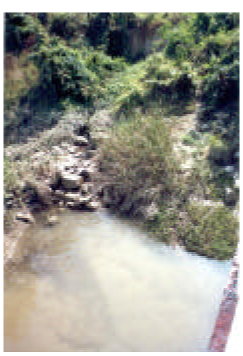
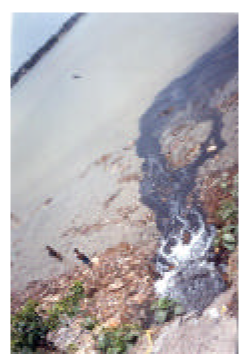
Rapid Estimation of
Major Wastewater Discharges to River Hooghly between the stretch of Palta to DhanKheti Khal







2003



West Bengal Pollution Control Board

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1. Introduction

The Kolkata Metropolitan Area (KMA) is the major urban agglomeration in the state of West Bengal. The river Hooghly, the lower most stretch of the river Ganga, forms the principal drainage line dividing the KMA into two parts *(Figure-1)*. While flowing through this state, the river is receiving both the industrial effluents and domestic effluents the municipal towns located on both the banks of the river. The river is also the major water resource for the three municipal corporations and other municipalities, non-municipal towns and rural mouzas with total population of about 13.22 million (2001 census). Huge quantity of river water is abstracted and treated regularly for supply in the municipal towns on both sides of the river. The river water is used for various purposes like bathing, washing, fishing, industrial cooling, drinking etc.

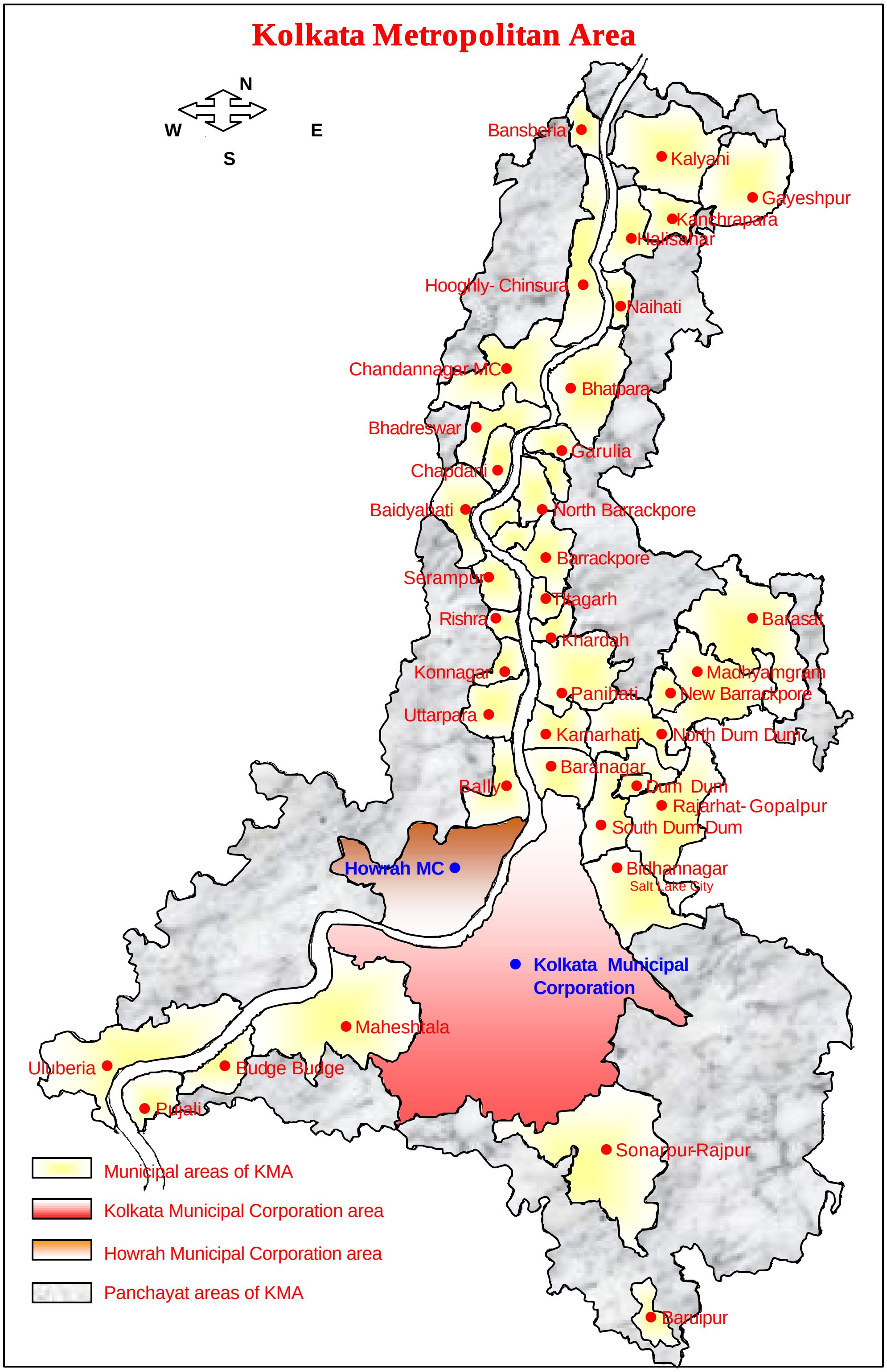
Since early eighties, the West Bengal Pollution Control Board has been monitoring the water quality of the river for assessment it's water quality. Recent data indicate that at a few locations the Biochemical Oxygen Demand (BOD) level (*Table-1*) of the river water is about to cross the 'safe limit' of 3 mg/l. This has attracted the attention of the West Bengal Pollution Control Board. Although several studies have made to assess the pollution load to the river from different sources, considering the seriousness of the issue the Board decided to reassess the contribution of waste discharged to the river water from different sources in the lower stretch of the river in order to take necessary steps to combat the problem.

Table-1: Annual mean BOD concentration at different sampling stations during 1991, 2001 and 2002

Sampling stations	1991	2001	2002
Palta	0.91 mg/l.	2.41 mg/l.	2.25 mg/l.
Dakshineswar	0.87 mg/l.	2.95 mg/l.	2.96 mg/l.
Uluberia	0.96 mg/l.	2.21 mg/l.	2.41 mg/l.
Safe limit	**3 mg/l.**	**3 mg/l.**	**3 mg/l.**

2. Background Information

The National Environmental Engineering Research Institute (NEERI) & the Kolkata Metropolitan Development Authority (KMDA) conducted a rapid monitoring of the BOD loading of the outfalls in Kolkata Metropolitan Area (KMA) during the year 1991. A total of 262 outfalls were covered under this study. The river stretch of 100 km between Kalyani and Birlapur in eastern bank and Tribeni and Uluberia in western bank receives maximum wastewater from approximately 250 outfalls.


Kolkata Metropolitan Area
N
W
E
S
Bansberia
Kalyani
Gayeshpur
Kanchrapara
Halisahar
Hooghly- Chinsura
Naihati
Chandannagar MC
Bhatpara
Bhadreswar
Garulia
Chapdani
Baidyabati
North Barrackpore
Barrackpore
Serampur
Titagarh
Barasat
Rishra
Khardah
Konnagar
Madhyamgram
Panihati
New Barrackpore
Uttarpara
Kamarhati
North Dum Dum
Baranagar
Bally
Dum Dum
Rajarhat- Gopalpur
South Dum Dum
Howrah MC
Bidhannagar
Salt Lake City
Kolkata Municipal Corporation
Maheshtala
Uluberia
Budge Budge
Pujali
Sonarpur-Rajpur
Baruipur
Municipal areas of KMA
Kolkata Municipal Corporation area
Howrah Municipal Corporation area
Panchayat areas of KMA

The river Hooghly is a well mixed estuary and is tidal in nature. The pollutants travel seaward or landward depending upon the low tide or high tide condition prevailing in the river during discharge. On the other hand the wastewater flow and BOD concentration also varies with time *(Figure-2 & 3)*. During high tide the water level rises above the invert level of the drains near the mouth and results into backflow of the river water into the drains. The bigger drains are provided with lockgate arrangements. These lockgates are kept closed during high tide to prevent intrusion of tidal water inside them. The wastewater thus gets accumulated in the drain and discharged in the receding water level *(Figure-4)*. During low tide the river is subjected to critical condition in terms of pollution load and flow quantity.

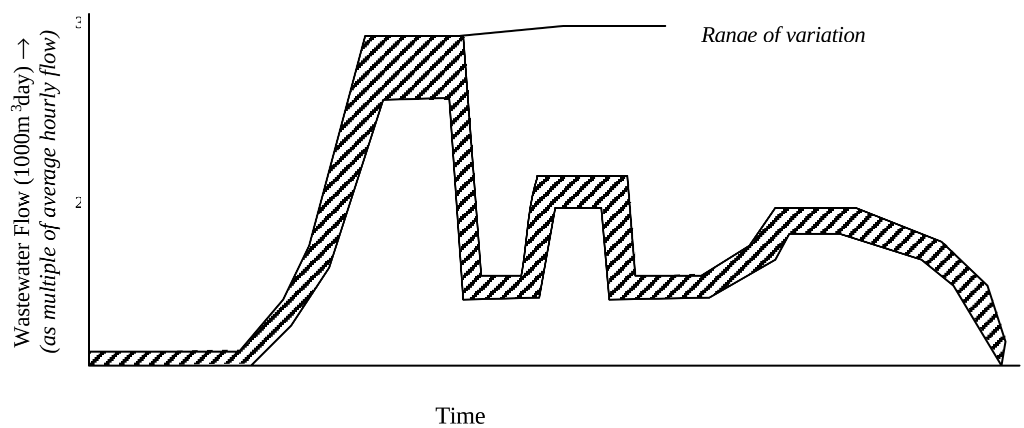


Figure-2: The variation of wastewater flow with time

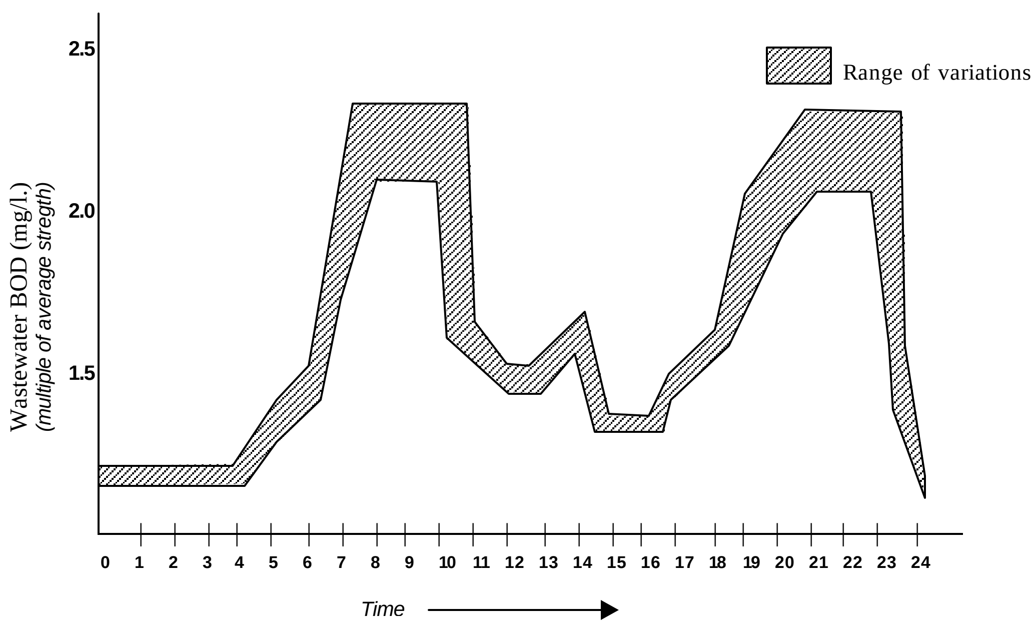


Figure-3: The variation of BOD concentration in wastewater with time

The analysis of data of NEERI study showed that

- More than 70 percent of this BOD load is contributed by the 15-26 major outfalls.
- The contribution of BOD load from domestic and industrial and other sources were 75 percent and 25 percent.

The slope of the city of Kolkata being away from the river; the main sewage canal of the Kolkata discharges to Kultigung in the eastern side of the city. Even though the city sewage of Kolkata is taken care of by the East Kolkata Wetland, contribution form the outfalls carrying domestic waste is found to be much higher than the industrial sources.

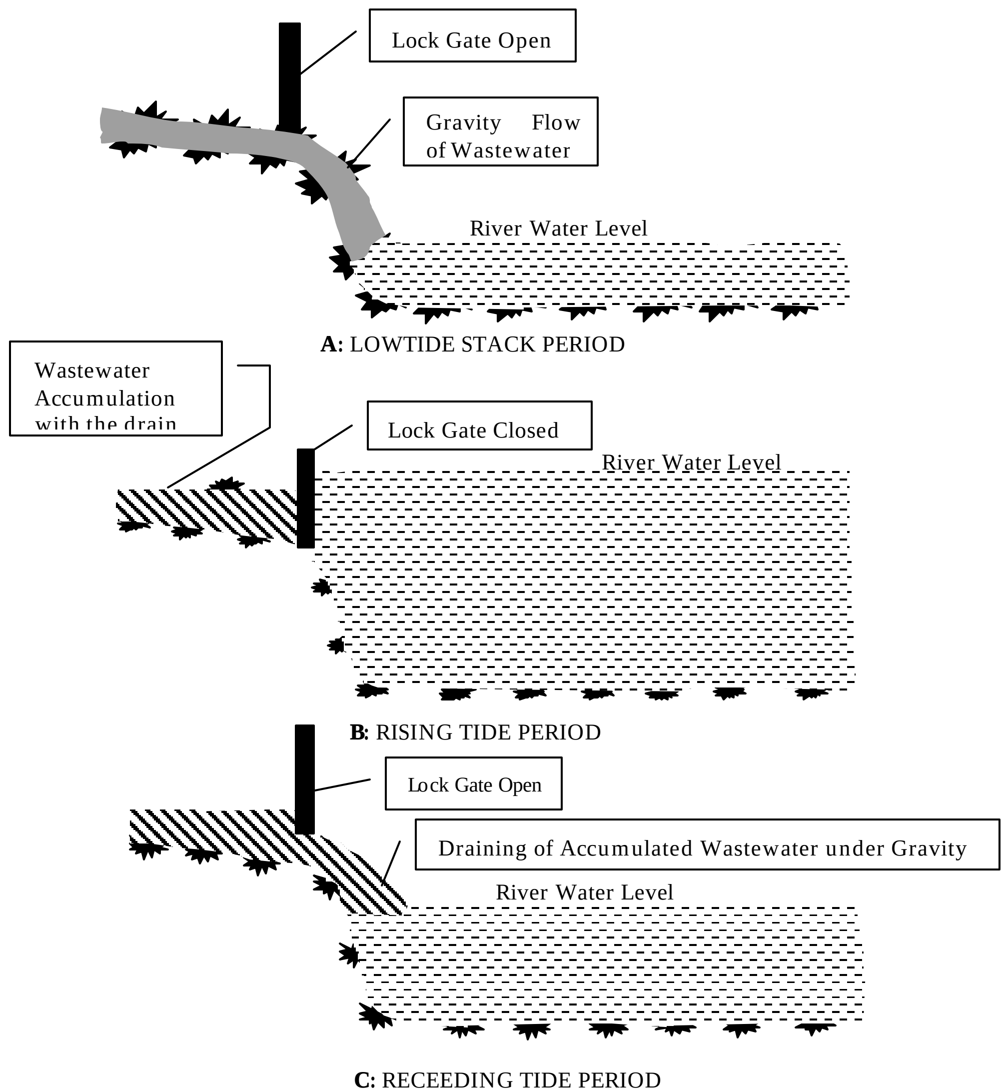


Figure-4: The variations in flow regime in drains with provisions of lockgate

3. Pollution control initiatives in the last decade

Several studies conducted to assess the river quality in different regions of the Ganga identified the following factors responsible for pollution of the river:

(a) the discharge of polluted wastewaters from the factories on either banks of the Ganga contribute about 25 percent of total pollution load;

(b) the discharge of domestic wastewaters and sewage from different cities and towns situated on both sides of the river, bathing of animals in the river, discharge of run-off containing toxic pesticides and other chemicals from the agricultural fields, throwing of half-burnt or unburnt carcasses into the river, dumping of solid wastes along the bank of the rivers, washing of materials in the river using soaps and detergents etc. contribute about 75 percent of total pollution load.

3.1 Pollution Control of river Ganga: the Ganga Action Plan

Considering the problem of pollution of the river Ganga and the recommendations of Central Pollution Control Board on the basis of their survey in June, 1984, the Government of India established the Central Ganga Authority in 1985 under the Chairmanship of the Prime Minister of India and having the Chief Ministers of Uttar Pradesh, Bihar and West Bengal as members along with some other selected Union Ministers and Secretaries. In June 1985, the Ganga Project Directorate (GPD) was established under the Ministry of Environment & Forests, Government of India. The main purpose of the Authority was to adopt a definite time-bound programme for abatement of pollution of the Ganga and to implement the same under the scheme named Ganga Action Plan (GAP). In June, 1986 the Prime Minister formally launched the Ganga Action Plan at Varanasi. The function of the CGA was to apprise and clear the Projects prepared by the field level agencies, release funds and co-ordinate various activities under the GAP. An interdepartmental Steering Committee was set up to formulate the components of the programmes. Besides, the Central Pollution Control Boards and the State Pollution Control Boards constituted under the Water (Prevention and Control of Pollution) Act, 1974 were empowered to monitor and control the pollution of the river from the industrial sources. In addition the Ganga Project Directorate was empowered to control the domestic and municipal sources.

It was decided by the GPD that the water of the Ganga should at least be brought up to the bathing standard relating to certain important parameters, such as

- BOD should not be more than 3 mg/l.
- DO (Dissolved Oxygen) should be more than 5 mg./l.
- Total Coliform should not be more than 10,000 MPN/100ml and Fecal Coliform should not be more than 2,500MPN/100 ml.

3.2 Ganga Action Plan

The Ganga Action Plan (GAP) extends over three states Uttar Pradesh, Bihar and West Bengal, through which the Ganga has flown to meet the Bay of Bengal. The objectives of Ganga Action Plan are to improve the quality of water to make it fit for human use. In order to achieve this, the following activities were decided to be taken up:

1. Pollution abatement to improve the water quality by:
   - interception and diversion of domestic sewage;
   - treatment of sewage with the objective to make it innocuous for disposal in the environment and to effect resource recovery where ever feasible;
   - prevent toxic waste discharge into the river from identified grossly polluting industrial units;
   - control of non-point pollution from human defecation, throwing of unburnt and half-burnt bodies and agricultural runoff.
2. To conserve the bio-diversity of the river and have an integrated river basin management approach.
3. To undertake research in consonance with the above objectives.
4. To gain experience for taking up similar action plan in grossly polluted stretches of other rivers.

In order to frame suitable schemes to achieve the above objectives, surveys were carried out to ascertain the status of pollution contributed by each Class-I city (population exceeding one lakh) situated along the bank of the river. Based on these studies schemes were framed which could address the problem and result in the improvement of water quality. Various schemes were categorised as:

Core Sector Schemes

- Interception and diversion of domestic waste water including construction and rehabilitation of intercepting sewers and pump houses.
- Construction of new sewage treatment plants or renovation or augmentation of existing plants with emphasis on resource recovery.

Non-core Sector Schemes

- Low cost sanitation;
- Installation of crematoria;
- River front development;
- Miscellaneous, such as water quality monitoring, research programmes, management of wastes from grossly polluting industries etc.

The Ganga Action Plan has two phases – Phase–I and Phase-II. The GAP (Phase-I) started in West Bengal in 1986. Under this Plan the State Government had taken up a total of 110 schemes with 100% Central financial assistance. The State Government has taken up both the schemes under Core and Non-core sectors in Phase-I. The GAP (Phase-I) was executed mainly through four agencies viz. like Kolkata Metropolitan Development Authority & Kolkata Metropolitan Water & Sanitation Authority, Public Health Engineering Directorate and Municipal Engineering Directorate. The GAP Phase-II was commenced from 1996-97.

Subsequently, at the central level the GPD also expanded and it was renamed the National River Conservation Directorate (NRCD).

3.3 Industrial Pollution Control

The major water polluting industries of the state have been brought to compliance path through continuous pressure and persuasion from the West Bengal Pollution Control Board. All of them have installed effluent treatment plants. Although a total of 79 large and medium industries discharge their effluent directly or indirectly to the river, 12 industries discharge directly to the river. These industries along with other major water polluting industries are regularly monitored by the Board following a fixed schedule. In case of non-compliance legal actions are initiated. Over the years the number of defaulters have been reduced considerably. Most of these industries are discharging effluent with pollutant levels below permissible limit. This suggests the pollution load from industrial sources have reduced considerably.

4. Methodology

4.1 Reconnaissance survey

The survey team conducted reconnaissance survey along the both banks of the river. The river stretch between Palta to Dhankheti Khal has been covered in this study as the survey conducted by NEERI in 1991 indicated that the river receives maximum organic loading in this stretch. It includes zone V-VIII of the ten zones surveyed by the NEERI in 1991 *(Figure-5)*. One thirty one outfalls are covered in this stretch during the present survey. Most of these outfalls were already identified and mapped in the NEERI-KMDA report published in 1993. Two new outfalls have also been identified during the present survey. The photographs of these outfalls are at *Annexure I*. During this survey the flow were measured in as many outfalls as possible to obtain preliminary estimate of wastewater discharged though each of these outfalls.

4.2 Cross checking the data and prioritizing the sampling points

The information available regarding the location of these oufalls are cross-checked with the NEERI-KMDA report and recent remote sensing data available with the Institute of Wetland Management & Ecological Design (IWMED) to ensure no outfall is missed during the study. The information gathered from this study suggested that at least thirty eight

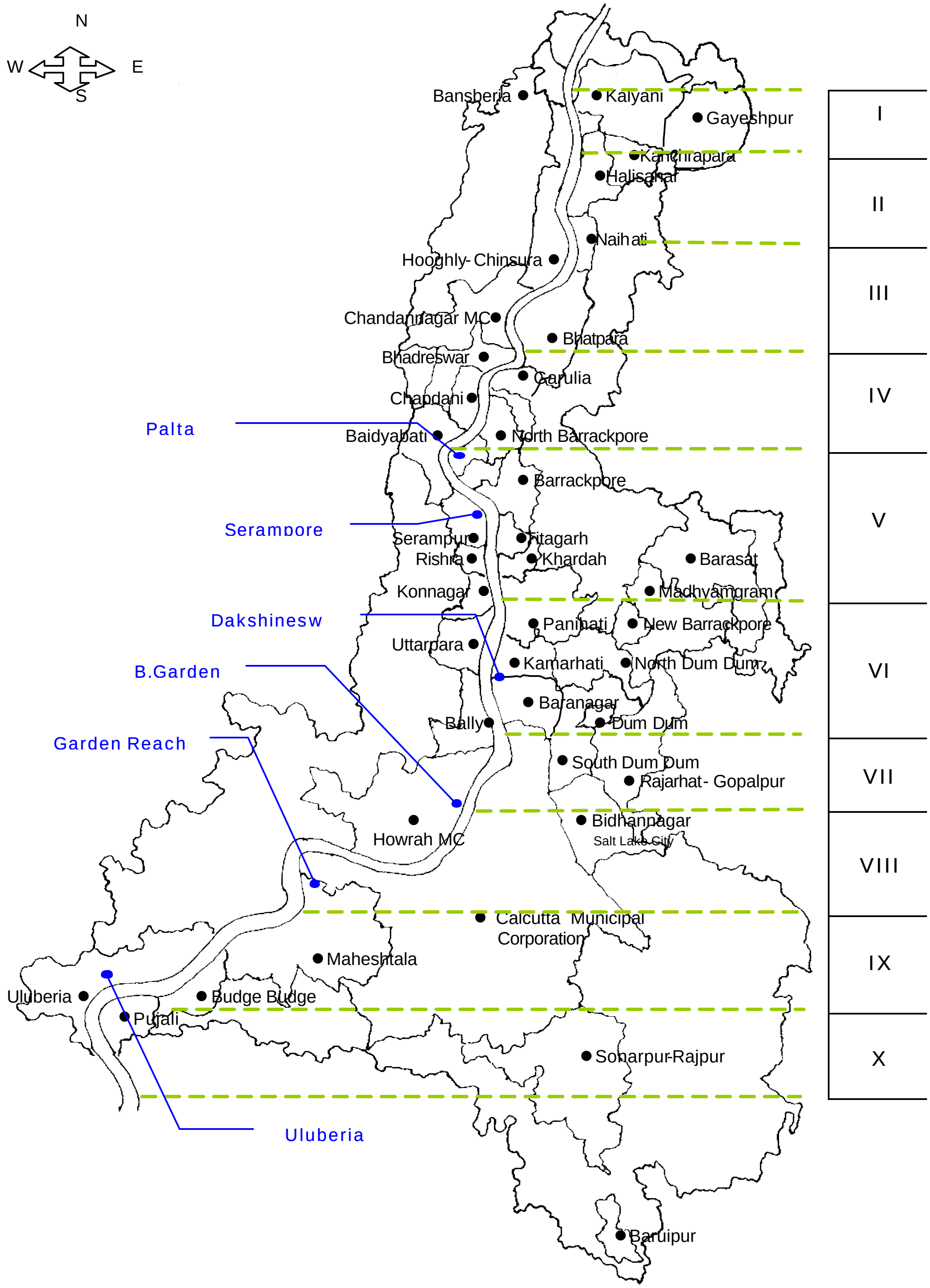


Figure-5: Kolkata Metropolitan Area (KMA) showing Zone Schemes in river Hooghly

outfalls must be covered to compare the amount of BOD discharged to the river currently with that of the previous study. One new major outfall is also considered for monitoring.

4.3. Selection of sampling schedule

Samplings were scheduled in such a manner that dilution due to intrusion of tidal water from the river Hooghly remained minimal. The zone VIII was selected as the first stretch of the river for this survey. Three samples were collected at an interval of four hours at each of the eight outfalls from both banks and at three points in the river.

Three different teams were assigned to collect the samples from the outfalls at both banks. Another team collected river water.

The sampling was conducted in the stretch from Howrah Bridge to Dhan Kheti Khal on 24.2.2003. The sampling in the upstream stretch upto Palta was conducted on 22.4.2003 and 23.4.2003. During this survey zone V- VII was covered. The study included monitoring of the following parameter:

- The flow in outfalls by surface float method or by weir wherever applicable.
- pH, Temperature, BOD, COD and TKN (Total Kjeldhal Nitrogen) were measured for the samples collected from the outfalls.
- pH, Temperature, DO, BOD, COD and TKN were measured for the river water.

5. Results and Observations

The results of this survey are scaled to obtain average BOD loading and average flow discharged from these outfalls. The average waste load in terms of BOD is estimated by multiplying the average BOD by the average flow data. The BOD discharge results available in NEERI-KMDA report are also converted to obtain average BOD discharges from these outfalls during 1991. The 2003 results are compared with 1991 results *(Table-2)* and *(Figure-6)*. The results indicate there is an overall reduction in BOD load, discharged through these 38 outfalls. The BOD load, discharged through many of these outfalls has reduced considerably but in certain outfalls this has increased many fold during the last twelve years.

During this survey it was noticed by the survey team that in many areas municipal solid wastes are dumped on both banks of the river. The leachates of these wastes flow to the river. This waste also flows with the surface run-off to the river during monsoon period and also during high tide and contribute to increase the BOD level of the river.

Moreover, the survey team also observed that at many places the lockgates and the interceptions meant for diversion of wastewaters are not maintained properly. These lockgates, interception and diversion works need regular maintenance.

The regular water quality monitoring records maintained by the State Board shows that the Coliform count is also river high in this river stretch. The high value of total and fecal coliform indicates microbial contamination form municipal waste sources.

Although the total BOD load discharged through these 38 outfalls have reduced over this twelve years period but during this period the BOD level of the river water has increased. This apparent anomaly may be due to the fact that this study has covered major outfalls located in the five downstream zones of KMA. The change in wastewater discharges in the upstream major outfalls are proposed to be estimated in non-monsoon period. The total estimate of wastewater discharged in KMA would be available once the study is complete.

The probable other probable reasons for this increase in BOD are:

a) Indiscriminate dumping of municipal solid wastes along the river bank;
b) Increase in non-point discharge in the upstream of the river due to population explosion;
c) Inadequate functioning of interception diversion work at certain locations;
d) Availability of less dilution water compared to total waste discharged from different sources during lean season.

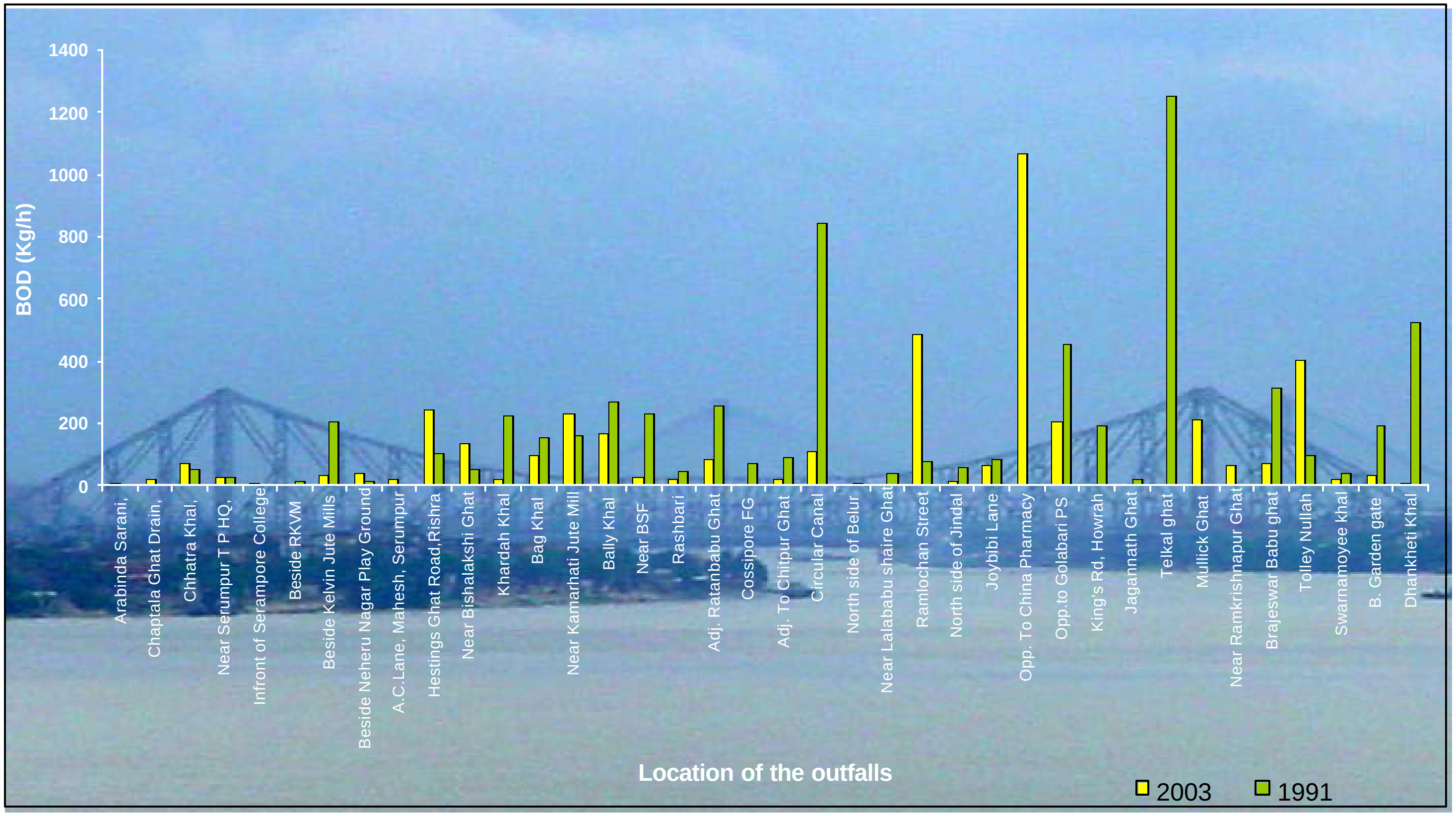
However, these inferences were arrived on the basis of single day observations. The study may be extended in post and pre monsoon season in detail in all the ten zones to obtain a complete database.

Table – 2: Average BOD load through different major outfalls estimated during 1991 and 2003

Out fall No.	Location of the Outfall	Average BOD load (in Kg/hr.)		Comparison between 1991 and 2003 survey results
		1991	2003	
V/R-1	Arabinda Sarani, Chatra, Serumpur by the side of Abdul Mannan's house	0.00	5.66	insignificant flow in 1991
V/R-2	Chaptala Ghat Drain, by the side of Banyan tree, Chatra, Serumpur	3.57	19.40	five times hiegher
V/R-3	Chhatra Khal, Chatra, Serumpur	49.38	71.13	higher
V/R-4	Near Serumpur Traffic Police HQ, M. G. Rd, Serumpur	25.06	28.51	almost same
V/R-5	Infront of Serumpore College	3.55	6.94	two times higher
V/L-1	Beside RKVM	17.01	0.84	95% reduction
V/L-3	Beside Kelvin Jute Mills	206.73	35.71	83% reduction
V/R-7	Beside Nehru Nagar Play Ground	10.67	43.12	four times higher
V/R-8	A. C. Lane, Mahesh, Serumpur	4.80	22.64	five times higher
V/R-11	Hestings Ghat Road, Rishra	106.30	242.10	two times higher
V/L-5	Near Bishalakshi Ghat	53.62	134.83	three times higher
V/L-6	Khardah Khal, P. K. Biswas Road	222.93	23.32	90% reduction
V/R-12	Bag Khal, at municipal boundary of Rishra and Konnagar municipality	152.83	100.65	34% reduction
VI/L-5	Near Kamarhati Jute Mill	163.30	230.21	1.4 times higher
VI/R -9	Bally Khal	272.00	168.22	38% reduction
VI/L-12	Near BSF	231.34	29.00	87% reduction
VI/R -13	Rashbari, 6 Kakeswartala lane, Bally	46.02	22.02	52% reduction
VI/L-16	Adj. Ratanbabu Ghat, 1/3 Chandra Kumar Rou Lane, Kolkata-2	254.90	82.20	68% reduction
VI/L-17	Cossipore Ferry Ghat	72.41	3.03	96% reduction
VI/L-21	Adj. To Chitpur Ghat, 8 , Dilarjung Road	90.97	23.26	74% reduction

Out fall No.	Location of the Outfall	Average BOD load *(in Kg/hr.)* 1991	2003	Comparison between 1991 and 2003 survey results
VII/L-1	Circular Canal	846.09	108.80	87% reduction
VII/R-2	North side of Belur	8.94	0.00	Not available
VII/R-4	Near Lalababu Shaire Ghat	38.64	4.46	88% reduction
VII/R-5	Ramlochan Street	77.81	486.40	six times higher
VII/R-6	North side of Jindal Factory	60.98	12.37	80% reduction
VII/R-7	Joybibi Lane, Belur	84.69	63.10	25% reduction
VII/R-8	112 J. N. Mukherjee Road Opp. to China Pharmacy	0.00	1069.78	could not be measured in 1991
VII/R-14	Opp. to Golabari Police Station	456.72	203.46	55% reduction
VII/R-15	King's Road, Howrah	191.30	0.00	not available
VII/L-8	Jagannath Ghat	19.48	0.00	not available
VIII/R-3	Telkal Ghat, (Launch Ghat)	1249.38	3.65	99% reduction
VIII/R-4	Mullick Ghat, Intercepted	0.00	211.84	no flow in 1991
New	Near Ramkrishnapur Ghat	0.00	64.52	no flow in 1991
VIII/R-8	Brajeswar Babu Ghat	314.71	70.39	78% Reduction
VIII/L-2*	Tolley Nullah at Dahi Ghat	99.20	405.91	four times higher
VIII/R-10	Swarnamoyee Khal, 5/6 Foreshore Road	42.60	18.58	55% reduction
VIII/R-11	Botanical Garden Gate, 37/39 Foreshore Road	190.13	32.72	835 reduction
VIII/L-10	Dhankheti Khal	526.75	6.04	99% reduction
Total BOD load in Kg./hr.		**8187.80**	**6057.77**	**25% reduction**

* *Excavation work was going on during 2003 sampling*



Figure–6: Estimated BOD load during 1991 and 2003 reaching Hooghly river through different major outfalls

Photographs of different outfalls discharging waste water to the river Hooghly

Dhankheti Khal, Garden Reach
(24-02-2003)

CESC Balughat, Garden Reach
(24-02-2003)

Chandpal Ghat
(24-02-2003)

Gwalior Monument
(24-02-2003)

CPT Jetty
(24-02-2003)

Jagannath Ghat
(24-02-2003)

Raja Bagan Kheya Ghat Khal
(24-02-2003)

Ram Lochan Street, Belur
(23-04-2003)


n

Shibpur Bichali Ghat
(24-02-2003)

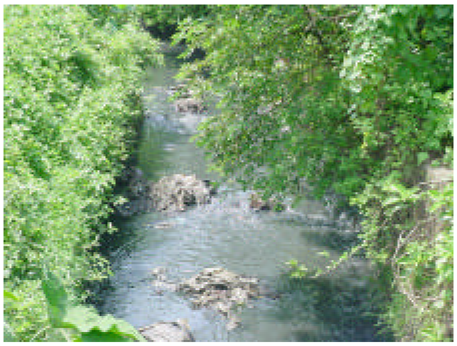
Brajeswar Babu Ghat
(24-02-2003)

North side of Jindal Factory
(23-04-2003)

Rashbari, Belur
(22-04-2003)

Bally Khal
(23-04-2003)

Bally Khal
(23-04-2003)



Bag Khal
(22-04-2003)

Sadgop Para Lane Drain, Mahesh, Srirampore *(22-04-2003)*

Namakgola Ghat, Kings Road, Howrah *(23-04-2003)*

Joy Bibi Lane, Belur
(23-04-2003)

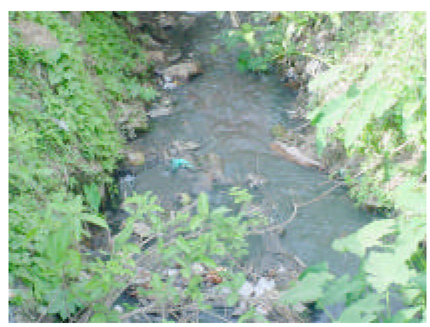
Abani Dutta Road, Salkia, Howrah
(23-04-2003)

Abani Dutta Road, Salkia, Howrah
(23-04-2003)

Asutosh Chatterjee Lane Drain, Srirampore *(22-04-2003)*

Dey Street drain, in front of Srirampore College *(22-04-2003)*

Telkal Ghat
(24-02-2003)



Drain by the side of Serampore Traffic Pollice HQ *(22-04-2003)*

Mullick Ghat Road
(24-02-2003)

Martin Burn
(24-02-2003)

Ramkrishnapore Ferry Ghat– right side (opp. of Eden Gardens) *(24-02-2003)*

Shibpore Burning Ghat
(24-02-2003)

Botanical Garden
(24-02-2003)

Swarnamoyee Khal
(24-02-2003)

Lala Babu Shaire Ghat, Belur

(23-04-2003)