EDITORIAL

The concept of Bio-mapping water quality of rivers in the country has been establishment by Central Pollution Control Board using Biological Water Quality Criteria (BWQC). The information from Bio-mapping helps in collection of baseline data on taxonomical distribution of benthic macro-invertebrates, which are natural indicator for water quality assessment of various rivers in a river basin. Such information can be utilized for classification and zoning of water bodies according to their level of ecological sustenance and degradation.

Bio-mapping of rivers in Meghalaya among North-Eastern states has been accomplished earlier. The findings of the studies of Bio-mapping of perennial rivers of Assam have been compared with the studies undertaken for Meghalaya State in the present issue of `Parivesh' Newsletter.

The information for the issue of Parivesh has been collected, collated and compiled by Dr. (Mrs.) Pratima Akolkar in collaboration with Mrs. Gayatri Devi and Mr. Manoj Saikia, Scientists of Assam State Pollution Control Board. The project has been coordinated at Central Pollution Control Board by Dr. C. S. Sharma under the supervision of Dr. S. D. Makhijani and Dr. B. Sengupta. The manuscript has been typed by Sh. K. P. Shrivastava.

The bio-map of perennial rivers of Assam has been prepared by Mrs. Bonya Basu and Sh. Surajmal.

(**V. Rajagopalan**)
Chairman, CPCB

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1.0 INTRODUCTION

1.1 RIVERS BIO-MAPPING CONCEPT

The concept of water quality mapping had been initiated with the identification of beneficial uses of water in terms of primary water quality criteria. CPCB has prepared Water Quality Atlas of the Indian Rivers System on the basis of five major uses of river water such as:

a) Drinking water source without conventional treatment but after disinfection;

b) Outdoor bathing organized;

c) Drinking water source with conventional treatment followed by disinfection;

d) Propagation of wildlife, fisheries;

e) Irrigation, industrial cooling, controlled waste disposal.

The concept of bio-mapping originated alongwith use of biological system for classification and zoning of water bodies according to their level of ecological degradation.

- Bio-mapping is classification of biological water quality data of river basin in the form of a colour map of various biological classes of water bodies. Different colours such as Blue, Light Blue, Green, Orange and Red, on a river basin map indicate various grades of water quality in terms of clean, slight pollution, moderate pollution, high pollution and severe pollution in the water body respectively.

- Bio-mapping is a continuous bio-monitoring programme of river basin, which should be carried out every year to obtain information on changes in biological water quality maintaining an inventory of the biological life sustained by the river.

- Bio-mapping is carried out effectively for the rivers and tributaries of a river basin, where as bio-monitoring can be done for all surface water bodies and the water quality class can be depicted by colour comparison.

- Bio-mapping of water quality has become significantly important exercise for pollution control activities because:

    a) It gives an immediate impression of the quality of a water body, subjected to multiple designated-best-uses.
    b) It helps in the identification of water bodies, in need of improvement.
    c) To know the extent of pollution control needed for restoration of water quality.

d) To collect the information on long-term cumulative effects of all adverse environmental factors.
e) To maintain and restore the ecological sustainability of the water body in terms of its wholesomeness.
f) Action plans can be prepared by simple colour comparison of the colour maps of water quality drawn for previous years.
g) It may also help in performing the formulation of national pollution control programme.

1.2 RIVERS BIO-MAPPING TECHNIQUES

- Benthic macro-invertebrates are the best suitable biological marker among the biotic communities in an aquatic ecosystem for bio-mapping.
- Locations on a river basin map are selected for biological sampling.
- Biological sampling is undertaken at about 0 to 5 cm depth of bottom substratum layer with the help of nets, shovels, dredges, artificial substratum etc.
- Taxonomic identification of benthic macro-invertebrates up to family level is undertaken at sampling locations itself.
- Collection of relevant environmental information according to field protocols.
- Biological water quality evaluation by – a) Saprobic score; b) Diversity score.
- Assigning the water quality class to each sampling location with respect to combinations of saprobic and diversity score of benthic macro-invertebrates collected from selected sampling locations.
- Biological water quality assessment with the help of Biological Water Quality Criteria (BWQC).
- Translating the biological water quality class of each location on river basin map to respective colours assigned in BWQC.
- Grouping the benthic macro-invertebrate families collected from various locations of river stretch with respect to Biological Water Quality Class and Indicator Colours.

1.3 BIOLOGICAL WATER QUALITY CRITERIA (BWQC)

This BWQC criteria is based on the range of saprobic values and diversity of benthic macro-invertebrate families with respect to water quality (Table 1). To indicate changes in water quality according to pollution levels, the taxonomic groups of benthic macro-invertebrate families with their saprobic score range from 0 to 10, in combination with the range of diversity score from 0 to 1 have been classified into five different classes. The abnormal combination of saprobic

score and diversity score indicates sudden change in environmental conditions and poor substratum of water body.

Table 1: Biological Water Quality Criteria (BWQC)

S. No.	Taxonomic groups	Range of saprobic score (BMWP)	Range of Diversity Score	Water quality Characteristic	Water quality Class	Indicator Colour
1.	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Diptera	7 and more	0.2 - 1	Clean	A	Blue
2.	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Planaria, Odonata, Diptera	6 – 7	0.5 - 1	Slight Pollution	B	Light blue
3.	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Odonata, Crustacea, Mollusca, Polychaeta, Coleoptera, Diptera, Hirudinea, Oligochaeta	3 – 6	0.3 - 0.9	Moderate Pollution	C	Green
4.	Mollusca, Hemiptera, Coleoptera, Diptera, Oligochaeta	2 – 5	0.4 & less	Heavy Pollution	D	Orange
5.	Diptera, Oligochaeta No animals	0 – 2	0 - 0.2	Severe Pollution	E	Red

2.0 BIO-MAPPING OF IMPORTANT PERENNIAL RIVERS OF ASSAM STATE

The North-Eastern state of Assam is generously endowed with water resources. The project on Bio-mapping of important perennial rivers of Assam State had been initiated at following rivers in the state since April, 2003:

- The Brahmaputra River
- The Buridihing River
- The Disang River
- The Jhanji River
- The Dhansiri River
- The Elenga Beel System Pond
- The Subansiri River
- The Borak River

Information regarding the sources, the districts through which the rivers flow and name of the major industries on their banks are given in the Table 2:

Table 2: Major river systems, their origin and flow pattern of various rivers of Assam State

S. No.	River	Source of the river	Confluence Point	Major Districts on the course of the river	Major industries on the course
1.	The Brahmaputra River	The river flows through Tibet and enter India at Arunachal Pradesh United with several rivers like Dibang, Lohit, Siang, Kundil etc. and flows through the Assam Valley to fall in the bay of Bengal	Bay of Bengal	Tinsukia, Dibrugarh, Dhemaji, North Lakhimpur, Sibsagar, Jorhat, Golaghat, Sonitpur, Darrang, Nagaon, Kamrup, Barpeta, Goalpara, Bongaigaon, Dhubri	No major industries are situated at the river bank. Guwahati Refinery at Guwahati, Kamrup discharges their treated effluent directly into the river.
2.	The Buridihing River	Arunachal Pradesh	Brahmaputra at Dihingmukh	Tinsukia, Dibrugarh	Coal India Ltd., Margherita; Oil India Ltd., Duliajan; Assam Oil Division, Digboi
3.	The Disang River	Arunachal Pradesh	Brahmaputra at Disangmukh	Dibrugarh, Sibsagar	Brahmaputra Valley Fertilizer, Namrup, Assam Petrochemicals Ltd., Namrup; ONGCL drilling site are located at the site of the river bank.
4.	The Jhanji River	Nagaland	Brahmaputra at Jhanjimukh	Sibsagar, Jorhat	-
5.	The Dhansiri River	Nagaland	Brahmaputra at Dhansirimukh	Golaghat	Numaligarh Refinery (NRL)
6.	The Elenga Beel System Pond	Natural water body	-	Morigaon	HPC, Nagoon Paper Mill at Jagiroad
7.	The Subansiri River	Arunachal Pradesh	Brahmaputra at Alichiga	Dhemaji, North Lakhimpur	Construction of 2000 MW National Hydroelectric Power Corporation is going on
8.	The Borak River	Manipur	Meghna	Silchar, Karimganj, Badarpur	HPC, Cachar Paper Mill at Panchgram

2.1 SURFACE WATER RESOURCES AND THEIR USES

The water use status of perennial rivers of Assam is presented ahead.

S. No.	Districts/State	City/Town/Sampling period	Surface water resources	Water use status of surface water bodies
1.	Miao, Arunachal Pradesh	Miao April, 2003	River Buridihing	No human influences.
2.	Assam Distt. Tinsukia	Margherita April, 2003	River Buridihing	Sand recovery, bathing, washing, stone crushing unit, domestic sewage disposal through surface run offs, Tea gardens on opposite bank.
3.	Assam Distt. Dibrugarh	Gammon Dullang, Khowang April, 2003	River Buridihing	Grazing, bathing, run offs from upper Assam Industrial areas of oil and coal fields, vegetable farming, paddy cultivation, fishing, sand recovery, Jokai Reserve wildlife.
4.	Assam Distt. Sibsagar	Dihingmukh, Dibrugarh April, 2003	River Buridihing	Vegetable farming, bathing, washing, fishing, boating etc., paddy fields.
5.	Assam – Arunachal Pradesh	Dillighat May, 2003	River Disang	Raw water intake for drinking water supply, raw water intake of Industrial and coal mining on opposite bank of river. Forest area, HFC Tea garden, wildlife.
6.	Namrup, Assam Distt. Dibrugarh	Lalpagarighat May, 2003	River Disang	Water body receives effluents of HFC, surface run offs from Namrup Industrial township, vegetable cultivation, stone collection, ferry services.
7.	Sibsagar, Assam	Rajabari May, 2003	River Disang	Cattle wading, sand recovery, washing, bathing, fishing, grazing cattle
8.	Sibsagar, Assam	Sepaigaon, Disangmukh	River Disang	Receives HFC effluents, vegetable cultivation, cattle wading, sand recovery, boat transport, bathing and washing activities, wildlife, paddy cultivation
9.	Assam - Nagaland Border Distt. Sibsagar	Amguri Tea Estate Rajabari May, 2003	River Jhanji	Vegetable, mustard farming, cattle wading, tea gardens and bamboo forest.
10.	Sibsagar, Assam	Jhanji May, 2003	River Jhanji	Effluent discharge from Tuli Paper Mill (Presently closed), cattle wading, sand recovery, bathing, washing, drinking, grazing. Canals joining the water body, surface run offs from Amboori Town at opposite bank.
11.	Jorhat, Assam	Jhangi Mukh, Kumargaon May, 2003	River Jhanji	Vegetable and paddy farming, boating, fishing, washing, wildlife etc. grazing animals and forest.
12.	Karbi-Anglong Assam and Nagaland Border	Kesharidubi, Tengani, Nambar May, 2003	River Dhansiri	Sugarcane and maize cultivation, vegetable farming, cattle wading, boating, bathing and washing, wild life.
13.	Numaligarh, Assam Distt. Golaghat	Numaligarh May, 2003	River Dhansiri	Drinking water intake, sand recovery, bathing, washing, fishing, discharge of NRL (Refinery) effluents.

S. No.	Districts/State	City/Town/Sampling period	Surface water resources	Water use status of surface water bodies
14.	Golaghat – Nagaon District Border	Dhansirimukh May, 2003	River Dhansiri	Boating, cattle wading, washing, bathing, fishing and drinking.
15.	Belguri, Assam Nowgong/ Morigong	Jagiroad, Belguri May, 2003	Ellenga Beel, System pond	Back flow of Jagiroad Paper Mill effluents join the beel, vegetable and paddy cultivation, washing
16.	Morigaon	Jagiroad, Morigaon May, 2003	Ellenga Beel, System pond	Receives Hindustan Paper Mills effluent.
17.	Assam – Arunachal Pradesh Border, North Lakhimpur	Gerukamukh May, 2003	River Subansiri	Dam construction for Hydro-electric power generation.
18.	North Lakhimpur Assam	Chaowlohoaghat May, 2003	River Subansiri	Cattle wading, sand recovery, washing, bathing and fishing etc.
19.	Lakhimpur Assam	Alichiga, Bordubi May, 2003	River Subansiri	Fishing, paddy farming, forestry, melon farming, cattle wading
20.	Assam-Manipur Border	Phuler Tal, Jiribam May, 2003	River Borak	Tea gardens cultivation activities, cattle wading, sand recovery, washing, bathing and ferry transport, forestry.
21.	Silchar, Assam	Katakhal May, 2003	River Borak	Panchgram HPC township, cattle wading, sand recovery, bathing, washing, municipal waste discharge.
22.	Silchar, Assam	Badarpur ghat, Badarpur May, 2003	River Borak	HPC Panchgram effluent discharge, cattle wading, bathing, washing, fishing, drinking etc.
23.	Karimganj, Assam-Bangladesh Border	Kalibarighat May, 2003	River Borak	Bathing, washing, fishing and ferry transport, cattle wading
24.	Tinsukia, Assam	Sakhowa ghat April, 2003	River Brahmaputra	Ferry services, melon farming, cattle wading, transport
25.	Dibrugarh, Assam	Nagagholli, Maizan	River Brahmaputra	Cultivation of tea garden, cattle wading, dredging, sand recovery, ferry ghat, fishing, transport, forestry.
26.	Sibsagar, Assam	Desangmukh	River Brahmaputra	Vegetable cultivation, cattle wading, bathing, washing, fishing
27.	Jorhat, Assam	Nimatighat	River Brahmaputra	Cattle wading, ferry services, bathing, washing, Kakilamukh Bird Sanctuary, Forestry
28.	Golaghat, Assam	Dhanbari camp	River Brahmaputra	Sand recovery, fishing, bathing, boating etc. cultivation, forestry, discharge of NRL effluents
29.	Nagaon, Assam	Bhomoraguri, Silghat	River Brahmaputra	Sand recovery, fishing, bathing, washing
30.	Guwahati, Assam	Saraighat	River Brahmaputra	Ferry services, cattle wading, sand recovery, fishing, bathing, washing, boating and human settlement.
31.	Bongaigaon, Assam	Goalpara near Panchratna bridge May, 2003	River Brahmaputra	Cattle wading, sand recovery, fishing, bathing, washing, drinking, ferry transport.

S. No.	Districts/State	City/Town/Sampling period	Surface water resources	Water use status of surface water bodies
32.	Dhubri, Assam	Dhubri May, 2003	River Brahmaputra	Cattle wading, sand recovery, fishing, bathing, washing, cultivation.
33.	Guwahati, Assam	Sadilapur near Savaighat bridge, Pandu ghat November, 2003	River Brahmaputra	Discharge of Refinery effluents (NRL) open defaecation, town runoffs, water discharge, vegetable cultivation, cattle wading, cremation, fishing, jetty, boating, bathing.
34.	Karimganj, Assam	Badarpur ghat November, 2003	River Borak	Water intake of railway, sand dredging, vegetable cultivation, bathing, boating, paddy cultivation, sand recovery, fishing
35.	Karimganj, Assam	Karimganj, Kalighat November, 2003	River Borak d/s	Fishing, vegetable cultivation, washing, bathing
36.	Cachar, Assam	Kathakhal on NH-44 November, 2003	River Borak	Vegetable cultivation, fishing, sand recovery, paddy cultivation
37.	Cachar, Assam	Dilkhush Tea Estate, Opp. to Fooler Tal November, 2003	River Borak Upstream	Vegetable cultivation, ferry services, water intake, boating, bathing and washing, tea gardens.
38.	Assam Meghalaya Border	New-Malidor, Jalalpur November, 2003	River Malidor	Dredging, sand recovery, stone collection.
39.	Silchar – Manipur Border	Fooler Tal November, 2003	River Borak upstream	Ferry services, Dilkhush Tea Estate, Vegetable cultivation, bathing, washing, and drinking water intake.
40.	Sonitpur, Assam	Bukagaon, Balipara November, 2003	River Jia-Bharali	Water Intake, cultivation, religious activities, dredging and sand recovery, fishing, bathing, paddy cultivation, and brick formation.
41.	Lower Subansiri Lakhimpur, Assam	Gerukamukh November, 2003	River Subansiri u/s	Dredging, sand recovery, transport, stone collection from river bed and transport to dam site, fishing, washing, bathing, open defaecation, mining, drilling at upstream.
42.	Arunachal Pradesh Border	Dhulumukh November, 2003	River Subansiri upstream	Washing, bathing, boating, drinking water for wildlife transport of the River stones by motorboats to dam construction site.
43.	North Lakhimpur, Assam	Chauldhua village November, 2003	River Subansiri d/s	Vegetable cultivation, cattle wading, dredging, sand recovery, stone collection from River bed for road construction, boating, fishing, open defaecation, village settlement.
44.	North Lakhimpur, Assam	Chauldhuaghat November, 2003	River Subansiri d/s (midstream)	Fishing
45.	Lakhimpur, Assam	Alichiga November, 2003	River Subansiri d/s	Cattle wading, transport by motor boats, fishing, birds habitat, cultivation
46.	Lakhimpur, Assam	Pahumara, Lakhimpur November, 2003	River Ranganadi	Hydro-electric power generation at upstream, paddy cultivation, cattle wading, drinking water source, dredging and sand recovery, vehicle washing, bathing, fishing and transport by boat, religious activities, idol immersion, cremations.

S. No.	Districts/State	City/Town/Sampling period	Surface water resources	Water use status of surface water bodies
47.	Lakhimpur, Assam	Bogi Nadi, Milanpur November, 2003	River Boginadi	Drinking water, vegetable cultivation, cattle wading, dredging and sand recovery, bathing, washing and fishing, human settlement, paddy cultivation.
48.	Assam – Arunachal Pradesh Border	Parbati Nagar, Harmutty Tea Estate Bandardua – Itanagar Border November, 2003	River Dikrong	Cattle wading, dredging, sand recovery, fishing, bathing, boating.
49.	Sonitpur, Assam	Bhoomuraguri, Tejpur	River Brahmaputra	Vegetable, paddy cultivation, bathing, washing, fishing and boating, open defaecation, wildlife.
50.	Bongaigaon, Assam	Jogighopa November, 2003	River Brahmaputra	Water Intake of Jogighopa Paper Mill, coal transport by ship and boats, cremation, mustard vegetable cultivation, fishing, open defaecation, paddy field, human settlement.

2.2 HYDROLOGICAL STATUS AND ENVIRONMENTAL PROBLEMS

Hydrological status of a water body is an important factor, which determines the status of establishment of biological communities of Benthic macro-invertebrate families. A mature colonization of benthic macro-invertebrate communities in a water body is essential for actual water quality assessment. A number of human activities such as melon farming on River bank, cultivation, brick kilns and brick formation on catchment of river sand dredging, stone collection from river bed for road construction and stone crushers etc. are detrimental activities responsible for habitat destruction in terms of change in flow, depth, self purification capacity of water body and alteration in substratum type, which in turn determine the establishment of fauna and flora in a water body. The tributaries River Brahmaputra viz. River Buridihing, River Disang and River Subansiri possess natural substratum in their upstream reaches in Assam State. Their substratum composed of mainly Boulders, Cobbles, Pebbles and Gravel with comparatively less percentage of sand. The flow of water in these reaches ranges from 0.6 to 1.0 m/s. These habitats are suitable for biological establishments. Other rivers generally have sandy and clay substratum providing poor habitat for proper colonization of biological communities.

Table 3: Hydrological status of perennial rivers of Assam (2003)

S. No.	Name of Rivers	Location	District/State	Period of Sampling	Approx. Depth (Meters)	Approx. width Mts/Kmts	Approx. velocity of Flow m/s	Substratum composition	
								Substratum type	Percentage approx.
1.	River Buridihing	Bed camp	Miaow, Arunachal Pradesh	April, 2003	3.0	25.0	1.0	Boulders Cobbles	20 20
				December, 2003	2.0	20.0	0.9	Pebbles Gravels	30-40 20-30
		Dihing, Ferry ghat	Margherita	April, 2003	6.1	200.0	0.6	Sand	70
				December, 2003	5.185	200.0	0.4	Clay	30
		Gammon, Dullang	Khowang	April, 2003	9.15	115.0	0.5	Sand	70-80
				December, 2003	7.32	150.0	0.4	Clay	20-30
		Dihingmukh	Dibrugarh	April, 2003	3.66	80.0	0.4	Sand	70
				December, 2003	8.0	150.0	0.6	Clay	30
2.	River Disang	Lalpagarighat	Namrup	May, 2003	2.135	200.0	0.5	Boulders Cobbles	10 20
				December, 2003	1.525	180.0	0.3	Pebbles Gravel Clay	10-30 30-40 20
		Dillighat	Assam-Arunachal Pradesh Border	May, 2003	3.355	200.0	0.6	Boulders Cobbles	50-70 20
								Pebbles Clay	10 20
		Rajabari	Sibsagar	May, 2003	3.66	200.0	0.4	Sand Silt	30-40 10
				December, 2003	3.05	200.0	0.3	Clay	70
		Sepaigaon Disangmukh	Sibsagar	May, 2003	6.1	200.0	0.5	Sand Silt	10 20-30
				December, 2003	4.88	200.0	0.4	Clay	70
3.	River Jhanji	Amghri Tea Estate Rajabari	Assam-Nagaland Border	May, 2003	0.915	30.0	-	Gravel Sand	40 40-50
				December, 2003	1.525	50.0	0.3	Clay	10-20
4.	River Jhanji	NH-Crossing Jhanji	Sibsagar	May, 2003	3.0	200.0	0.2	Sand Silt	60 20
				December, 2003	4.0	200.0	0.3	Clay	20
		Jhanjimukh, Kumargaon	Jorhat	May, 2003	3.66	30.0	0.4	Sand	50-60
				December, 2003	3.05	50.0	0.3	Clay	40-50
5.	River Dhansiri	Kesharidubi Tengani, Nambar	Karbi-Anglong District Assam-Nagaland Border	May, 2003	4.0	70.0	0.2	Sand Clay	50-60 40
				December, 2003	3.0	80.0	0.3	Silt	50
		NRL Jetty at NH-Crossing	Numaligarh	May, 2003	5.0	300.0	0.7	Sand Silt	30 10
				December, 2003	5.0	250.0	0.5	Clay	40-60
		Dhansiri Mukh	Golaghat Nagaon District Border	May, 2003	3.0	200.0	0.6	Sand Silt	40-50 10
				December, 2003	3.0	220.0	0.5	Clay	40-50

S. No.	Name of Rivers	Location	District/State	Period of Sampling	Approx. Depth (Meters)	Approx. width Mts/Kmts	Approx. velocity of Flow m/s	Substratum composition	
								Substratum type	Percentage approx.
6.	Ellenga Beel System Pond	Belguri	Jagiroad	May, 2003	1.0	20.0	-	Clay	100
				December, 2003	1.0	20.0	-		
		Jogiroad other sie of Bridge	Morigaon	May, 2003	-	-	-	Clay	100
				December, 2003	1.0	20.0	-		
7.	River Subansiri River Subansiri	Gerukamukh Subansiri lower HE. Project	North Lakhimpur, Assam-Arunachal Pradesh Border	May, 2003	6.0	200.0	0.9	Boulders Cobbles Pebbles Gravel Sand	20 10 10 20 30-85
				November, 2003	1-20.0	300.0	0.227	Clay Detritus	10 5
		Opposite Bank of Gerukamukh	Dhulumukh Arunachal Pradesh	May, 2003	-	-	-	Boulders Cobbles Pebbles Sand	5 5 30 60
				November, 2003	20.0	1.5	0.24		
		Chaolohoa ghat	North Lakhimpur	May, 2003	4.0	300.0	0.9	Boulders	10
				November, 2003	1-3.0	250.0	0.18	Cobbles Pebbles Gravel Sand	20 10-50 10-60 40-50
					0.305	150.0	0.43	Clay Silt Detritus	10 5 5
		Alichiga, Bordubi	North Lakhimpur	May, 2003	6.1	250.0	0.7	Sand	50-100
				November, 2003	1-3.0	200.0	0.15-0.25	Clay	50
8.	River Borak	Fooler Tal, Jiribam	Assam-Manipur Border	May, 2003	-	-	-	Sand	75
				November, 2003	4.0	250.0	0.13	Clay	25
		Kathakal on NH-44 u/s of Badarpur	Cachar / Assam	May, 2003	7.0	80.0	0.6	Boulders Sand Clay	30 30-50 20-40
				November, 2003	10.0	200.0	0.21	Detritus	10
		Badarpurghat	Karimganj / Assam	May, 2003	8.0	150.0	0.6	Sand	20-60
				November, 2003	8.0	400-500	0.13	Clay	40-70
		Kalibarighat	Karimganj Assam-Bangladesh Border	May, 2003	10.0	100.0	0.7	Boulders Pebbles Sand Clay	40 10 15-20 20-70
				November, 2003	3-4	300.0	0.117	Detritus	5
		Dilkhush Tea Estate Opposite bank to Fooler Tal	Assam – Manipur Border	May, 2003	-	-	-	Clay	100
				November, 2003	2.0	250.0	0.23	-	-

S. No.	Name of Rivers	Location	District/State	Period of Sampling	Approx. Depth (Meters)	Approx. width Mts/Kmts	Approx. velocity of Flow m/s	Substratum composition	
								Substratum type	Percentage approx.
9.	River Brahmaputra	Saikhowaghat	Tinsukia	April, 2003	9.15	1.609	1.2	Gravel Sand	5-10 70-75
				December, 2003	9.76	1.609	1.0	Clay	20
		Nagagholli, Maizan	Dibrugarh	April, 2003	7.625	1.609	1.0	Sand	70-80
				December, 2003	6.1	-	1.0	Clay	20-30
		Desangmukh	Sibsagar	May, 2003	-	-	-	Sand	60
				December, 2003	8.235	500.0	1.0	Clay	40
		Nimatighat	Jorhat	May, 2003	9.0	400.0	1.0	Sand	70
				December, 2003	10.0	400.0	1.0	Clay	30
		Dhanbari Camp	Golaghat	May, 2003	3.965	2.5	1.0	Sand	70-80
				December, 2003	3.05	2.0	0.9	Clay	20-30
		Bhomuraguri Silighat on NH-37A	Sonitpur district	May, 2003	12.0	400.0	1.0	Sand	80-100
				December, 2003	2.0	2.8	0.18-0.30	Clay	20
		Saraighat Bridge Sadilapur Pandy ghat	Guwahati	May, 2003	20.0	500.0	1.0	Sand	30-90
				November, 2003	6.1-15.25	1.5	0.125	Clay	10-70
		Joghigopa near Panchratna Bridge on NH-37	Goalpara Town	May, 2003	20.0	400.0	1.0	Sand	40-100
				November, 2003	>100	2.0	0.142	Clay	0-60
		Balasur	Dhubri	May, 2003	3.66	3.0	1.0	Sand	70
				December, 2003	3.05	-	1.0	Clay	30
10.	River Malidor	Jalalpur New Malidor	Assam- Meghalaya border	November, 2003	0.305	150.0	0.3-0.133	Cobbles Pebbles Gravel Sand	20 50 10 10
11.	River Jia Bhorali	Bukagaon	Balipara	November, 2003	10-15	200.0	0.27	Pebbles Sand Clay	10 80 10
12.	River Ranganadi	Pahumara Road Bridge on NH-52	Lakhimpur	November, 2003	0.2	150.0	0.76	Sand	100
13.	River Boginadi	Boginadi Milanpur	Lakhimpur district	November, 2003	0.2-0.3	100.0	0.66	Cobbles Pebbles Sand	10 5 85
14.	River Dikrong	Harmutty Tea Estate on NH-52, near Higher Secondary School	Parbati Nagar Bandardua Assam-Arunachal Pradesh Border	November, 2003	0.5-1.5	200.0	0.71	Pebbles Gravel Sand	20 10 70

Table 3.1: Hydrological status of perennial rivers of Assam (2004)

	Name of Rivers	Location	District/State	Period of Sampling	Approx. Depth (Meters)	Approx. width Mts/Kmts	Approx. velocity of Flow m/s	Type of water body	Substratum composition	
									Substratum type	Percentage approx.
1.	River Buridihing	Dihing, Ferry ghat	Margherita	October, 2004	5.795	200.0	0.5	Run Depositing Eroding Canalized	Sand Clay	80 20
		Bed Camp	Miao, Arunachal Pradesh	October, 2004	2.5	30.0	1.0	Run	Boulders Cobbles Pebbles Gravel	30 10 40 20
		Gammon, Dullang	Khowang	October, 2004	6.1	200.0	0.5	Run Eroding Canalized	Sand Clay	80 20
		Dihingmukh	Dibrugarh	October, 2004	10.0	150-200	0.7	Run Depositing Eroding Canalized	Sand Clay	70 30
2.	River Disang	Lalpagarighat	Namrup	October, 2004	2.745	200.0	0.4	Run Depositing Eroding Canalized	Sand Clay	30 70
		Dillighat	Assam-Arunachal Pradesh Border	October, 2004	3.05	200.0	0.5	Run Canalized	Boulders Cobbles Pebbles Clay	50 20 20 10
		Rajabari	Sibsagar	October, 2004	2.745	200.0	0.4	Run Depositing Eroding Canalized	Sand Clay	30 70
		Sapaigaon Disangmukh	Sibsagar	November, 2004	3.66	200.0	0.5	Run Depositing Eroding Canalized	Sand Silt Clay	10 20 70
3.	River Jhanji	Amguri Tea Estate	Assam-Nagaland Border	November, 2004	1.22	50-100	0.4	Run Eroding	Gravel Sand Clay	40 50 10
		NH-Crossing Jhanji	Sibsagar	November, 2004	1.22	200.0	0.4	Run Depositing Eroding Canalized	Sand Silt Clay	60 20 20
		Jhanjimukh, Kumargaon	Jorhat	November, 2004	2.745	50-100	0.3	Run Depositing Eroding Canalized	Sand Clay	70 30

	Name of Rivers	Location	District/State	Period of Sampling	Approx. Depth (Meters)	Approx. width Mts/Kmts	Approx. velocity of Flow m/s	Type of water body	Substratum composition	
									Substratum type	Percentage approx.
4.	River Dhansiri	Kesharidubi Tengani, Nambar	Karbi-Anglong	November, 2004	4.0	100.0	0.4	Run Eroding Canalized	Sand Clay	70 30
		NRL Jetty at NH-Crossing	Numaligarh	November, 2004	4.0	100.0	0.4	Run Eroding Canalized	Sand Clay	70 30
		Dhansiri Mukh	Golaghat Nagaon District Border	November, 2004	4.0	250.0	0.4	Run Depositing Eroding Canalized	Sand Silt Clay	60 10 20
5	Ellenga Beel System Pond	Belguri	Jagiroad	December, 2004	1.0	20.0	No flow	Pool Depositing Canalized	Clay	100
		Belguri	Jagiroad	December, 2004	1.0	20.0	No flow	Pool Depositing Canalized	Clay	100
6.	River Subansiri	Gerukamukh Subansiri lower HE. Project	North Lakhimpur, Assam-Arunachal Pradesh Border	December, 2004	10.0	300.0	0.4	Run	Pebbles Sand	20 80
		Opposite Bank	Dhulumukh Arunachal Pradesh	-	-	-	-	-	-	-
		Chaolohoa ghat	North Lakhimpur	December, 2004	4.0	250.0	0.2	Run Depositing Eroding Canalized	Pebbles Gravel Silt	30 60 10
		Alichiga	North Lakhimpur	December, 2004	3.0	200.0	0.4	Run	Sand Clay	90 10
7.	River Borak	Fooler Tal, Jiribam	Assam-Manipur Border	November, 2004	5.0	250.0	0.2	Run	Cobbles Sand Clay	80 20
		Kathakal on NH-44 u/s of Badarpur	Cachar / Assam	November, 2004	8.0	200.0	0.3	Run Canalized	Cobbles Sand Clay	10 60 30
		Badarpurghat	Karimganj / Assam	November, 2004	6.0	300-400	0.2	Run Depositing Canalized	Sand Clay	30 70
		Kalibarighat	Karimganj Assam-Bangladesh Border	November, 2004	3.0	300.0	0.2	Run Canalized	Sand Clay	30 70
		Dilkhush Tea Estate Opposite bank to Fooler Tal	Assam – Manipur Border	-	-	-	-	-	-	-

	Name of Rivers	Location	District/State	Period of Sampling	Approx. Depth (Meters)	Approx. width Mts/Kmts	Approx. velocity of Flow m/s	Type of water body	Substratum composition	
									Substratum type	Percentage approx.
9.	River Brahmaputra	Saikhowa ghat	Tinsukia	October, 2004	10.675	Very wide	1.2	Run Eroding Canalized	Gravel Sand Clay	10 80 10
		Nagagholli, Maizan	Dibrugarh	October, 2004	6.1	Very wide	1.0	Run Eroding Canalized	Sand Clay	80 20
		Desangmukh	Sibsagar	November, 2004	9.15	500-700	1.0	Run Eroding Canalized	Sand Clay	70 30
		Nimatighat	Jorhat	November, 2004	15.0	Very wide	1.0	Run Eroding Canalized	Sand Clay	80 20
		Dhanbari Camp	Golaghat	November, 2004	3.05	Very wide	1.0	Run Eroding Canalized	Sand Clay	80 20
		Bhomuraguri Silighat on NH-37A	Sonitpur district	November, 2004	3.0	2 km	0.4	Run Eroding Canalized	Sand Clay	90 10
		Saraighat Bridge Sadilapur Pandu ghat	Guwahati	December, 2004	4.575	Very wide	0.2	Run Depositing Eroding Canalized	Sand Clay	80 20
		Joghigopa near Panchratna Bridge on NH-37	Goalpara Town	December, 2004	1.0	20.0	No flow	Depositing Canalized	Clay	100
		Balasur	Dhubri	November, 2004	3.05	Very wide	1.0	Run Eroding Canalized	Sand Clay	80 20
10.	River Malidor	Jalalpur	Assam- Meghalaya border	November, 2004	-	100.0	0.2	Run Canalized	Boulders Cobbles Pebbles Gravel	20 20 40 20
11.	River Lubha	Near Lubha bridge	Sonapur, Meghalaya	November, 2004	2.0	80.0	0.4	Run Canalized	Boulders Cobbles	80 20

Table 4: Environmental Problems related to various activities in vicinity of Perennial Rivers in Assam

S. No.	Rivers/Water bodies	Location of Stretch	Activities	Environmental Problems
1.	River Buridihing	Bed camp at Miao in Arunachal Pradesh	Forest Miaow, stone collection from catchment of River, Birds habitat	Habitat destruction due to stone removal from riverbed.
		Dihing, ferry ghat at Margherita	Sand recovery, bathing, washing, urban activities, grazing, stone crusher units, Tea gardens, surface drainage discharge.	Habitat destruction due to stones removal for stone crushing, silting in river, nutrient run offs through tea garden and sewage discharge affect water quality.
		Gammon, Dullang at Khowang, NH-37	Grazing, farming, bathing, activities of upper Assam Industrial area of Oil and Coal fields, vegetable, paddy cultivation, fishing, sand recovery, Jokai Reserve Wildlife, forest.	Industrial activities affect the water and air quality and sensitive zone of wildlife reserve.
		Dihingmukh at Dibrugarh	Vegetable farming, bathing, washing, fishing, boating, paddy fields, human settlement	Silting in water body through surface run offs, water quality gets affected.
2.	River Disang	Dillighat at Assam-Arunachal Pradesh Border	Drinking water supply Industrial and Coal mining activities, Tea gardens, wildlife.	Water quality affected due to surface run offs from Industrial and Coal mining activities and Tea gardens.
		Lalpagari ghat at Namrup Industrial Township	Activities of Industrial township of Namrup. Vegetable cultivation, stone collection, ferry transport of Hindustan Fertilizer Corporation.	Habitat destruction due to stone removal from Riverbed, silting in water body through surface run offs, water quality affected due to HFC effluents.
		Rajabari, Sibsagar	Cattle wading, sand recovery, washing, bathing and fishing.	Silting in water body from surface run offs.
		Sepaigaon, Disangmukh, Sibsagar	Vegetable cultivation, cattle wading, sand recovery, boat transport, bathing, washing wildlife, paddy fields, human settlement.	Silting in water body, fish kills reported by villagers. Water quality affected due to HFL effluent discharge.
3.	River Jhanji	Amgwa Tea Estate, Rajabari Assam-Nagaland border	Nagaland Paper Mill (presently un-operated), vegetable, mustard, Tea garden, cultivation in catchment, bamboo forest, deforestation.	Muddy colour water, silting in water body through surface runoff. Deforestation due to use of bamboo as raw material for paper manufacturing.
		NH-Crossing, Jhanji at Sibsagar	Tuli Paper Mill (Presently unoperated) cattle wading, sand recovery, bathing, washing, drinking etc. grazing land etc.	Water quality problems.
		Jhanjimukh, Kumargaon at Jorhat near Teok	Vegetable and paddy farming, boating, fishing,, washing, boating wildlife.	Habitat destruction for wildlife.

S. No.	Rivers/Water bodies	Location of Stretch	Activities	Environmental Problems
4.	River Dhansiri	Kesharidubi, Tengani Nambar, Assam-Nagaland border	Sugarcane, vegetable and maize cultivation in the catchment, cattle wading, boating, bathing, washing wildlife.	Habitat destruction for wildlife.
		NRL Jetty at NH-Crossing, Numaligarh	Numaligarh Refinery activities, drinking water intake, sand recovery, bathing, washing, fishing, discharge of NRL effluents.	Water quality problems.
		Dhansirimukh, Golaghat, Nagaon District border	Wildlife of Kaziranga National Park, receiving NRL effluents, cattle wading, washing, bathing, fishing and drinking.	Drinking water quality problems.
5.	Elenga Beel System Pond	Belguri, Jagi Road	Jagi Road Paper Mill, vegetable and paddy cultivation, washing.	Water quality problems due to discharge of Paper Mill effluents. Deforestation due to use of bamboo as raw material for paper manufacturing.
		Jagiroad, other side of bridge, Morigaon	HPC Jagiroad activities. Deforestation of Bamboo forest	Discharge of effluents of Hindustan Paper Mill effluents, water quality problems.
6.	River Subansiri	Gerukamukh, Subansiri Lower H.E. Project, North Lakhimpur District	Dam construction activities for Hydroelectric power generation project of NHPC, Deforestation, extensive sand, stone dredging activities, sand recovery, transport of river stones by motor boats to dam site, fishing, washing, bathing, open defaecation, mining, drilling at dam site.	River Bed habitat destruction, silting in water body, loss of biodiversity, poor quality of road, national highway due to use of river stones, silting on vegetation.
	River Subansiri u/s	Dhulumukh, Arunachal Pradesh border	Washing, bathing, boating, drinking water for wildlife, river stones transport to dam site on motor boats, mining and drilling of NHPC on dam site.	River Bed habitat destruction, loss of biodiversity, silting in water body.
	River Subansiri m/s	Chaowldhoa ghat N. Lakhimpur	Cattle wading, sand recovery, washing, bathing, fishing, vegetable cultivation, dredging, river bed stones are removed for road construction, open defaecation grazing, forest, village settlement.	River bed habitat destruction, water quality problems, silting in water body.
	River Subansiri d/s	Alichiga	Deforestation, cattle wading, transport by motor boats, fishing, boating, birds habitat, pumping river water for cultivation.	Soil erosion of river banks water quality problems doe to surface run offs. Habitat destruction for resting birds.
7.	River Ranganadi	Pahumara Lakhimpur	Ranganadi Hydal Project of NEPCO, Kemang in Arunachal Pradesh, settlement of Bamundaloni village on the bank of river paddy cultivation, cattle wading, drinking water, dredging, sand recovery, vehicle washing, bathing, and fishing, transport by boat, religious activities, idol immersion, cremation etc.	Silting in water body, water quality problems.
8.	River Boginadi	Boginadi Milanpur Lakhimpur District	Drinking water for local residents, village settlement on the River bank, vegetable cultivations, cattle wading, dredging, sand recovery, stone collection from river bed, bathing, washing and fishing, grazing, paddy cultivations.	Water quality problems through surface run offs. Rive bed habitat destruction.

S. No.	Rivers/Water bodies	Location of Stretch	Activities	Environmental Problems
9.	River Dikrong	Parbati Nagar Bandardua	Tea estate on opposite bank, cattle wading, dredging, sand recovery, fishing, bathing, boating, river stones, removed for construction material, grazing land, paddy cultivation.	Water quality problems through surface run offs. Riverbed habitat destruction. Silting in water body.
10.	River Barak	Fooler Tal, Jiribam Assam-Manipur border	Ferry services, Tea gardens, cattle wading, sand recovery washing, bathing, forestry.	Water quality problems due to surface run offs. Silting in water body.
		Fooler Tal opposite bank, Dilkhush Tea estate	Water Intake, vegetable cultivation, transport by ferry service, boating, bathing, washing, Tea gardens	Silting in water body, water quality due to surface run offs.
		Badarpur, Badarpurghat	Construction of new railway bridge, water intake of railways, vegetable cultivation, bathing, boating, paddy cultivation, dredging and sand recovery, discharge of HPC effluents, deforestation of bamboo forest.	Water quality problem, habitat destruction of riverbed. Deforestation due to use of bamboo as sole raw material for paper manufacturing, silting in water body.
		Kalibarighat, Karimganj, Assam-Bangladesh border	Bathing, washing, fishing, ferry transport cattle wading, religious activities, BSF camp water intake of Bangladesh, vegetable cultivations, solid waste disposal.	Water quality problems, water hyacinth.
		Kathakhal, Silchar	Sewage discharge of township Panchgram Hindustan Paper Mill, cattle wading, sand recovery, bathing, washing, fishing, vegetable, paddy cultivation.	Water quality problems, habitat destruction of river catchment.
11.	River Malidor	New Malidor, Jalalpur, Assam-Meghalaya Border	Stone crushing, stone collection from river bed and transport by truck, deforestation, dredging, sand recovery.	Habitat destruction of river bed silting in water body.
12.	River Jiabharali	Bukagaon, Balipara Division	Water intake for drinking water supply, cultivation, religious activities, dredging, sand recovery, fishing, bathing, paddy cultivation, brick kiln.	Water quality problems due to surface run offs, habitat destruction of river catchment.
13.	River Brahmaputra	Saikhowaghat, Tinsukia	Ferry services, melon farming, cattle wading	Soil erosion, silting in water body, floods, sandy substratum.
		Nagagholli, Maizan, Dibrugarh	Tea garden, cattle wading, dredging, sand recovery, ferry ghat, fishing & transport.	Water quality problems through surface run offs, floods, sandy substratum
		Desangmukh, Sibsagar	Vegetable cultivation, cattle wading, bathing, washing, fishing	Floods, sandy substratum.
		Nimatighat, Jorhat	Ferry services, bathing, washing, Kakilamukh Bird's sanctuary	Floods, sandy substratum.
		Dhanbari Camp, Golaghat	Sand recovery, fishing, bathing, boating, cultivation, NRL effluent discharge.	Water quality problems, floods, sandy substratum.
		Bhomoraguri Silighat, Sonitpur District	Sand recovery, fishing, bathing, washing, vegetable, paddy cultivation, open defaecation, Kala Bhomoraguri wildlife, Teak forest, deforestation.	Floods, soil erosion, tree falling due to desilting, habitat destruction.
		Saraighat, Sadilapur, Guwahati	Discharge of Guwahati Refinery effluent, ferry services, cattle wading, sand recovery, bathing, washing, fishing & human settlements, Town, run offs vegetable cultivation open defaecation.	Water quality problems, sandy substratum.
		Jogighopa near Panchratna bridge Golpara	Bongaigaon industrial township, coal storage on the river bank and transport of coal through motor boats, cremation ground, cultivation, fishing, open defaecation, water intake of Joghighopa Paper Mill, Paddy fields, coal depot, human settlements, brick kiln.	Water quality problems, soil erosion, sandy substratum, habitat destruction of river bank, use of bamboo as sole raw material for paper manufacturing, deforestation in the area.
		Dhubri	Bongaigaon on the opposite bank, cattle wading, washing, sand recovery, fishing, bathing.	Floods

Table 5: Water Quality Status of River Brahmaputra & its Tributaries

S. No.	Parameters		Values	Location
1.	pH	Average	7.44	-
		Minimum	5.44	Buridihing at Margherita
		Maximum	11.2	Elenga Beel at Jagi Road
2.	Conductivity (µmhos/cm)	Average	272.13	-
		Minimum	48.0	River Borak at Panchgram
		Maximum	2590.0	Elenga Beel at Jagi Road
3.	DO (mg/l)	Average	6.29	-
		Minimum	0.6	Elenga Beel at Jagi Road
		Maximum	10.3	River Subansiri at Gerukamukh
4.	BOD (mg/l)	Average	4.13	-
		Minimum	0.3	River Borak at Panchgram
		Maximum	46.0	Elenga Beel at Jagi Road
5.	Chloride (mg/l)	Average	27.5	-
		Minimum	2.0	River Borak at Panchgram, River Disang at Gudamghat, R. Brahmaputra at Pandughat
		Maximum	406.0	Elenga Beel at Jagi Road
6.	Total Dissolved Solids (mg/l)	Average	210.36	-
		Minimum	46.0	River Disang at Gudamghat
		Maximum	1718.0	Elenga Beel at Jagi Road
7.	Sulphate (mg/l)	Average	23.81	-
		Minimum	0.72	River Subansiri at Gerukamukh
		Maximum	175.2	Elenga Beel at Jagi Road
8.	Nitrate (mg/l)	Average	0.309	-
		Minimum	BDL	River Brahmaputra at Maizan
		Maximum	2.25	River Disang at Gudamghat
9.	Boron (mg/l)	Average	1.218	-
		Minimum	BDL	10 times out of 22 observations
		Maximum	2.37	River Borak at Panchgram
10.	Amm. Nitrogen (mg/l)	Average	0.049	-
		Minimum	BDL	10 times BDL, 10 times in Traces
		Maximum	1.0	Elenga Beel at Jagi Road
11.	Total coliforms MPN/100 ml	Average	-	-
		Minimum	300.0	River Buridihing at Margherita
		Maximum	24,000	River Disang, Elenga Beel, River Borak and River Dhansiri
12.	Faecal coliforms MPN/100 ml	Average	-	-
		Minimum	30.0	River Dhansiri at Golaghat
		Maximum	14,000	River Disang at Gudamghat

BDL = Below detection limit

2.3 PERENNIAL RIVERS OF ASSAM – LOCATION AND MORPHOLOGICAL FEATURES

RIVER BURIDIHING

River Buridihing is major tributary of the Brahmaputra in Assam, which arises from the eastern part of Assam and Arunachal Pradesh border.

a. River Buridihing at Bed Camp, Miao (Arunachal Pradesh)

This sampling site is located at upstream of River Buridihing at Miao in Arunachal Pradesh. There is not much human influence on water body except for the removal of River bed stones. The water body is covered on both the banks by Miao Forests.

b. River Buridihing at Dihing Ferryghat, Margherita

The sampling location on Buridihing River is situated on the border of Assam at Margherita near the Railway bridge and NH Road bridge. Margherita is located at downstream of coal mining activities. Hillocks are present on the opposite bank of River. The catchment of opposite bank is covered with Tea gardens. The water body gets influenced by several human activities after entering the Assam border. N.E. Coalfields of Tikak, Tirap etc. are situated upstream of this location.

c. River Buridihing at Gammon, Dullang at Khowang

The sampling site of River Buridihing at Khowang is located near National Highway No. 37. The water body has crossed the entire Upper Assam Industrial areas of Oil and Coal fields. Jokai Reserve Wildlife is located in vicinity of sampling location.

d. River Buridihing at Dihingmukh, Dibrugarh

At downstream of this location, River Buridihing joins River Brahmaputra, a number of small streams join River Buridihing. Wild Ducks and common birds are quite often observed at this location.

RIVER DISANG

River Disang is another major tributary confluencing with the River Brahmaputra at its south bank carrying discharge of Namrup Fertilizer and Assam Petrochemicals Ltd. and its basin covers the catchment area of ONGC Ltd. activities in Sibsagar District. The Disang River originates from Patki Bunn (Naga Hills). The maximum altitude near the source is 2594.15 mtr. The Tisa (original name of the river) after moving 60.8 km towards north, meets its first tributary Towaizo. The combined flow moves further north and meets tributary Tiratjo.

Moving further north, the river appears in the plains near Namrup, a place of historic as well as of industrial importance (Nam means water and rup means silver). The name refers to water shining like silver. From Namrup, the River flows towards north – western direction through the plains of Dibrugarh District. The River flows through the alluvial plains of Dibrugarh and Sibsagar District. After flowing further in west-south-west direction to about 86.4 km, the River meets another tributary Bor Timak Nadi, which originates from the foothills, on the left bank. After crossing a distance of about 22.4 km towards south-west, the River meets, with main tributary Safrai then passes through Nangala – maraghat and turns north. Following a further course, river meets the Diroi and the Dimou tributaries on its right bank. Finally, the river meets Brahmaputra, after a total course of 572 km (including the course of tributaries) near Disangmukh at a distance of 11.2 km from the sub-divisional town Sibsagar.

a. River Disang at Dillighat

Dillighat is the starting point of River Disang at Assam-Arunachal Pradesh Border. At this location, river Disang enters into plains towards upstream of Namrup industrial area. The water body possess pristine water quality at this locations. The coal mining areas are located on the opposite bank of River. The sampling station is located towards coal mining site. Water intake for drinking water supply is towards Arunachal Pradesh. The water intake point is surrounded by Forest and HFC. Tea gardens are located on either side of Dillighat Bridge on River Disang. The area inhabits wildlife such as Tiger, Deer, wild Boar and Elephant. This stretch of river is used for drinking without treatment.

b. River Disang at Lalpagri Ghat, Namrup

The River Disang passes through the Namrup Industrial township before reaching to this location, the River gets all possible effluent drains from industrial town and municipal waste. HFC effluents are also discharged in the River. The sampling site is located near Bamboo bridge. This stretch of River Disang is used for outdoor bathing. Namrup Tea estate is also situated in the vicinity of this location.

c. River Disang at Rajabari, Sibsagar

The sampling site is located by the side of the NH-37. Sibsagar, Rajabari and Dimow towns are located on the bank of River around this location. The opposite bank of River is a grazing land. ONGC drilling operation is done at upstream of Bhojo. An important tributary River Diroi joins River Disang at National Highway crossing.

d. River Disang at Disangmukh, Sibsagar

This is the end point of the River before mixing with the Brahmaputra. Tea gardens are located in nearby areas. The sampling stations on River Disang is located at Sapaigaon. Wild ducks, common birds and wild elephants are often observed at this location. Fish kills are often reported by villagers.

RIVER JHANJI

a. River Jhanji

River Jhanji originates from hills of Nagaland and flows through upper Assam. Jhanji river is one of the major south bank tributaries joining at the middle stretch of the River Brahmaputra. Earlier, the river Jhanji used to carry the discharge from the Tuli Paper Mill at Nagaland. River Jhanji arises from Naga hills and enters Assam-Nagaland border at Tuli where the Nagaland Paper Mills is located. Bamboo forests surrounds the Tea garden surrounding the sampling location. Amghri Tea Estate is located on the opposite bank of River towards Nagaland border.

b. River Jhanji at Amguri Tea Estate, Rajabari

At this location River Jhanji enters the border of Assam from Nagaland. Amguri Tea Estate is located on the opposite bank of River towards Nagaland border.

c. River Jhanji at Sibsagar

The sampling site on River Jhanji was selected at NH-37 crossing of Jhanji. Earlier at this location River Jhanji carried the wastewater discharge from Tuli Paper Mills in Nagaland. Now this industry is not operational.

d. River Jhanji at Jhanji Mukh, Jorhat

River Jhanji joins River Brahmaputra at upstream of this location at Kumargaon near Teok. The surrounding land is used for grazing and forest.

RIVER DHANSIRI

A major south bank tributary to the river Brahmaputra flowing through Golaghat District and supposed to carry the discharge from Numaligarh refinery. River Dhansiri rises from Karbi-Anglong District of Assam and Nagaland Border.

a. River Dhansiri at Keshardubi

The sampling site on River Dhansiri is located near the bamboo bridge across the River connecting villages of Tengani and Nambar etc. Sampling site at Keshardubi is situated in between Dimapur and Golaghat. The opposite bank of River Dhansiri is closed to Nagaland and North Cachar Hills. Wildlife of Elephant, Tiger and Deer are found in this area.

b. River Dhansiri at NRL Jetty, Numaligarh

The sampling site is near Jetty of Numaligarh Refinery Ltd. (NRL) at NH-Crossing. NRL effluents are discharged here.

c. River Dhansiri at Dhansirimukh

Dhansirimukh is the confluence point to River Brahmaputra. The sampling site on river Dhansiri was selected before confluence at boating ghat near Golaghat and Nagaon District border. Common birds and wild ducks are observed here. Surrounding land is used for grazing. Kaziranga National Park ranges are located towards Nagaon on the riverbank. Sampling site is towards Golaghat bank.

ELLENGA BEEL SYSTEM POND

This is a beel system with low lying lands and becomes a small rivulet in lean season but during rainy season the entire low lying area becomes inundated and takes the shape of a beel. This system receives ETP discharge and wastewater from Nagaon Paper Mill of HPC Ltd. Two drains from the paper mill containing different types of sludge ultimately reach the beel systems and causes siltation problem. The water quality of this beel reach the River Kapili / Kalong as a small stream.

a. Ellenga Beel at Belguri, Jagiroad

The water body is stagnant in the village area. Vegetable and paddy cultivation is done in the vicinity. Water hyacinth growth throughout the surface of water body. Surrounding land is covered by forest Kapili River flows in close vicinity.

b. Ellenga Beel System Pond, Jagiroad, Morigaon

This is a vast ecosystem comprising beel water. The site is nearby the HPC Nagaon Paper Mill outlet. Sampling site was selected on the other side of bridge on Elenga beel system pond towards HPC Jagiroad. Water Hyacinth grows throughout the water body.

RIVER SUBANSIRI

This River is one of the major north bank tributaries of Brahmaputra. The River enters into Assam to confluence with the River Brahmaputra after flowing through the hills and forest of Arunachal Pradesh. Dam construction of NHPC is the major activity here. Dam is yet to be constructed. The surrounding of opposite bank is covered by forest. Subansiri is named due to having gold in its sand many years ago.

a. River Subansiri at Gerukamukh

The sampling site on River Subansiri is located at Gerukamukh Subansiri lower Hydro-electric project, near Kendriya Vidyalaya, and between upstream of stone bridge under construction on river and downstream of dam site. NHPC, HE project of 2000 MW is under construction. Earlier the entire area was under Brahmaputra Board. Three months ago the area was inhabited by township, which was taken over by NHPC. Now NHPC township exists alongwith schools and medical centre with 20 beds. Dept. of Forest of Assam Govt. takes care of afforestation activities.

River Subansiri at Gerukamukh

b. River Subansiri at Dhulumukh

Dhulumukh is located in Arunachal Pradesh towards opposite bank of Gerukamukh. Extensive stone harvesting from River bed of Subansiri is carried out transporting through motor boats towards Dam site, where

mining and drilling of NHPC Dam site is done. The surrounding land is grazing and forest.

c. River Subansiri at Chauldhoaghat

The sampling site is located near the NH Bridge at Chauldhua village in North Lakhimpur. Thakaraguri village is located on the opposite bank of River Sugansiri. Sampling site was selected in between Road Bridge and Rail Bridge Opp. to J. K. Hotel on National Highway. Arunachal Pradesh hills are located towards Rail Bridge. The backwater of the river is used for various purposes like washing, bathing etc.

River Subansiri at Chauldhoaghat

d. River Subansiri at Alichiga, Bordubi

Alichiga is located 90 km downstream from Gerukamukh near Trinayan Mandir at Nutal, Tinali. Morolia village is located on the opposite bank of River Subansiri. The sampling site was selected before confluence of River Subansiri with River Brahmaputra. Lakhimpur town is about 20-25 km from this location. The sampling was carried out on the Subansirimukh bank towards ferry ghat and also at opposite bank towards Morolia village. The forest is covered on the other bank towards Jorhat. River Subansiri joins River Brahmaputra in Majulighat at a distance of about 4 km downstream from this location.

Bio-monitoring at River Subansiri at Alichiga

RIVER BORAK

River Borak is one of the important River in Borak valley of Assam state. River Borak comes from Manipur and passes through Silchar, Kathakal, Badarpur, Karimganj and then enters the Bangladesh territory.

1. River Borak at Fuler Tal, Jiribam

   Through Fuler Tal sampling location river enters the Assam-Manipur border. The transport activity for crossing border is through ferry ghat services. The entire area is covered mainly by Tea gardens in the catchment. The other bank of river is towards Silchar, Sonbari and Manipur. Tea gardens start from Assam border.

2. River Borak at Dilkhush Tea Estate

   This is the opposite bank of River Borak at Fooler Tal. The water body comes from the Manipur Border. The sampling site is located at upstream of water intake point. Borak valley starts from Assam border. From Ratachera Assam border is about 10 km on NH-44 and Badarpur is located at 44 km.

b. River Borak at Kathakal

The sampling site on River Borak is located adjacent to NH-44 at the outskirts of Silchar township. The sampling site is towards Anandpur, Kathakal of Silchar town. Panchgram H.P.C. is also located on this bank

at upstream. Gonirgram Siripur Part-I is located on the opposite bank. The surrounding area is urban, Drain from Chachapra from Tukargram joins at upstream of this sampling location. Sampling location is in between Badarpur and Silchar. Chorangi Bazar is located on the opposite bank.

River Borak at Jiribam

River Borak at Kathkal

Bio-monitoring of River Borak, Kathakal

c. River Borak at Badarpurghat, Badarpur

This monitoring station was chosen on Borak river in the Borak Valley to assess the effect of effluent discharged in it from the Cachar Paper Mills at Panchgram in Cachar district. The sampling site on the River Borak is located after the confluence of HPC Panchgram effluents at Badarpur ghat. The sampling site is between the Old Railway Bridge and Road Bridge. The entire stretch is subjected to construction activities of the New Railway Bridge. The water intake of railway is located near the sampling site. Panchgram HPC effluents join before Gamoh Bridge on River Borak. Katighra is on the opposite bank of River. River Dhansiri also joins River Borak at this point.

d. River Borak Downstream at Kalibarighat, Karimganj

The sampling site is at the border area of Assam and Bangladesh. The sampling site on River Borak is located between Steamerghat and Kalibarighat near Kalibari town in Karimganj. Charbazar is located at upstream. Bamboo boats float on the bank of River Borak to be used for various human activities. The BSF camp is located at upstream and Jakhiganj of Bangladesh is located towards opposite bank.

BRAHMAPUTRA BASIN

The Brahmaputra Basin extends over an area of nearly 5,80,000 km^2 and traverses a distance of about 2900 km through Tibet (China), India and

Bangladesh. In India, the basin lies in the states of Arunachal Pradesh, Assam, Nagaland, Meghalaya and North Bengal. The Brahmaputra Basin is bounded on the north by the Himalayas, on the east by the Patkai range of hills running along the Assam-Myanmar Border, on the south by the Assam range of hills and on the west by the Himalayas. The ridge separates it from the Ganga Basin. The Basin has a maximum east-west length of about 1,540 km and a maximum north-south width of about 682 km along 93^0 east longitude.

The River rises in the great glacier in the northern – most chain of the Himalayas in the Kailash range at an elevation of about 5,510 m at a latitude of 30'-31' N, longitude of 82'-10'E just south of the lake called Konggyu Tsho. It enters India across the Sadiya frontiers tract, west of Sadiya town into the Assam valley. Here it is joined by two more tributaries viz. the Dibang or Siang and the Lohit, from here onwards the River is known as the Brahmaputra. The River then descends down into the Assam valley from east to west for a distance of about 720 km with its channels meandering from side to side and forming several islands, one of these islands, Majuli covers an area of 1,250 km^2. During its course the River receives many more tributaries both from the north and the south while some of them are trans-Himalayan Rivers with considerable discharge.

The Brahmaputra has the highest discharge of all the Rivers, because of heavy annual average rainfall in the catchment area. The River has eight significant tributaries in India; three from the north are the Manas, the Kameng (or the Jia Bhoreili) and the Subansiri and three from the east are the Dibang or Siang, the Lohit and the Buri Dihing and two from the north west are the Tista and the Jaldhaka.

a. River Brahmaputra at Saikowaghat, Tinsukia

River Brahmaputra started from the eastern end of Assam, Tinsukia and Dibrugarh Districts. These Districts are having maximum number of small, medium and a few large-scale industries like Digboi Refinery, Oil and Namrup Fertilizers alongwith the coal mining activities by north Eastern Coal Fields at Margherita and Ledo etc. At Saikhowaghat, Tinsukia the River Dibang, Dihing, Kundil, Lohit from Arunachal Pradesh and Dhola, join together to River Brahmaputra. The sampling site is erosion prone and a ferry ghat is located near the sampling station.

b. River Brahmaputra at Nagagholli, Maizan, Dibrugarh

Maijan is situated at the upstream of major townships of upper Assam. The sampling site is located in between Dibrugarh and Tea gardens. Digboi nullah carries the confluence with Dihing River, which is a major tributary to the Brahmaputra.

c. River Brahmaputra at Disangmukh, Sibsagar

The major activity that has direct bearing on the environment is the drilling of crude oil in Sibsagar district by ONGC Ltd. The ONGC Ltd has four major Oil fields at Gelaki, Lakwa, Demalgaon and Rudrasagar, which are continuously kept under vigilance by PCBA (Board). The sampling site is situated at about 16 km from the Sibsagar township.

d. River Brahmaputra at Nimatighat, Jorhat

The sampling site on River Brahmaputra is located at Nimatighat of Jorhat town. Majuli is located on the opposite bank of River at Lakhimpur. Kakilamukh Bird Sanctuary is located at this point. Wild elephants are also found in the sanctuary.

e. River Brahmaputra at Dhanbari Camp, Golaghat

At this location a major tributary River Dhansiri joins on the south bank of River Brahmaputra. River Dhansiri mostly cover the District of Golaghat and supposed to carry the wastewater from Numaligarh Refinery and contribute water quality to River Brahmaputra. Kaziranga ranges are located on the bank of River Brahmaputra.

f. River Brahmaputra at Bhomuraguri, Silighat

Bhomuraguri is located in between Silighat and Nagaon in Sonitpur District. The sampling location on River Brahmaputra is situated at a distance of 6 km from Tejpur town on NH-37A, which joins NH-37 at Kaliabar to NH-52 at Mission Chariali, crossing the River after Brahmaputra Road Bridge. Before construction of the Road Bridge on River, it was a ferry ghat with human settlement on the bank. The ferry and motor boats were used to transport people from one place to other through River. Ari fishes (*Mystus Singhala*) are collected from River Brahmaputra and sold here. The forest department of Assam also maintained the Teak forest. River Buridihing, Disang, Dikrong, Jhanji, Subansiri, Dhansiri and other tributaries join River Brahmaputra at upstream of this location. Further, ahead River goes downstream to Bangladesh. Tejpur is located on the opposite bank of sampling site.

g. River Brahmaputra at Saraighat, Guwahati

Saraighat Bridge connects both the north & south bank of River Brahmaputra near Sadilapur at Guwahati. The sampling site is located at Pandughat before the Road Bridge. The Refinery effluents are discharged at upstream of this location. The Refinery is located at Noonmati. This is the downstream of Central Guwahati.

River Brahmaputra at Guwahati

Bio-monitoring of River Brahmaputra at Bhomuraguri

h. River Brahmaputra at Joghigopa

Situated at the downstream of Assam, Jogighopa is about 20 km from Bongaigaon, Industrial Township of Assam. Golpara is the nearest town to this location. Joghigopa is situated across the Panchratna Bridge also known as Naranarayan Setu on River Brahmaputra on NH-37. This town is located at a distance of 168 km from Guwahati. The sampling site is located near water intake point of Jogighopa Paper Mill in District Bongaigaon. Central Govt.'s Archaeological Department has developed historic site on the hill side. The entire catchment of River Brahmaputra at this location is used for coal storage, transport from Garo Hills of Meghalaya state. 2.8 km long rail cum Road Bridge is also present parallel to NH-37. Bamboo boats are used for various human activities on the bank. Pine tree shrubs have been planted on the bank. Beetle nut and Palm trees are common at this place. A big wetland has been formed from the flood water of Brahmaputra, which extends parallel to NH-37. After Guwahati, a number of tributaries like Manas, Puthimari, Pagladia, and Beki etc. join the Brahmaputra before Jogighopa.

River Brahmaputra at Joghigopa

i. River Brahmaputra at Dhubri

This is situated further downstream of Assam. Dhubri is the last monitoring station on River Brahmaputra before entering the territory of Bangladesh. After crossing the Dhubri District, the River takes its way to the Bangladesh. A match factory existed earlier at this location. Bongaigaon is located on the opposite bank of River.

j. River Jia-Barali at Bukagaon

River Jia-Barali before entering the Assam border, known as River Kameng in Arunachal Pradesh. Sampling locations on River Jia-Barali at Bukagaon is about 345 km from Jonai and 16 km from Jamuguri of Balipara Division on NH-52. The sampling site is located on River Jia-Barali near Road Bridge of NH-52. Department of Irrigation is located on the opposite bank at Towbhanga village. The sampling site is in between Rail Bridge and Road Bridge on River Jia-Barali. River Jia-Barali originates from the hills of Arunachal Pradesh and joins to River Brahmaputra. Fishing competition is held every year among N-E-States for maximum fish catch. The maximum weight reported for fish catch is 17 kg.

Bio-monitoring of River Jia-Barali

RIVER MALIDOR, NEW MALIDOR, JALALPUR

River Malidor passes through Meghalaya State and Karbi Anglong Tea Estate of Assam at Assam-Meghalaya border. River goes downstream to Bangladesh. The sampling location is situated near New Malidor, Jalalpur at Jaintia Hill Border Road. Sonapur is 48 km and Shillong is 145 km from this location. The sampling site on River Malidor was selected on NH-44 near Shiv Temple. Kalain is at 18 km from this location. Beetle nut plantation is common vegetation. Badarpur is 44 km and Umkiang is located at 3 km distance. Tea cultivation is done on hills near Kalain. White Rhododendrons are planted all along the forest. Borak valley starts from the Assam border at this location.

RIVER RANGANADI AT PAHUMARA, LAKHIMPUR

River Ranganadi is an important tributary of River Subansiri. Ranganadi originates from Arunachal Pradesh and joins River Subansiri at Pabori Reserve Forest, about 10-20 km from sampling site. Hydro-electric power generation is the major activity of Ranganadi Hydel Project of NEPCO Kameng in Arunachal Pradesh. The sampling site on Ranganadi is located near Road Bridge of NH-52, and 6 km from North Lakhimpur at Pahumara village. Bamundoloni village is situated on the opposite bank of River. Railway Bridge is parallel to Road Bridge on River Ranganadi. Egrets are observed quite often at this location.

River Ranganadi at Lakhimpur

RIVER BOGINADI AT MILANPUR, LAKHIMPUR

Boginadi comes from hills of Arunachal Pradesh and joins to River Subansiri at downstream at a distance of 3-4 km at Ghaggerghat. The sampling site is located at 16 km from Lakhimpur district on a bypass from NH-52 near Namghar. The opposite bank of River Boginadi is inhabited by Lalpari village. Ratanpur nullah from Hills join River Boginadi about 300-500 mtrs upstream from sampling site.

RIVER DIKRONG AT BANDARDUA

River Dikrong is a tributary of River Brahmaputra. River Dikrong arises from Arunachal Pradesh and joins River Brahmaputra at Majuli in Assam. The River Dikrong passes through border of Bandardua in Assam and Arunachal Pradesh. Itanagar is 25 km from NH-52 crossing. The sampling site on River Dikrong was selected at Harmutty Tea Estate near Higher Secondary School, Parbati Nagar, Bandardua. Harmutty Tea Estate is located towards the opposite bank of River Dikrong.

River Boginadi

Bio-monitoring of River Boginadi

2.4 BIO-MONITORING OF PERENNIAL RIVERS IN ASSAM STATE

The bio-assessment of Perennial Rivers in Assam State was undertaken using Biological Water Quality Criteria (BWQC) using Saprobic Score and Diversity Score of water quality (Table 6).

Fig 1 : Bio-Mapping of Some Important Perennial Rivers of Assam (Year 2003)

Fig 2 : Bio-Mapping of Some Important Perennial Rivers of Assam (Year 2004)

Table 6: Bio-monitoring of Perennial Rivers in Assam State

S. No.	Rivers/ Sampling Period	Location of Stretch	Temperature ^{0}C		Dissolved oxygen mg/l	pH	Saprobic Score	Diversity Score	Biological Water Quality Class	Biological Water Quality
			Air	Water						
1.	River Buridihing	Bed Camp at Miao in Arunachal Pradesh	32.0	20.0	7.9	7.7	8.2	0.5	A	Clean
			20.0	17.0	9.3	7.5-7.8	9.5	0.5	A	
	April, 2003	Dihing, Ferryghat at Margherita	24.0	23.0	6.3	6.5	5.3	0.37	C	Moderate Pollution
			24.0	23.0	6.9	6-6.5	4.8	0.42	C	
	October, 2004	Gammon, Dullang at Khowang, NH-37	23.0	21.0	5.9	6.7	5.3	0.48	C	Moderate Pollution
			24.0	22.0	6.7	6-7	5.2	0.40	C	
		Dihingmukh at Dibrugarh	22.0	22.0	6.9	6.0	5.8	0.43	C	Moderate Pollution
			22.0	20.0	6.5	6-7	5.6	0.40	C	
2.	River Disang	Dillighat, Assam-Arunachal Pradesh border	26.0	21.0	7.6	6.8	7.3	0.5	A	Clean
			19.0	16.0	8.6	7-8	8.7	0.5	A	
	May, 2003	Lalpagari ghat at Namrup Industrial township	22.0	18.0	6.6	6.0	5.0	0.44	C	Moderate Pollution
			22.0	18.0	6.0	7-7.5	5.0	0.29	D	Heavy Pollution
	November, 2004	Rajabari,Sibsagar	30.0	26.0	6.0	6.8	4.8	0.41	C	Moderate Pollution
			22.0	19.0	7.1	6-7	6.0	0.45	C	
		Sepaigaon, Disangmukh Sibsagar	30.0	25.0	5.8	6.4	5.7	0.39	C	Moderate Pollution
			22.0	20.0	6.8	6-7	5.3	0.44	C	
3.	River Jhanji	Amguri, Tea Estate, Rajabari, Assam-Nagaland Border	31.0	24.0	6.2	6.8	6.2	0.51	B	Slight pollution
			20.0	18.0	7.4	7-7.5	6.6	0.53	B	
	May, 2003	NH-Crossing, Jhanji at Sibsagar	30.0	26.0	6.7	6.5	5.7	0.39	C	Moderate Pollution
			23.0	21.0	6.7	6-7	5.3	0.42	C	
	November, 2004	Jhanjimukh, Kumargaon at Jorhat near Teok	30.0	24.0	6.0	6.5	5.7	0.43	C	Moderate Pollution
			22.0	20.0	6.7	6-7	5.2	0.30	C	
4.	River Dhansiri	Kesharidubi, Tengani Nambar, Assam-Nagaland border	26.0	22.0	5.9	7.0	6.5	0.54	B	Slight pollution
			20.0	17.0	7.4	7-8	6.5	0.55	B	
	May, 2003	NRL Jetty at NH-Crossing, Numaligarh	30.0	27.0	6.8	6.4	5.7	0.3	C	Moderate Pollution
			22.0	20.0	6.9	6-7	5.2	0.45	C	
	November, 2004	Dhansirimukh, Golaghat Nagaon district border	29.0	26.0	6.9	6.3	5.2	0.42	C	Moderate Pollution
			20.0	17.0	7.0	7-7.5	4.7	0.35	C	
5.	Ellenga Beel System Pond	Belguri, Jagi Road	32.0	29.0	1.4	7.9	5.0	0.31	D	Heavy pollution
	May, 2003		23.0	21.0	0.8	7-8	3.5	0.36	C	Moderate Pollution
	December, 2004	Jagi road, other side of Bridge, Morigaon	33.0	29.0	0.6	8.0	2.7	0.37	D	Heavy pollution
			23.0	20.0	0.2	8.9	2.4	0.37	D	
6.	River Subansiri	Gerukamukh, Subansiri lower H.E. Project, North Lakhimpur District	24.0	16.0	7.5	7.7	7.0	0.43	A	Clean
		Chaowlohoa ghat North Lakhimpur	27.0	17.0	7.1	7.3	6.7	0.5	B	Slight pollution
	May, 2003	Alichiga, Bordubi	29.0	22.0	6.3	7.0	5.0	0.33	C	Moderate Pollution
7.	River Borak	Fuler Tal, Jirbam, Assam-Manipur Border	30.0	28.0	6.3	7.2	6.1	0.5	B	Slight pollution
		Katakhal, Silchar	29.0	27.0	6.0	6.8	5.8	0.5	C	Moderate Pollution
	May, 2003	Badarpurghat, Badarpur	32.0	29.0	6.1	5.7	5.2	0.43	C	Moderate Pollution
		Kalibarighat, Karimganj, Assam-Bangladesh border	31.0	28.0	6.4	5.9	5.8	0.47	C	Moderate Pollution

S. No.	Rivers/ Sampling Period	Location of Stretch	Temperature ^{0}C		Dissolved oxygen mg/l	pH	Saprobic Score	Diversity Score	Biological Water Quality Class	Biological Water Quality
			Air	Water						
8.	River Brahmaputra	Saikhowaghat, Tinsukia	26.0	24.0	6.9	6.7	7.2	0.5	A	Clean
			19.0	17.0	8.2	7-7.5	7.8	0.5	A	
		Nagagholli, Maizan, Dibrugarh	24.0	19.0	7.6	7.0	6.0	0.5	B	Slight pollution
			20.0	18.0	7.8	7.0	5.7	0.45	C	
		Disangmukh, Sibsagar	30.0	24.0	6.7	6.6	5.6	0.5	C	Moderate Pollution
			23.0	20.0	7.9	6-7	6.0	0.5	C	
	November, 2004	Nimatighat, Jorhat	28.0	20.0	7.4	7.6	5.3	0.39	C	Moderate Pollution
			22.0	19.0	7.5	7.0	5.7	0.50	C	
		Dhanbari Camp, Golaghat	30.0	26.0	6.3	6.2	5.7	0.36	C	Moderate Pollution
			21.0	18.0	7.9	7-8	5.8	0.5	C	
	December, 2004	Bhomuraguri, Silighat	28.0	28.0	6.6	7.2	5.7	0.44	C	Moderate Pollution
			22.0	20.0	7.8	6-7	6.0	0.56	C	
		Saraighat, Guwahati	29.0	27.0	7.5	7.8	5.2	0.46	C	Moderate Pollution
		Jogighopa near Panchratna Bridge	32.0	30.0	7.7	7.9	5.4	0.44	C	Moderate Pollution
	April-May, 2003		22.0	20.0	7.8	7.0	5.0	0.45	C	
		Dhubri	31.0	27.0	6.7	6.9	5.6	0.35	C	Moderate Pollution
			22.0	20.0	7.7	6-7	6.2	0.50	B	
9.	River Brahmaputra November, 2003 December, 2004	Pandu ghat, Sadilapur near Saraighat Bridge	20.0 22.0	23.0 20.0	6.9 7.4	7.0 7.0	5.0 5.7	0.56 0.46	C C	Moderate Pollution
10.	River Borak	Badarpur, Badarpurghat	29.0	25.0	6.7	6-7	6.16	0.43	C	Moderate Pollution
			23.0	20.0	6.9	6-7	5.7	0.47	C	
		Kalighat, Karimganj	26.5	22.5	6.9	6-7	5.3	0.45	C	Moderate Pollution
			22.0	20.0	7.0	6-7	5.8	0.47	C	
	November, 2003	Katakhal on NH-44	26.0	23.5	7.4	6-7	5.7	0.61	C	Moderate Pollution
			23.0	21.0	7.6	6-7	5.7	0.58	C	
	November, 2004	Dilkhush Tea Estate opposite to Fuler Tal	25.6	20.5	7.3	6-7	5.0	0.33	C	Moderate Pollution
11.	River Malidor November, 2003 November, 2004	New Malidor, Jalalpur, Assam-Meghalaya Border	27.0 21.0	23.0 19.0	8.5 8.4	7.0 7.0	7.8 9.2	0.26 0.32	A A	Clean
12.	River Borak Upstream November, 2003 November, 2004	Fuler Tal	26.5 23.0	24.0 20.0	7.0 7.3	6-7 6-7	5.0 5.2	0.31 0.33	C C	Moderate Pollution
13.	River Jia-Bharali	Bukagaon on NH-52	24.0	23.0	6.7	6-6.5	4.8	0.7	C	Moderate Pollution
14.	River Subansiri upstream	Gerukamukh, Subansiri lower H.E. Project	28.0	19.0	8.8	7-7.5	8.1	0.5	A	Clean
	November, 2003		19.0	17.0	8.5	7-8	8.2	0.5	A	
		Dhulumukh, Arunachal Pradesh border	26.5	16.5	8.7	7-7.5	9.3	0.5	A	Clean
	December, 2004	Chauldhuaghat (Pub) north Lakhimpur	25.5	21.0	8.2	6-7	9.0	0.57	A	Clean
			22.0	20.0	7.9	6-7	8.7	0.5	A	

S. No.	Rivers/ Sampling Period	Location of Stretch	Temperature ^{0}C		Dissolved oxygen mg/l	pH	Saprobic Score	Diversity Score	Biological Water Quality Class	Biological Water Quality
			Air	Water						
15.	River Subansiri Downstream	Alichiga, 90 km from Gerukamukh	24.0 22.0	18.5 19.0	7.4 7.9	6-7 6-7	5.3 5.5	0.33 0.37	C C	Moderate Pollution
16.	River Ranganadi November, 2003	Pahumara, Lakhimpur	31.0	25.0	7.1	6.0	4.0	0.32	D	Heavy Pollution
17.	River Boginadi	Boginadi, Milanpur, Lakhimpur District	28.5	29.0	6-9	6.0	6.16	0.52	B	Slight pollution
18.	River Dikrong November, 2003	Harmutty Tea Estate on NH-52, near Higher Secondary School, Bandardua	22.5	19.5	7.3	7-7.5	6.8	0.6	B	Slight pollution
19.	River Brahmaputra	Bhomuraguri Sonitpur District	27.0	21.5	7.6	6-7	6.0	0.2	C	Moderate Pollution
		Jogighopa on NH-37 Panchratna Bridge	27.0	26.0	7.6	7.0	5.1	0.48	C	Moderate Pollution
20.	River Lubha November, 2004	Near Lubha Bridge Sonapur, Meghalaya	22.0	20.0	8.6	7.0	10.0	0.4	A	Clean

Table 7: Clean Water (Class `A') Stretches of Rivers in Assam State (2003)

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Buridihing April & December, 2003	Miao (Arunachal Pradesh)	Bed Camp	*EPHEMEROPTERA/Heptageniidae, Ephemeridae, Pothaminthidae, Caenidae, Baetidae, Leptophlebiidae* *PLECOPTERA/Perlidae* *TRICHOPTERA/Goeridae, Rhyacophilidae* *ODONATA/Lestidae, Gomphidae,Corduliidae* *MOLLUSCA/Viviparidae, Thiaridae, Bithynidae* *COLEOPTERA/Hygrobidae, Noteridae* *CRUSTACEA/Atydae* *HEMIPTERA/Nepidae* *PLANARIA/Planariidae*
2.	River Disang May & December, 2003	Assam-Arunachal Pradesh Border	Dillighat	
3.	River Subansiri May & November, 2003	Gerukamukh, North Lakhimpur	Subansiri Lower H.E. Project	
		Dhulumukh Arunachal Pradesh Border	Opposite Bank of River at Gerukamukh	
		North Lakhimpur	Chauldhuaghat	
4.	River Brahmputra May & December, 2003	Tinsukia	Saikowaghat	
5.	River Malidor November, 2003	New Malidor Jalalpur, Assam-Meghalaya Border	Shiv temple near NH-44	

Table 7a: Clean Water (Class `A') Stretches of Rivers in Assam during 2004

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Buridihing	Miao (Arunachal Pradesh)	Bed Camp	*EPHEMEROPTERA/Heptageniidae, Ephemeridae, Caenidae* *PLECOPTERA/Perlidae* *TRICHOPTERA/Goeridae* *ODONATA/ Gomphidae, Lestidae* *MOLLUSCA/ Thiaridae* *CRUSTACEA/Atydae*
2.	River Disang	Assam-Arunachal Pradesh Border	Dillighat	
3.	River Subansiri	Gerukamukh, North Lakhimpur	Subansiri Lower H.E. Project	
		Dhulumukh Arunachal Pradesh Border	Opposite Bank of River at Gerukamukh	
		North Lakhimpur	Chauldhuaghat	
4.	River Lubha	Near Lubha Bridge	Sonapur, Meghalaya	
5.	River Malidor	Jalalpur	Assam Meghalaya Border	

Table 7b: Slightly Polluted Water (Class `B') Stretches of Rivers in Assam State (2004)

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Jhanji November, 2004	Rajabari, Assam – Nagaland Border	Amguri Tea Estate	*ODONATA/ Lestidae, Gomphidae* *MOLLUSCA/ Thiaridae* *CRUSTACEA/Atydae, Gammaridae* *HEMIPTERA/Nepidae*
2.	River Dhansiri November, 2004	Kesharidubi, Tengani, Nambar	Assam – Nagaland Border	
3.	River Brahmaputra December, 2004	Balasur	Dhubri	

Table 7c: Moderately Polluted Water (Class `C') Stretches of Rivers in Assam State (2004)

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Buridihing October, 2004	Dihing, Margherita	Ferry ghat	*TRICHOPTERA/Hydropsychidae ODONATA/ Lestidae, Gomphidae, Libellulidae CRUSTACEA/Atydae, Gammaridae MOLLUSCA/Thiaridae, Sphaeridae, Viviparidae, Unionidae, Planorbidae, Lymnaeidae, HEMIPTERA/Nepidae COLEOPTERA/ Gyrinidae, Hydrophilidae OLIGOCHAETA/Oligochaetes DIPTERA/Chironomidae*
		Gommon	Dullang at Khowang NH-37	
		Dibrugarh	Dihingmukh	
2.	River Disang November, 2004	Rajabari,	Sibsagar	
		Sipaigaon, Disangmukh	Sibsagar	
3.	River Jhanji November, 2004	Jhanji	NH-Crossing at Sibsagar	
		Jorhat, Jhanjhimukh	Kumargaon near Teok	
4.	River Dhansiri November, 2004	Numaligarh	NRL Jetty at NH-Crossing	
		Golaghat, Dhansirimukh Nagaon	Nagaon district border	
5.	Ellenga Beel System Pond December, 2004	Belguri	Jagi Road	
6.	River Brahmaputra November-December, 2004	Dibrugarh	Nagagholli, Maizan	
		Disangmukh	Sibsagar	
		Jorhat	Nimatighat	
		Golaghat	Dhanbari Camp	
		Bhomuraguri	Silighat	
		Guwahati	Saraighat	
		Jogighopa	Near Panchratna Bridge	
		Guwahati	Pandughat, Sadilapur near Saraighat Bridge	
7.	River Borak November, 2004	Badarpur	Badarpur Ghat	
		Karimganj	Kalighat	
		Katakhal	On NH-44	
		Fuler Tal	Fuler Tal	
8.	River Subansiri downstream	Alichiga	80 km from Gerukamukh	

Table 7d: Highly Polluted Water (Class `D') Stretches of Rivers in Assam State (2004)

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Disang November, 2004	Namrup	Lalpagari Ghat at Namrup Industrial township	*CRUSTACEA/Atydae* *ODONATA/ Gomphidae* *MOLLUSCA/ Sphaeridae, Thiaridae* *HIRUDINEA/Glossiphonidae, Hirudidae* *DIPTERA/Chironomidae* *OLIGOCHAETA/Oligochaetes*
2.	Ellenga Beel System Pond December, 2004	Jagi road, Morigaon	Other side of Bridge	

Table 8: Slightly Polluted Water (Class `B') Stretches of Rivers in Assam State (2003)

S. No.	Rivers/Water Bodies & Sampling period	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Jhanji May & December, 2003	Rajabari, Assam-Nagaland border	Amghri Tea Estate	*EPHEMEROPTERA/Leptophlebiidae* *PLECOPTERA/Perlidae* *TRICHOPTERA/Hydropsychidae* *ODONATA/Lestidae, Gomphidae,Libellulidae, Corduliidae* *MOLLUSCA/Viviparidae, Thiaridae, Bithynidae, Unionidae, Planorbidae* *CRUSTACEA/Atydae, Gammaridae* *HEMIPTERA/Nepidae* *COLEOPTERA/Gyrinidae, Haliplidae, Hygrobidae* *DIPTERA/Chironomidae*
2.	River Dhansiri May & December, 2003	Assam-Nagaland Border	Kesharidubi, Tengani, Nambar	
3.	River Brahmaputra May & December, 2003	Maizan, Dibrugarh	Nagagholli	
		Dhubri	Dhubri	
4.	River Subansiri May, 2003	North Lakhimpur	Chaowlohoaghat	
5.	River Borak May, 2003	Jirbam, Assam-Nagaland Border	Fuler Tal	
6.	River Boginadi November, 2003	Milanpur, Lakhimpur District	Boginadi Pul	
7.	River Dikrong November, 2003	Bandardua, Harmutty Tea Estate	Parbati Nagar, Near Higher Secondary School, NH-52	
8.	River Disang December, 2003	Sepaigaon, Sibsagar	Desangmukh	

Table 9: Moderately Polluted Water (Class `C') Stretches of Rivers in Assam State (2003)

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	River Buridihing	Dihing, Margherita	Ferry ghat	*TRICHOPTERA/Hydropsychidae* *ODONATA/Gomphidae, Lestidae, Libellulidae* *MOLLUSCA/Thiaridae, Sphaeridae, Viviparidae, Planorbidae, Hydrobiidae, Ancylidae, Bithynidae, Lymnaeidae,* *CRUSTACEA/Atydae, Gammaridae* *HEMIPTERA/Nepidae, Belastomatidae* *COLEOPTERA/Heliplidae, Gyrinidae, Hydrophilidae, Dytiscidae, Noteridae* *HIRUDINEA/Glossiphonidae* *OLIGOCHAETA/Oligochaetes* *DIPTERA/Chironomidae*
		Gomman, Dullang at Khowang	Near NH-37 Road Bridge	
		Dibrugarh, Sibsagar	Near NH-Road Bridge, Maizan Tea Estate	
	April & December, 2003			
2.	River Disang	Namrup Industrial Township	Lalpagari ghat	
		Rajabari, Sibsagar	Near NH-37 Road Bridge	
		Sipaigaon, Sibsagar	Disangmukh	
	May & December, 2003			
3.	River Jhanji	Jhanji at Sibsagar	NH-Crossing	
		Kumargaon at Jorhat	Jhanjimukh near Teok	
	May & December, 2003			
4.	River Dhansiri	Golaghat / Numaligarh	NRL Jetty at NH-Crossing	
		Golaghat-Nagaon District border	Dhansirimukh	
	May & December, 2003			
5.	River Subansiri	Bordubi, Lakhimpur	Alichiga	
	May & November, 2003			
6.	River Borak	Golaghat / Silchar	Katakhal	
	May, 2003	Karimganj / Badarpur	Badarpurghat	
		Karinganj, Assam-Bangladesh Border	Kalibarighat	
		Kathakal	On NH-44	
		Dilkhush Tea Estate	Opposite to Fuler Tal	
		Assam-Manipur border	Fuler Tal	

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
7.	River Brahmaputra	Sibsagar	Disangmukh	
		Jorhat	Nimatighat	
		Golaghat	Dhanbari camp	
		Silighat	Bhomuraguri	
		Guwahati	Saraighat	
		Jogighopa	Near Panchratna Bridge	
	May, November & December, 2003	Dhubri	Dhubri	
8.	River Jia-Bharali November, 2003	Sonitpur	On NH-52 Road Bridge	
9.	Ellenga Beel System Pond December, 2003	Nowgaon	Jagiroad	

Table 10: Highly Polluted Water (Class `D') Stretches of Rivers in Assam State (2003)

S. No.	Rivers/Water Bodies	District/Town/ Village	Location of stretch	Taxa/Families of benthic macro-invertebrates available from Rivers
1.	Ellenga Beel May & December, 2003	Morigaon / Jagiroad	Jagi Road	*EPHEMEROPTERA/Baetidae* *CRUSTACEA/Atydae* *MOLLUSCA/Viviparidae, Planorbidae, Sphoeridae, Thiaridae* *COLEOPTERA/Haliplidae* *HEMIPTERA/Pleidae* *HIRUDINEA/Glossiphonidae, Hirudidae* *DIPTERA/Chironomidae* *OLIGOCHAETA/Oligochaetes*
			Jagiroad, other side of Jagiroad	
2.	River Ranganadi November, 2003	Lakhimpur	Pahumara	
3.	River Disang December, 2003	Namrup Industrial Township	Lalpagari ghat	

Table 11: Taxonomic Composition of Benthic Macro-Invertebrates collected from Rivers of Assam

S. No.	Taxa	% Taxonomic composition of Benthic Macro-invertebrates in Biological Water Quality Class				
		Class `A'	Class `B'	Class `C'	Class `D'	Class `E'
1.	Arthropoda	80.0	73.68	58.33	41.66	0.0
	(i) Insecta	93.75	63.45	85.71	33.33	0.0
	(ii) Crustacea	6.25	14.28	14.28	20.0	0.0
2.	Mollusca	15.0	26.31	33.33	33.33	0.0
3.	Platyhelminthes	5.0	0.0	0.0	0.0	0.0
4.	Annelida	0.0	0.0	8.33	25.0	0.0

Table 12: Development of Biological Water Quality Criteria for Rivers of Assam State

S. No.	Taxonomic Group	Range of Saprobic score (1-10)	Range of Diversity Score (0-1)	Water quality characteristics	Water Quality Class	Indicator Colour
1.	EPHEMEROPTERA, PLECOPTERA, TRICHOPTERA, ODONATA, MOLLUSCA, COLEOPTERA, CRUSTACEA, HEMIPTERA, PLANARIA	7.0 - 9.3	0.26 - 0.57	Clean	A	Blue
2.	EPHEMEROPTERA, PLECOPTERA, TRICHOPTERA, ODONATA, MOLLUSCA, CRUSTACEA, HEMIPTERA, COLEOPTERA, DIPTERA	6.0 - 6.8	0.5 - 0.6	Slight pollution	B	Light Blue
3.	TRICHOPTERA, ODONATA, MOLLUSCA, CRUSTACEA, HEMIPTERA, COLEOPTERA, HIRUDINEA, OLIGOCHAETA, DIPTERA	3.5 - 6.16	0.2 - 0.7	Moderate pollution	C	Green
4.	EPHEMEROPTERA, CRUSTACEA, MOLLUSCA, COLEOPTERA, HEMIPTERA, HIRUDINEA, DIPTERA, OLIGOCHAETA	2.2 - 5.0	0.3 - 0.37	Heavy pollution	D	Orange
5.	No benthic macro-invertebrates	0.0 - 0.0	0.0 – 0.0	Severe pollution	E	Red

3.0 BIOLOGICAL WATER QUALITY ASSESSMENT OF PERENNIAL RIVERS IN ASSAM STATE

In Assam State, 46 numbers of river stretches have been assessed for bio-mapping of 14 rivers and tributaries. Out of 46 rivers stretches, 7 river stretches belonging to 5 major rivers namely, River Buridihing at Miaow, River Disang at Dillighat, River Subansiri at Gerukamukh, Dhulumukh, in North Lakhimpur, River Brahmaputra at Tinsukia and River Malidor at New Malidor were indicating the clean water quality (Class `A'). Nine river stretches of total 8 numbers of Rivers

such as River Jhanji at Rajabari, River Dhansiri at Nambar, River Brahmaputra at Dibrugarh, River Subansiri at, River Borak at Fuler Tal, River Boginadi at Lakhimpur District, River Dikrong at Bandardua and River Disang at Desangmukh were slightly polluted (Class `B'). Moderate pollution in water quality of Class `C' was observed in 26 number of river stretches of 9 rivers and tributaries like River Buridihing, River Jhanji, River Dhansiri, River Subansiri, Borak River, River Brahmaputra, River Jia-Bharali and Ellenga Beel Pond System at various locations and different seasons (Table 9). Water quality of Ellenga Beel System Pond at Belguri and Morigaon in May and December was found polluted. Therefore, 4 river stretches of 3 number of water bodies including River Ranganadi and River Disang at Namrup Industrial Township were lying in Class `D' of highly polluted water quality. None of the water bodies showed severe pollution Class `E' of water quality.

River Brahmaputra from its origin to its downstream reaches exhibits different classes of water quality at nine locations (A to I) as shown in Fig. 1. River Brahmaputra water quality is clean only in its upstream stretches at Saikowaghat in Tinsukia. At downstream of this location River Brahmaputra gets slightly polluted at Maizan in Dibrugarh. Rest of the seven locations from downstream Dibrugarh, the water quality of River Brahmaputra remains moderately polluted in Class `C' of water quality. These locations are at Sibsagar, Jorhat, Golaghat, Silighat, Guwahati, Jogighopa and Dhubri. At Dhubri, the water quality of River Brahmaputra gets diluted by the confluence of several tributaries and thus regains its water quality from moderate to slightly polluted water quality class `B' specially during month of December, 2003.

The taxonomic composition of Benthic macro-invertebrates collected from clean water quality stretches (Class `A') of Rivers (Table 7) in Assam supported 20 number of families whereas slightly polluted (Class `B') river stretches were indicated by 19 numbers of families (Table 8). Maximum of 24 numbers of families showed moderate pollution (Class `C') of water quality (Table 9). Highly polluted (Class `D') water quality inhabited only 10 numbers of families (Table 10). 80% of Arthropods dominated the clean water quality stretches. Their population gradually reduced with the increase in pollution of water quality of Class `B, C & D. Molluscs and Annelids were maximum in highly polluted water of Class `D'. No benthic animals belonging to Class `E' were observed (Table 12).

A comparison of Bio-map (Fig. 1 & 2) of year 2003 & 2004 indicates no change in water quality at most of the locations on River Brahmaputra & its tributaries except for few locations. For example, the biological water quality of River Disang at Lalpagari Ghat at Namrup Industrial Township has changed, from Moderate Pollution (Class `C') in 2003 to Heavy Pollution (Class `D') in year 2004. Similarly, the biological water quality of River Brahmaputra at Nagagholli, Maizan in Dibrugarh was slightly polluted in year 2003 and degraded to Heavy Pollution (Class `D') in year 2004.

Water quality of River Brahmaputra at Nagagholli Maizan in Dibrugarh was slightly polluted (Class `B') in 2003 and shifted to Moderate Pollution (Class `C') in 2004. On the other hand, water quality of Ellenga Beel System Pond at Jagiroad, Belguri indicates improvement in year 2004 indicating Moderate Pollution and upgrading from Heavy Pollution during year 2003. Dhubri Station is the last sampling location on River Brahmaputra, which depicts the overall water quality of River Brahmaputra at downstream of Assam State. The biological water quality of River Brahmaputra improved to slight pollution (Class `D') in 2004 compared to Moderate Pollution (Class `C') in year 2003. Following table indicates the total number of families of benthic macro-invertebrates collected during year 2003 and 2004:

Biological Water Quality Class	Total Number of Families of Benthic Macro-Invertebrates	
	Year 2003	Year 2004
A	19	9
B	19	6
C	24	17
D	12	8

An actual water quality assessment relies on collection of mature colonization of benthic macro-invertebrates. Quite often the change in observations of water quality could be due to insufficient biological sampling.

4.0 COMPARISION OF BIOLOGICAL STATUS OF RIVERS IN MEGHALAYA AND ASSAM STATE

Although, Assam and Meghalaya are the sister states of North-Eastern India, their rivers differ from each other with respect to Taxonomical composition of biota (Table 13 & 14) and Biological Water Quality Criteria evolved from the saprobic score and diversity score of water quality (Table 15). Diptera and Megaloptera Taxonomic group of benthic macro-invertebrate families, were totally absent in clean water quality class `A' Rivers of Assam. Plecoptera group was absent in Class `B' water quality and Ephemeroptera and Megaloptera were absent in Class `C' Water Quality Rivers of Assam compared to taxonomic groups of water quality classes of Meghalaya State.

Taxonomic groups of Crustacea, Hemiptera and Ephemeroptera were the additional Taxa existed in the water quality class `D' of highly polluted rivers of Assam. Taxonomic groups of benthic macro-invertebrates of `E' Class water quality were not observed in Rivers of Assam and Meghalaya.

Table 13: Comparison of Taxonomic composition of Benthic Macro-invertebrates in Assam & Meghalaya

S. No.	Group/Taxa	% Taxonomic composition of Benthic Macro-invertebrates									
		BWQC Class `A'		BWQC Class `B'		BWQC Class `C'		BWQC Class `D'		BWQC Class `E'	
		Meghalaya	Assam	Meghalaya	Assam	Meghalaya	Assam	Meghalaya	Assam	Meghalaya	Assam
1.	Arthropoda	86.95	80.0	87.5	73.68	77.14	58.33	57.14	41.66	0.0	0.0
	Insecta	97.5	93.75	89.28	63.45	96.29	85.71	100.0	33.33	0.0	0.0
	Crustacea	2.5	6.25	7.15	14.28	3.7	14.28	-	20.0	0.0	0.0
2.	Mollusca	10.86	15.0	9.37	26.31	11.428	33.33	14.28	33.33	0.0	0.0
3.	Platyhelminthes	2.17	5.0	3.12	0.0	-	0.0	-	0.0	0.0	0.0
4.	Annelida	-	0.0	-	0.0	11.42	8.33	28.57	25.0	0.0	0.0

Table 14: Comparison of Biological Status of Rivers of Meghalaya and Assam

S. No.	Taxonomic Group		Range of Saprobic score		Range of Diversity Score		Water quality	Water Quality Class	Indicator Colour
	Meghalaya	Assam	Meghalaya	Assam	Meghalaya	Assam			
1.	EPHEMEROPTERA PLECOPTERA TRICHOPTERA ODONATA MOLLUSCA CRUSTACEA HEMIPTERA COLEOPTERA DIPTERA PLANARIA MEGALOPTERA	EPHEMEROPTERA PLECOPTERA TRICHOPTERA ODONATA MOLLUSCA CRUSTACEA HEMIPTERA COLEOPTERA PLANARIA - -	7.0-8.6	7.0-9.3	0.2-0.8	0.26-0.57	Clean	A	Blue
2.	EPHEMEROPTERA PLECOPTERA TRICHOPTERA ODONATA MOLLUSCA CRUSTACEA HEMIPTERA COLEOPTERA DIPTERA PLANARIA	EPHEMEROPTERA PLECOPTERA TRICHOPTERA ODONATA MOLLUSCA CRUSTACEA HEMIPTERA COLEOPTERA DIPTERA -	6.0-6.7	6.0-6.8	0.47-0.72	0.5-0.6	Slight pollution	B	Light Blue
3.	EPHEMEROPTERA TRICHOPTERA ODONATA MOLLUSCA CRUSTACEA HEMIPTERA COLEOPTERA DIPTERA MEGALOPTERA HIRUDINEA OLIGOCHAETA	TRICHOPTERA ODONATA MOLLUSCA CRUSTACEA HEMIPTERA COLEOPTERA DIPTERA HIRUDINEA OLIGOCHAETA - -	3.4-6.2	4.2-6.16	0.2-0.8	0.2-0.7	Moderate pollution	C	Green
4.	MOLLUSCA DIPTERA HIRUDINEA COLEOPTERA OLIGOCHAETA - - -	MOLLUSCA DIPTERA HIRUDINEA COLEOPTERA OLIGOCHAETA CRUSTACEA HEMIPTERA EPHEMEROPTERA	2.6-6.0	2.2-5.0	0.2-0.3	0.3-0.37	Heavy pollution	D	Orange
5.	No benthic macro-invertebrates		0.0	0.0	0.0	0.0	Severe pollution	E	Red

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