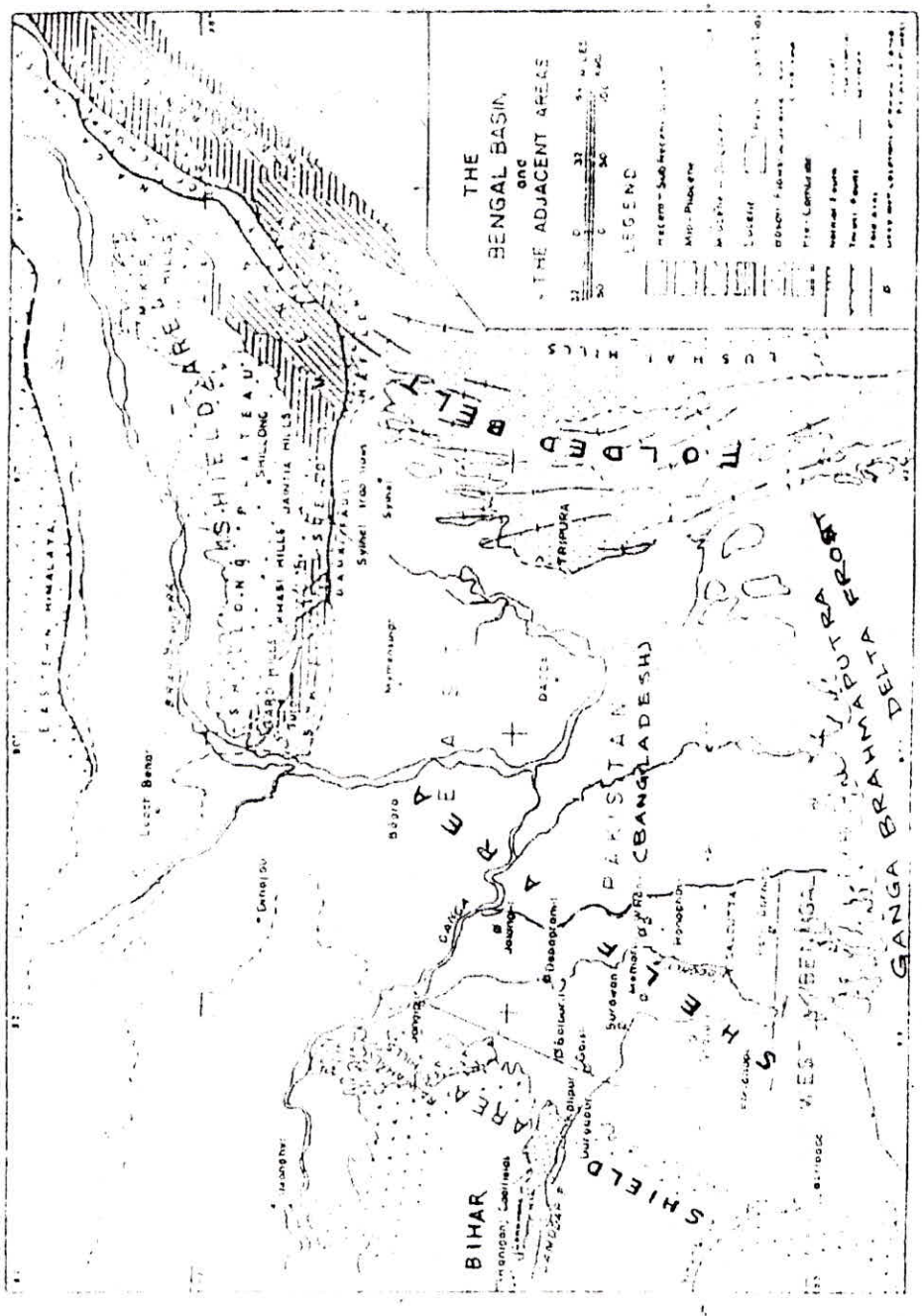
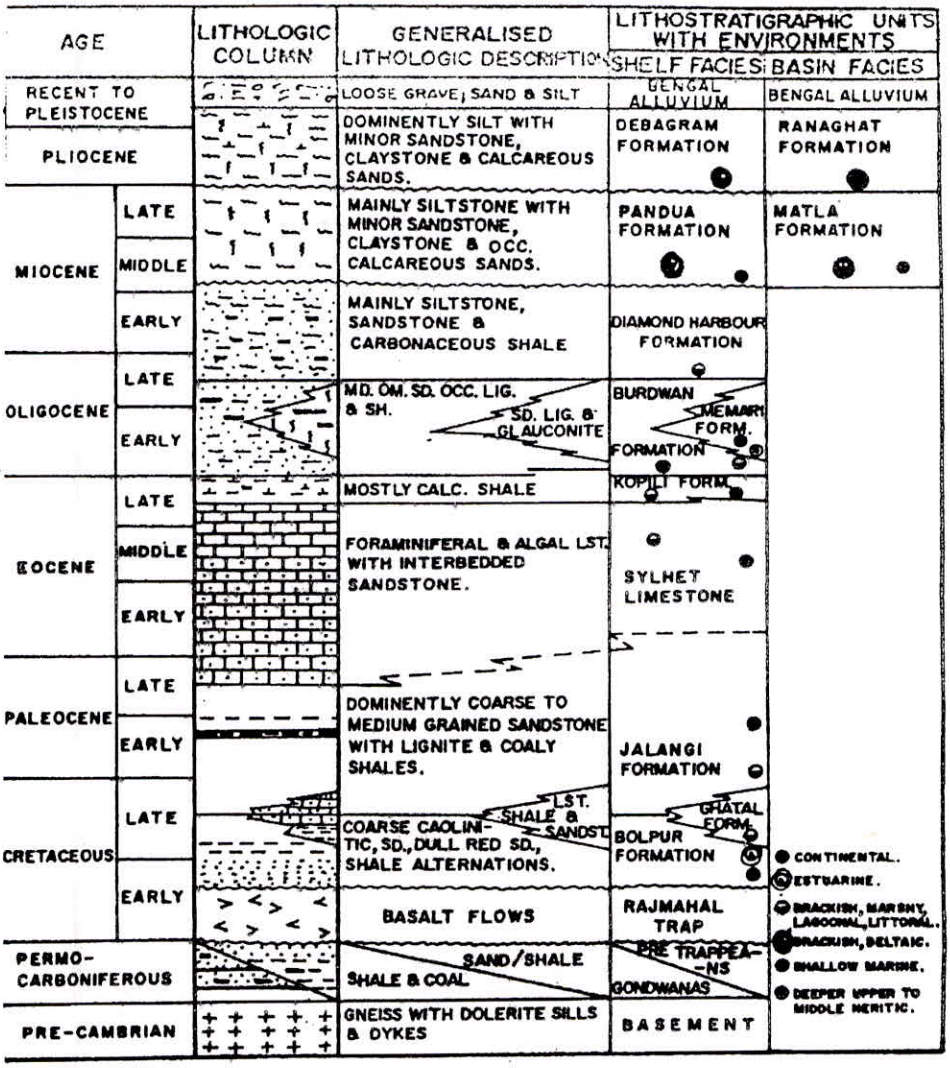
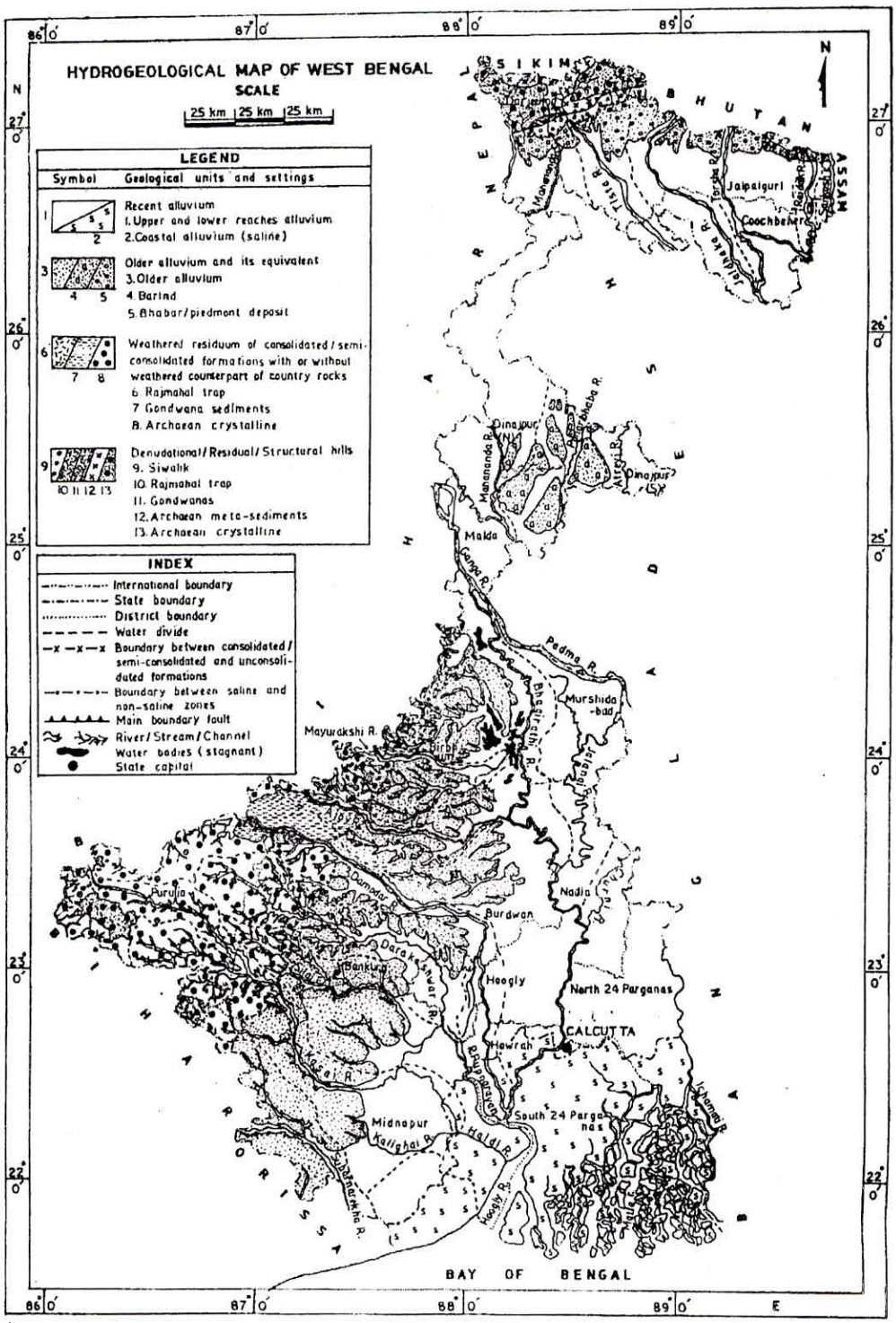


Table – I STRATIGRAPHY OF BENGAL BASIN




HYDROGEOLOGICAL MAP OF WEST BENGAL
SCALE
25 km 25 km 25 km
LEGEND
Symbol Geological units and settings
Recent alluvium
1. Upper and lower reaches alluvium
2. Coastal alluvium (saline)
Older alluvium and its equivalent
3. Older alluvium
4. Barind
5. Bhabar/piedmont deposit
Weathered residuum of consolidated/semi-consolidated formations with or without weathered counterpart of country rocks
6. Rajmahal trap
7. Gondwana sediments
8. Archaean crystalline
Denudational/Residual/Structural hills
9. Siwalik
10. Rajmahal trap
11. Gondwanas
12. Archaean meta-sediments
13. Archaean crystalline
INDEX
International boundary
State boundary
District boundary
Water divide
Boundary between consolidated/semi-consolidated and unconsolidated formations
Boundary between saline and non-saline zones
Main boundary fault
River/Stream/Channel
Water bodies (stagnant)
State capital
SIKIM
BHUTAN
ASSAM
NEPAL
Jaipaiguri
Coochbehar
Dinajpur
Malda
Murshidabad
Birbhum
Nadia
Burdwan
Purulia
Bankura
Hoogly
North 24 Parganas
CALCUTTA
Howrah
South 24 Parganas
Midnapur
BAY OF BENGAL
Mayurakshi R.
Damodar R.
Darakeswar R.
Kasai R.
Kangsabati R.
Haldi R.
Hoogly R.
Subarnarekha R.
Ichamati R.
Jalangi R.
Mahananda R.
Tangon R.
Teesta R.
Karatoya R.
Punarbhaba R.
Mora Bhagirathi R.
Padma R.
Bhagirathi R.
Jalangi R.
Ganga R.

Part – II : Hydrogeology of West Bengal

G.C.Taylor (!959) had divided India into eight **"Ground Water Provinces"**. Different parts of the state of West Bengal fall in five provinces out of Taylor' s eight provinces The distribution of those provinces within the territory of the state is as below .

1. **Precambrian Crystalline Province** of Purulia, Bankura, Birbhum Pashchim Medinipur & Bardhaman - Western peninsular shield of Chhottanagpur plateau
2. **Gondwana sedimentary Province** Bardhaman, Bankura, Purulia. – Intra –cratonic basins of continental fluvial deposits
3. **Rajmahal Trap Province,** (equivalent to Deccan Trap province of Taylor"s classification) of Birbhum – Late cretaceous basaltic intermittent lava flow through fssures.
4. **Ganga – Brahmaputra Alluvial Province** comprising around two third of the state. – Prolonged sedimentation of Holocene period
5. **Himalayan High land Province** of Darjeeling and Jalpaiguri districts – Extra – Peninsular region Eastern Himalaya.

Table: II HYDROGEOLOGIC PROVINCES OF WEST BENGAL

Sl.No.	Province	Rock type , broad hydro geologic condition & type areas.
1	Precambrian Crystalline Province	Major rock types are phyllites, mica schists, biotite gneiss, granite gneiss, anortosite of Archean to proterozoic age, quartzite. Anisotropic aquifers developed in fractures and fissures of the massive hard rocks under the cover of weathered mantle or recent river borne alluvium. Down to a depth of 3m to 12m
2	Gondwana sedimentary Province	Lower Gondwana Group of rocks, Sand stone, shale,silt stone, clay stone , inter bedded with Coal seams of Ranigunj Coal field down to a depth of 1000m+ . Talchir The Barakar & Ranigunj formations are usually very low yielding aquifers. The ground water flows through fractures and fissures of the consolidated sedimentary rock mass.
3	Rajmahal Trap Province	Basaltic rock, outpouring of the basalt flows on the foreland shelf of Bengal basin occurred in geologic age Late Jurassic & Early Cretaceous time with few inter trappean layers . Bolpur formation of post lava flow is represented by sand stone and shale. Water bearing subsurface fracture zones are insignificant within the depth of 75m. bgl.
4	Ganga – Brahmaputra Alluvial Province	This province includes unconsolidated /recent alluvium of Brahmaputra valley, river borne sedimentary formations of Tista - Mahananda plains, Ganga – Bhagirathi Plains, Coastal areas, and Older alluvium of Bhabar zones in parts of Darjeeling & Jalpaiguri, Barind tracts of Malda & Dakshin Dinajpur, Lateritic terrains of Birbhum, Bardhaman, Bankura, Pashchim Medinipur, and Murshidabad. The area possesses varied aquifer characteristics from very high potential aquifer zones to very low potential areas.
5	**Himalayan High land Province**	13 blocks of Darjeeling district and 5 blocks (part or full) are of Himalayan Mountain Terrain with trellis drainage & V- type cross-ridges. Ground water seepage from fractures, joints, fissures etc. has developed potential spring lines in hill areas. These springs supports the major domestic needs.

On the basis of the comparable aquifer characteristics and flow dynamics within the ground water repositories, the above stated five groups may be further put into two major groups.

1. **Fissured formations** of ground water province 1, 2, 3 & 5.
2. **Porous formation** of province 4. This province can further be sub divided into two sub groups.

FISSURED FORMATIONS

A] *Fissured formations of Extra- Peninsular Region.*

The area covered by this formations of rock type occupies the hilly (slope factor > 20%) Himalayan Hilly region of the state i.e. except Siliguri subdivision the whole of the Darjeeling district and northern peripheral part of the Jalpaiguri district falling in five blocks. These are the areas of V- type cross ridges, summit and cliffs, with sub-parallel and trellis drainage.

Major rock types which are found towards north from Terai plain of Siliguri are

i) A narrow strip of Siwalik sandstone, slate etc.
ii) A belt of lower Gondwana (Permian) sedimentary rocks.
iii) Lower Gondwanas overlain by metapelites, psamites and carbonates.
iv) High and low grade granite gneisses.

In spite of very high rainfall this area happens to be a water scarce area. The domestic demand is largely catered by the seepages from fractures , joints and fissures to form spring lines along the tectonic lineaments. The thickness of the regolithic cover varies from 1m to 5m. The area is not very promising for dug wells because ground water flows very quickly from higher elevation to a lower elevation .

Peninsular Region and Intracratonic Basin rocks

This part is the extension of the Chhotonagpur Plateau in Pashchim Medinipur (NW part), Bankura, Purulia, Bardhaman and Birbhum districts in West Bengal.. All total 41 blocks fall, fully or partly, on plateau area. This peninsular shield occupying almost entire Purulia district, major part of the Bankura district, part of Birbhum and Pashchim Medinipur districts and part of one block (Salanpur) of the Bardhaman district.This hard rock area is underlain by the meta basics, meta sediments, and intrusive. The most common rock types are granites and gneisses often intruded by Pegmatites and Quartz veins. Thickness of weathered zones varies from 5m to 18m which forms the near surface aquifer, being developed through dug wells. Underlying the weathered mantle down to various depths occur fracture system which, under favourable condition, are capable of giving dependable ground water supplies.. Bore wells tapping the fracture system can sustain low capacity pumpage to yield water.

Generally the depths of the bore holes in fracture zones are ranging from 30m to 70m; yield varying from less than one meter cube per hour to $7m^3$ /hr. But this yield may increase to as high as $20m^3$/hr at close vicinity of the shear zone. Emergence of of rejection level fluoride in ground water in many blocks of the Purulia and Bankura districts are the major problem of the districts and a big

challenge for the Rural Water Supply Schemes. Concerted efforts of the government departments & Universities are on the task to understand the source of fluoride and geogenic causes of the fluoride mobilization in ground water.

HYDROGEOLOGY OF ADDA AREA – GONDWANA ROCKS OF PERMO-CARBONIFEROUS AGE

The available rocks of hydrological condition of ADDA (Asansol Durgapur Development Authority) area/reveal that

i) The ground water in the area occurs under water table condition and also in deeper confined aquifers.

ii) Barakar, Raniguanj and Punchet sandstones of Gondwana rocks with interconnected fractures are the water bearing zones (aquifers).

iii) The yield is very limited to as low as 15 m^3/ hr - 38 m3/hr with drawdown 30m -45m.

iv) Average transmissivity is around 70m^2 / day for the above formation and it decreases depending on the compactness of the sandstones. The transmissivity of the Barakar formation is much higher (~200m^2/day) than panchet formation (60 m^2 / day) and lowest (50 m^2 / day) for Ranigunj formation. Storativity ranges from 1.5 X 10^{-3} to 3 X 10^{-4} for the three formations. The compact sandstones of Lower Gondwana have much lower transmissivity 2-28 m^2 / day and Storativity 1.6 x 10^{-4} to 6.9 X 10^{-4}

v) The aquifers of Gondwana rocks, south of the Damodar river in Bankura district have grater ground water potentially than that of northern part.

vi) Mine water discharge from different collieries is around 65 mgd in dry period and 104 mgd in monsoon period (source: report of CMPDIL, Coal India of July 1987).

vii) It is projected that the shortfall in the demand will be around 300 mgd(source: report of CMPDIL of July 1987). The same report has recommended induced infiltration and artificial recharge of ground water for partial mitigation of the above shortfall.

viii) The aquifers of Tertiary sediments are more potential than Groundwana rocks. The transmissivity ranges from 300 to 700 m /day. The hydraulic conductivity ranges from 14.68 to 31.4 m/day with 37% porosity for water table aquifers. For deeper aquifers the porosity varies from 35 - 42% with permeability 12.8m/day to 36.2 m/day. The tubewell yield capacity may vary from 50m^3 /hr to 150m^3 / hr.

ix) North - western part of Birbhum district is by and large covered by Basalt and equivalent ultrabasic rock. Sheet basalt with cooling cracks fractures and joints are separated by intratrappeans. Intratrappeans as porous formation act as aquifers at shallow depth or down below the top phreatic aquifer. The fractures conditions often stores water of significant quantity variable yield capacity (as low as 0.5 m^3/hr - 12 m^3/hr). Ground water in Basaltic terrain is infested by fluoride contamination at some places.

POROUS FORMATIONS

A. **Tertiary Sediments**

- Mio-Pliocene sediments of pebbly grit, gravels, red shale, ferruginous sand / sand stone of Darjeeling and Jalpaiguri
- Isolated pockets of quartz-feldspathic sand with lateritic mantle
- Confined to semi-confined nature
- Moderately seasonal gwl fluctuation
- Poor transmissivity with low discharge

B. **Lateritic Terrain**

- Laterites are vesicular but the vesicles are generally disconnected to form poor conduit flow
- At places, irregular multi-directional cracks are developed to form flow path for local recharge of shallow aquifer
- At the bottom of the lateritic profile presence of lithomerge clay often give rise to **perched aquifer** causing high level of seasonal fluctuation of gwl in dug wells
- Rapid surface over land flow allows limited scope for adequate saturation fo shallow aquifer. Thus vadose zone extend by pushing down the phreatic water surface.
- In places of Kasai river basin permeability of the lateritic profile is high to support the ground water abstraction from big diameter dug wells by deploying low capacity pumps for irrigation use.

C. **Porous formation of fluvial and deltaic provenance are given in Table**

District wise aquifer condition in West Bengal

In West Bengal aquifer characteristic varies considerably from north to south and west to east. Out of 341 blocks in 19 districts by and large most of the areas show aquifer under both water table as well as confined condition. Shallow aquifers show water table condition while deeper aquifer is under semi confined to confined condition. The entire coastal area consist of 59 blocks is under confined condition(29 blocks in S.24 parganas, 5 blocks in N. 24 Parganas, 9 blocks in Howrah and 16 blocks in Purba Medinipur). The aquifer feeding Kolkata is also under confined condition.

Table below gives district wise at a glance in respect to aquifer condition.

District	Formation	Aquifer condition
Purulia, Bankura, West Medinipur, Barddhaman, Birbhum	Consolidated/ Semitoconsolidated/ Hard Crystalline rocks	Ground water occurs in: b. Weathered residuum within 10m bgl. ii) Fractures within 65m bgl having discharge within 20 cumec/hr.
Purulia, Barddhaman, Birbhum	Gondwana Sandstone	Ground water occurs in the fractured zone with in 100m bgl generally discharging 10 cumec/hr with maximum discharge of 22 cumec/hr.

District	Formation	Aquifer condition
Darjeeling, Jalpaiguri, Kochbihar, Uttar and Dakshin Dinajpur, Malda, Murshidabad, Nadia, North 24 Parganas, Hugli, Haora, Purba and Paschim medinipur, Barddhaman, Bankura, Birbhum Coastal areas/ North 24 parganas, South 24 Parganas, Purba Medinipur, Haora and Kolkata.	Unconsolidated/ Recent to Subto Recent Alluvium Unconsolidated/ Recent to Subto Recent Alluvium	Ground water occurs both under unconfined and confined condition within the explored depth of maximum 600 m bgl. Aquifers are fairly thick and regionally extensive with large yield prospect of about 150 cumec/hr. In Birbhum and Bankura districts, aquifers beyond 136 m bgl up to the drilled depth to 350 m bgl in the Tertiary formation are found under auto flow condition. The occurrence of Arsenic in ground water in the depth span of 20 – 80 m bgl restricted mainly in the eastern part of Bhagarathi river has posed a serious problem. Fresh ground water bearing aquifers occurring in varying depth ranges within 180 – 360 m bgl within the drilled depth of 600 m bgl have been established. The fresh group of aquifers is sandwiched between saline/brackish aquifer. The top saline/brackish aquifer lies within the depth span of 20 – 180 m with maximum depth to 320 m bgl in the extreme south. Suitably constructed tube well tapping 35m cumulative thickness can yiekd 100 – 150 cumec/hr. Shallow fresh water aquifers occufers occur in present day sand dunes in Digha to Ramnagar area of East Medinipur district down to the depth of 9m bgl and in levee deposit within 50 m bgl in Baruipur to Sonarpur to Bhangar to Caning tract in South 24 parganas. High concentration of as in ground water is reported in this levee deposit.
Bhabar Zone: Parts of Darjeeling and Jalpaiguri	Older Alluvium	In the subtomontane zone of the Himalaya, the sediments consist of untoassorted materials varying from boulders to sand of various grades. The aquifers with deep water table are characterized by high seasonal variation of water level to the tune of 10 – 12m. Recent exploration identified the potential granular zones within the depth range of 150m bgl capable of yielding up to 68 cumec/hr.
Barind Tract parts of Malda, Dakshin Dinajpur.		Ground water semi confined to confined condition below a blanket of about 60m thick clay beds. Saturated granular zone of discontinuous nature generally occurs in the depth span of 65 – 110m, which is capable of yielding up to 50 cumec/hr.
Lateritic Terrain parts of Bhirbhum, Barddhaman, Bankura, Murshidabad, Paschim Medinipur.		The maximum thickness of older alluvium is within 50m, which is capped by laterites. Individual aquifer in older alluvium is of limited thickness and discontinuous in nature has poor yield prospect. Recent exploration in the tract has indicated the presence of unconsolidated to semitoconsolidated Tertiary gravel and sandstone, which is porous in nature, within depth zone of 100 -140m bgl with the yield prospect of 180 cumec/hr.

Ground Water Level (GWL) in diverse hydrogeologic terrain of West Bengal – An Overview

As we have already discussed about the diverse groundwater repository condition of the state , it will be relevant to discuss about the broad Ground Water Level condition in the context of that diversity of the terrain condition and present situation of the ground water development.

Let us divide the situation appraisal in different paragraph as it is discussed for the hydrogeologic description.

Precambrian crystalline province of Peninsular region of Purulia, Bankura, Pashchim Medinipur , a small patch in Burdwan district (at Salanpur), & Birbhum, (GWL are given in meter below ground level)

In Purulia district the GWL for pre monsoon period is within a range of 3m – 12m and that for post monsoon period is 1m- 5m. There is no significant fall in decadal trend analysis. Hence the ground water level is harmonious with the precipitation and directly related with the intensity of the rainfall and rate of over land flow.

In Bankura district GWL for pre monsoon period is within 6 – 12m and post monsoon GWL is in the range of 2m- 5m. The vegetative cover for the Bankura is less and abstraction rate is comparably greater than Purulia.

In Passhchim Medinipur the range of GWL s are 6 – 14m & 2 – 5m respectively for pre & post monsoon. No significant falling trend is noticed.

In Birbhum for granite & gneissic terrain The pre monsoon GWL is in the range of 4 – 8m and that for post- monsoon it is 2 – 5m. It is note worthy that in basaltic terrain with intra trapeans the GWL is at at greater depth of Pre monsoon 12 – 17m and post monsoon at 2 – 5 .

Extra peninsular region of Himalaya: In this part of the state the high land province has the slope factor >20% and Ground water form the spring zone.

Brhamaputra Alluvial Province of Coochbehar ,Jalpaiguri and Siliguri Mahakuma:

Premonsoon GWL is within 8m and generally remains 4-7m. GWL for summer months is usually greater in Jalpaiguri in comparison to Coochbehar District

The post monsoon GWL in Coochbehar district< 3.5m. and that of Jalpaiguri ranges 2-8m.

There is no significance falling trend in GWL both for Pre and Post monsoon.

Tista ,Mahananda and Tangan plain of Uttar Dinajpore /Dakshin Dinajpore and Malda:

The Premonsoon GWL for U&D Dinajpore is within the range of 4-7m and that of Postmonsoon

Within the range of <4-4.5m. The picture for Premonsoon of GWL for Malda is different. In Malda district the Pre monsoon GWL is usually 5-11m where as Post monsoon GWL is in the range of 3-6m.

The **Barind** area falling in parts of these three districts is a water scarce area. Here the GWL goes as below as 30m during Premonsoon and even during Post monsoon it rises only upto 25m.as recorded from Habibpur of Malda. But in general the Premonsoon GWL for Barind area ranges between 6-15m depending on the physiography of the areaand the postmonsoon varies from 4-6m.

Gangetic Alluvial plain and Damodar Valley Area of Murshidabad ,Nadia, North-24 Parganas,Howrah, Hooghly&Burdwan:

In almost all the above districts concern able declining trend of GWL has been noticed from the decadal analysis of GWL data. It is as high as 52cm/Year at Suti P.S. of Murshidabad District and 30cmm/Year at Sagardighi P.S.Even the decadal analysis of Post monsoon GWL shows as high as 40cm/Year falling trend in those blocks. 20-35cm/year falling trend for the pre monsoon period is common in many blocks Howrah,Hooghly,Burdwan and Murshidabad. In the lower reaches of Ajoy basin very high rate of falling trend has been noticed. Such falling trend of GWL happens to be the manifestation of high growth of tubewells.The range of GWL in these districts are given below in table

DISTRICT	PREMONSOON GWL (in m.b.g.l.)	POSTMONSOON GWL (in m.b.g.l.)
Murshidabad	5 to 21	3 to 20
Nadia	5 to 9	4 to 6
North 24 Parganas	Urban:<12 Rural area <9	Urban:<9 Rural area <3
Howrah	Urban: 11-14 Rural area 8 to10	Urban 8 to10 Rural area <8
Hooghly	8 to 23 Except western upland of Goghat P.S. 15 to18	5 to12 4 to 7
Burdwan Central	8 to 20	4 to14
South Damodar	1 to18	8 to16
Damodar Flood Plain	7 to 11	4 to 8

Aquifer parameters of porous formations of Bengal Basin

Sl. No.	Area	Transmissivity in m^2 / day	Storativity
1.	Bhagirathi plain Bengal Alluvium of Gangetic river deltaic sedimentation (Unconfined-Semi-unconfined)	>6000 to 10500 (Nadia)	0.002-0.003 (Nadia)
2.	-do-	5000-5500 (Kalna)	1.42×10^{-3}-1.39×10^{-4}
3.	Lower catchments of Damodar valley in Bardhaman (Leaky)	2000-5144	2.23×10^{-3}-1.863×10^{-3}
4.	Upper Allivial part of Galsi (Confined)	286	2.1×10^{-4}-1×10^{-4}
5.	Semiconconsolidated Tertiary of Durgapur – Burdwan (Confined)	300	----
6.	Tertiary sediments (Confined)	>300 to <700	----
7.	Barind of North Bengal (Confined)	293-974	9.87×10^{-3}-0.783×10^{-3}
8.	Terai of North Bengal (Unconfined and Confined)	2000-5000	0.02 – 0.07
9.	Deeper aquifers of saline area	1316-8221	1.2×10^{-4}- 1.55×10^{-4}
10.	Mahananda Plain	900-2590	1.7×10^{-3}

SALIENT POINTS ON CHEMISTRY OF GROUNDWATER OF THE STATE

The state can broadly be divided into three hydrochemical parameter zone

1. Low chloride and high bicarbonate type spreading over north Kolkata metropolis to foothills of Himalaya.
2. Chloride-bicarbonate type in and surroundings of Kolkata i.e. KMA area.
3. Sodium and high chloride type roughly 50 km away towards north from shore line.

- Groundwater of Kochbehar, Jalpaiguri and Darjeeling is less mineralized with low hardness. Hardness is around 220 mg/l at Kochbehar whereas within 100 mg/l at Jalpaiguri and Darjeeling.
- The major groundwater problem in the state are (i) salinity hazard in costal tract of Medinipur, North and South 24 Parganas, Howrah. Subsurface disposition of fresh and saline warter are of all the possible types, i.e.

(a) Saline water overlying fresh water aquifers.

(b) Fresh water overlying saline water aquifers.

(c) Alternating sequence.

In Subarnarekha basin high fluoride aquifers are in depth range 8-100 m that for Kosai basin (Haldia area) 40-115 m. In Howrah and 24 Parganas aquifers are saline with in depth range 20-150 m. The deeper aquifers in the depth span of 115-300 m at Digha area; 125-300 m in Haldia area and 170-350 m in South 24 Parganas are relatively fresh with chloride level within permissible limit.

- Above permissible limit iron concentration in groundwater of deeper aquifer is common for South Bengal districts and Malda districts of North Bengal.
- Arsenic contamination in groundwater of the state has come up as serious quality hazard for 81 blocks in linear tract extending NNW-SSE from Kaliachak of Malda district through of east of Murshidabad, Nadia, Bardhaman, Hugli, N-24 Pargans, S-24 Pargans and Howrah. Arsenical groundwater mainly lies within the shallow (20-100 m bgl) and middle aquifers (40-120 m bgl) of Holocene sediments.
- Fluoride concentration in groundwater of West Bengal was first reported from Birbhum district in early nineties. At the early stage of detection, fluoride concentration above detection level was reported in an around hard rock terrain of Birbhum, Bankura and Purulia. But in recent past fluoride toxic ground water became a menace over Barind tract of Dinajpur and Malda.

The significant findings are

(a) Groundwater in fractured granite and gneissic rock are fluoride toxic in many places of, Bankura, Birbhum and Purulia.

(b) Gondwana sedimentary rocks below topmost Coal seam at depth 30 m are often sink for fluoride toxicity.

(c) Similar to Birbhum high level of fluoride in groundwater are also reported from Gondwana sedimentary formation of Ranigunj Coal Field.

(d) Fluoride in groundwater above rejection level are reported from Tapan, Gangarampur of D.Dinajpur and Ratua-II, Bamangola of Malda district at greater depths (>200 m).

(e) Rejection level fluoride infested groundwater is reported from Coastal deltaic sediment of Baruipur, 24 Parganas.

A few important issues of GMB basin

- GMB basin aquifer are one of the richest aquifer s in the world. Holocene aquifer are often as wide as 500 km^2.
- Due to the presence of large extensive Holocene aquifers, West Bengal ranked second among major Indian states in terms of gross replenishable ground water per unit of net cultivable area and ranks third in terms of the same gross replenishable ground water per unit of geographical area.
- Some of the potential and widely spread aquifers are under the threat of arsenic and fluoride contamination above rejection level.
- In many administrative block of GMB basin concernable decline in ground water level indicates intensive extraction of ground water gradually ascending to the state of over exploitation.
- In many blocks the tube wells (pump fitted) density is more than 20 per 100 ha.
- GMB basin needs proper ground water resource management for sustainable development of the depleting renewable resource.

Without Water, Life is Threatened.
- Bertone, Roman Catholic Church , Vatican City