CHAPTER 3

ROAD TRANSPORT CONDITIONS AND FUTURE DEVELOPMENT PROSPECTS IN THE STUDY AREA

CHAPTER 3 ROAD TRANSPORT CONDITIONS AND FUTURE DEVELOPMENT PROSPECTS IN THE STUDY AREA

3.1 Existing Road Transport

3.1.1 Road Network

(1) Road Classification

In India, roads are classified into the following four (4) categories:

- National highways including expressways;
- State highways;
- Major district roads; and
- Other roads (urban and village roads).

(2) Road Network in India

The arterial road network in India consists mainly of the following six (6) national highways: NH1, NH2, NH4, NH5, NH6, and NH8. These arterial roads form the so-called golden quadrilateral, which comprises Delhi, Mumbai, Chennai and Kolkata. Other arterial roads connect to these six (6) arterial roads as branch roads (see **Figure 3.1.1**)

The National Highways Authority of India is responsible for the national highways including the expressways and each state takes care of the state highways within the state while each district takes care of the rural and other roads within their districts. The total length of roads by category is set forth in **Table 3.1.1**.

Table 3.1.1 Road Length by Category in India

Unit: km

Type	Length
Expressways	200
National Highways	66,590
State Highways	128,000
Major District Roads	470,000
Rural and Other Roads	2,650,000
Total	3,314,790

Source: NHAI

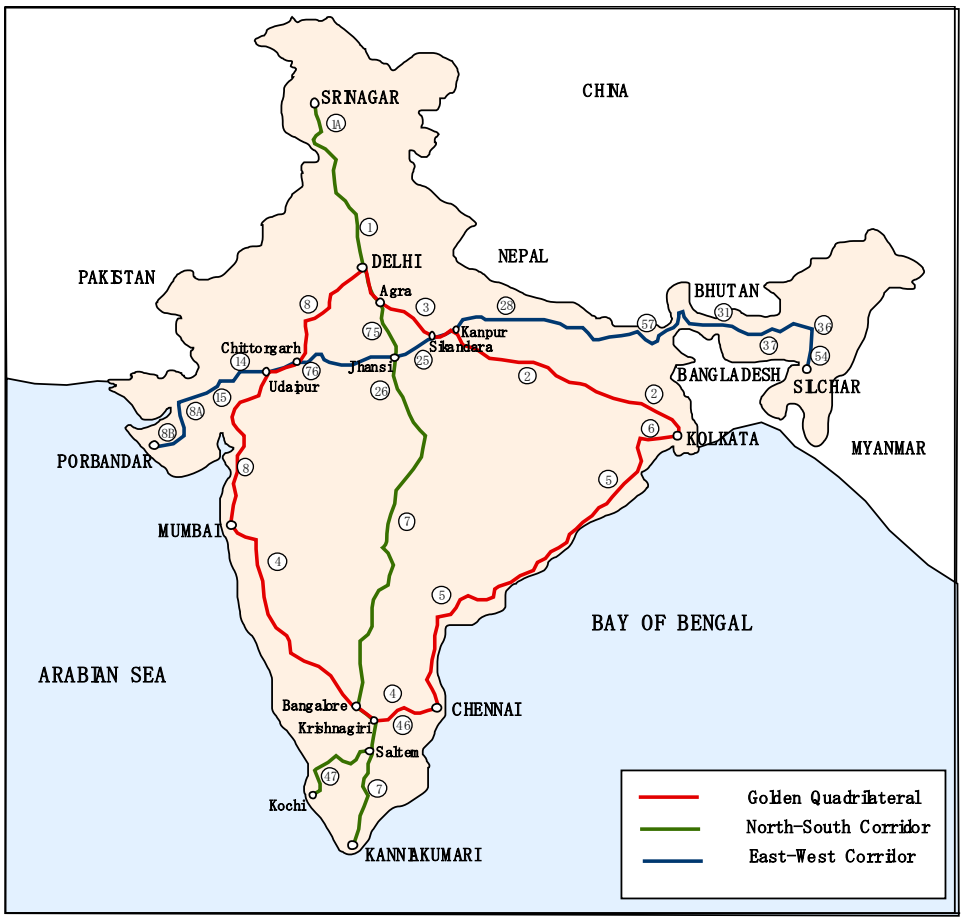


Figure 3.1.1 National Highways Network in India

3.1.2 Arterial Road Network Condition

(1) Road Network in West Bengal and the Study Area

a) Network Perspective

Table 3.1.2 shows the length of roads in West Bengal by category with a total of around 17,000 km. With regard to the configuration of the road network, Kolkata is located at the eastern end of the arterial national highway grid and is connected to Delhi by NH2 and Mumbai by NH6. Another important feature is the north-south development corridor, which is comprised of NH31, NH34 and NH35 in conjunction with the connection to Bangladesh in the eastern part of West Bengal, and Nepal and Bhutan. NH2, NH6, NH34 and NH35 make up the backbone of the state-wise road network in West Bengal.

b) Road Connectivity with the International Gateways

There are three major international gateways in West Bengal other than the land cross-border gateways mentioned above. These are Netaji Subhash Airport, Kolkata Dock and Haldia Port. Netaji Subhash Airport is connected to Kolkata City by NH34. Kolkata Dock is located alongside the 2nd Hugli Bridge in Kolkata City while Haldia Port is located inside of the Haldia Industrial Complex and is connected to the arterial national highway grid consisting of NH6 and NH41.

(2) Road Conditions in the Study Area

a) Road Length

The road lengths in the relevant districts in the study area are set forth in **Table 3.1.2** showing more than 8,000 km in total.

Table 3.1.2 Road Lengths in Relevant Districts in the Study Area

Unit: Km

District	Category				
District	National Hwy	State Hwy	District Rd	Rural Rd	Total
Total Medinipur	290	393	851	555	2,089
Haora	63	13	279	183	538
Hugli	57	234	313	580	1,184
24 North Parganas	93	147	557	547	1,344
24 South Parganas	141	185	450	441	1,217
Total Parganas	234	332	1,007	988	2,561
Kolkata					1,830
Study Area	644	972	2,450	2,306	8,202
W. Bengal	2,332	2,470	6,330	6,225	17,357

Source: P.W.D. (Road), Govt. of W. Bengal
Note: Lengths in the district are as of 2004. Lengths of NH and SH in W. Bengal are as of 2006.

b) Level of Service of Roads

The main road characteristics in the study area are shown in **Table 3.1.3**. All major roads in the study area have been paved once and the surface conditions on the national highways are satisfactory due to the maintenance activities that are carried out. However, the surface conditions on some of the state highways and other roads are unsatisfactory. In particular, in terms of narrow roads with a width of between 3-4 meters, vehicles and other users have been experiencing traffic congestion and low levels of service.

Table 3.1.3 Major Road Characteristics in the Study Area

No.	From	To	Distance (km)	Carriageway Width (m)	Surface Condition	Land use
1	Dumdum (Air Port)	Krishnanagar	97.0	6.5 - 7.0	Good & partly fair	Built-up, agricultural and barren area.
2	Dakbanglo More Barasat	Bangaon	53.0	5.0 -7.0	Good & partly fair	Built-up, agricultural and industrial area.
3	Bangaon	Chakdah	31.0	5	Fair, poor and partly very poor	Built-up and agricultural area
4	Kolkata (Backbagan)	Chakdah (Simurali)	75.2	15 - 30	Good & fair	Built-up and industrial area
5	Barrackpur	Barasat	14.1	7 - 8.0	Good & fair	Mostly built-up area
6	Bally (Bhuiapara)	Dum dum Airport	13.0	14 – 20 m	Good & fair	Built-up area
7	E M Bypass (Near Science city)	Gosaba (Ghatkhali Farryghat)	97.0	5 - 7 m	Good, fair & partly poor	Built-up, agricultural & partly industrial area
8	Kulpi	Science City	68.0	up to 59.0 km 2 lanes /after that 4 - 6 lanes	Good & fair	Built-up and agricultural area. Around 47 – 56 km industrial area
9	Kona (NH-6)	Bakkhali	139.1	12 – 18 m in 4 lanes (partly 36 m) /4 – 7 m in 2 lanes	Good, fair & partly poor	Built-up, agricultural and partly industrial area
10	Bally (Bhuiapara)	Kharagpur	115.0	14 – 18 m in 4 lanes	Good	Built-up, agricultural, industrial and barren area
11	Mecheda (NH-41)	Haldia (Dockgate)	53.7	8 - 9 m	Good & fair	Built-up and agricultural area

12	Haldia (Ranichak)	Tamluk More (Mecheda)	53.7	5.0 - 7.0 m	Good, fair and partly poor	Built-up and agricultural area
13	Contai	Nandakumar	52.8	5.0 - 7.0 m	Good & fair	Built-up and agricultural area
14	Belda	Contai	53.1	7 m	Good & fair	Built-up and agricultural area
15	Chandrakona Road	Sonakonia	108.4	5 - 7 m in 2 lanes /18 m in 4 - 6 lanes	Good & partly poor	Built-up, agricultural and partly industrial area
16	Tamluk (Manicktala More)	Panskura	25.6	3.5 - 4 m	Poor & very poor	Built-up and agricultural area
17	Bally (Bhuiapara)	Burdwman	85.0	18 – 20 m	Good	Built-up and agricultural area
18	Baidyabati Chowrastha	Jaminbaria (Singur)	9.5	6 - 7 m	Good, fair & poor	Built-up, agricultural and industrial area
19	Kazipara (Howrah)	Navadwip	114.0	4 - 8 m	Good, fair & poor	Built-up, agricultural and patly industrial (3-10, 12-20, 27-35km) area
20	Nabadwip-(He mantapur)	Krishnanagar (Palpara more)	16.4	5 - 7 m	Good	Built-up and agricultural area
21	Sarisa (Ashram More)	Nurpur	12.3	5.5 - 7.0	Good & fair	Built-up and agricultural area
22	Raichak More	Raichak Ferryghat	2.2	6.5 - 7.0	Good	Built-up, agricultural and industrial area
23	Kamarpole (Sarisa)	Kalicharan pur (Raichak)	5.6	3 - 4 m	Fair, poor & very poor	Built-up and agricultural area
24	Brojalal chak	Kukrahati	13.5	4 - 6 m	Good, fair & poor	Built-up and agricultural area
25	Chingrighata(E MBy Pass)	Tegharia (V I P Road)	16.4	20 - 22 m	Good	Built-up area
26	Hestings(Kolka ta)	Dumdum Airport	22.8	28 m in 6 -8 lanes /23 m in 4 - 6 lanes	Good	Built-up area
27	Fatepur	Falta	13.5	5 m	Good, fair, poor & very poor	Built-up and agricultural area
28	Dostipur	Dighirpar	2.6	5 m	Good	Built-up and agricultural area
29	Falta	Nurpur	10.7	3.5 - 4 m in 1.5 lanes /4 - 7 m in 2 lanes	Good, fair, poor & very poor	Built-up, agricultural and industrial area

30	Amtala (N H-117)	Baruipur (Padmopukhur)	17.5	5 - 6 m	Good	Built-up and agricultural area
31	Naihati (Baroda Bridge)	Ashoke Nagar (Building More)	25.3	4 - 6 m	Good, fair, poor & very poor	Built-up and agricultural area

Source: Survey by the JICA Study Team

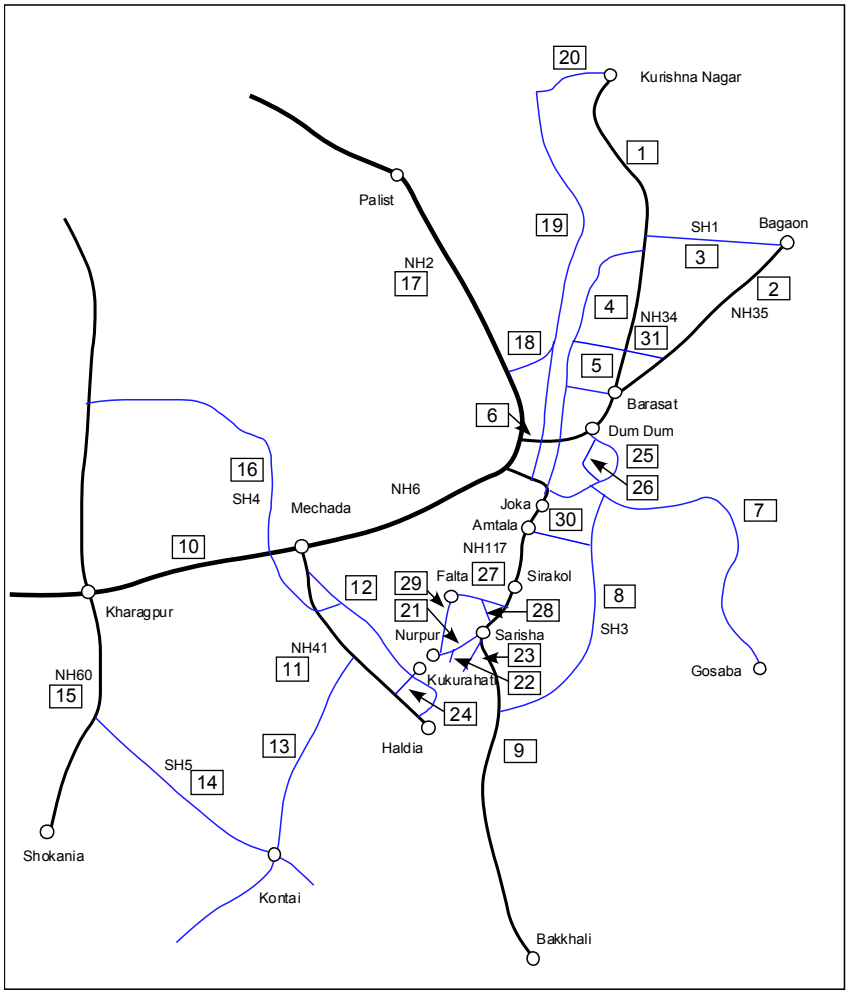


Figure 3.1.2 Existing Main Roads in the Study Area

c) Network Conditions

Raichak Side

The road network on the north side and the south side of the Hugli River shows different features. The major built-up areas on the north side of the Hugli River (the Raichak side), are connected to Kolkata City by NH117. Many state highways and major district roads are feeder roads to NH117.

There are no 4-lane arterial roads in South 24 Parganas. Although the Diamond Harbour Road is a single major road connecting Raichak, Nurpur, Kulpi Falta, Sarisha and Sirakol, and Kolkata, this road consists of only 2-lanes and is always congested around the existing built-up areas. SH3 could also be a major regional road in South 24 Parganas. The road width is, however, narrow and the function of the road is more like a community road rather than a regional road as it passes through densely populated areas. High speed vehicles, buses, trucks, low speed non-motorized vehicles and pedestrians use the same carriageway.

Kukrahati Side

The Haldia Industrial Complex and Haldia Port are the only major facilities located on the Kukrahati side of the Hugli River and are connected to the arterial national grid (NH6) only through NH41, which is currently being widened to 4-lanes. Although SH4 is located on the Kukrahati side, this road is serving mainly community traffic. It takes around three to four hours for traffic to move between Haldia and Kolkata along NH6, despite the distance being only 90 km as the crow flies.

d) Current Toll Charges

There are four (4) toll roads/gates in the study area:

- Kona Expressway;
- The bridge crossing Hugli River in the northern part of Bendal;
- NH2 near Durgapur; and
- New toll gates on NH6 after the junction with NH2.

In terms of the former two toll gates, low charges are applied to the traffic due to the rather old road and bridge. The latter two roads, NH2 and NH6, attract similar toll rates as these are new roads. With regard to NH41, a widening improvement project to 4-lanes is currently on-going under the scheme of a toll road. The toll rate has not yet been shown.

Table 3.1.4 Existing Toll Rates (1)

Unit: Rs / car

Type	Kona Expressway	Bridge near Bandel
Motorcycle	5	5
Sedan/Jeep/Van	10	8
Mini Bus	25	8-10
Large Bus	50	26-65
Truck	80	

Table 3.1.5 Existing Toll Rates (2)

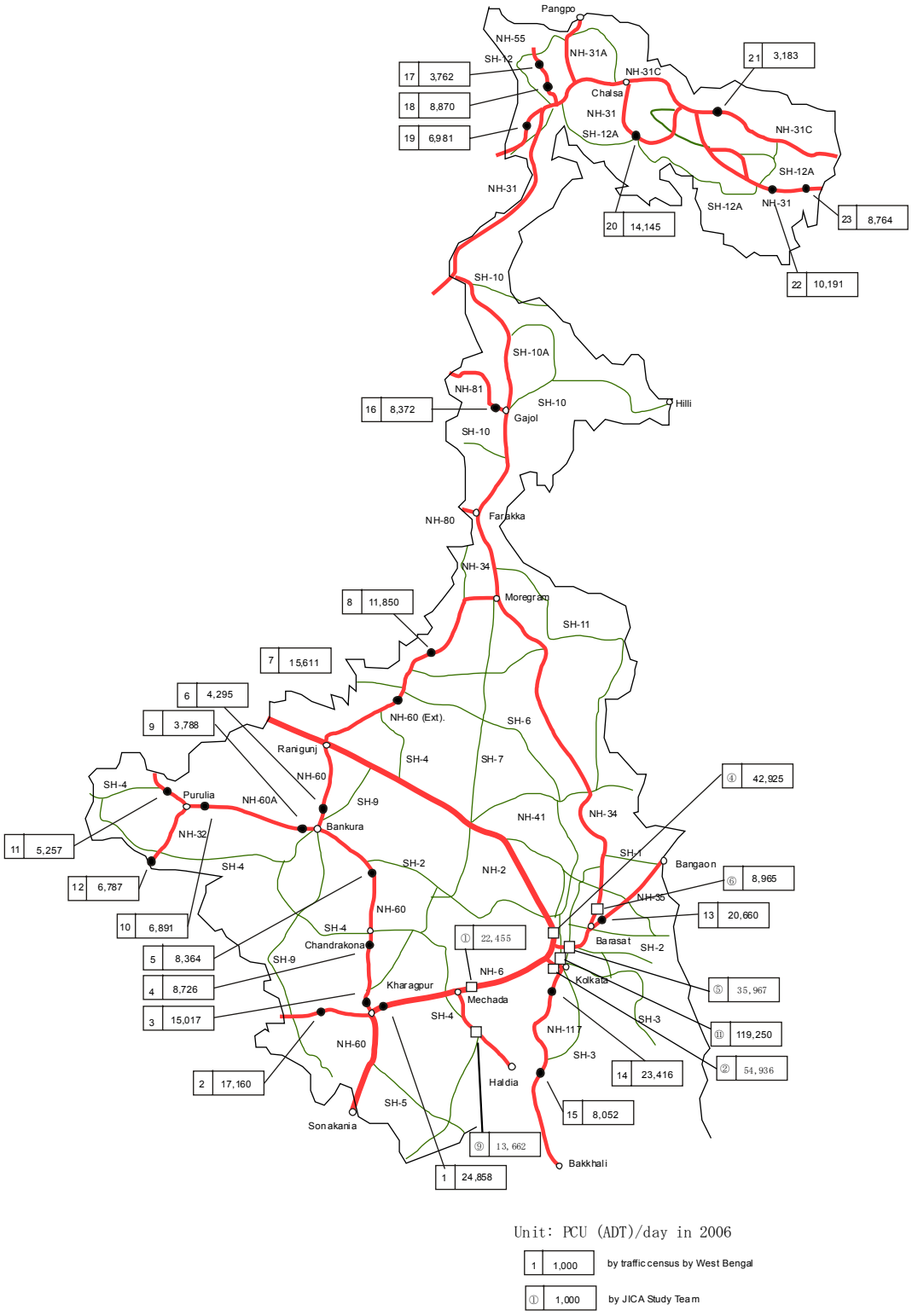
Unit: Rs / car

Type	New Gate on NH 6		NH 2	
	Single Journey	Multiple Journey	Single Journey	Multiple Journey
Car/Jeep/Van	30	50	35	50
Light Commercial Vehicle	55	85	60	90
Truck & Bus	110	165	120	180
Heavy Construction Machinery	240	360	255	385

e) Traffic Volumes

There are 23 traffic count stations in West Bengal, covering the major national highways and state highways. In terms of passenger car units (pcu), the traffic crossing the Haora Bridge is the largest, showing around 119,000 pcu although this traffic was counted not by West Bengal but by the JICA Study Team during the course of the study. The second Hugli Bridge has the second largest traffic volume showing around 55,000 pcu, which was also counted by the JICA Study Team. **Figure 3.1.3** shows the traffic volumes in 2006, which were partly supplemented by the traffic survey undertaken by the JICA Study Team.

In terms of the traffic volumes on NH117, around 23,000 pcu and 8,000 pcu were counted at Joka and Kulpi respectively.



Traffic Volume in West Bengal (2006)

Figure 3.1.3 Traffic Volumes in West Bengal

3.1.3 Traffic Related to the Ports

(1) Kolkata Dock and Haldia Port

a) Throughput in the Port

Table 3.1.6 compares the total throughput in the Kolkata Dock System to the Haldia Dock Complex. The Haldia Dock Complex shows a dominant position in terms of the total throughput with more than 3.5 times the throughput of the Kolkata Dock System.

Table 3.1.6 Throughput by Port

Unit: Tons

Year	Import	Export	Total
A. KOLKATA DOCK SYSTEM (KDS)			
2000 - 2001	5,929	1,229	7,158
2001 - 2002	4,490	884	5,374
2002 - 2003	6,337	864	7,201
2003 - 2004	7,559	1,134	8,693
2004 - 2005	8,201	1,744	9,945
B. HALDIA DOCK COMPLEX (HDC)			
2000 - 2001	17,250	5,592	22,842
2001 - 2002	18,460	6,569	25,029
2002 - 2003	20,123	8,480	28,603
2003 - 2004	22,677	9,890	32,567
2004 - 2005	25,005	11,257	36,262

Source: Kolkata Port Trust

Container transport occupies an important position in the current function of the ports. **Table 3.1.7** sets forth the container throughput using a TEU base. The Kolkata Dock System has a slightly larger throughput than the Haldia Dock Complex.

Table 3.1.7 Container Throughput

Unit: TEU

Year	Import	Export	Total
A. KOLKATA DOCK SYSTEM (KDS)			
2003-2004	77,515	44,904	122,419
2004-2005	89,156	70,086	159,242
B. HALDIA DOCK COMPLEX (HDC)			
2003-2004	54,054	82,603	136,657
2004-2005	53,084	75,429	128,513

Source: Kolkata Port Trust

(2) Transport Mode

Table 3.1.8 and **Table 3.1.9** show the transport mode by port in terms of tonnage and composition. In relation to the Kolkata Dock System, road transport plays a dominant position and water transport follows in second position in terms of dispatches. The other transport modes do not show significant figures. In relation to the Haldia Dock Complex, pipeline transport shows the highest volume of all of the modes as there are many petrochemical factories that import oil products from abroad as well as raw products. The salient feature is that the railway indicates a significant 34% share, which is more than double that of road transport. The major commodities transported by railway are iron ore when received and coking coal when dispatched. Such bulky cargo is transported by railway, despite the single track and low level of frequency of the service.

Table 3.1.8 Transport Mode in Tonnage by Port

Unit: Tons

Import / Export	Rail	Road	Water	Pipeline	Total
A. KOLKATA DOCK SYSTEM (KDS)					
Received	34	1,702	8	0	1,744
Dispatched	251	3,066	4,862	23	8,201
Total	285	4,768	4,869	23	9,945
B. HALDIA DOCK COMPLEX (HDC)					
Received	6,964	3,083	37	1,040	11,124
Dispatched	5,300	2,419	2	17,108	24,828
Total	12,264	5,502	39	18,148	35,952

Source: Kolkata Port Trust

Table 3.1.9 Transport Mode in Terms of Composition by Port

Import / Export	Rail	Road	Water	Pipeline	Total
A. KOLKATA DOCK SYSTEM (KDS)					
Received	0.02	0.98	0.00	0.00	1.00
Dispatched	0.03	0.37	0.59	0.00	1.00
Total	0.03	0.48	0.49	0.00	1.00
B. HALDIA DOCK COMPLEX (HDC)					
Received	0.63	0.28	0.00	0.09	1.00
Dispatched	0.21	0.10	0.00	0.69	1.00
Total	0.34	0.15	0.00	0.50	1.00

Source: Kolkata Port Trust

(3) Border Traffic between Nepal and Bhutan

The development of the north-south corridor is one of the development issues in West Bengal. **Table 3.1.10** and **Figure 3.1.4** show the current border trade between India and Nepal and India and Bhutan. Exports to Nepal show a dominant position accounting for as much as around 1,900 thousand tons per year over the latest three years. Border trade other than exports to Nepal show a low level of activity.

Table 3.1.10 Imports & Exports

Unit: 1000 tons

Country	Category	2002/2003	2003/2004	2004/2005
Nepal	Import	380	683	620
	Export	1,857	1,759	1,899
Bhutan	Import	97	97	132
	Export	56	152	142

Source: Ministry of Commerce and Industry

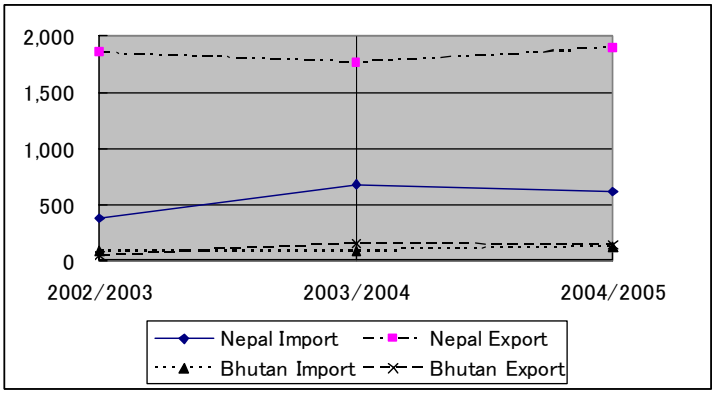


Figure 3.1.4 Trend in Imports & Exports

Table 3.1.11 shows the share of the border trade in monetary terms between India and Nepal and India and Bhutan. Out of India's total border trade the share of trade with Nepal and Bhutan is less than 1% in terms of both imports and exports. In addition, out of the total border trade traffic, the proportion of land transport through West Bengal is understood to currently a small amount of the total, although there are no definite statistics to support this fact. The border trade between India and Nepal and India and Bhutan should be discussed from the viewpoint of future strategic development after completion of the transport development projects.

Table 3.1.11 Share of Border Trade

Country	Category	2004/2005	
		Value($ million)	Share
Nepal	Import	346	0.33%
	Export	743	0.89%
Bhutan	Import	71	0.07%
	Export	85	0.10%
Indian Total	Import	105,338	100.00%
	Export	83,536	100.00%

Source: Ministry of Commerce and Industry

3.2 Existing Bridges Built over the Hugli River near Kolkata

(1) Features of the Bridges

There are four (4) bridges including one that is currently under construction that will cross the Hugli River near Kolkata City. Kolkata City, which is the capital of West Bengal state, is separated from the western part of India by the Hugli River. These bridges have a very important role in connecting Kolkata City to the western part of India as well as to Haora, which is located on the western side of the Hugli River and is the second largest city in West Bengal. These bridges are explained as follows:

Table 3.2.1 Characteristics of the Bridges

No.	Name	Bridge Type	Main Span (m)	Total Bridge Length	Width & No. of Lanes	Foot path	Clearance Below	Opened Year	Jurisdiction	Status
1	2nd Hugli Bridge (Vidyasagar Setu Bridge)	Cable-stayed (road)	457 m	823 m	35m (6 lanes)	2.5 m x 2	26 m	1992	HRBC	Existing
2	Hoara Bridge (Rabindra Setu Bridge)	Balanced cantilever (Road)	457 m	705 m	6 lanes (21m)	4.5 m x 2	low	1943	Kolkata Port Trust	Existing
3	Vivekananda Bridge		105 m x 7 =725 m		5.4 m (Rail track) 4 m x 2 (Road)	2.4 m x 2	low	1931	Eastern Railway	Existing
4	2nd Vivekananda Bridge	Extradose	110 m x 7=770		6 lanes		Low	To be 2007	MoSRTH (BOT)	Under construction

(2) Function of the Bridges

a) Second Hugli Bridge

All of the bridges are very important in terms of connecting the road network. The second Hugli Bridge connects NH2, NH6 and NH117 through the Kona Expressway, which is a toll road. This enables the traffic from Kolkata City and South 24 Parganas to easily move onto the national arterial road network, consisting of NH2 and NH6. The bridge has an air draft of as high as 26 m due to its close location to the Kolkata Dock.

b) Haora Bridge

The most important function of this bridge is that it connects the Haora Railway Station with the centre of Kolkata City. Many pedestrians walk between the Haora Railway Station and the city centre of Kolkata on the foot-pass on the bridge. In addition, heavy traffic uses the bridge because it is the shortest route between Haora City and the Kolkata city-centre.

c) Vivekananda Bridge

This is a multi-use bridge consisting of a 2-track railway together with road traffic. The width of the carriageway for the road traffic is as narrow as around 4 m and this decreases the efficiency of the road capacity over the bridge.

d) Second Vivekananda Bridge

This bridge is currently under construction at a location 50 meters downstream from the existing Vivekananda Bridge and is expected to open March 2007. The bridge will function as part of the Belghoria Expressway together with the bridge approach road with a length of 6.1 km in total, which is also under construction. The bridge will directly connect NH2 and NH34. In addition, this is expected to contribute to the formation of an eastern ring road around Kolkata City in conjunction with the Barasat Bypass, and the Eastern and Southern Expressway, and will avoid passing through the most congested area in Kolkata City.

e) Capacity for Traffic Crossing the Hugli River

The total number of lanes on the bridges crossing the Hugli River near Kolkata City is around 15 lanes, excluding the second Vivekananda Bridge, which is currently under construction. In other words, the road traffic capacity across the river is around 195,000 pcu /day based on a capacity of 13,000 pcu per lane.

Most of the traffic is currently concentrated on Haora Bridge. The total road traffic capacity of the bridges crossing the Hugli River, excluding the future second Vivekananda Bridge, already appears to be saturated even considering that the road capacity per lane is larger than that of the IRC, although the second Vivekananda Bridge will shortly provide additional capacity. The construction of a new bridge would appear to be, physically, very difficult due to the densely built-up area along the Hugli River near Kolkata City. This limitation in the road traffic capacity crossing the Hugli River may become a regional development constraint in the future.

Table 3.2.2 Traffic Crossing the Hugli River

St. No.	Bridge	Traffic
5	Vivekananda Bridge	36,967
11	Haora Bridge	119,250
2	2nd Hugli Bridge	54,936
	Total	211,153

3.3 Traffic Surveys

3.3.1 Objectives

The traffic surveys were conducted to achieve the following objectives:

- To obtain up-to-date information on traffic conditions in the southern part of West Bengal State;
- To analyse transport characteristics through interviews of road and ferry users;
- To quantify existing transport movements in the southern part of West Bengal State; and
- To provide basic data for the traffic demand forecast.

3.3.2 Description of the Traffic Surveys

i) Outline of the Traffic Surveys

The outline of the traffic surveys is described below:

Table 3.3.1 Outline of the Traffic Surveys

Survey	Objectives	Coverage	Method
1. Traffic Count Survey	To grasp traffic volumes and vehicle types in the major road sections	11 stations	Manual traffic volume count (vehicles) 24 hours (1day/7days)
2. Roadside OD Interview Survey	To capture trip information for vehicles in the major road sections	9 stations	Direct interview of drivers at roadsides 24 hours (1day)
3. Freight Transport Survey	To understand the characteristics of freight transport	2 stations	Manual traffic volume count and OD interview for LCV/trucks 24 hours (1day)
4. Ferry Ghat Survey	To capture trip information for ferry passengers	3 stations	Manual passenger volume count, direct interview of ferry passengers and traffic volume count for arrival and departure vehicles at ferry ghat

Source: JICA Study Team

ii) Survey Contents

- Traffic Count Survey and Roadside OD Interview Survey

iii) Survey Item

- Vehicular traffic count
- Roadside interview of drivers

iv) Survey Method

The traffic count survey was carried out by vehicle classification, and direction at each station at 15-minute intervals. The counts were carried out continuously over 24 hours (8:00 – 8:00 on the next day) on one (1) day or seven (7) days. In accordance with the "Manual for Survey, Investigation and Preparation of Road Projects (IRC:SP:19-2001)", the vehicle classification was adopted as shown in the following table:

Table 3.3.2 Vehicle Classification

Motorised Vehicle (Fast Moving Vehicle)	1) 2-Wheeler 2) 3-Wheeler/Auto Rickshaw 3) Car/Jeep/Van/Taxi 4) Mini Bus 5) Full Bus 6) LCV (Light Commercial Vehicles, e.g. Mini Truck)	7) 2-Axle Truck 8) 3 or more Axle Truck 9) Articulated Truck 10) Agricultural Tractor
Non-Motorised Vehicle (Slow Moving Vehicle)	1) Cycle 2) Cycle Rickshaw	3) Animal Drawn Vehicle 4) Others (Specify)

Source: IRC:SP:19-2001

The roadside OD interview survey was conducted to obtain trip information through interviews of a sample of vehicle drivers on the roadside. The following items were covered in the interviews:

(1) Vehicle Type
(2) Seating Capacity
(3) No. of Passengers on Board
(4) Trip Purpose
(5) Origin & Destination
(6) Major Commodity (Truck only)
(7) Loading Capacity (Ton) (Truck only)
(8) Load Factor (Pickup and Truck only)
(9) Estimated Travel Time (Minutes)
(10) Travel Time Cost

The target sample rate was set at 10%. During the 24 hours (8:00 – 8:00 on the next day) on a weekday (1 day) when the traffic count survey was being conducted, the roadside OD interview survey was also conducted. Vehicle drivers were interviewed by safely flagging down a sampled vehicle, in cooperation with police enforcers.

At the toll plaza near the second Hugli Bridge, the traffic volumes were expected to be the highest out of all of the survey stations. To avoid serious traffic congestion due to flagging down the sampled vehicles, the interview items were simplified by including only the vehicle type, origin and destination and major commodity.

For the traffic count survey a temporary camp was built at each survey station to protect the surveyors from the scattered rain that occurs during the monsoon season. The surveys were properly conducted without any interruptions. Although the OD interview surveys were sometimes hampered due to the scattered rain, enough samples were obtained.

Traffic Count Survey

v) Survey Coverage

In order to provide detailed information on the volumes and characteristics of the present traffic on the main roads in the southern part of West Bengal State, the locations of the survey stations were selected through discussions between the JICA Study Team and the Counterpart Team. As a result, the following survey stations were selected:

- 2 stations in South 24 Parganas District
- 2 stations in North 24 Parganas District
- 1 station in East Medinipur District
- 1 station in West Medinipur District
- 4 stations in Haora District
- 1 station in Hugli District

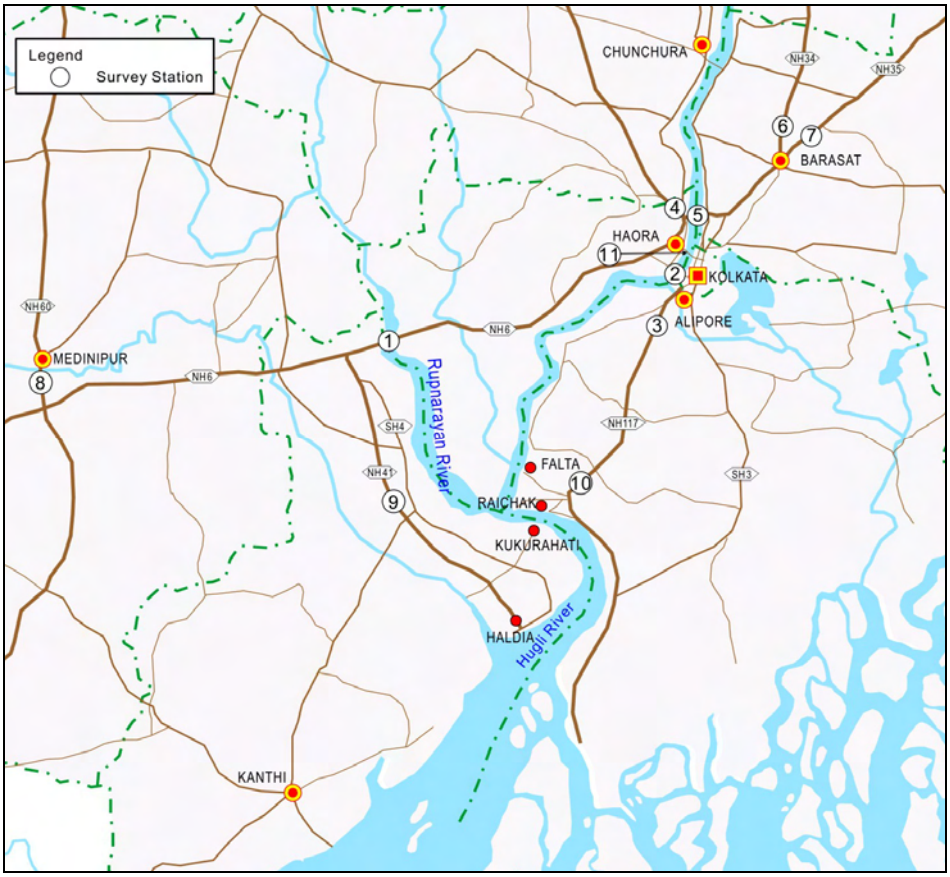
OD Interview Survey

The traffic count survey was conducted at all of the above stations (11 stations), while the OD interview survey was carried out at only nine stations (excluding Haora Bridge (Haora District) and 38 km of NH.117 (South 24 Parganas District)). The survey stations and survey periods for both the traffic count survey and the OD interview survey are shown in **Table 3.3.3** and **Figure 3.3.1**.

Table 3.3.3 Survey Stations for Traffic Count Survey and Roadside OD Interview Survey

Station	Location	District	Survey Date	
			Traffic Count	OD Interview
1	72 km of NH.6 (near bridge crossing the Rupnarayan River)	Haora	28/07/06 ~ 03/08/06	02/08/06
2	Toll Plaza near the second Hugli Bridge	Haora	09/08/06	09/08/06
3	24 km of NH.117 (near Joka)	South 24 Parganas	14/07/06 ~ 20/07/06	17/07/06
4	NH.2 near the junction of NH.2 and NH.6	Hugli	14/07/06 ~ 20/07/06	20/07/06
5	Vivekananda Bridge	Haora	18/07/06	18/07/06
6	29 km of NH.34 (near Barasat)	North 24 Parganas	21/07/06 ~ 27/07/06	25/07/06
7	6 km of NH.35 (near Barasat)	North 24 Parganas	21/07/06 ~ 27/07/06	24/07/06
8	118 km of NH.60 (near Medinipur)	West Medinipur	28/07/06 ~ 03/08/06	03/08/06
9	27 km of NH.41 (before Nandakumar Junction)	East Medinipur	14/07/06 ~ 20/07/06	01/08/06
10	38 km of NH.117 (after Shirakol)	South 24 Parganas	14/07/06 ~ 20/07/06	-
11	Haora Bridge	Haora	27/07/06	-

Source: JICA Study Team



Source: JICA Study Team

Figure 3.3.1 Survey Stations for the Traffic Count Survey and Roadside OD Interview Survey

- **Freight Transport Survey**

i) Survey Item

- Traffic count survey
- Truck OD interview survey

ii) Survey Method

Truck OD Interview Survey

The traffic count survey was conducted near the ports and the industrial areas. The traffic volumes by vehicle type and direction at 15-minute intervals were counted. In addition, the truck OD interview survey was carried out through interviews of sampled truck drivers in order to grasp information such as the origin and destination, commodity type, loading capacity and load factor.

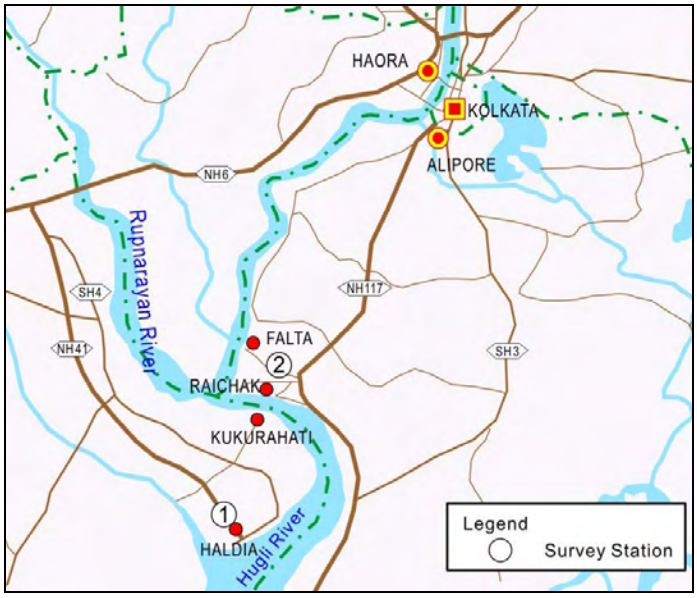
iii) Survey Coverage

Two survey stations were selected out of the major freight generating sites around Raichak and Kukrahati as shown in **Table 3.3.4** and **Figure 3.3.2**. Both the traffic count survey and the truck OD interview survey were carried out over 24 hours (8:00 – 8:00 on the next day) on a weekday. As factories are dispersed over a wide area in Haldia and Falta, the survey stations were located on the access roads near the factories in order to capture the main movements.

Table 3.3.4 Survey Stations for the Freight Transport Survey

Station	Location	District	Survey Date
1	50 km of NH.41 near the Haldia Dock Complex and the Halida Industrial Development Area	East Medinipur	31/07/06
2	District road near the Falta Special Economic Zone	South 24 Parganas	04/08/06

Source: JICA Study Team



Source: JICA Study Team

Figure 3.3.2 Survey Stations for the Freight Transport Survey

- **Ferry Ghat Survey**

iv) Survey Item

The ferry ghat survey is divided into three parts:

- Passenger count survey
- Passenger OD interview survey
- Arrival and departure vehicle count survey

v) Survey Method

Passenger OD Interview Survey

Passengers exiting from and entering onto passenger ferries were counted manually, and some of the passengers were interviewed in and around the ferry ghats. In the passenger OD interview survey, information such as the means of transport to/from the ferry ghat, trip purpose, origin and destination, estimated travel time and travel time costs were collected. In addition, vehicles arriving at and departing from the ferry ghats were counted manually. At Diamond Harbour, vehicles stopping in front of the ferry ghat were counted, because there are no parking spaces for vehicles.

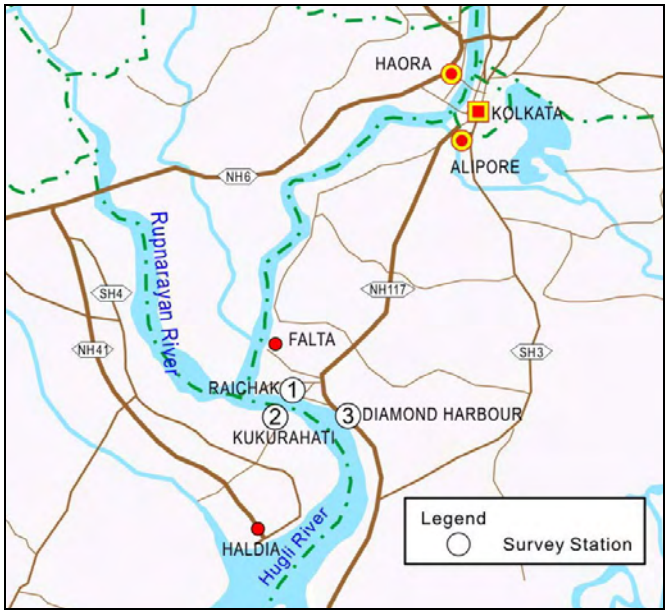
vi) Survey Coverage

Ferry ghats that will be affected by the improvement of the crossing method between Raichak – Kukrahati were selected as the survey stations. The survey was conducted during the ferry operating hours over 3 days as shown in **Table 3.3.5** and **Figure 3.3.3**.

Table 3.3.5 Survey Stations for the Ferry Ghat Survey

Station	Location	Ferry Operating Route	Survey Period	Survey Date
1	Raichak	- Raichak - Kukrahati	06:00 ~ 21:00	24/07/06 ~ 26/07/06
2	Kukrahati	- Raichak - Kukrahati - Diamond Harbour - Kukrahati	06:00 ~ 21:00	24/07/06 ~ 26/07/06
3	Diamond Harbour	- Diamond Harbour - Kukrahati	06:00 ~ 20:00	01/08/06 ~ 03/08/06

Source: JICA Study Team



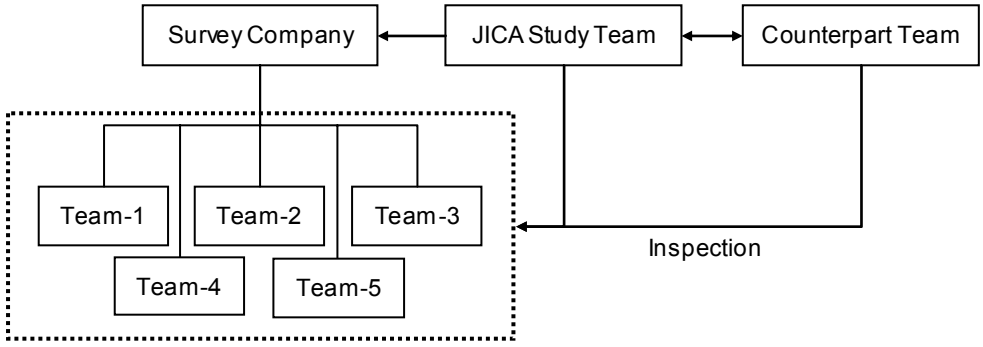
Source: JICA Study Team

Figure 3.3.3 Survey Stations for the Ferry Ghat Survey

vii) Survey Implementation

The survey was implemented based on the organizational structure illustrated in **Figure 3.3.4**. The survey inspections (sample checking of data being captured) were systematically conducted by the JICA Study Team and the Counterpart Team for quality assurance and to confirm the proper arrangement of the enumerators and interviewers.

In addition, police officers in the East Medinipur, West Medinipur North 24 Parganas, South 24 Parganas, Haora and Hugli districts provided support in consultation with the JICA Study Team, the Counterpart Team and the survey company for the traffic surveys.

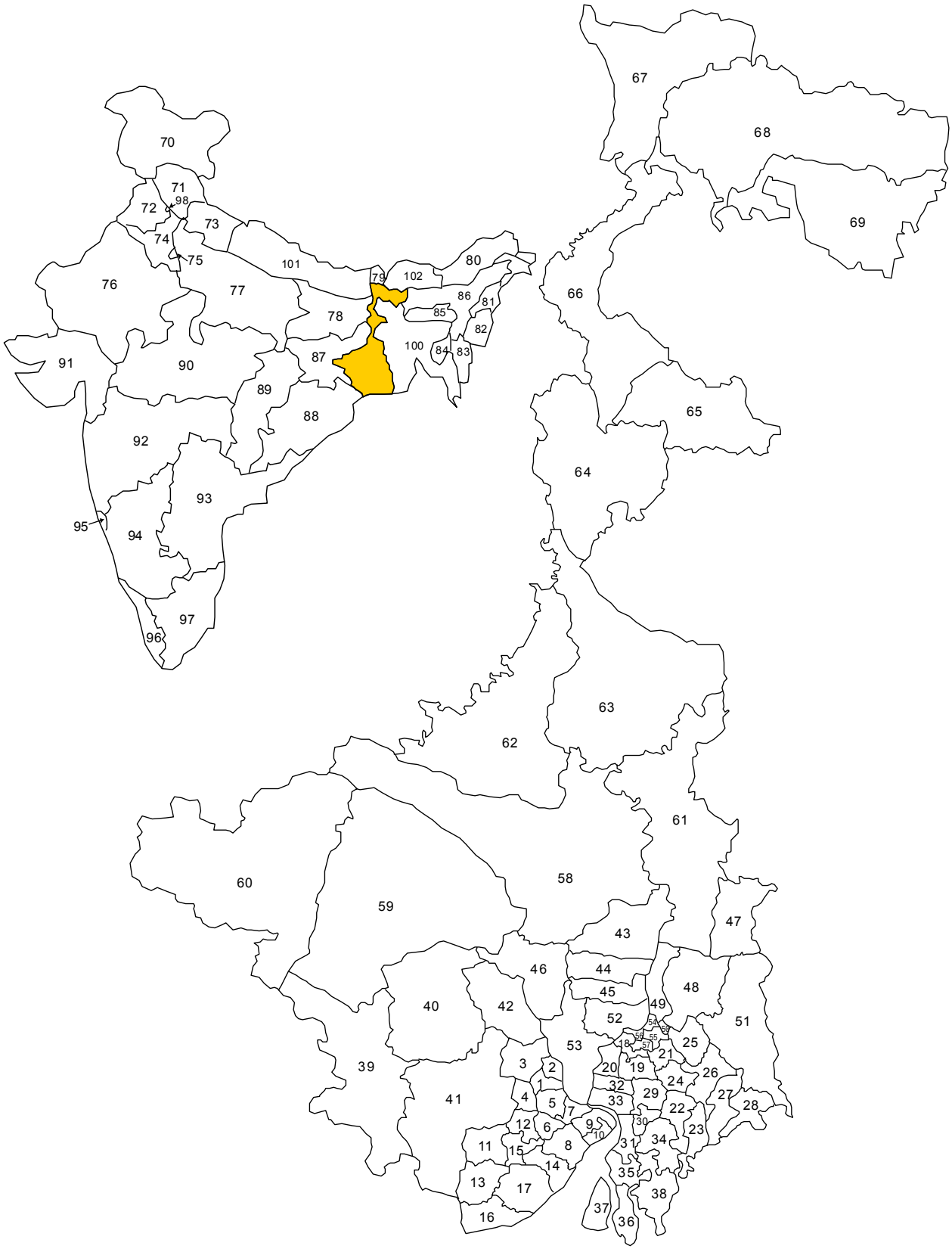


Source: JICA Study Team

Figure 3.3.4 Survey Organization

viii) Traffic Zone

Traffic zones were established for the sake of coding the origins and destinations in the traffic surveys and traffic demand forecasts. India and the neighbouring countries were divided into 102 traffic zones. In the direct influence area located on both banks of the Hugli River, South 24 Parganas and East Medinipur districts were divided based on combining "C.D Block" levels. Haora District, West Medinipur District, North 24 Parganas District and Hugli District were zoned based on "Sub-Division" boundaries. Kolkata City was divided into four zones taking into account the present land use conditions. For the remaining districts in West Bengal State each district was classified as one traffic zone. The traffic zones are delineated in **Figure 3.3.5** and the names of each zone are described in **Table 3.3.6**. In addition, the zones were consolidated into 26 larger zones for presentation purposes.



Source: JICA Study Team

Figure 3.3.5 Traffic Zone System

Table 3.3.6 Traffic Zones (1/2)

Large Zone No	Traffic Zone No	State/Country	District	Sub-Division	Ward/C.D Block
1	1	West Bengal	East Medinipur	Tamluk	Tamluk
	2	West Bengal	East Medinipur	Tamluk	Sahid Matangini
	3	West Bengal	East Medinipur	Tamluk	Panskura
	4	West Bengal	East Medinipur	Tamluk	Moyna
	5	West Bengal	East Medinipur	Tamluk	Nandakumar
	6	West Bengal	East Medinipur	Tamluk	Nandigram III
	7	West Bengal	East Medinipur	Haldia	Mahishadal
	8	West Bengal	East Medinipur	Haldia	Nandigram I & II
	9	West Bengal	East Medinipur	Haldia	Sutahata
	10	West Bengal	East Medinipur	Haldia	Haldia
	11	West Bengal	East Medinipur	Egra	Patashpur I
	12	West Bengal	East Medinipur	Egra	Bhagawanpur I
	13	West Bengal	East Medinipur	Egra	Egra
	14	West Bengal	East Medinipur	Contai (Kanthi)	Khejuri
	15	West Bengal	East Medinipur	Contai (Kanthi)	Bhagawanpur II
	16	West Bengal	East Medinipur	Contai (Kanthi)	Ramnagar
	17	West Bengal	East Medinipur	Contai (Kanthi)	Contai (Kanthi)
2	18	West Bengal	South 24 Parganas	Alipore (Sadar)	Maheshtala
	19	West Bengal	South 24 Parganas	Alipore (Sadar)	Bishnupur
	20	West Bengal	South 24 Parganas	Alipore (Sadar)	Budge-Budge
	21	West Bengal	South 24 Parganas	Baruipur	Sonarpur & Rajpur
	22	West Bengal	South 24 Parganas	Baruipur	Joynagar & Majilpur (M)
	23	West Bengal	South 24 Parganas	Baruipur	Kultali
	24	West Bengal	South 24 Parganas	Baruipur	Baruipur
	25	West Bengal	South 24 Parganas	Baruipur	Bhangore
	26	West Bengal	South 24 Parganas	Canning	Canning
	27	West Bengal	South 24 Parganas	Canning	Basanti
	28	West Bengal	South 24 Parganas	Canning	Gosaba
	29	West Bengal	South 24 Parganas	D.Harbour	Mograhat
	30	West Bengal	South 24 Parganas	D.Harbour	Mandirbazar
	31	West Bengal	South 24 Parganas	D.Harbour	Kulpi
	32	West Bengal	South 24 Parganas	D.Harbour	Falta
	33	West Bengal	South 24 Parganas	D.Harbour	Diamond Harbour
	34	West Bengal	South 24 Parganas	D.Harbour	Mathurapur
	35	West Bengal	South 24 Parganas	Kakdwip	Kakdwip
	36	West Bengal	South 24 Parganas	Kakdwip	Namkhana
	37	West Bengal	South 24 Parganas	Kakdwip	Sagar

	38	West Bengal	South 24 Parganas	Kakdwip	Patharpratima
3	39	West Bengal	West Medinipur	Jhargram	
	40	West Bengal	West Medinipur	Sadar	
	41	West Bengal	West Medinipur	Kharagpur	
	42	West Bengal	West Medinipur	Ghatal	
4	43	West Bengal	Hooghly	Sadar	
	44	West Bengal	Hooghly	Chandannagar	
	45	West Bengal	Hooghly	Serampur	
	46	West Bengal	Hooghly	Arambagh	
5	47	West Bengal	North 24 Parganas	Bangaon	
	48	West Bengal	North 24 Parganas	Barasat	
	49	West Bengal	North 24 Parganas	Barrackpur	
	50	West Bengal	North 24 Parganas	Bidhanagar	
	51	West Bengal	North 24 Parganas	Basirhat	
6	52	West Bengal	Howrah	Sadar	
	53	West Bengal	Howrah	Uluberia	
7	54	West Bengal	Kolkata		1~56
	55	West Bengal	Kolkata		57~74, 81~93, 101~110
	56	West Bengal	Kolkata		75~80, 132~141
	57	West Bengal	Kolkata		94~100, 111~131

Source: JICA Study Team

Table 3.3.6 Traffic Zones (2/2)

Large Zone No	Traffic Zone No	State/Country	District
8	58	West Bengal	Burdwan (Barddhaman)
9	59	West Bengal	Bankura
10	60	West Bengal	Purulia
11	61	West Bengal	Nadia
12	62	West Bengal	Birbhum
13	63	West Bengal	Murshidabad
14	64	West Bengal	Malda
15	65	West Bengal	Dakshin Dinajpur (South Dinapur)
16	66	West Bengal	Uttar Dinajpur (North Dinajpur)
17	67	West Bengal	Darjeeling
18	68	West Bengal	Jalpaiguri
19	69	West Bengal	Cooch Behar (Koch Bihar)
20	70	Jammu and Kashmir	
	71	Himachal Pradesh	
	72	Punjab	
	73	Uttaranchal	
	74	Haryana	
	75	Delhi	
	76	Rajasthan	
	77	Uttar Pradesh	
	78	Bihar	
	79	Sikkim	
21	80	Arunachal Pradesh	
	81	Nagaland	
	82	Manipur	
21	83	Mizoram	
	84	Tripura	
	85	Meghalaya	
	86	Assam	
22	87	Jharkhand	
	88	Orissa	
	89	Chhattisgarh	
	90	Madhya Pradesh	
	91	Gujarat	
	92	Maharashtra	
23	93	Andhra Pradesh	
	94	Karnataka	
	95	Goa	
	96	Kerala	
	97	Tamil Nadu	
20	98	Chandigarh	
	99	Other Territories (Lakshadweep, Lakshadweep, Daman & Diu, Dadra & Nagar Haveli, Pondicherry, Andaman & Nicobar Island)	
24	100	Bangladesh (Border)	
25	101	Nepal (Border)	
26	102	Bhutan (Border)	

Source: JICA Study Team

3.3.3 Results of the Traffic Surveys

(1) Results of the Traffic Count Survey

a) PCU Factor

In order to compare the different traffic volumes and take account of the different traffic compositions, it is generally recommended that the traffic volumes should be converted from vehicles to passenger car units (PCU) by applying passenger car equivalents. In accordance with the "Guidelines for Capacity of Roads in Rural Areas (IRC64-1990)", the PCU factors were applied in order to estimate the traffic volumes expressed in PCU, as described in the following table.

Table 3.3.7 PCU Factor

	No	Vehicle Type	PCU Factor
Fast Vehicle	1	Two Wheeler	0.50
	2	Three Wheeler/Auto Rickshaw	1.00
	3	Car/Jeep/Van/Taxi	1.00
	4	Mini Bus	2.00
	5	Full Bus	3.00
	6	Light Commercial Vehicle	1.50
	7	2-Axle Truck	3.00
	8	3 or More Axle Truck	3.00
	9	Articulated (Trailer) Truck	4.50
	10	Agricultural Tractor	1.50
Slow Vehicle	11	Cycle	0.50
	12	Cycle Rickshaw	2.00
	13	Animal Drawn	8.00
	14	Others (Hand Cart)	3.00

Source: IRC64-1990: Guidelines for Capacity of Roads in Rural Areas

b) Traffic Volumes

Table 3.3.8 and **Table 3.3.9** show the volumes of motorised and non-motorised vehicles recorded at 11 stations. The daily traffic volumes at Station 2, Station 5 and Station 11 are the results of the one day traffic count. The other stations show the average daily traffic volumes (ADT) obtained from the consecutive seven day traffic count.

Out of all of the stations, the highest traffic volume was observed at Haora Bridge (Station 11), which is a main bridge for passenger transport between Kolkata City and Haora District. The second highest traffic volume was recorded at the Toll Plaza near the second Hugli Bridge (Station 2). The Hugli River crossing stations (Stations 2, 4 & 11) near to Kolkata City indicated the higher traffic volumes. **Figure 3.3.6** illustrates the magnitude of traffic at each survey location in the southern part of West Bengal. NH2 and NH6 composing the "Golden Quadrilateral" under the "National Highways Development Project" showed significantly high traffic volumes consisting of a substantial share of freight transport.

Table 3.3.8 Motorised Traffic Volumes Recorded at 11 Stations

Station No	Unit: Vehicle/24hours, both directions											PCU
	Two Wheeler	Three Wheeler	Car/ Jeep/ Van/ Taxi	Mini Bus	Full Bus	LCV	2-Axle Truck	3 or more Axle Truck	Artic-ulated Truck	Agric-ultural Tracto r	Total	
Station 1	555 (5.7)	153 (1.6)	1,972 (20.1)	95 (1.0)	583 (5.9)	1,255 (12.8)	3,102 (31.6)	1,668 (17.0)	426 (4.3)	4 (0.0)	9,812 (100.0)	22,455
Station 2	9,986 (21.4)	970 (2.1)	27,317 (58.6)	213 (0.5)	1,427 (3.1)	2,535 (5.4)	2,879 (6.2)	825 (1.8)	452 (1.0)	0 (0.0)	46,604 (100.0)	54,936
Station 3	1,872 (19.1)	1,122 (11.5)	2,930 (29.9)	92 (0.9)	1,618 (16.5)	1,021 (10.4)	973 (9.9)	162 (1.7)	10 (0.1)	0 (0.0)	9,799 (100.0)	15,005
Station 4	2,602 (11.9)	827 (3.8)	5,410 (24.7)	42 (0.2)	665 (3.0)	2,992 (13.7)	6,546 (29.9)	2,301 (10.5)	500 (2.3)	19 (0.1)	21,903 (100.0)	42,925
Station 5	3,234 (16.3)	1,227 (6.2)	4,366 (22.0)	54 (0.3)	695 (3.5)	2,966 (14.9)	5,507 (27.7)	1,652 (8.3)	135 (0.7)	20 (0.1)	19,856 (100.0)	35,967
Station 6	1,051 (19.8)	487 (9.2)	1,325 (25.0)	33 (0.6)	568 (10.7)	634 (11.9)	1,004 (18.9)	181 (3.4)	14 (0.3)	12 (0.2)	5,309 (100.0)	8,695
Station 7	1,369 (22.4)	1,631 (26.7)	1,692 (27.7)	18 (0.3)	130 (2.1)	642 (10.5)	555 (9.1)	68 (1.1)	11 (0.2)	1 (0.0)	6,117 (100.0)	7,318
Station 8	3,720 (40.5)	267 (2.9)	1,932 (21.1)	92 (1.0)	624 (6.8)	538 (5.9)	1,468 (16.0)	482 (5.2)	27 (0.3)	25 (0.3)	9,175 (100.0)	12,931
Station 9	364 (6.5)	35 (0.6)	997 (17.7)	22 (0.4)	658 (11.7)	533 (9.5)	1,196 (21.3)	1,412 (25.1)	400 (7.1)	6 (0.1)	5,622 (100.0)	13,662
Station 10	691 (17.2)	186 (4.6)	1,192 (29.6)	74 (1.8)	800 (19.9)	514 (12.8)	446 (11.1)	78 (1.9)	44 (1.1)	3 (0.3)	4,028 (100.0)	6,818
Station 11	14,753 (16.6)	1,423 (1.6)	48,562 (54.5)	7,889 (8.9)	10,717 (12.0)	2,198 (2.5)	3,066 (3.4)	389 (0.4)	65 (0.1)	3 (0.0)	89,065 (100.0)	119,250

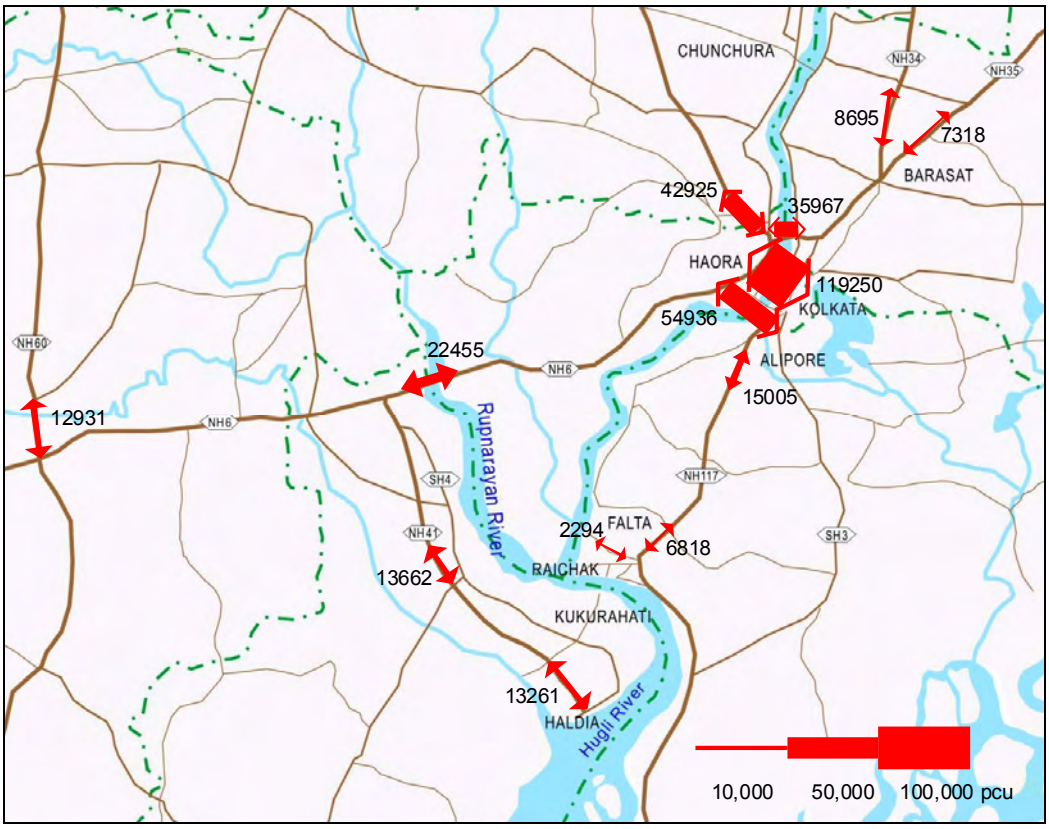
Note: Figures in parentheses indicate % share.

Source: JICA Study Team

Table 3.3.9 Non-Motorised Traffic Volumes Recorded at 11 Stations

Station No	Unit: Vehicle/24hours, both directions					PCU
	Cycle	Cycle Rickshaw	Animal Drawn	Others	Total	
Station 1	818	122	1	81	1,022	905
Station 2	2	3	0	1	6	10
Station 3	4,522	762	1	6	5,291	3,810
Station 4	1,236	320	1	8	1,565	1,290
Station 5	1,781	272	0	3	2,056	1,444
Station 6	2,429	1,130	1	30	3,591	3,578
Station 7	2,154	999	1	6	3,160	3,097
Station 8	2,292	167	7	0	2,465	1,535
Station 9	806	249	0	4	1,059	911
Station 10	1,063	651	1	0	1,715	1,841
Station 11	11,057	2,048	0	655	13,760	11,590

Source: JICA Study Team



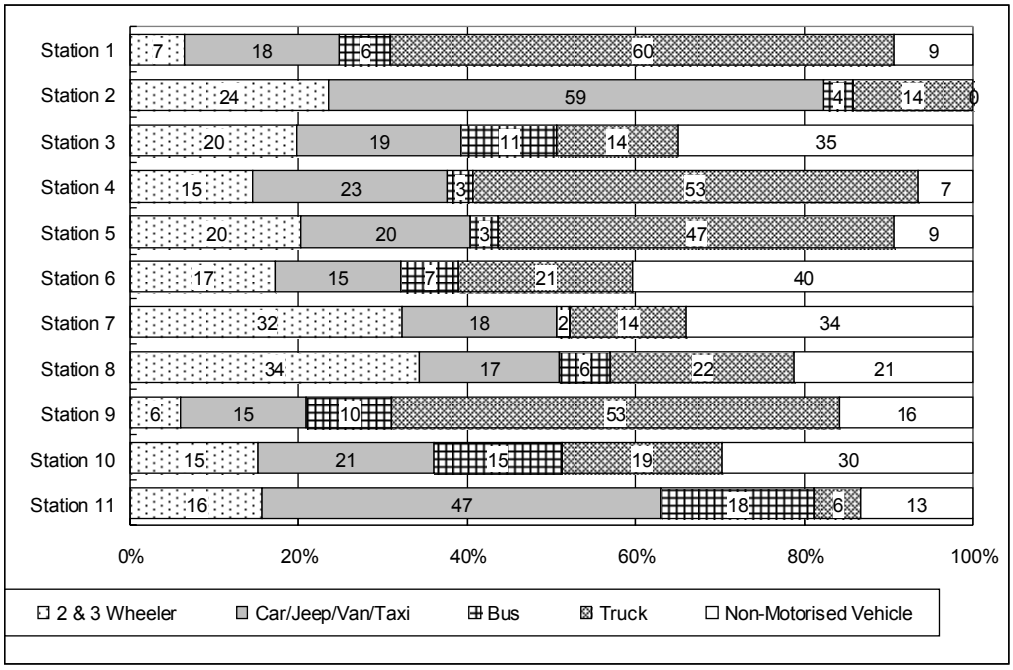
Note: Above figure include the results of traffic counts in Freight Transport Survey.
Source: JICA Study Team

Figure 3.3.6 Motorised Traffic Volumes Recorded at the Traffic Count Stations

c) Vehicle Composition

The vehicle composition at each survey station is presented in **Figure 3.3.7** and summarizes the characteristics of the traffic flow, as follows:

- A high proportion of passenger transport vehicles including 2 and 3 wheelers, cars/jeeps/vans/taxis and buses were observed at Haora Bridge (Station 2) and the Toll Plaza near the second Hugli Bridge, accounting for 87% and 81% of the total traffic, respectively. It is inferred that passenger transport concentrates in and around Kolkata City due to urban activities.
- A high proportion of freight transport (trucks) was recorded at NH6 (Station 1), NH2 (Station 4), Vivekananda Bridge (Station 5) and NH41 (Station 9). This result indicates that these highways play the role of a freight transport corridor in the southern part of West Bengal.

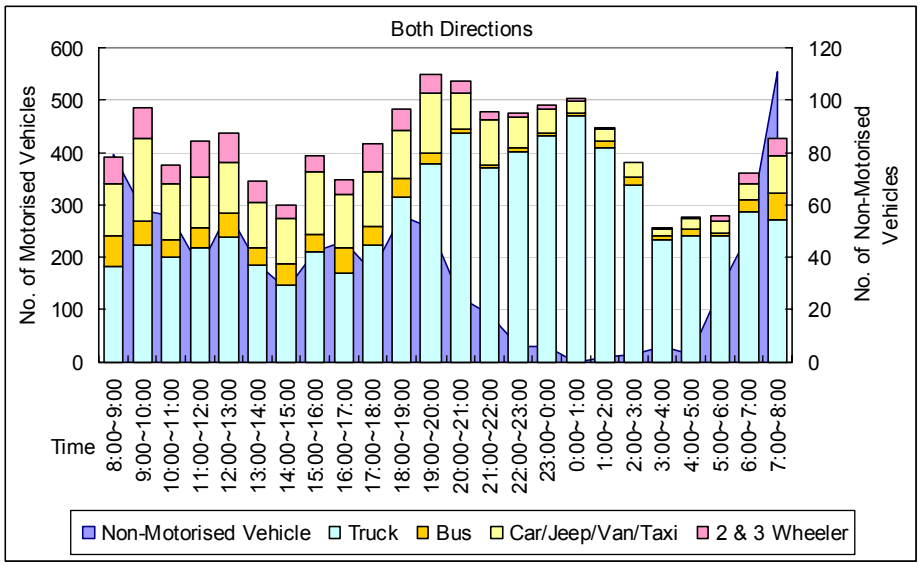


Source: JICA Study Team

Figure 3.3.7 Vehicle Composition

d) Hourly Fluctuations

In order to grasp the traffic flow by vehicle type during the peak hour, **Figure 3.3.8** illustrates the hourly fluctuations at NH6 on 3rd August (Station 1). In terms of motorised vehicles, the morning peak appeared between 9:00 and 10:00, while the evening peak was not clear and varied from 19:00 to 02:00 due to active truck movements. On the other hand, for non-motorised vehicles active movements were observed during the daytime and decreased from 20:00.



Source: JICA Study Team

Figure 3.3.8 Hourly Fluctuations at NH6 on 3rd August

(2) Results of the OD Interview Survey

a) Number of Samples

Through the OD interview survey, 24,253 samples were obtained from motorised vehicle drivers and these are presented by vehicle type in **Table 3.3.10**. The sampling rates at all of the survey stations reached more than 10%, which was the target sampling rate as mentioned earlier. The total average sampling rate was considerably higher at 20.8%.

Table 3.3.10 Number of Samples

Station No	Number of Samples										Sampling Rate (%)
	Two Wheeler	Three Wheeler	Car/ Jeep/ Van/ Taxi	Mini Bus	Full Bus	LCV	2-Axle Truck	3 or more Axle Truck	Artic-ulated Truck	Total	
Station 1	58	28	273	46	278	241	626	390	100	2,040	20.8
Station 2	1,262	287	4,886	40	1,014	227	537	153	80	8,486	18.2
Station 3	159	181	437	24	828	273	241	57	3	2,203	22.5
Station 4	29	94	230	3	301	410	873	237	49	2,226	10.2
Station 5	29	83	175	2	281	394	841	186	14	2,005	10.1
Station 6	61	236	232	1	325	157	364	31	0	1,407	26.6
Station 7	77	559	386	9	85	230	210	28	6	1,590	26.0
Station 8	142	33	160	20	246	164	686	223	17	1,691	18.5
Station 9	47	18	141	20	590	191	561	818	219	2,605	46.4
Total	1,864	1,519	6,920	165	3,948	2,287	4,939	2,123	488	24,253	20.8

b) Average Passenger Occupancy

The average passenger occupancy by vehicle type is shown in **Table 3.3.11**. Considering the seating capacity of buses, the average number of passengers was relatively high.

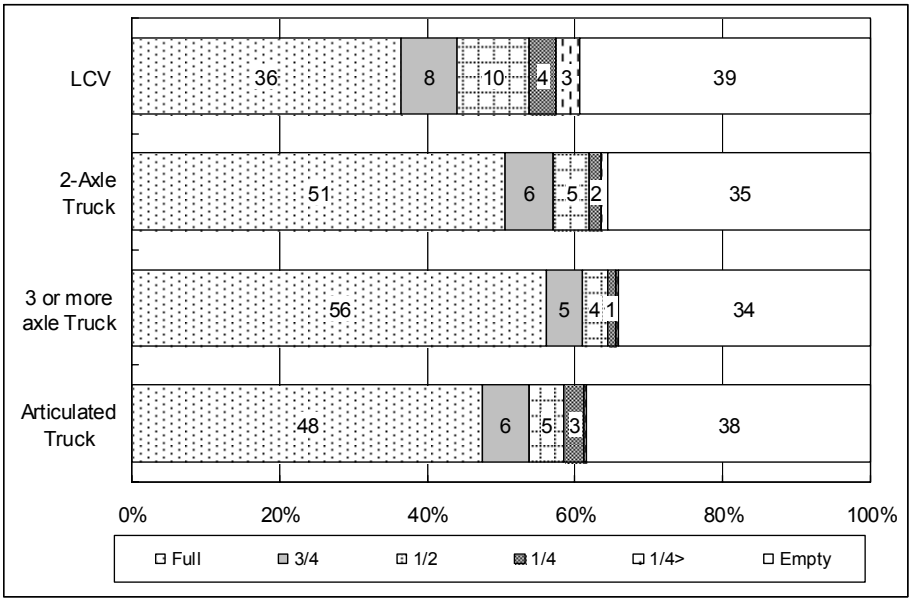
Table 3.3.11 Average Passenger Occupancy

	Average Passenger Occupancy (passenger/vehicle)
Two Wheeler	1.58
Three Wheeler	4.11
Car/Jeep/Van/Taxi	3.97
Mini Bus	24.06
Full Bus	41.72

Source: JICA Study Team

c) Loading Condition

In terms of freight transport, the loading condition by truck type is illustrated in **Figure 3.3.9**. Empty trucks accounted for less than 40%, while about half of the trucks, except for the LCV, were full loaded.



Source: JICA Study Team

Figure 3.3.9 Loading Condition by Truck Type

d) Commodity Type

Table 3.3.12 shows the commodity type by truck type. The major commodities carried by LCV and 2-axle trucks were agricultural products and construction materials. Meanwhile, the commodities carried by 3 or more axle trucks and articulated trucks were minerals, chemicals and metals.

Table 3.3.12 Commodity Type by Truck Type

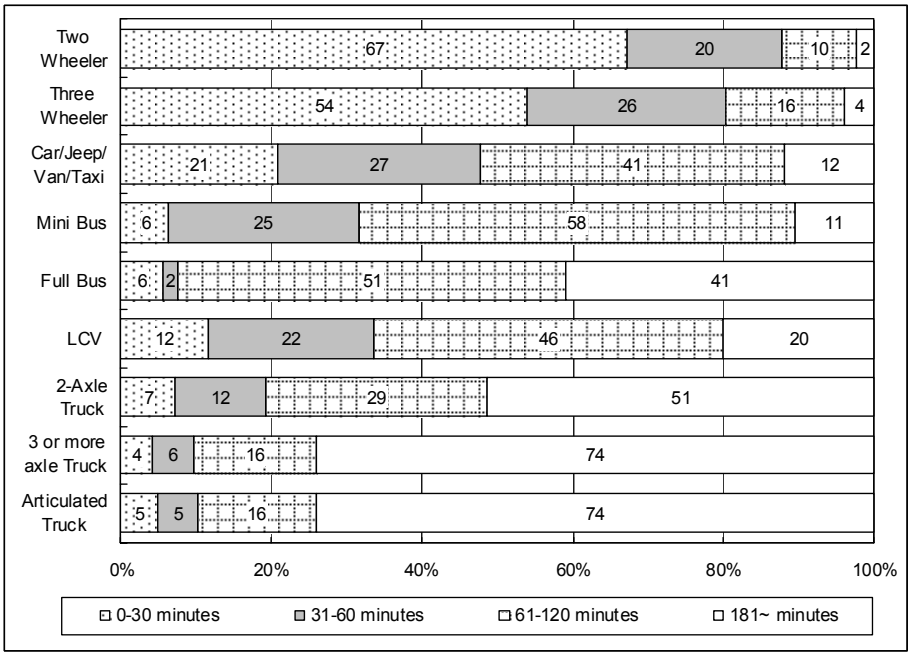
Unit: %

Commodity Type	LCV	2-Axle Truck	3 or more Axle Truck	Articulated Truck
Agriculture (Rice, Corn, Vegetable, Fruit, etc.)	37.5	23.0	16.6	3.8
Forestry (Log, Timber, Plywood, etc.)	5.8	3.7	3.0	4.4
Fishery (Fish, Shell, Seaweed, etc.)	6.4	2.1	3.0	0.6
Minerals (Coal, Copper, Iron, Salt, etc.)	5.1	8.9	18.7	15.2
Metals & Machines (Steel, Generator, Car & Bike, etc.)	4.9	4.6	6.5	15.6
Chemicals (Petroleum, Alcohol, Acid, etc.)	8.6	17.2	26.8	31.4
Light Industry / Electronics (Machine Parts, IC, Electronic& Electrical Appliances, etc.)	6.0	3.0	2.8	3.5
Miscellaneous Industry (Garment, Shoes, etc.)	7.3	4.3	5.3	9.5
Construction (Sand, Cement, Gravel, Asphalt, Concrete, Re-Bar, Beam, etc.)	7.1	25.0	10.8	5.1
Others	11.2	8.2	6.3	10.8
Total	100.0	100.0	100.0	100.0

Source: JICA Study Team

e) Travel Time

The travel time by vehicle type is illustrated in **Figure 3.3.10**. The travel time for more than half of the two and three wheelers was less than 30 minutes, while that of the mini and full buses was 61 to 120 minutes. In terms of freight transport, it was clear that the travel time distribution for LCVs was different to that of the other trucks. In addition, it was found that as the vehicle size increases, the travel time also increases.



Source: JICA Study Team

Figure 3.3.10 Travel Time by Vehicle Type

(3) Results of Freight Transport Survey

a) Traffic Volumes

The results of the traffic count survey near Haldia and Falta are described in **Table 3.3.13**. Higher traffic volumes were observed near Haldia which incorporates the "Haldia Dock Complex" and the development area. With regard to vehicle composition near Haldia, 3 or more axle trucks constituted the dominant share of all traffic at 32.2% followed by 2-axle trucks (22.5%). The freight transport near Haldia accounted for 67.8%. On the other hand, the traffic volumes near Falta were only 2,294 pcu and the dominant mode of transport was passenger transport, which accounted for 84.4%.

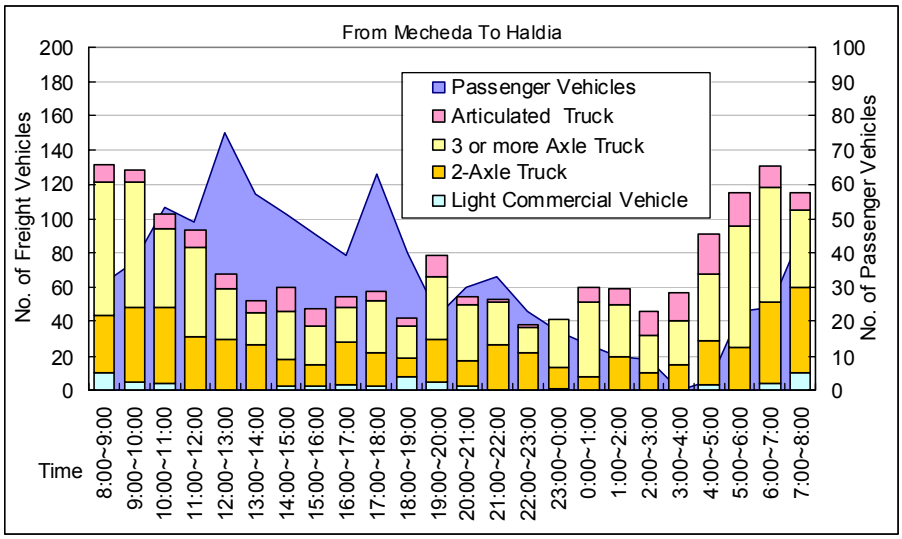
Table 3.3.13 Motorised Traffic Volumes at the Freight Survey Stations

	Unit: Vehicle/24hours, both directions											PCU
	Passenger Transport					Freight Transport					Total	
	Two Wheeler	Three Wheeler	Car/ Jeep/ Van/ Taxi	Mini Bus	Full Bus	LCV	2-Axle Truck	3 or more Axle Truck	Artic-ulated Truck	Agric-ultural Tractor		
Haldia (Station 1)	687 (12.9)	63 (1.2)	737 (13.9)	16 (0.3)	204 (3.8)	128 (2.4)	1,195 (22.5)	1,713 (32.2)	568 (10.7)	1 (0.0)	5,312 (100.0)	13,261
Falta (Station 2)	489 (25.6)	772 (40.4)	267 (14.0)	8 (0.4)	77 (4.0)	113 (5.9)	129 (6.7)	32 (1.7)	24 (1.3)	2 (0.1)	1,913 (100.0)	2,294

Note: Figures in parentheses indicate % share.
Source: JICA Study Team

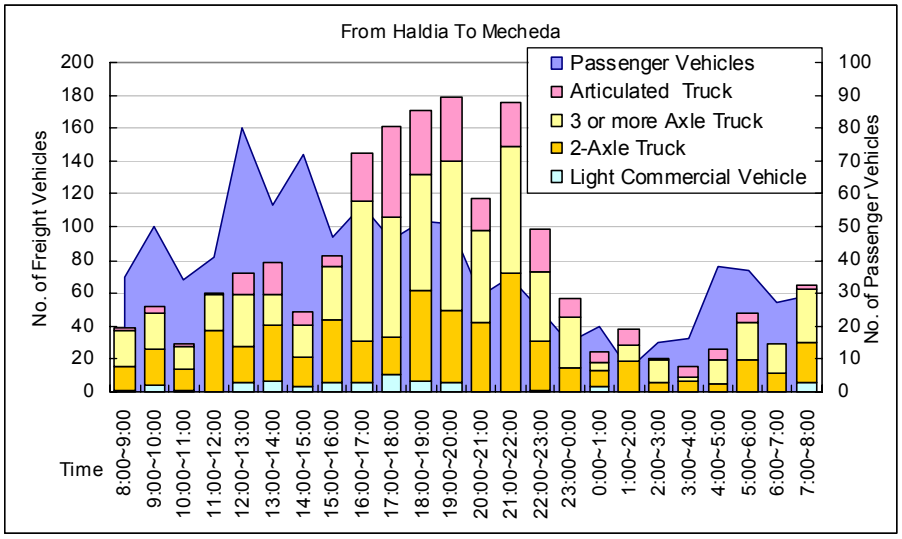
b) Hourly Fluctuations near the Haldia Development Area

Figure 3.3.11 and **Figure 3.3.12** illustrate the hourly fluctuations in each direction near Haldia. There was a higher volume of traffic moving towards Haldia between 04:00 and 12:00, while the volume travelling towards Mecheda was concentrated between 16:00 and 23:00. It appears that freight transport departs for its destination during the night time after loading/unloading goods in Haldia during the daytime. Furthermore, this trend may be affected by the truck ban inside Kolkata City between 08:00 and 21:00.



Source: JICA Study Team

Figure 3.3.11 Hourly Fluctuations (from Mecheda to Haldia)



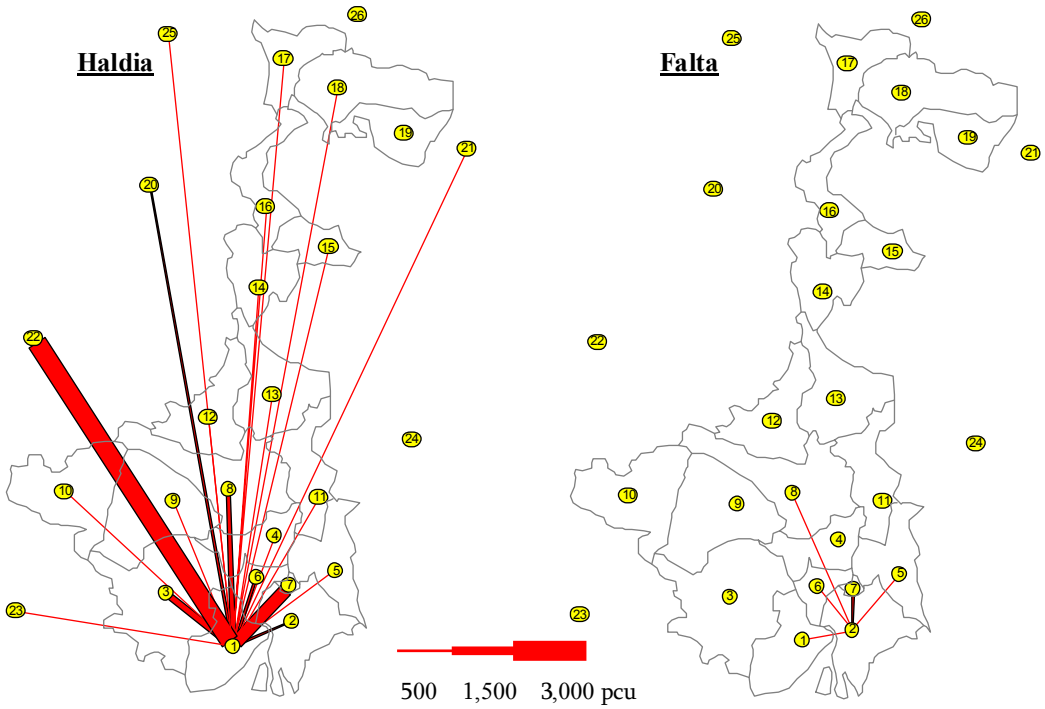
Source: JICA Study Team

Figure 3.3.12 Hourly Fluctuations (from Haldia to Mecheda)

c) Freight Characteristics

As a result of the truck OD interview survey, 1,067 and 176 samples were obtained near Haldia and Falta respectively. The sampling rates were relatively high, accounting for 29.9% and 59.1%, respectively. The origin and destination data collected in the truck OD interview survey was adjusted to reflect the total traffic volumes by vehicle type, and the OD matrices were prepared. Based on the OD matrices and zoning map, desire lines for Haldia and Falta were drawn in order to represent the origin and destination, respectively. (See **Figure 3.3.13**)

It was confirmed that Haldia and Falta have a close relationship with Kolkata City in terms of logistics. In addition, a significant volume of freight transport appeared between Haldia and Jharkhand State. This can be explained by the fact that Jharkhand State, which has rich mineral resources such as iron ore, coal, copper ore and mica, and the related industries, rely on the Haldia Dock Complex as a main gateway for imports and exports.



Source: JICA Study Team

Figure 3.3.13 Freight Transport Characteristics at Haldia and Falta

The commodity types transported near Haldia and Falta are shown in **Table 3.3.14**. The dominant commodities transported near Haldia and Falta were chemicals. Industrial activities in the Haldia development area through the Haldia Dock Complex may create this high share of chemicals. The second highest share of freight transported near Haldia was minerals. According to the cargo exports from the Haldia Dock Complex from 2004 – 2005[1], iron ore, which is one of minerals, had the highest share of all commodities received by road.

1 Administration Report & Annual Accounts with Audit Report 2004-2005, Kolkata Port Trust

Table 3.3.14 Share of Each Commodity Item in Haldia and Falta

Unit:%

Major Commodity	Haldia	Falta
Chemical	42.5	16.3
Mineral	26.7	0.0
Metal & Machine	9.2	6.1
Construction	8.3	11.2
Agriculture	4.8	12.2
Light Industry	2.2	5.1
Forest	1.0	1.0
Miscellaneous Industry	0.7	11.2
Fishery	0.3	1.0
Others	4.3	35.7
Total	100.0	100.0

Source: JICA Study Team

(4) Results of Ferry Ghat Survey

a) Passenger and Traffic Volumes

Table 3.3.15 shows the average passenger and traffic volumes obtained from the results of the three day count in the Raichak, Kukrahati and Diamond Harbour ferry ghats. Kukrahati ferry ghat provides stopping and parking spaces for the arriving and departing vehicles and operates two routes and recorded the highest passenger and traffic volumes of the three ferry ghats. In relation to traffic volumes at three ferry ghats, a high share of non-motorised vehicles was observed. However, more than 80% of ferry passengers used buses as their means of transport to/from the ferry ghats according to the results of the ferry passenger OD interview survey.

Table 3.3.15 Passenger and Traffic Volumes at Ferry Ghats

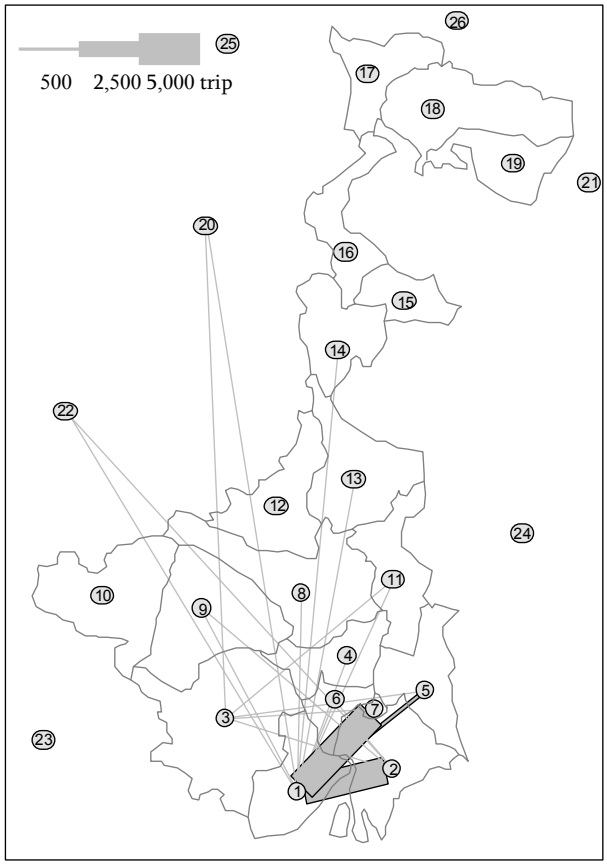
		Raichak	Kukrahati	Diamond Harbour
Number of Ferry Passengers		4,223	5,589	2,379
Motorised Vehicles	Two Wheeler	104	157	15
	Three Wheeler	97	202	4
	Car / Jeep / Van / Taxi	102	230	83
	Mini Bus	0	47	183
	Full Bus	162	174	419
	Light Commercial Vehicle	2	0	0
	2-Axle Truck	18	2	0
	Total	485	812	703
Non Motorised Vehicles	Cycle	420	440	11
	Cycle Rickshaw	117	226	302
	Animal Drawn	0	1	0
	Others	0	0	1
	Total	537	667	314

Note: Above traffic volumes are the number of both arrival and departure vehicles.
Source: JICA Study Team

b) Ferry Passenger Characteristics

A total of 5,075 ferry passengers were interviewed during the ferry passenger OD interview survey over three days. From the results of the survey, the passenger OD matrices were prepared after expansion to adjust the average daily ferry passenger volumes.

Figure 3.3.14 illustrates the ferry passenger movements. The trips between East Medinipur District and Kolkata City and between East Medinipur District and South 24 Parganas were dominant OD patterns, accounting for 90% of all trips. It can be concluded that the ferry service is an essential method of transport for people living on both banks of the Hugli River.



Source: JICA Study Team

Figure 3.3.14 Ferry Passenger Movements

CHAPTER 4

NATURAL CONDITIONS IN THE STUDY AREA

CHAPTER 4 NATURAL CONDITIONS IN THE STUDY AREA

4.1 Meteorology

4.1.1 Climate

The climate in the project area in West Bengal is classified as a tropical monsoon climate, which consists of three seasons namely; the winter season, the summer season, and the monsoon season. The winter season is during the three months from December to February. The summer season consists of the pre-monsoon period from March to mid-June, and the post-monsoon period from October to December. During the monsoon season, from mid June to September, there is high humidity and temperatures and almost 75% of the annual rainfall.

The average annual temperature is 26.8°C in Kolkata. The maximum temperature exceeded 40°C and reached a high of 43°C in May 2002 and the minimum temperature fell to 6°C in January 2003.

Table 4.1.1 Maximum and Minimum Temperature by Month (°C)

Month	1999		2000		2001		2002		2003	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Jan	31	11	31	10	30	11	30	13	28	6
Feb	36	14	31	15	35	13	34	13	33	13
Mar	39	19	35	29	37	17	37	19	37	16
Apr	38	25	38	20	39	23	37	19	38	21
May	39	22	38	20	38	21	43	22	40	22
Jun	39	25	36	25	34	25	38	24	38	25
Jul	35	24	36	24	34	25	37	25	35	25
Aug	34	23	36	25	34	25	35	24	35	36
Sep	34	24	35	23	36	24	35	24	35	25
Oct	34	22	35	20	35	23	36	19	35	23
Nov	32	16	33	18	34	19	33	17	33	15
Dec	29	14	30	13	31	13	31	12	29	12
For Year	39	11	38	10	39	11	43	12	40	6

Source: India Meteorological Department

The mean maximum temperature is 36°C in summer and the mean minimum temperature is 12°C in winter in Kolkata.

Table 4.1.2 Mean Maximum and Mean Minimum Temperature by Month (°C)

Month	1999		2000		2001		2002		2003	
	Mean Max	Mean Min	Mean Max	Mean Min	Mean Max	Mean Min	Mean Max	Mean Min	Mean Max	Mean Min
Jan	26	14	27	15	26	13	26	16	24	12
Feb	31	19	28	18	31	18	29	18	29	19
Mar	35	23	33	23	34	22	34	23	32	22
Apr	36	27	35	25	36	26	34	25	36	26
May	34	26	34	26	35	26	36	27	36	27
Jun	33	26	33	26	32	26	34	27	34	27
Jul	32	26	32	27	32	26	34	28	33	27
Aug	32	27	33	26	33	27	32	26	33	27
Sep	31	26	32	26	33	26	32	26	33	26
Oct	31	25	32	25	32	25	32	24	31	25
Nov	30	20	31	21	30	22	30	20	30	19
Dec	28	17	27	15	27	15	27	16	26	16

Source: India Meteorological Department

The normal annual rainfall in Kolkata is 1,883 mm, and there are approximately 2,500 annual sunshine hours.

4.1.2 Rainfall

There are 33 rainfall gauging stations in and around the sub-catchment area as shown in **Figure 4.1.1**. The observation work is managed by the regional office of the India Meteorological Department (IMD). The meteorological data i.e. temperature, rainfall, relative humidity, wind direction and wind velocity are recorded twice a day at each of the respective stations.

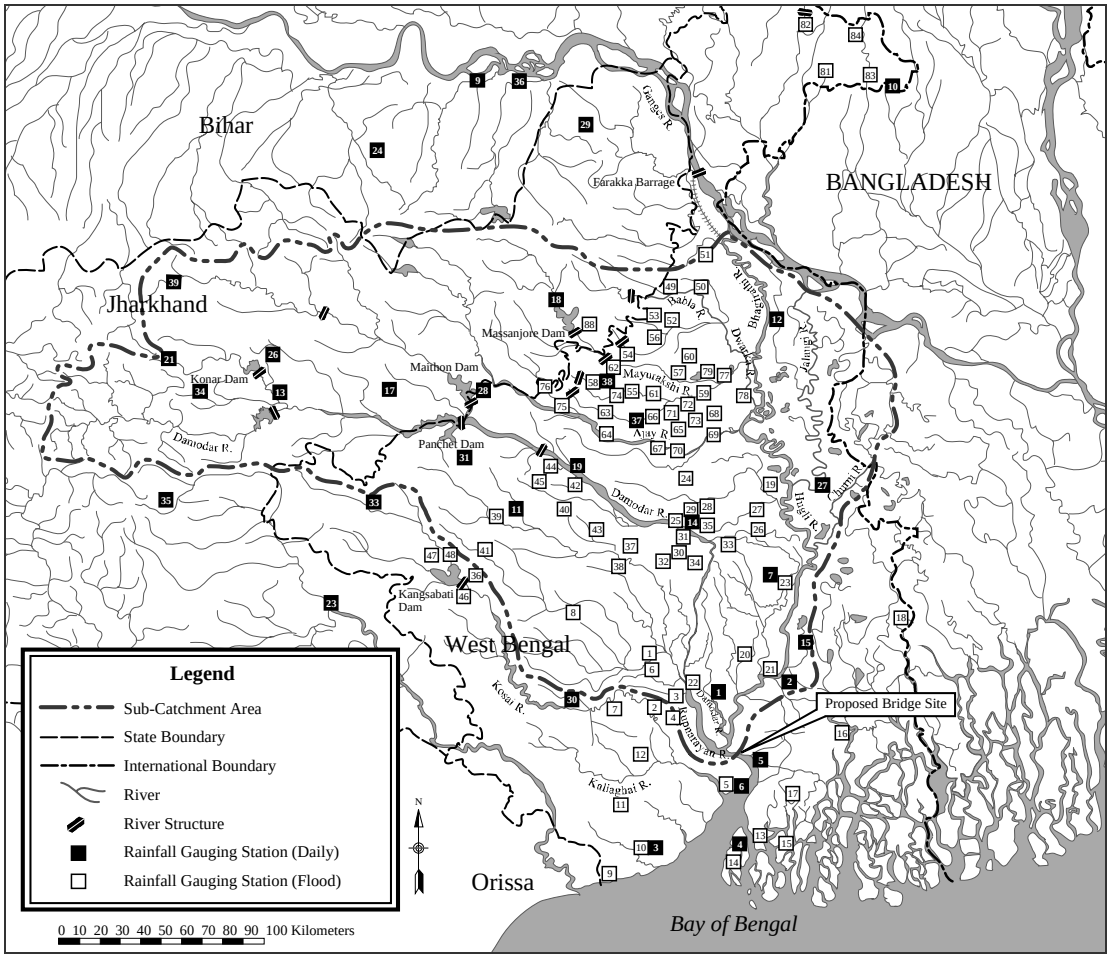


Figure 4.1.1 Rainfall Gauging Stations

In addition, the rainfall gauging stations managed by the Irrigation and Waterways Department of the Government of West Bengal, are densely distributed in the West Bengal part of the study area as shown in the figure above. However, the period of data collection at these stations is limited to the times when floods occur as this data is used for the mitigation of flood damage.

The average rainfall in the State of West Bengal is 1,750 mm, of which more than 75% occurs during the monsoon period. While the hilly region receives the heaviest rainfall, ranging from 2,500 mm to 5,000 mm, the southern districts in the plains receive an average of 1,125 mm to 1,875 mm.

According to the "Climatological Tables 1951-1980" published every 30 years by the IMD, the rainfall characteristics at some of the gauging stations in the study area are shown in **Table 4.1.3**.

Table 4.1.3 Rainfall Characteristics at IMD's Rainfall Gauges in the Study Area

Month	Ulberia (22º30'N, 87º57'E)				Bankura (23º14'N, 87º04'E)				Sri Neiketan (23º39'N, 87º42'E)			
	Max (mm)	Ave (mm)	Min (mm)	Rainy days	Max (mm)	Ave (mm)	Min (mm)	Rainy days	Max (mm)	Ave (mm)	Min (mm)	Rainy days
Jan	66.8	14.1	0.0	6.8	124.2	10.0	0.0	0.8	38.0	10.5	0.0	0.9
Feb	82.4	21.3	0.0	1.3	135.7	17.8	0.0	1.5	122.9	21.4	0.0	1.6
Mar	126.1	38.2	0.0	2.7	143.5	27.9	0.0	1.9	166.6	25.0	0.0	1.8
Apr	233.7	51.5	4.9	3.9	158.1	36.7	0.0	2.6	162.3	48.8	0.0	2.9
May	309.9	121.7	4.1	7.2	358.1	61.0	0.0	4.1	187.6	99.7	0.2	5.9
Jun	488.8	220.5	97.4	11.8	908.2	195.3	45.8	10.2	556.8	244.7	55.1	10.4
Jul	438.5	346.6	162.4	15.9	558.1	276.8	116.2	15.5	571.7	299.3	147.5	15.6
Aug	741.1	386.2	220.1	16.3	628.9	277.7	84.3	15.9	479.4	268.5	144.2	15.2
Sep	1066.7	315.5	105.9	11.3	729.7	256.2	69.2	11.7	768.4	242.7	61.4	10.9
Oct	180.8	94.6	15.1	4.6	325.4	114.3	0.0	5.7	308.8	122.0	20.9	5.4
Nov	46.0	21.5	0.0	1.1	107.1	10.8	0.0	0.7	48.8	12.8	0.0	0.8
Dec	67.6	17.8	0.0	0.7	37.0	2.9	0.0	0.3	46.3	4.3	0.0	0.3
Yearly	-	1649.5	-	83.6	-	1287.4	-	70.9	-	1399.7	-	71.7

Source: Climatological Tables 1951-1980, India Meteorological Department

Note : The statistical periods are 1970-1980 at Ulberia, 1951-1980 at Bankura, and 1960-1980 at Sri Neiktan

4.1.3 Tides

(1) Gauging Stations

The Hugli River is a tidal river with a tidal range of between 1.0 m and 6.0 m. The Kolkata Port Trust (KoPT) has 10 tidal water level gauging stations along the Hugli River between the estuary and Tribeni which is located 110 km upstream of the Hugli – Rupnarayan confluence. The tidal levels on the KoPT's gauges are measured four times a day in order to record the higher high water, lower high water, higher low water and lower low water levels.

(2) Seasonal Variations

According to the KoPT's observations, the tidal level is the lowest during the spring tide in the dry season. The least availability of depth in the river reach, i.e. the lowest low water (L.L.W) occurs during this period. It is noted from nearly two decades of past records that the low water level during the dry season spring tide in the Raichak – Kukrahati reach was recorded at a minimum level of 0.08 m with respect to local datum, which is 2.82 m below mean sea level. The recorded highest high water (H.H.W) level during this season was 7.35 m with respect to local datum. The range of the tides observed in this reach during the spring neap tides varies between 1.0 m and 6.0 m.

(3) Tidal Influence

The tidal influence in the Hugli River reaches as far as Swaruprunj which is located

approximately 282 km from the estuary. Backflow also occurs in this reach during high-tides.

4.1.4 Wind

The prevailing wind direction in the monsoon season, from June to September, is southerly. In the dry season, from November to January, the prevailing wind direction is northerly. The prevailing wind direction in April and October is not definitive.

The mean wind speed (daily average) exceeds 20 km/hr several days a year.

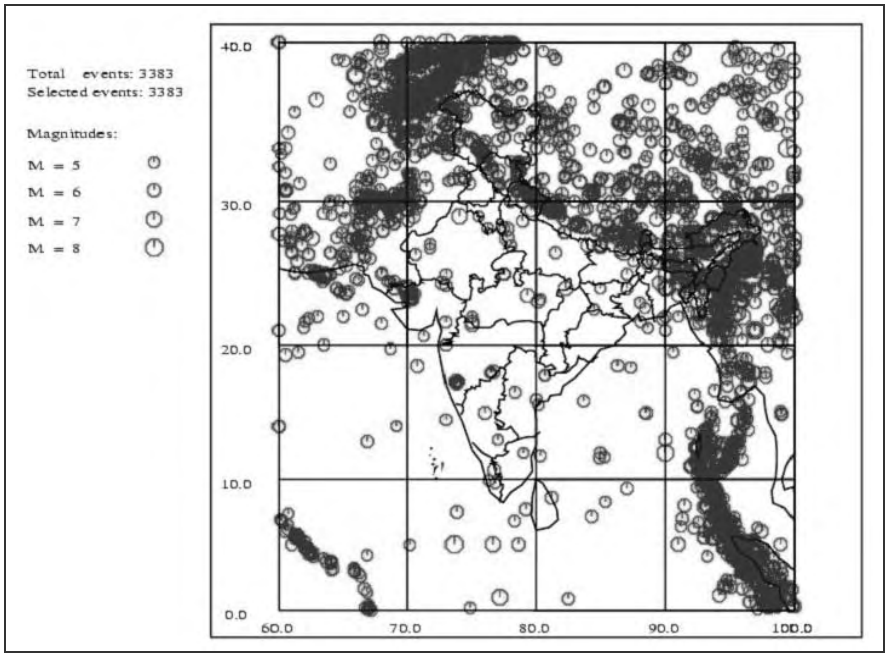
Cyclones occur mainly in the pre-monsoon (April to May) and the post monsoon (October to November) seasons in the Bay of Bengal region. Over the 100 years from 1891 to 1990, 35 cyclones, which are in the "Severe Cyclonic Storm" category with wind speeds higher than 25 m/s, crossed the Bay of Bengal coast up to 90°E longitude and between 21-22°N latitude. Wind velocities exceeding 30 m/sec were recorded during these cyclones.

The wind load along the east coast of India, including the project area, needs to be doubled to comply with the specifications in the IRC Standard for Roadway Bridge Design. This is likely to increase the wind velocity by 58% from 33.2 m/sec up to 52 m/sec at an elevation of 10 m above the ground.

4.1.5 Earthquakes

All of the states of India have experienced earthquakes, as shown in **Figure 4.1.2**. The epicentral map is made up of earthquakes (with magnitude ≥5.0) from the IMD catalogue for the period from 1800 to September 2001.

The recent significant earthquakes that have occurred in India are shown in **Table 4.1.4**.



Source: India Meteorological Department (IMD)

Figure 4.1.2 Epicentral Map

Table 4.1.4 Significant Earthquakes since 1991

Date	Epicentre		Location	Magnitude
	Lat (Deg N)	Long (Deg E)		
1991 OCT 20	30.75	78.86	Uttarkashi, Up hills	6.6
1993 SEP 30	18.07	76.62	Latur-Osmanabad, Maharashtra	6.3
1997 MAY 22	23.08	80.06	Jabalpur, Mp	6.0
1999 MAR 29	30.41	79.42	Chamoli Dist, Up	6.8

Source: Press Information Bureau, Govt. of India

The nearest seismic observatory to the project area is located in Kolkata.

4.2 River Hydrology

4.2.1 River System

The Bhagirathi – Hugli River, with a length of about 507 km, branches off the right bank of the Ganges River at Biswanathour, at about 42 km downstream of the Farakka Barrage. A part of the discharge of the Ganges River is supplied into the Bhagirathi River at the Farakka Barrage through the feeder canal with a capacity of 1,132 m^3/s (= 40,000 cusec). The Bhagirathi River meets the Jalangi River at the 218 km point (downstream from the end of the feeder canal), where its name changes into the Hugli River. The Hugli River divides Kolkata City and flows into the Bay of Bengal after meeting with the Damodar River and the Rupnarayan River.

The sub-catchment area of the Bhagirathi – Hugli River is estimated to be about 59,500 km^2. However, the watershed boundary line between the Bhagirathi – Hugli River and the Ganges

River can not be definitely provided because there are a few spill distributaries out of the Ganges River flowing into the Bhagirathi – Hugli River.

4.2.2 Water Level

In the downstream reaches of the Hugli River basin, there are at least 12 water level gauging stations for daily measurements. The observation work is managed by the Western Circle-I Office of the Irrigation and Waterways Department, as shown in **Figure 4.2.1**.

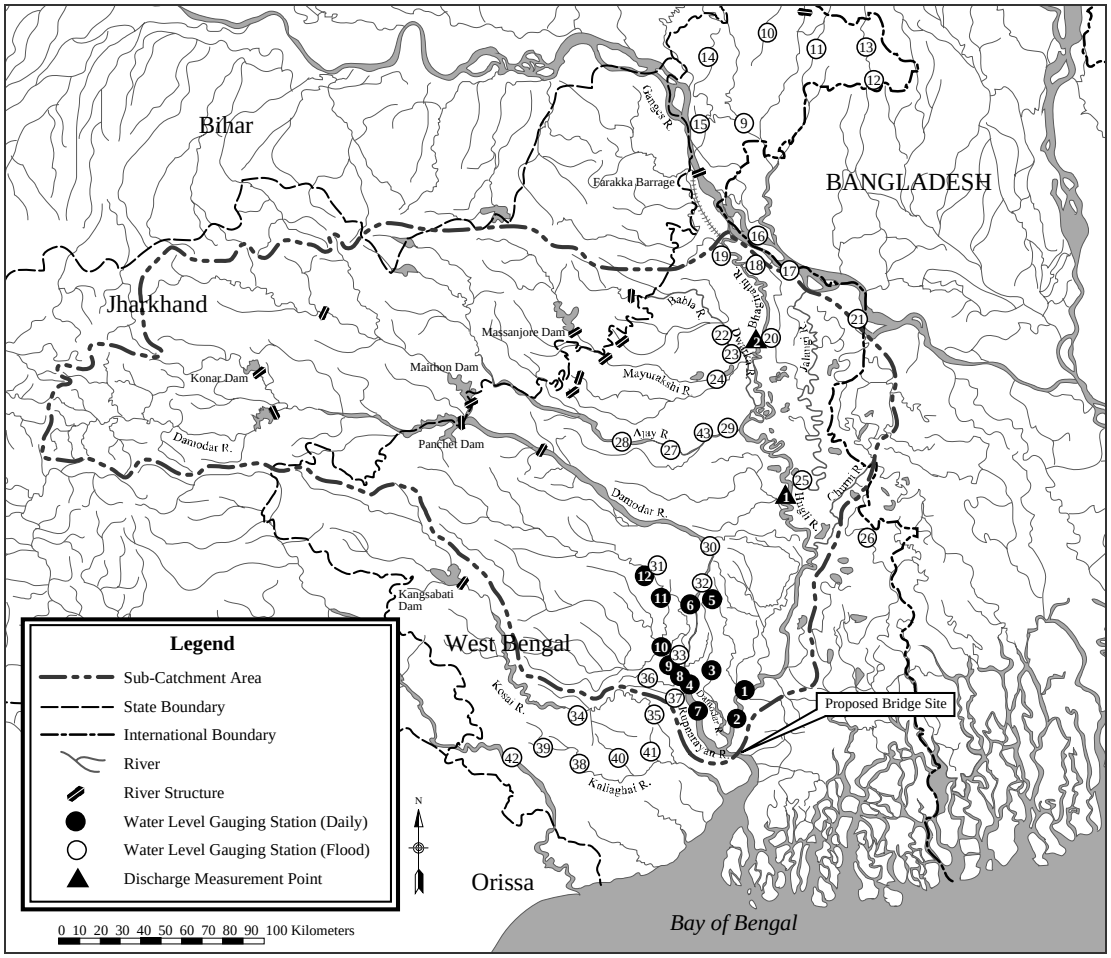


Figure 4.2.1 Water Level Gauging Stations and Discharge Measurement Points

In addition, the water level gauging stations managed by the Drawing Office of the Irrigation and Waterways Department are densely distributed throughout the West Bengal part of the study area as shown in the above figure. However, the period of observation work at these stations only coincides with the occurrence of floods as the data is used for the purpose of mitigating flood damage.

As described in sub-section 4.1.3 (3), the downstream reaches of this river basin are affected by tidal fluctuations. **Figure 4.2.2** shows the high water level of the Hugli River in 2005 at Seijiberia, located 32 km upstream of the Hugli – Rupnarayan confluence, which is station No.1 (daily) in **Figure 4.2.1**.

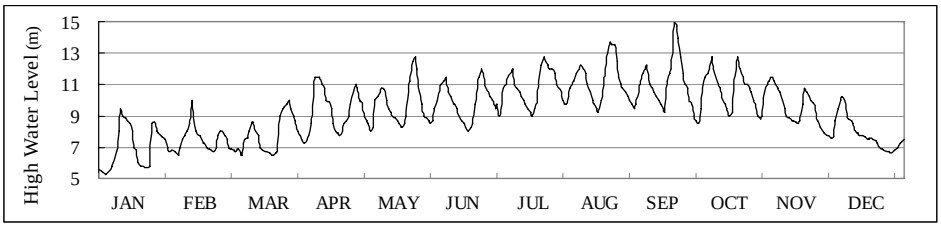


Figure 4.2.2 High Water Level at Seijiberia in 2005

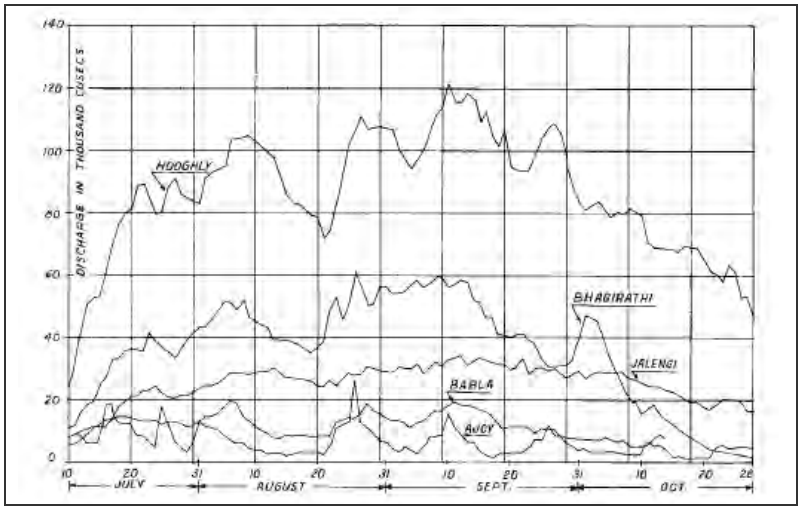
The water level variations throughout the year depend on the monsoon cycle. The mean water level is the lowest during the non-monsoon season (December – March), and increases gradually from the pre-monsoon period (March – June) to the moderate-monsoon period (July – mid August). The water level is the highest during the full-monsoon period (mid August – September), and decreases during the post-monsoon period (October – December). The range of variations throughout the year is estimated to be about 5.0 m at Seijiberia.

4.2.3 Discharge

There are two existing discharge observation stations along the Bhagirathi – Hugli River, namely Swarpugunji managed by KoPT and Berhampur (Gorabazar) managed by the Central Water Commission of the Ministry of Water Resources. These discharge observation stations are currently closed due to the issue of water intake from the Farakka Barrage, resulting a shortage of water in Bangladesh.

The maximum upland discharge is reportedly approximately 8,500 m^3/s during the monsoon period (July – August). The average perennial discharge is 1,312 m^3/s (= 40,000 cusec), which is the design capacity discharge of the feeder canal from the Farakka Barrage to the Bhagirathi – Hugli River.

The fresh water discharge from the tributaries to the Hugli River is seen over a period of approximately 70 days a year during the monsoon period only. A typical hydrograph of the Hugli River and its major tributaries is shown in **Figure 4.2.3**. The average discharge of Hugli River during the monsoon period is estimated to be approximately 2,831 m^3/s (= 100,000 cusec) based on the figure below.



Source: Sunil K. Bhattacharya, Deltaic Activity of Bhagirathi – Hugli River System, Journal of the WATERWAYS, HAOBORS AND COASTAL ENGINEERING DIVISION, Proceedings of the American Society of Civil Engineers, February 1973

Figure 4.2.3 Typical Hydrograph for the Bhagirathi - Hugli River System

4.2.4 Floods

In the state of West Bengal flooding has occurred on an annual basis, although flood waters in the Ganges River during the monsoon period are released into Bangladesh and the Damodar River, a major tributary flowing into the downstream reaches of the Hugli River from the western side, has several dams and developed channel networks in the catchment area.

According to the "Annual Flood Report" published by the Irrigation and Waterways Department (I&W Department) of the Government of West Bengal, the I&W Department has 88 rainfall gauging stations and 43 river water level gauging stations in West Bengal for the measurement (on an intermittent basis) of flood occurrences. The location maps are shown in **Figure 4.1.1** and **Figure 4.2.1**, respectively

(1) Past Major Floods

The state of West Bengal, which covers approximately 61% of the catchment area, has experienced a significant number of floods causing severe inundation over the last 50 years. It has been noticed that the severity of floods has increased during the last two decades.

Severe flooding took place twice during the 1950s (i.e. in 1956 and 1959) once in the sixties (1968), twice in the seventies (1971 and 1978), three times in the eighties (1984, 1986, 1987) and six times during the nineties (1991, 1993, 1995, 1997, 1999 and 2000).

Analysis of the area affected by the flooding, as presented in **Table 4.2.1,** from 1960 to 2005 implies the recurrence of significant floods in the state.

Table 4.2.1 Flood Affected Area (1960 – 2005)

Flood affected area (km^2)	Years of occurrence	Total No. of years
below 500	1985, 89, 92, 94, 97, 2001 and 2005	7
between 500 – 2,000	1962, 63, 64, 65, 66, 72, 75, 96, 2003 and 2004	10
between 2,000 – 5,000	1960, 61, 67, 69, 70, 74, 76, 80, 81 and 82	10
between 5,000 – 10,000	1973, 77, 93, 95 and 98	5
between 10,000 – 15,000	1968, 79, 83, 90 and 99	5
between 15,000 – 20,000	1971, 86, 87 and 88	4
above 20,000	1978, 80, 84 and 2000	4

Source: Annual Flood Report 2005, Irrigation and Waterways Department, Govt. of West Bengal

In the year 2000, a particularly severe flood occurred due to unprecedented wide spread rainfall between 17-21 September 2000, resulting in high discharges in the rivers and an unprecedented rise in the water level. This caused breaches of the embankment and water over-topped in many locations along the Bhagirathi – Hugli river system. The maximum daily rainfall was recorded at 618 mm/day at Suri located near the Mayurakshi River, a tributary of the Bhagirathi – Hugli River. A total rainfall of 1,621 mm over the 8 days from 18 – 25 September was recorded at Tantloi, near to the Mayurakshi River. The water levels in the rivers in the southern part of West Bengal exceeded the D.L. and E.D.L. at 27 gauging stations and 19 stations, respectively, out of a total of 40 stations. The consequences of the flooding on the river structures and inundated areas are summarized below.

Table 4.2.2 Consequences of the Flood in 2000

No.	Affected Items	Quantity
1.	Total length / no. of breaches	221.73 km / 786 nos.
2.	Total damaged length of embankment	601.00 km / 41 nos.
3.	Total damaged length of protective works	145.65 km
4.	Total no. of sluices damaged	481 nos.
5.	Total inundated area	23,971 km^2

Source: Annual Flood Report 2000, Irrigation and Waterways Department, Govt. of West Bengal
Note : Excluding the districts of North Bengal

(2) Characteristics of Flooding and Inundation

The area suffering from flood damage in West Bengal is basically the recipient of run-off generated outside of the state e.g. in Jharkhand and Bihar. The state of West Bengal has typical basin characteristics. In the northern region, the rainfall is high and the ground is steep, mainly in the sub-Himalayan region. Due to continual deforestation and Dolomite mining in the hills, the river beds are silted up on a day-to-day basis reducing the carrying capacity of the rivers causing the flooding. In the south and central region, heavy rainfall and run-off coming from the upper catchment area causes drainage congestion and inundation due to the very flat ground slopes in the region and the topography in these lower areas.

4.3 Topography

The topography of the project area is relatively flat and almost all of the project area (covering the access roads) is in the floodplain. The inclination of the land is less than 1:1,000.

4.4 Geology and Sub-soil

The geological period of the project area is the recent quaternary. The upper portion of the sub-soil consists of soft to medium alluvial clay, the thickness of which is from several to 20 m +/-. Beneath the alluvial clay, relatively dense sandy and/or gravelly soil appears and is deemed to be the supporting ground layer.

CHAPTER 5

INITIAL ENVIRONMENTAL EXAMINATION

CHAPTER 5 INITIAL ENVIRONMENTAL EXAMINATION

5.1 Initial IA Guidelines, Laws and Regulations Relevant to the Study

(1) Application of JICA Guidelines

The policy, legal and administrative framework on EIA relevant to the Study should include the JICA Guidelines for the environment and social considerations. As per the JICA Guidelines the present feasibility study deals with a project classified under Category A, for which appropriate screening is required in order to identify the people affected by the project, environmentally sensitive areas such as primary forests, tropical rain forests, mangrove forests, national parks, heritage sites, areas where ethnic minorities or indigenous people reside, areas involving a number of involuntary resettlements and other impacts that may significantly affect the natural and social environment.

Further, it is also the policy of JICA that the Study should ascertain compliance of all laws and regulations related to the environmental impact assessment and other relevant laws and regulations of the Government of India.

(2) Application of EIA Notification Process of the Government of India

a) Major Legal Framework for EIA in India

The major legal framework on the protection of the environment in India consists of water, air and noise pollution acts. These are the so-called "Three Environmental Acts of India". There are also a number of additional acts, the major of which are listed as follows:

i. Constitution

ii. Environment (Protection) Act of 1986

iii. Water (Prevention and Control of Pollution) Act of 1974 and Cess Act

iv. Air (Prevention and Control of Pollution) Act of 1981

v. Noise Pollution (Regulation and Control) Rules of 2000 under the Environment (Protection) Act of 1986

vi. Wildlife (Protection) Act of 1972

vii. Notification of 27 January 1994 on Environmental Impact Assessment (EIA) of Development Projects

b) Environmental Impact Assessment Process

The basis of the environmental impact assessment is provided in the Notification of the

Government of India issued on 27 January 1994 as shown in Appendix A.

In Schedule I of the Notification, the road construction project involves land acquisition and is subject to environmental clearance using the proforma provided in Schedule II of the Notification. This licenses the project for implementation as a result of screening by a committee of environmental impact assessors whose function and membership details are provided in Schedule III of the Notification. Schedule IV provides the details for a public hearing to be held by the State Pollution Control Board for the state in which the project is implemented. Thereafter, environmental clearance is assessed by the central government in the case of a project that has a national level of economic development. **Figure 5.1.1** shows the general procedure for environmental clearance.

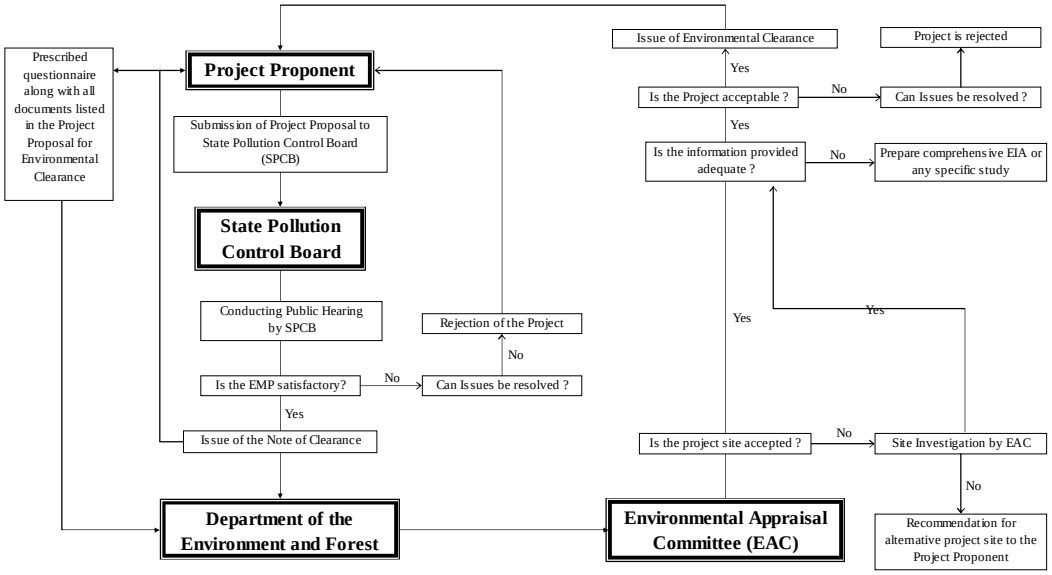


Figure 5.1.1 Flow Chart of the Procedure of Environmental Clearance

c) EIA Requirements

The EIA notification issued in January 1994 and amended in May 1994 provides the obligations for the preparation of an EIA report for obtaining environmental clearance. This is a statutory requirement for 29 identified activities, including highway projects. However, provided that the highway project is only for widening and strengthening of existing roads, including marginal land acquisition along the existing alignment, environmental clearance is not required.

The circular dated 15 October 1999 of the Ministry of Environment and Forests clarified the definition of 'marginal land acquisition' as that not exceeding a total width of 20 m on either side of the existing alignment. However, the latest land acquisition act of the state of West Bengal provides further obligations in terms of the area of land acquisition as explained in section 3.

d) Public Hearing

Schedule IV of the above notification dated 10 April 1997 provides for public hearing procedures. Under the provision, the State Pollution Control Board should provide notice of an environmental public hearing, which shall be published in at least two newspapers widely circulated in the region around the project site. One of these newspapers shall be in the vernacular language of the locality concerned. The State Pollution Board shall mention the date, time and place of the hearing. The suggestions, views, comments and objections of the public shall be invited at the hearing and registration for participation is required within thirty days from the date of the publication of the notification.

e) National Policy on Resettlement and Rehabilitation

The Ministry of Rural Development has issued a "National Policy on Resettlement and Rehabilitation for Project Affected Families – 2003", as published in the Gazette of India, Extraordinary Part I, Section 1, No. 46, dated 17 February 2003. This is given in Appendix B and provides the following policy items:

i. To minimize displacement and to identify non-displacing or least-displacing alternatives;

ii. To plan the resettlement and rehabilitation of project affected families (PAFs) including the special needs of tribal and vulnerable sections;

iii. To provide a better standard of living for PAFs; and

iv. To facilitate harmonious relationships between the requiring body and the PAFs through mutual cooperation.

The above policy also states that the "Commissioner for Resettlement and Rehabilitation" appointed by the state government should not be below the rank of commissioner/secretary of that government if the project involves the displacement of 500 families or more in the plain areas.

(3) West Bengal State Government's Policy on Land Acquisition

The Land Acquisition Branch of the Land and Land Reforms Department of the Government of West Bengal issued the Order of G.O.No.1701-LA-3M-07/06, Kolkata, 6 June 2006. This is to amend the existing West Bengal Land Acquisition Manual – 1991. The major points of concern are as follows:

i. The Land and Land Reform Department requests that the project proponent submits the land schedule, land use data, ownership data and any other relevant information, documents, certificates and undertakings as complete in all regards as per G.O.No.1702-LA-3M-07/06, Kolkata, 6 June 2006;

ii. An application for land acquisition should be made in hard copy as well as in soft copy as the Land and Land Reform Department will computerize the process. For each case, the Land and Land Reform Department will employ the relevant number of computer operators to ensure the fastest process;

iii. The funding for the compulsory acquisition of land for public projects should be borne by the Public Exchequer and the project proponent should make a deposit of not less than 50% of the total cost of land acquisition, which should be paid at the time of application;

iv. Administrative approval of such land acquisition shall be made within five (5) days provided that more than 100 acres of land acquisition proposals are sent with prior approval of the Cabinet;

v. The division and fragmentation of land areas (subject to acquisition), shall not, under any circumstances, be made on a piece-meal basis but should be treated as one entity of land acquisition;

vi. If compulsory land acquisition involves the resettlement of families, such families should be provided with a rehabilitation and resettlement package, the cost of which should be borne and strictly implemented by the project proponent;

vii. Families subject to resettlement shall be required to submit applications in the prescribed form detailing the self-assessed claim on the land and anything attached to it. Thereby the Land and Land Reform Department shall be able to award consent for compensation;

viii. After the public notification of land acquisition, there shall be a mandatory period of 30 days for hearing objections;

ix. Land acquisition shall be made based on the computerised data of market value for the different classes of land subject to acquisition; and

x. Provided there are no disputes, the entire land acquisition process shall be completed within six to seven months in total from the date of the receipt of the application for land acquisition.

5.2 Present Condition of the Natural Environment (Bio-Physical Environment)

5.2.1 Air Quality

No previous air quality surveys have been conducted around the study area. The current air quality surrounding the national and local feeder roads is basically in a good condition as the daily volumes of regional traffic are small and all national and feeder roads run through open spaces where air circulation is possible and pollutants emitted from vehicular emissions tend to be dispersed quickly. Several brick factories exist on both sides of the Hugli River and CO2 emissions from these factories may be significant around the study area.

Periodical air quality surveys are carried out across the West Bengal Region, including Kolkata and Haldia cities, by the West Bengal Pollution Control Board. During these surveys, 12 air quality parameters, such as PM10, NO2 and CO, are measured at fixed monitoring stations. **Figure 5.2.1** shows the partial survey results of this air quality survey. From these results, it can be seen that the air quality in both Kolkata and Haldia is higher than the current air quality environmental standards applied for both residential and industrial areas.

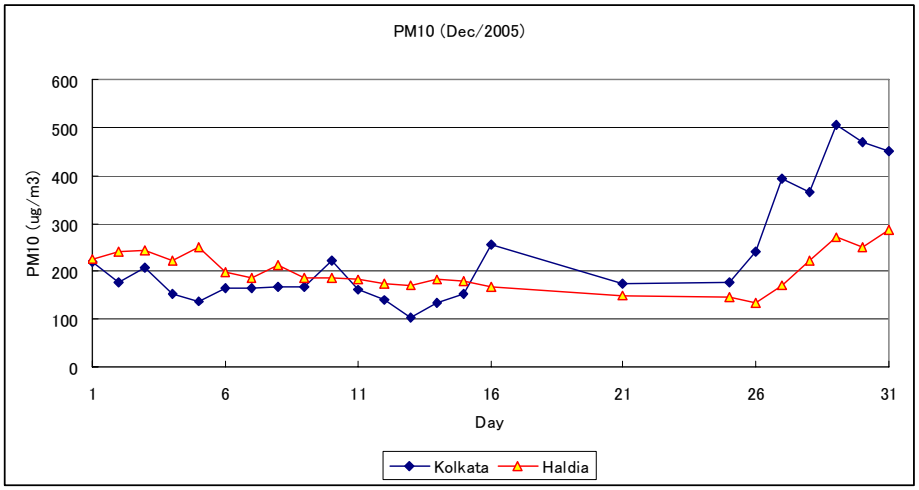


Figure 5.2.1 Periodical Air Quality Survey Results for West Bengal (PM10, ug/m3, Dec/2006)

Note: Daily Air Quality Standard (PM10) for industrial and residential areas is 150 and 100 ug/m3, respectively. (Source: http:// www.wbpcb.gov.in/html/air_auto_disp.php)

5.2.2 Water Quality

Periodical water quality monitoring is conducted at eight points along the Hugli River by the Central Pollution Control Board (see **Table 5.2.1**). From these monitoring results, it can be seen that the water quality in the Hugli River is deteriorating.

Table 5.2.1 Overall Water Quality Condition of the Hugli River

	Monitoring Place	Desired Class	1997	1998	1999	2000
1	Baharampore	B	B	B	N/A	D
2	Serampore	C	B	B	N/A	D
3	Dakshineshwar	B	D	B	N/A	D
4	Garden Reach	C	B	B	N/A	D
5	Hawrah-Shivpur	C	D	B	N/A	D
6	Uluberia	D	B	B	N/A	D
7	Palta	B	D	B	N/A	D
8	Diamond Harbour	C	B	B	N/A	D

Note that Class A: Drinking Water resources without conventional treatment but after disinfection, Class B: Outdoor bathing (organized), Class C: Drinking water resources after conventional treatment and disinfection, Class D: Propagation of Wildlife and Fisheries,

(Source: http://cpcb.nic.in/cpcb/water/waternew/advance_serach/waterc.php, 2006)

5.2.3 Soils and Sedimentation

In general, most parts of the Ganges Delta floodplain have heavy alluvial sediments (the so-called Holocene sedimentary succession). This alluvial sediment consists of clay, silt, and sand layers, and forms a multiple aquifer system. The water body of the Hugli River contains a large amount of silt and clay (i.e. the turbidity of the river water is high) and the current sedimentation process in the Hugli River is still significant although the multi-purpose Farraka barrage was constructed in the upstream of the Ganges River system for regional flood control as well as for flushing sediments accumulated over the downstream Ganges Delta [Rudra, 2006].

It is reported that both clay and peat layers contain higher concentration of arsenic compared with those of both the silt and sand layers [Pal et. al., 2002]. Due to this fact, the arsenic concentration of the groundwater in most parts of the West Bengal Region is considerable and is one of the important environmental and human health issues.

Several cracks, holes and/or on-going erosion, caused by the possible existence of the dispersive clay commonly found across Southeast Asia, are observed along both riverbanks of the Hugli River (see **Figures 5.2.2a** and **5.2.2b**).

5.2.4 Noise/Vibration

No past roadside noise/vibration surveys have been conducted around the study area. Basically, the current noise conditions surrounding the national and local feeder roads are reasonable as the daily traffic volumes are small. A roadside noise survey was conducted at

several points across Kolkata City. **Figures 5.2.3a** and **5.2.3b** show the roadside noise measured in 1993 and 2004. From these monitoring results, it can be seen that there was a significant reduction in the roadside noise between 1993 and 2003. This reduction (or improvement in the roadside noise environment) can be explained by the following reasoning. Since 1993, the urban traffic conditions have been greatly improved through the implementation of better traffic management programs and several flyovers and viaducts in congested urban areas were constructed. Consequently, the severity of city-wide traffic congestion has been alleviated to some extent and the roadside noise environment has greatly improved.

5.2.5 Bad Odors

In the past, no significant public awareness of any obnoxious odor-related issues have been raised around the West Bengal Region, so there are no official records of bad odor-related issues [Ghosh, personal communication, 2006].

Figure 5.2.2a Erosion of a riverbank due to the possible existence of dispersive clay

Note that several pipings that triggered the erosion of this site are recognized (Kukrahati, photo taken on 1 July 2006).

Figure 5.2.2b Initial stage of erosion possibly caused by the existence of dispersive clay.

Note that similar holes are found along both riverbanks of the Hugli River (Kukrahati, photo taken on July 01, 2006).

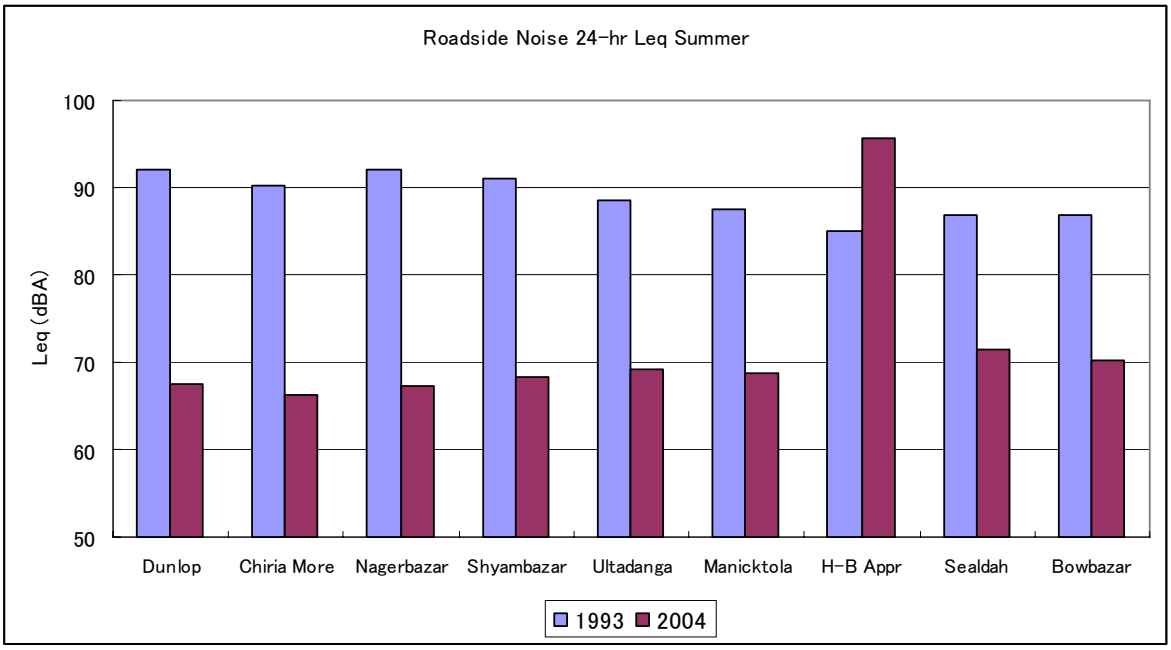


Figure 5.2.3a Roadside Noise Leq (dBA) – Kolkata, Summer (part 1)

(Source: http://cpcb.nic.in/cpcb/water/waternew/advance_serach/waterc.php, 2006)

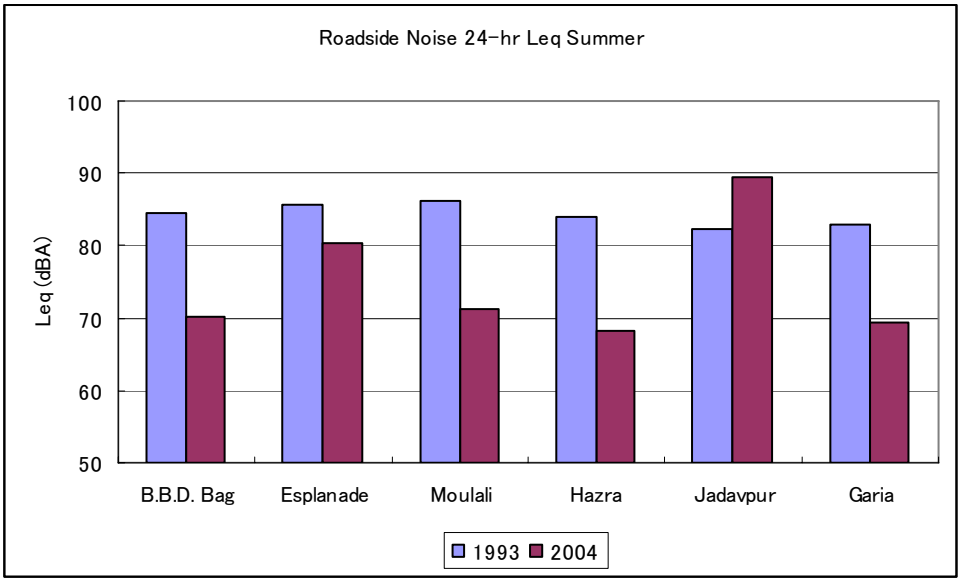


Figure 5.2.3b Roadside Noise Leq (dBA) – Kolkata, Summer (part 2)

(Source: http://cpcb.nic.in/cpcb/water/waternew/advance_serach/waterc.php, 2006)

5.2.6 Topography and Geology (Flood Inundation and Tributaries)

(1) Meteorological Features

The annual rainfall around the study area is over 1400 mm/year. The elevation of most of the study area is below 10 meters above the sea level. The regional land slope is less than 10 m per km and is highly prone to flooding during the rainy (i.e., monsoon) season. Usually the dry season continues for seven months (November - May), while the monsoon season occurs over the remaining five months (June - October). The typical wind direction is Northwest during the dry season and Southeast during the monsoon season. The annual average temperature is approximately 25°C, with an average summer temperature of 30.5 °C and an average winter temperature of 18°C.

(2) Hugli River

Both Raichak and Kukrahati are ferry points and transit towns connecting Kolkata and Haldia, and are located in the middle part of the Ganges Delta floodplain. This is about 70 km from Kolkata, the state's capital, and approximately 20 km from Haldia.

The most important geographic features around the study area are the Hugli River and its tributaries such as the Rupnarayan and the Haldi rivers. The vast Hugli floodplains have been developed by the rapid sedimentation process of these rivers (the so-called Holocene sedimentary succession, as mentioned above), and these areas are mainly used as farmlands such as rice paddies.

From a geographical point of view, the Hugli River is highly unstable and frequently changes in terms of its geo-morphological features, meandering to the eastward around the study area.

The typical river cross-section around the study area is U or V-shaped. The average depth of the Hugli River is around 10.0 m and the deepest part would exceed more than 20.0 m (see the natural and river engineering study section of this main report for more detailed information).

It is well known that the tides have a significant influence on the local flow patterns in the Hugli River around the study area. Due to this influence, the local flow in the Hugli River frequently changes its circulation pattern. It is roughly estimated that the ratio of the Hugli downstream river flow to the tidal flow from the river mouth is 1:78 (Rudra, 2006). **Figures 5.2.4a** and **5.2.4b** show the typical water level fluctuations in the Hugli River, as summarized in the tide tables for the Hugli River. From these figures, it can be seen that strong diurnal fluctuations exist at each port along the Hugli River and the tidal ranges observed at the five ports varied between 2.0 – 7.0 m. Also, a certain time lag exists between the fluctuation patterns. These lags are mainly due to the difference in

geographical location of each port, and the order of magnitude of the tidal range tends to be weaker depending on how far away the port is from the river mouth

(3) Erosion

Many on-going riverbank erosion sites were found along both sides of the Hugli River although several riverbank protection methods have been tentatively implemented (see **Figures 5.2.5a** and **5.5.5b**). This erosion is mainly caused by the combination of the following factors: (i) the implementation of inadequate riverbank protection methods, (ii) significant wind-induced waves generated during the monsoon season, in particular, cyclones (iii) the possible existence of dispersive clay layers within the embankment material, as mentioned earlier.

Current riverbank protection methods commonly recognized in the Hugli River are classified into the following five categories: (i) simple piling up of bricks without any adhesion, (ii) piling up of bricks with mortar, (iii) gabions using laterite rocks, (iv) bamboo fences with sandbags, and (v) large-scale sandbags. More detailed information on the current river protection methods is summarized in the river engineering study section of this main report.

(4) Local Drainage System and Inundation

During the monsoon season, inundation becomes one of the critical issues around the West Bengal Region. It is known that the floodplain on both sides of the Hugli River is prone to large-scale inundation, although no official records of this inundation damage on local communities and/or agricultural production exist [Sen, personal communication, 2006].

Basically, large-scale inundation occurs mainly due to the combination of the following factors: i.e., (i) poor regional drainage systems, (ii) flatness and low altitude over the entire study area and the resulting small hydraulic gradient associated with the regional drainage process, and (iii) frequent changes in the local topography due to the rapid localized sedimentation occurring during the flood events, changing the direction of the regional hydraulic gradient.

5.2.7 River Bed

From the field investigation carried out in early July 2006, it is observed that most of the river bed of the Hugli River is classified as riverine sediment, mainly composed of silt, clay and/or fine sand (**Figures 5.2.6a** and **5.2.6b**). Several brick factories, located along both sides of the Hugli River, use these river bottom sediments as brick material.

It is reported that the heavy metal concentration is relatively high in the river bed sediment, as detected at several sites in the Hugli River. This is mainly due to the discharge of untreated effluents originating from the surrounding factories or industrial complexes [Mitra, personal communication, 2006]. Due to this fact, the bio-accumulation of these heavy

metals within several aquatic species is one of the important environmental issues across the West Bengal Region [Mukberjee, personal communication, 2006].

5.2.8 Flora/Fauna

The West Bengal Region, including the Bay of Bengal and the Sundarban Delta, has rich flora/fauna, and approximately 170 aquatic species have been recorded. Among them, almost 80 species occur around the lower Ganges Delta, and five of these species are classified as migratory species, moving around the Hugli River [Mitra, personal communication, 2006]. Within this regional ecosystem, the Bay of Bengal is regarded as an important breeding and spawning area for most of the species. Due to this rich biodiversity of aquatic species and abundant fish resources, coastline and riverine local fisheries are thriving around this region.

No important biological reserves exist around the study area, and there is no important flora that would need any special protection or high-valued forests around the floodplain of the study area. Currently, most of the biologically important areas around the lower Ganges Delta are protected by state law as part of the CRZ (i.e., Coastal Regulation Zone). The perimeter of this CRZ is demarcated 11 miles away from the coastal line in both the upstream and seaward directions. It is confirmed that the study area for this proposed project does not lie within this state CRZ [Barai, personal communication, 2006], although it is located within close proximity of the upstream side of the Sundarban Delta. Therefore, it can be said that the biological connection between the study area for the proposed project and the CRZ defined by state law is not negligible.

It is reported that the Ganges River dolphin (platanista gangetia), IUCN-vulnerable, that used to be hunted across the Ganges River basin, occurs around the study area and is still occasionally caught in local fishing gear [Mitra, personal communication, 2006]. In the past, this dolphin was caught for its meat and oil. However, due to conservation efforts organized by several environmental NGOs such as WWF-India, the importance of the conservation of this species was recognized by local fishery people, and currently most of the dolphins caught are released safely although some of the dolphins to be released are already dead due to injuries caused by the fishing gear [Mitra, personal communication, 2006].

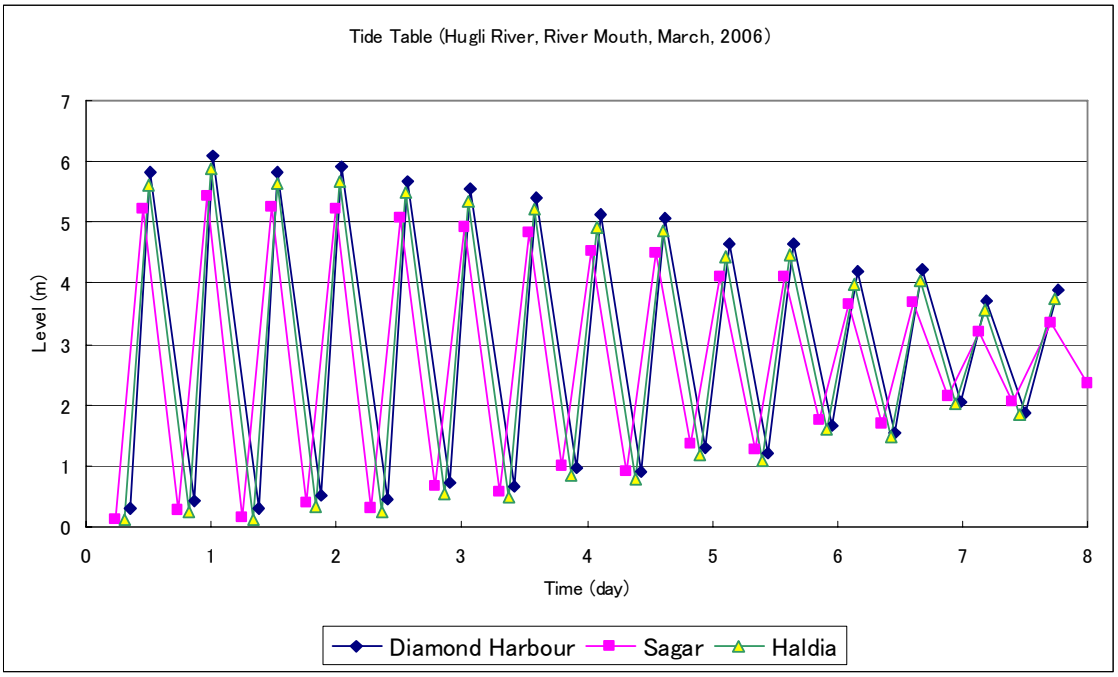


Figure 5.2.4a Water Level Fluctuation Pattern
(Hugli River: Diamond Harbour, Sagar, and Haldia)

(Source: Tide Table for the Hugli River 2006, Direction of Marine, Port of Kolkata, Government of India, 2005)

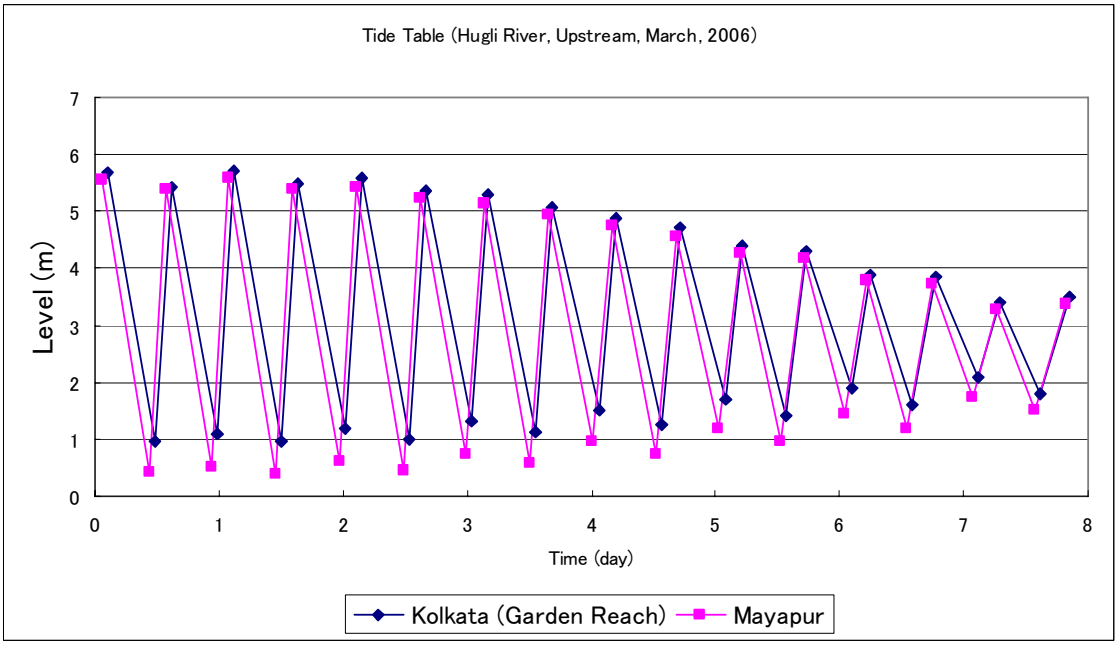


Figure 5.2.4b Water Level Fluctuation Pattern (Hugli River: Kolkata and Mayapur)

(Source: Tide Table for the Hugli River 2006, Direction of Marine, Port of Kolkata, Government of India, 2005)

Figure 5.2.5a On-going Riverbank Erosion in the Hugli River

Note that the wind-induced waves are hitting an unprotected riverbank near to Kukrahati. Photo taken on 1 July 2006.

Figure 5.2.5b Emergent Riverbank Protection Activity

Note that many bricks are piled up without any adhesives (such as mortar) around Kukrahati. Photo taken on 1 July 2006.

Figure 5.2.6a Exposed Riverbed of the Hugli River during a Low Tide Period

Note that several brick factory workers are excavating clay from the exposed river bottom. Kukrahati, Photo taken on 1 July 2006.

Figure 5.2.6b Exposed Riverbed of the Hugli River during the Low Tide Period.

Kukrahati, Photo taken on 1 July 2006.

5.2.9 Water Resources

One water treatment plant exists on the right hand side of the Hugli River. However, no district-wide water supply system is currently established around the study area. The water resources commonly used around study area are ponds, dug wells, boreholes (i.e., hand-pump well, see **Figure 5.2.7**) and rivers. As mentioned earlier, the groundwater in some parts of the West Bengal Region is contaminated with arsenic, and it is unknown if the aquifer around the study area has a similar water quality problem. Note that no reservoirs used for the storage of rain water, as is commonly recognized in Southeast Asia, have been found around the study area.

Figure 5.2.7 Hand-pump Well in the Kukrahati Area (photo taken on 1 July 2006)

Note that the small pond near the hand-pump site is commonly recognized around the study area.

5.2.10 Accidents and Disasters

It is reported that several maritime accidents have occurred in the past and some of these are identified on the navigational charts of the Hugli River as wreckage points.

During every monsoon season, several cyclones are generated over the Bay of West Bengal and tend to cause significant damage across the West Bengal Region. The worst situation is when both a cyclone and a high tide occur simultaneously. Under this situation, huge wind-induced waves are generated across the Hugli River, and this river storm eventually causes destruction to several river facilities such as breaches of levys/dikes, the destruction of ferry ports and/or large-scale inundation. **Figure 5.2.8** shows a pier in Diamond Harbour that was damaged in a previous cyclone [Chakraborty, personal communication, 2006]. **Figure 5.2.9** shows the old river dike road, presumably damaged by a flood and/or erosion event in the Hugli River.

Figure 5.2.8 Damaged Ferry Pier in Diamond Harbour (photo taken on 8 July 2006)

Note: This pier was damaged by a river storm during a past cyclone event [Chakraborty, personal communication, 2006].

Figure5.2. 9 Damaged River Bank

(Right hand side of the Hugli River, 8 July 2006)

5.2.11 Outcomes of Initial Environmental Evaluation (IEE: Bio-Physical Environment)

A preliminary environmental site inspection was carried out during both June and July of 2006. Based on the major findings obtained during this preliminary environmental field inspection, literature reviews, and the outline of the proposed engineering options, described

earlier, the preliminary environmental examination of each bridge route was carried out, and the potential environmental issues associated with each bridge route were summarized.

Based on the findings obtained in July 2006, it was found that the surrounding environments for each bridge route alternative plan were very similar. Consequently, no major differences seem to exist, within this IEE evaluation, between the different bridge routes. Therefore, an individual evaluation of each bridge route alternative plan has not been carried out within this progress report; however an overall evaluation of all four bridge route plans has been conducted. It should be noted that the specific road alignments for the approach roads associated with each bridge route alternative plan are to be delineated at a later stage and a comprehensive IEE evaluation is to be carried out after each bridge and its associated approach road alternatives are finalized.

This preliminary environmental evaluation is based on environmental features commonly found for each bridge route plan. This preliminary examination is carried out for the following two scenarios: (i) Do - Nothing scenario, and (ii) Do - scenario. Under the do - scenario, negative environmental impacts that may be caused during and after the bridge construction work are identified, and the order of the magnitude of these impacts are evaluated qualitatively.

5.2.12 Results and Discussion

Tables 5.2.2 and **5.2.3** summarize the preliminary environmental evaluation of all of the bridge route alternative options during the construction and operation phases, respectively.

Table 5.2.2 IEE (Natural Environment: Bridge Route Option - Construction Phase)

	Do	Do-Nothing
1. Air quality		
Increased roadside air pollution.	C	C
2. Water Quality		
Risk of pollution of major tributaries.	A	D
3. Soil and sedimentation		
Potential for soil erosion (bridge).	B	D
Potential for soil erosion (approach road).	B	D
Disturbance to contaminated site.	B	D
4. Waste Disposal		
Generation of large amounts of construction waste.	A	D
5. Noise/Vibration		
Increased roadside noise, dust and vibration	B	D
6. Subsidence		
Potential for large-scale consolidation and related topographical changes due to earthworks.	B	D
7. Bad Odors		
Potential for the creation of bad odors due to long-term regional inundation and related biological decay of plants.	U	D
8. Topography and Geology		
Regional flood and inundation pattern change due to approach road construction.	B	D
Creation of new inundated area.	B	D
Potential for outbreak of water-borne diseases (second impact of inundation).	B	D
Potential for outbreak of mosquito-borne diseases (second impact of inundation).	B	D
Enhanced river bank erosion/scouring.	B	D
Potential for seepage/erosion of approach road.	B	D
9. River bed (e.g., benthos)		
Disturbance to river bed conditions (e.g., benthos).	A	D
10. Fauna/flora		
Destruction of riverside/floodplain vegetation.	B	D
Destruction of roadside vegetation.	B	D
		(Continued)

	Do	Do-Nothing
Disturbance to bird habitats or floodplain habitats.	B	D
Disturbance to aquatic ecosystems or habitats.	A	D
Reduced fish spawning and breeding areas (bridge).	D	D
Reduced fish spawning and breeding areas (approach roads).	C	D
11. Water Resources		
Water quality degradation.	A	D
Groundwater quality degradation.	B	D
Groundwater level drawdown.	D	D
Disturbance to regional groundwater flow.	D	D
12. Accidents		
Potential for increased traffic accidents.	B	D
Potential for increased vessel accidents (e.g. vessel collisions).	B	D
Breach of riverbank during monsoon period (e.g. cyclones)	B	A
13. Global warming (CO_2 emissions)		
Increased CO_2 emissions.	C	D

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 5.2.3 IEE (Natural Environment: Bridge Route Option – Operation Phase)

	Do	Do-Nothing
1. Air quality		
Increased roadside air pollution.	B	C
2. Water Quality		
Risk of pollution of major tributaries.	D	D
3. Soil and sedimentation		
Potential for soil erosion (bridge).	D	D
Potential for soil erosion (approach road).	D	D
Disturbance to contaminated site.	D	D
4. Waste Disposal		
Generation of large amounts of construction waste.	D	D
5. Noise/Vibration		
Increased roadside noise, dust and vibration	B	D

(Continued)

	Do	Do-Nothing
6. Subsidence		
Potential for large-scale consolidation and related topographical changes due to earthworks.	B	D
7. Bad Odors		
Potential for the creation of bad odors due to long-term regional inundation and related biological decay of plants.	U	D
8. Topography and Geology		
Regional flood and inundation pattern change due to approach road construction.	B	D
Creation of new inundated area.	B	D
Potential for outbreak of water-borne diseases (second impact of inundation).	B	D
Potential for outbreak of mosquito-borne diseases (second impact of inundation).	B	D
Enhanced river bank erosion/scouring.	B	D
Potential for seepage/erosion of approach road.	B	D
9. River bed (e.g., benthos)		
Disturbance to river bed conditiosn (e.g., benthos).	D	D
10. Fauna/flora		
Destruction of riverside/floodplain vegetation.	D	D
Destruction of roadside vegetation.	D	D
Disturbance to bird habitats or floodplain habitats.	D	D
Disturbance to aquatic ecosystems or habitats.	D	D
Reduced fish spawning and breeding areas (bridge).	D	D
Reduced fish spawning and breeding areas (approach roads).	D	D
11. Water Resources		
Water quality degradation.	D	D
Groundwater quality degradation.	D	D
Groundwater level drawdown.	D	D
Disturbance to regional groundwater flow.	D	D
12. Accidents		
Potential for increased traffic accidents.	B	D
Potential for increased vessel accidents (e.g. vessel collisions).	B	D
Breach of riverbank during monsoon period (e.g. cyclones)	B	A
13. Global warming (CO_2 emissions)		
Increased CO_2 emissions.	B	D

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

5.3 Present Condition of the Social Environment

The exact alignment of the approaching road and the point of river crossing, either by means of a bridge, tunnel, or ferrying boat, are currently being investigated through the engineering study. There are four nominated points for the river crossing as discussed in Chapter 6. The final number of families, shops and business establishments that are affected by the project is subject to further study as it depends on the final alignment of the approaching road and the means of river crossing. However, the following issues are noted:

a) Diamond Harbour I, District of South 24 Parganas

i. From the three crossing points, the approaching road will eventually pass through the township of Sarisha, either via the existing road or by passing through agricultural fields;

ii. Sarisha is a highly congested area and bypassing the centre of the town to the east is considered appropriate in order to decrease the required number of resettlements involved;

iii. Between the river bank and a location before the built-up area of Sarisha, 10 – 20 households or shops, including illegally and or temporarily encroached buildings, will be subject to resettlement provided that the bypass to the east of Sarisha is constructed;

b) Sutahata I, District of East Medinipur

i. From the three crossing points, the approaching road may have to pass through a series of villages before connecting to NH41 if the road is built in the same location as the existing local road, therefore 150 – 180 households and shops will be subject to resettlement;

(1) Cultural Heritage

There is a temple on the right bank of the river near the point nominated for the river crossing. This would restrict the alignment of the bridge or tunnel. There are no other cultural heritage sites that would restrict the alignment of the approaching road or the alignment of the means of crossing the river.

(2) Demographic Characteristics

a) Diamond Harbour I, District of South 24 Parganas

In general, the demographic characteristics of this area are agriculture and peasantry. Thus, if the approaching road passes through agricultural fields the following issues may arise:

i. Small landowners in the right of way may lose their entire holding, or the majority of their holding (i.e. the family could lose their means of making a living unless they have a secondary means of making a living); and
ii. Tenant farmers in the area could lose their whole livelihood if the land owner releases his/her holding for the right of way.

Depending on the results of a further in-depth study on the socio-economic conditions, it might be advisable that the approaching road should follow the existing road where possible in order to avoid unnecessary involuntary resettlement.

b) Sutahata I, District of East Medinipur

In general, the demographic characteristics of this area are a mixture of agriculture and local businesses. Thus, if the approaching road passes through agricultural fields the following issues may arise:

i. Although limited in number, small landowners in the right of way may lose their entire holding, or the majority of their holding (i.e. the family could lose their means of making a living unless they have a secondary means of making a living);

ii. Tenant farmers in this area could lose their whole livelihood if the land owner releases his/her holding for the right of way; and

iii. There is a larger number of households and shops subject to resettlement than in the area in Diamond Harbour I, South 24 Parganas, depending on the alignment of the approaching road (i.e. implementation of the resettlement and rehabilitation programme and land acquisition could take a much longer time and greater cost than for the Diamond Harbour I area).

5.4 Stakeholder Meetings

(1) Stakeholder Analysis

Any development initiative involves a range of stakeholders; those who are affected directly or indirectly, as well as positively or negatively by the implementation of the project. A stakeholder analysis is conducted to clarify meaningful ways of gaining the participation of the various stakeholders in the formulation and implementation of any development intervention and can serve the following purposes:

- To draw the attention and interest of the stakeholders in relation to the project and its consequences;
- To identify conflicts of interest between stakeholders involved in the project implementation;
- To help identify relationships between stakeholders that may enable strengthening of the project sponsorship, ownership and cooperation between the stakeholders; and
- To help to assess appropriate types of participation by the different stakeholders in the project planning and implementation.

A simple stakeholder analysis was conducted in the initial stage of the Feasibility Study on the Construction of Raichak- Kukrahati Bridge in order to identify the specific range of stakeholders to be involved during the fact-finding stage. This analysis provided clarification on how the stakeholders should participate in the project planning. The stakeholders will initially form a forum which will be the main venue for public consultation.

(2) Identification of Stakeholders

The ultimate stakeholders in the project are the local people and the road users in the state of West Bengal in general. Their interests are represented at different administrative levels of the state and local governments.

An initial list of stakeholders for the project was prepared by the PWD of West Bengal State. The identified stakeholders have been classified into primary stakeholders consisting of more-directly and less-directly related stakeholders, and secondary stakeholders. Primary stakeholders are those ultimately affected by the implementation of the project. Secondary stakeholders are further classified into: 1) Central and state government agencies; 2) Other public institutions; 3) Business communities; and 4) Intermediaries such as NGO's and aid organizations that are listed in **Table 5.4.1**. As is shown, each stakeholder identified above is assessed in terms of their importance and influence based on three classes: high, medium and low.

Criteria of H, M, and L of the Stakeholders are summarized as follows:

- During the first stage, public organizations are more concerned primarily with the Project implementation while private organizations are concerned but distant comparing to those of public organizations i.e. H and M are the classification respectively;
- During the second stage, public organizations and private organizations are almost equally concerned with the Project i.e. M for both organizations are the prevailing classification in general;
- Toward the third stage, those of directly affected are more concerned with the Project

than the public organizations i.e. H for PAPs while M to the public organizations; and

- Classification on importance and influence are generally classified on the same basis.

(3) Assessment of the Importance of Stakeholders

The identified stakeholders are assessed in terms of their relationship, importance and influence to the project with respect to the realization of the project as well as their effects on the project. The relationship of the stakeholder to the project is self-explanatory. The importance indicates the power that the stakeholder such that it would be able to give priority to the satisfaction of stakeholders' needs and interests through implementation of the project. Influence is explained as the power which the stakeholders have over the decision making process for the various aspects of the project. This is the extent to which stakeholders are able to persuade or coerce others into decision making.

Table 5.4.1 Identification of Stakeholders

Relationship of the Stakeholders to the Project	Assessment*	
	Importance	Influence
I. Primary Stakeholders		
1 More directly related stakeholders		
・ P.W.(Roads) Dept. of the West Bengal State Government	H	H
・ District of South 24 Parganas and East Medinipur	H	M
・ Sub-divisions of Haldia and Diamond Harbour	H	M
・ Blocks of Diamond Harbour I & II, Sutahata I & II	H	M
・ Haldia Development Authority	H	L
・ Falta Development Authority	H	L
・ Panchayat organizations at the Districts, Sub-divisions and Blocks of East Medinipur and South 24 Parganas	H	M
2 Less directly related stakeholders		
・ District Magistrate of East Medinipur and South 24 Parganas	H	M
・ Sub-division Development Authority of of East Medinipur and South 24 Parganas	H	M
・ Block Development Authority of of East Medinipur and South 24 Parganas	H	M
・ State Electricity Board	H	L
・ West Bengal Pollution Control Board	H	H
・ West Bengal Department of Environment and Forest	H	H
II Secondary Stakeholders		
1 Central Government Agencies		
・ Ministry of Finance	M	L
・ Ministry of Shipping, Road Transportation and Highways	M	L

・ Ministry of Environment and Forest	H	H
2 State Government Agencies		
・ Ministry of Public Works	H	H
・ Ministry of Finance	H	M
・ Ministry of Transport	H	H
・ Ministry of Lands and Land Reforms	H	H
・ Ministry of Environment and Forest	H	H
・ Ministry of Commerce and Industry	H	H
・ Ministry of Tourism	H	H
・ Kolkata Port Trust	H	H
・ Kolkata Metropolitan Development Authority	H	H
3 Other public institutions		
・ Superintendent of Police, East Medinipur	M	H
・ Superintendent of Police, South 24 Parganas	M	H
・ University of Kolkata	M	M
・ Road and Building Research Institute, PWD	M	L
4 Business communities		
・ Private firms in the Special Economic Zones in Falta and Haldia	H	L
・ Local farming communities in South 24 Parganas and East Medinipur	H	L
・ State-owned transportation companies	H	L
・ Local brick factories	H	M
・ Bus and Truck Operator Unions	M	L
・ Local Passenger Transportation Operators	M	L
・ Local Tourism Operators	M	L
5 Intermediaries		
・ NGOs active in South 24 Parganas and East Medinipur	M	H
・ News media	M	M
・ JICA	M	H
・ JBIC, ADB, UN Agencies	L	L

Note: * H - High, M - Medium, L - Low

(4) Appropriate Participation of Different Stakeholders

As a result of the assessment of the importance and influence of the stakeholders, four different groups have been identified as shown in **Table 5.4.2**.

Table 5.4.2 Grouping of Stakeholders

Group	Assessment		Appropriate Participation
	Importance	Influence	
1	H	H	Need to establish good working relationships with the general public for effective collaboration and support for successful implementation of the project.
2	H	M or L	Need to be treated carefully so that their interests will be protected and their needs satisfied.
3	M or L	H	Need to be well informed and consulted to reduce the risk of their negative intervention.
	M	M	
4	M	L	Need to be informed for possible involvement in the subsequent stages.
	L	L	

Note: * H - High, M - Medium, L - Low

(5) Important and Influential Participation of Different Stakeholders

As a result of the assessment of the importance and influence of the stakeholders in conjunction with the grouping of stakeholders, a list of organizations in the order of high importance and high influence to low importance and low influence in relation to the project was identified, as shown in **Table 5.4.3**.

Table 5.4.3 Identification of Stakeholders' Based on Importance and Influence

Groups	Stakeholders
Group 1	・ P.W.(Roads) Dept. of the West Bengal State Government
(H,H)	・ State Ministry of Transport
	・ State Ministry of Lands and Land Reforms
	・ State Ministry of Environment and Forest
	・ State Ministry of Commerce and Industry
	・ State Ministry of Tourism
	・ Kolkata Port Trust
	・ Kolkata Metropolitan Development Authority
	・ Central Ministry of Environment and Forest
	・ West Bengal Pollution Control Board
	・ West Bengal Department of Environment and Forest
	・ PAPs
Group 2	・ District of South 24 Parganas and East Medinipur
(H, M/L)	・ Sub-divisions of Haldia and Diamond Harbour
	・ Blocks of Diamond Harbour I & II, Sutahata I & II
	・ Haldia Development Authority
	・ Falta Development Authority

	・ Panchayat organizations at the Districts, Sub-divisions and Blocks of East Medinipur and South 24 Parganas ・ District Magistrate of East Medinipur and South 24 Parganas ・ Sub-division Development Authority of of East Medinipur and South 24 Parganas ・ Block Development Authority of of East Medinipur and South 24 Parganas ・ State Electricity Board ・ State Ministry of Finance ・ Private firms in the Special Economic Zones in Falta and Haldia

(Continued)

Groups	Stakeholders
	・ Local farming communities in South 24 Parganas and East Medinipur ・ State-owned transportation companies ・ Local brick factories
Group 3 (M/L, H) (M, M)	・ Central Ministry of Finance ・ Central Ministry of Shipping, Road Transportation and Highways ・ NGOs active in South 24 Parganas and East Medinipur ・ News media ・ JICA ・ Bus and Truck Operator Unions ・ Local Passenger Transportation Operators ・ Local Tourism Operators ・ Superintendent of Police, East Medinipur ・ Superintendent of Police, South 24 Parganas ・ University of Kolkata ・ Road and Building Research Institute, PWD
Group 4 (M/L, L)	・ JBIC, ADB, UN Agencies

Note: * H - High, M - Medium, L - Low

The analyzed list of stakeholders is shown in **Table 5.4.4**.

Table 5.4.4 Analytical List of Stakeholders

Stakeholders \ Impacts of Direct Concern	Construction Cost/Pay-back of Loan	Operation and Maintenance	Revenue from the Bridge/Road	River Crossing Time	Cost of River Crossing	Reduction of Road Congestion	Benefit to Regional Development	Business/Job Opportunities	Changes of Income/Revenue	Changes of the Environment	Changes of the Socio-economy	Remarks
1 Central Government of India	+++	O	O	O	O	O	+++	O	O	++	+++	Initiator of the Project for providing ODA from Japan
2 West Bengal State/PWD	+++	++	+++	O	O	O	+++	O	O	+++	+++	Project proponent as infrastructure provider
3 Local government (Districts)	O	O	O	+	O	O	+++	++	O	++		Increase of the opportunities of domestic investment
4 Local government (Sub-division, Block and Villages)	O	O	O	++	O	O	+++	++	O	++	+++	Increase of the opportunities of domestic investment
5 Cargo transportation												
1) Track operators	O	++	O	+++	++	++	O	+++	++	+	+	Increase of cargo between Kolkata and Haldia while traveling time is decreased
2) Ship Operators	O	+++	O	--	-	O	O	++	-	O	O	Restrictions during the construction period
6 Passenger transportation operators												
1) Bus	O	+++	O	+++	O	+++	+	+++	+++	O	O	Increase of passengers
2) Taxi	O	+++	O	O	O	+	O	++	+	O	O	Expected increase of passengers to the other side of Hugli river
3) Ferry	O	O	O	--	--	O	O	---	---	O	O	Loss of passengers using ferry
4) Non-motorized transportation	O	O	O	O	O	+	+	O	++	++	+++	Improvement of road makes relatively easy operation while increase of traffic could hamper their operation
7 Commerce and industry												
1) Kolkata based business owners	O	O	O	++	++	++	+	++	++	O	O	Increase of the volume of transportation to Haldia
2) Haldia based business owners	O	O	O	+++	+++	+++	+	+++	+++	O	O	Increase of the volume of transportation to Kolkata and further north
3) Business owners of other areas in West Bengal	O	O	O	O	O	O	O	+	+	O	O	-
8 Local communities												
1) Farmers												
a. Land owner along the road	O	O	O	O	O	O	O	O	++	O	+++	Loss of farming land along the road or gaining one-off cash income from the sale of land
b. Land owners in other areas of the Block	O	O	O	O	O	O	O	O	+	O	+	
c. Non-Land owner	O	O	O	O	O	O	O	O	-/+	O	O	-
2) Shop owners/keepers	O	O	O	O	O	O	+	++	+++	O	O	Increase of sales during the construction period
3) Factory/Office workers	O	O	O	++	++	++	+	++	++	O	O	Increase of opportunities to obtain job while traveling time is decreased
4) Business/Factory owners	O	O	O	O	O	O	+	++	++	O	O	Increase of the opportunities of business
5) Fishermen	O	O	O	O	O	O	O	O	O	++	O	Relatively small impact
6) Residents (PAPs)	O	O	O	O	O	O	O	O	+++	O	+++	Resettlement to other areas
7) Residents (Non-PAPs)	O	O	O	O	O	O	O	O	O	++	++	Probably road transportation could provide convenience
8) Minority/Low caste/Jobless Class	O	O	O	O	O	O	O	O	O	++	++	Probably road transportation could provide temporary job opportunities
9 Quasi-government organizations												
1) Haldia Development Authority	O	O	O	+++	+++	+++	+++	+++	+++	O	O	Increase of commerce and industry
2) Kolkata Port Trust	O	O	O	O	O	+	+++	O	O	O	O	Possibility of decreasing ships entering Kolkata while load of administration on shipping lane could increase
3) West Bengal Industrial Development Corporation	O	O	O	O	O	+	+++	O	O	O	O	Industry in general in West Bengal could thrive
4) West Bengal Industry and Infrastructure Corporation	O	O	O	O	O	+	+++	O	O	O	O	Impacts on developing other infrastructure could increase
5) Falta Development Authority	O	O	O	+++	+++	+++	+++	+++	+++	O	O	Increase of commerce and industry
10 Non-government organizations	O	O	O	O	O	O	O	O	O	+++	+++	Concerned with the socio-economic development of the local communities
11 Educational organizations	O	O	O	O	O	O	O	O	O	+++	+++	Increase of research opportunities on the Project and its impact to the economy in West Bengal as a whole
12 Contractors/Consultants	O	O	O	O	O	O	O	+++	+++	O	O	Increase of sales during the construction period
13 Construction material suppliers												
1) Cement	O	O	O	O	O	O	O	+++	+++	O	O	Increase of sales during the construction period
2) Steel	O	O	O	O	O	O	O	+++	+++	O	O	Increase of sales during the construction period
3) Wood/Plunk/Ply wood	O	O	O	O	O	O	O	+++	+++	O	O	Increase of sales during the construction period
4) Asphalt	O	O	O	O	O	O	O	+++	+++	O	O	
5) Stones/Sand/Soil	O	O	O	O	O	O	O	+++	+++	O	O	Increase of sales during the construction period
14 Others												Increase of sales during the construction period

Note:

+++ Relatively Large Direct and Positive Impact
++ Relatively Medium Direct and Positive Impact
\+ Relatively Small Direct and Positive impact
O No Impact

--- Relatively Large Indirect and Positive Impact
-- Relatively Medium Indirect and Positive Impact
\- Relatively Small Indirect and Positive impact

(6) First Stakeholder Meeting

The first stakeholder meeting was held, following the notification process outlined below:

Date	Process of Notification of the Stakeholder Meeting
7-8 June	Inception Report: Explanation on Stakeholders
9 June	Meeting
17 June	Draft of public notice for newspapers is suggested to PWD
19-27 June	Publication of the public notice in five local newspapers (1 English, 2 Bengali and 2 Hindi) by PWD
4 July	Period of accepting applications for participation Invitation letters sent out to participants
11 July	First Stakeholder Meeting: Stakeholders for Raichak side
12 July	Ditto : Stakeholders for Kukrahati side

The participation of the stakeholders on both occasions was very poor. However, although there was only a limited number of participants, there was active participation in the discussions and the following points are noted:

- The West Bengal State Government has made a significant step towards information dissemination on the project at this stage of the feasibility study. Thereby the local people directly affected by the project are well-informed of the project and thus confusion and anger amongst them may be avoided at the time of implementation;
- This meeting has been informative for the local panchayat organizations in terms of the promotion of the project as well as for information dissemination for the local people;
- The local chapter of the PWD is in a position to help the process of implementation of the project as well as the implementation stage. The PWD know the local conditions much better than the central government agencies and their local knowledge should be fully utilized;
- It is predicted that the construction of the bridge could cause siltation at the bottom of the bridge. The navigational channel could also be exposed to the danger of the bridge piers. Thus the tunneling option should be considered for the project.
- Local families have not been well-informed of projects in the past and some of these families have suffered due to the lack of communication on compensation for the rehabilitation of their livelihoods. They expressed a desire for the compensation scheme to be explicitly explained to them.

Table 5.4.5 Invitees of the First Stakeholder Meeting

a. Responded to News Papers

	Name of Stakeholders	Classification	Address
1	Gammon India Ltd.	C	19 ballygunge Circular Road, Kolkata 700 019
2	Sri Shyamal Pandit	G	District Statistical Office, Bureau of Applied Economics and Statistics, Baruipore, South 24 Parganas
3	Sri Ashish Kr. Adak	I	Vill+P.O.Kangonberia,. P.S. Bishunupur, South 24 Parganas
4	Sri Ansar Ali Sapuin	I	Vill+P.O.Patra, P.S. Diamond Harbour, South 24 Parganas
5	Sri Sujit Kr. Ukil	C	Shivam Technical Srvices Pvt. Ltd.
6	Sri Chandi Banerjee	C	Shivam Technical Srvices Pvt. Ltd.
7	Sri Asoke Banerjee	C	Shivam Technical Srvices Pvt. Ltd.
8	Dr. Sunil KR. Saha	G	National Test House, Sector V, CP Block, Sald Lake, Kolkata 700 091
9	Sri Sanjib Kr. Naskar	F	M/S Anukul Brick Manufacturing Industry, Kukrahati, P.S. Sutahata, East Medinipur
10	Sri Tathagata Roy	I	P-70, Lake Road, Kolkata 700 029

Note: G-Government Organization, C-Company, F-Factory, N-NGO, I-Individual,

b. NGOs in West Bengal (Kolkata, South 24 Parganas and East Medinipur)

	Name of Stakeholders	Classification	Address
1	WWF-India, West Bengal Office	N	Tata Centre, 5F., 43, J.L.Nehru Road, Kolkata 700 071
2	Terre des hommes India Society	N	P-53, C.I.T.Road, Scheme L-11, Kolkata 700 014
3	Institute of International Social Development	N	P65, Lake View Road, Kolkata 700 029
4	Human Potential Development Sociery	N	Kandarpapur, P.O.Goria, Kokata 700 084
5	Indian Council of Rehabilitation & Sports for the Disabled	N	47/1A, Palm Avenue, Kolkata 700 019
6	Harindanga Society for Rural Education	N	P.O. Chaberia, P.S. Falta, District of South 24 Parganas
7	South Asian Foundation for Human Initiatives	N	IB 163, 1F., Salt Lake City, Sector III, Kolkata 700 064
8	Fatehpur Parshi Club	N	Vill & P.O. Fatehpur, P.S.& Block Falta, District of South 24 Parganas
9	Development Dialogue 19	N	Sarat Chatterji Avenue, Kolkata 700 029
10	Bangiya Unnayan Parishad	N	C-16/3, Patuli Ghosh Para, P.O.Panchasayar, Kolkata 700 094
11	DISHA	N	X-3, Vidyasagar Niketan, Sector I, Salt Lake City, Kolkata 700 064
12	Institute of Social Works	N	29B, Chetla Central Road, Kolkata 700 027
13	Khadi Pratisthan	N	15, College Square, Kolkata 700 073
14	Gana Unnyayan Parishad	N	10, Gomes Lane, Kolkata 700 014
15	Gandhi Peace Foundation	N	5/18, Viveknagar, Jadavpur, Kolkata 700 039
16	Indian Institute of Rural Development	N	West Chowbags, P.S. Tiljala, Kolkata 700 036
17	Jana Vikash Sahajogi Samity	N	11/28, Satchasipara Lane, Kolkata 700 036
18	Liberal Association for Movement of People	N	66, Surya Sen Stree, Kolkata 700 009
19	La Martiniers SEOMP Society	N	11, Dr. U.N.Brahmachari Street, Kolkata 700 017
20	Loreto Convent School	N	P.O.Tangra, Kolkata 700 015
21	Manovikas Kendra Rehabilitation and Research Institute for the Handicapped	N	Sec.J, Eastern Metropolitan Bypass, Kolkata 700 078

Note: G-Government Organization, C-Company, F-Factory, N-NGO, I-Individual,

c. State and Local Government and Quasi-government Agencies (Listed only on PWD's letter)

	Name of Stakeholders	Classification	Address
1	Development Commissioner		Falta Special Economic Zone
2	Divisional Railway Manager (Eastern Railway)		Sealdah
3	Divisional Railway Manager (South Eastern Railway)		Kharagpur
O	Divisional Engineer		WESEB Haldia Division
5	Divisional Engineer		WBSEB Diamond Harbour Division
6	Executive Engineer		Irrigation Division
7	Executive Engineer		Irrigation Division, Tamluk, Medinipur
8	Executive Engineer		Minor Irrigation Dept., Haldia Division
9	Executive Engineer		Minor Irrigation Dept., Diamond Harbour Division
10	Executive Engineer		Public Health Engineering, Haldia Division
11	Executive Engineer		Public Health Engineering, Diamond Harbour Division
12	Vivekananda Mission		Netra Nitamay Niketan
13	Sarisha Ram Krishna Mission		
14	Executive Engineer Tamluk Highway Division		P.W.(Roads) Directrate
15	Executive Engineer Diamond Harbour Highway Division		P.W.(Roads) Directrate
16	Executive Engineer, Tamlum Division		PWD
17	Executive Engineer, Diamond Harbour Division		PWD
18	District Mageistrate (Notice to Panchayat Samities, Gram Panchayats, Krishak Samities, Bus and Truck Operaors Unions, Fery Transport Unions, Public Health Authorities, Educational Institutions, and others including Sub-divisional Officer of Diamond Harbour and Block		South 24 Parnagas
19	District Mageistrate (Notice to Panchayat Samities, Gram Panchayats, Krishak Samities, Bus and Truck Operaors Unions, Fery Transport Unions, Public Health Authorities, Educational Institutions, and others including Sub-divisional Officer of Haldia and Block Development Officer of		East Medinipur
20	Chief Executive Officer, Haldia Development Authority		Durgachak, Haldia, East Medinipur
21	Chair Person, Haldia Municipality		
22	Chair Person, Haldia Dock Complex		
23			

Note: G-Government Organization, C-Company, F-Factory, N-NGO, I-Individual,