



**ROADS & HIGHWAYS DEPARTMENT (RHD), MINISTRY OF COMMUNICATION (MOC)  
PEOPLE'S REPUBLIC OF BANGLADESH**

**PREPARATORY SURVEY FOR  
DHAKA-CHITTAGONG NATIONAL HIGHWAY NO.1  
BRIDGE CONSTRUCTION AND REHABILITATION PROJECT**

**(Project name:**

**THE KANCHPUR, MEGHNA, GUMTI 2ND BRIDGES CONSTRUCTION  
AND EXISTING BRIDGES REHABILITATION PROJECT)**

**FINAL REPORT**

**VOLUME 2 : APPENDICES (2)**

**(APPENDIX 14 - 18)**

**March 2013**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

**ORIENTAL CONSULTANTS CO., LTD.**

**KATAHIRA & ENGINEERS INTERNATIONAL**

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**Preparatory Survey for Dhaka-Chittagong National Highway No.1 Bridge  
Construction and Rehabilitation Project**

**(Project Name: The Kanchpur, Meghna, Gumti 2nd Bridges Construction  
And Existing Bridges Rehabilitation Project)**

**VOLUME2: APPENDICES**

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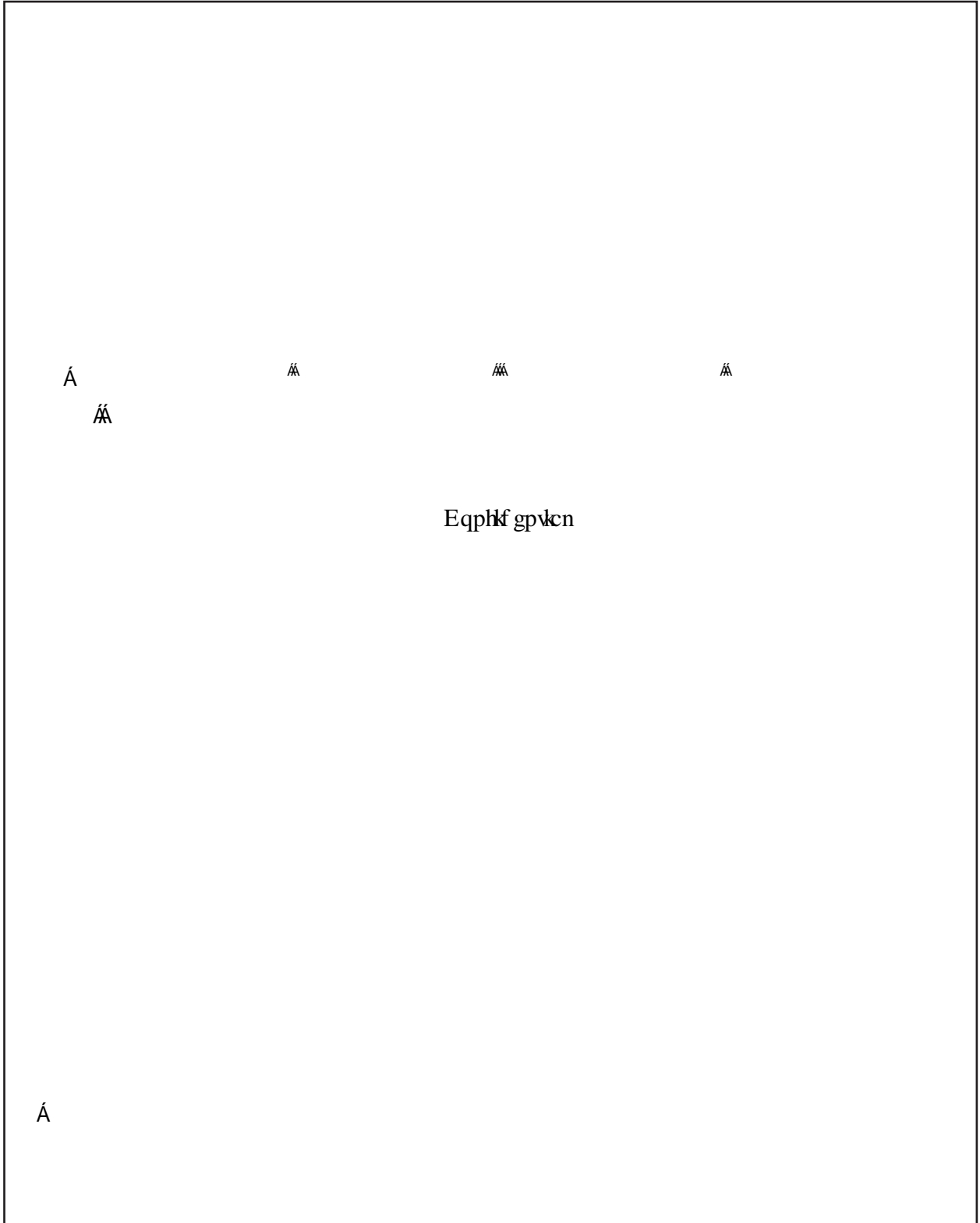
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**APPENDIX 14.**  
**TERMS OF REFERENCE**  
**FOR RAP IMPLEMENTING AGENCY**  
**(RAP-IA)**

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DHAKA-CHITTAGONG NATIONAL HIGHWAY NO.1 BRIDGE CONSTRUCTION AND  
REHABILITATION PROJECT

RAP Implementing Agency (RAP-IA)



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**APPENDIX 15.**  
**TERMS OF REFERENCE**  
**FOR CONSULTING ENGINEERS SERVICE**

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**TERMS OF REFERENCE  
FOR  
GENERAL CONSULTING SERVICES  
OF  
the KANCHPUR, MEGHNA, and GUMTI BRIDGES  
REHABILITATION and CONSTRUCTION PROJECT**

**SEPTEMBER 2012**

**ROAD AND HIGHWAY DEPARTMENT  
MINISTRY OF COMMUNICATION  
THE PEOPLE'S REPUBLIC OF BANGLADESH**

## **1. INTRODUCTION**

The Government of the People's Republic of the Bangladesh (GOB), through the Road and Highway Department (RHD), intends to engage a qualified and experienced general consulting firm (the Consultant) to provide the necessary engineering services for detailed design, Bid assistance and construction supervision of the Kanchpur, Meghna and Gumti Bridges Rehabilitation and Construction Project (the Project) under the ODA Loan provided by the Japan International Cooperation Agency (JICA).

## **2. PROJECT INFORMATION**

### **2-1. Background**

The National Highway No.1, namely, Dhaka-Chittagong Highway, is the lifeline for economy of Bangladesh with a capacity of 25,000 Annual Average Daily Traffic (AADT). The National Highway No.1 will be a part of the Asian Highway that connects with neighboring countries. On this highway, existing Kanchpur, Meghna and Gumti bridges are major structures, which are the only way to cross Sitalakhya, Meghna and Gumti rivers. But, these bridges, constructed in the year of 1977, 1991 and 1995, respectively, are being deteriorated for several years. Consequently, they need urgent rehabilitations. In addition, the existing bridges were designed and constructed according to the outdated design standard. Therefore, these existing bridges may necessitate seismic retrofitting to withstand earthquake excitations in accordance with current codes. In 2011, the National Highway No.1 almost exceeded its traffic volume capacity to 25,000 AADT counted at the approach of Kanchpur, Meghna and Gumti bridges. Recently, the Government of Bangladesh has decided to widen the National Highway No.1 into 4 lanes in order to mitigate excess traffic volume and remove traffic bottlenecks. But, these existing 2-lane bridges are becoming a critical bottleneck for traffic movement through National Highway No.1. It is obvious the existing 2-lane bridges will fail to cope with increased traffic volume of the National Highway No.1 and cause serious traffic congestion. Therefore, the construction of new 2nd Kanchpur, 2nd Meghna and 2nd Gumti bridges are becoming an essential issue.

### **2-2. Objectives**

The ~~overall~~ objective of the Project is to alleviate the traffic congestion of National Highway No.1, which can be possible by

- Construction of new 2<sup>nd</sup> Kanchpur, 2<sup>nd</sup> Meghna and 2<sup>nd</sup> Gumti bridges, thereby, contributing to economic development of Dhaka-Chittagong corridor
- Rehabilitation of existing Kanchpur, Meghna and Gumti bridges on the Dhaka-Chittagong National Highway No.1

Another important objective is to complete the whole project to ensure safe travelling on National Highway No.1 against further flood disaster since the tremendous damages for each respective bridge were caused of scouring by river flow.

The Project consists of the construction of above three (3) bridges and the rehabilitation of three (3) existing bridges with improvement of approach roads respectively within the section between Dhaka and Chittagong along National Highway No.1. Based on the



conduct of the preliminary design for the bridge components through the Preparatory Survey (F/S) of JICA in 2012, the implementation of the following three components was proposed under the financial assistance of Japanese ODA:

- (1) Component-I: Construction of 2nd Kanchpur Bridge and Rehabilitation of the existing Kanchpur Bridge across the Lakhya River with Approach Roads and Intersection
- (2) Component-II: Construction of 2nd Meghna Bridge and Rehabilitation of the existing Meghna Bridge across Meghna River with Approach Roads
- (2) Component-III: Construction of 2nd Gumti Bridge and Rehabilitation of the existing Gumti Bridge across Gumti River with Approach Roads

And, the Project component was proposed to formulate the implementation of following components given in table.

Comp.	New Bridges	Existing Bridges
I	<b>Kanchpur Bridge</b>	
	<ul style="list-style-type: none"> <li>■ Length: 396.5 m (41.6m+85.4m+97.6m+73.2m+54.9m+41.6m)</li> <li>■ Width: 18.4m (4 Lanes) (14.6m (road) + 1.1m (sidewalk )+2.7m(sidewalk))</li> <li>■ Superstructure Type Continuous steel narrow box girder bridge</li> <li>■ Substructure Type Abutment: Inverted T-type, 2 Nos. Pier: Columnar type, 5 Nos. Foundation: RC bored pile, 3 Nos Steel Pipe Sheet Pile (SPSP) 4 Nos.</li> </ul>	<ul style="list-style-type: none"> <li>■ Repair of cracks/ rebar exposures</li> <li>■ Expansion joint replacement</li> <li>■ Deck strengthening</li> <li>■ Steel Brackets</li> <li>■ Strengthening of pier including RC-lining and diaphragm wall</li> <li>■ Strengthening of foundation including steel pipe sheet piles (SPSP)</li> </ul>
II	<b>Meghna Bridge</b>	
	<ul style="list-style-type: none"> <li>■ Length: 930.0m (47.4m+9@87.0m+73.5m+23.9m)</li> <li>■ Width: 17.45m (4 Lanes) (15.25m (road) + 2x1.1m (sidewalk))</li> <li>■ Superstructure Type Continuous steel narrow box girder bridge</li> <li>■ Substructure Type Abutment: Inverted T-type, 2 Nos. Pier: Columnar type, 11 Nos. Foundation: RC bored pile, 5 Nos Steel Pipe Sheet Pile (SPSP) 8 Nos.</li> </ul>	<ul style="list-style-type: none"> <li>■ Repair of cracks/ rebar exposures</li> <li>■ Connecting girders (eliminating hinges/joints)</li> <li>■ Center hinges rehabilitation</li> <li>■ Expansion joint replacement</li> <li>■ Steel Brackets</li> <li>■ Strengthening of pier including RC-lining</li> <li>■ Strengthening of foundation including RC casting reinforcement and steel pipe sheet piles (SPSP)</li> </ul>
III	<b>Gumti Bridge</b>	
	<ul style="list-style-type: none"> <li>■ Continuous steel narrow box girder</li> <li>■ Length: 1410.0m (51.4m+7@87.0m+86.15m,86.15m+6@87.0m+51.4m)</li> <li>■ Width: 17.45m (4 Lanes) (15.25m (road) + 2x1.1m (sidewalk))</li> <li>■ Superstructure Type Continuous steel narrow box girder bridge</li> <li>■ Substructure Type Abutment: Inverted T-type, 2 Nos. Pier: Columnar type, 16 Nos. Foundation: RC bored pile, 10 Nos Steel Pipe Sheet Pile (SPSP) 8 Nos.</li> </ul>	<ul style="list-style-type: none"> <li>■ Repair of cracks/ rebar exposures</li> <li>■ Connecting girders (eliminating hinges/joints)</li> <li>■ Center hinges rehabilitation</li> <li>■ Expansion joint replacement</li> <li>■ Steel Brackets</li> <li>■ Repair of pier including RC- lining</li> <li>■ Repair of foundation including RC casting reinforcement and steel pipe sheet piles (SPSP)</li> </ul>

Following the F/S study, the Government of Japan through the JICA has decided to extend its loan to finance for the Project comprising three components above under 34th Loan Package in March 2013.

### **3. GENERAL TERMS OF REFERENCE**

#### **3-1. Scope of Works of General Consulting Services**

The main feature of the general consulting services is to lead the Project to be successfully completed timely. This will be achieved through the following:

- Engineering/Detailed Design
  - Review of the Feasibility Studies and relevant existing reports;
  - Preparation of the detailed design;
  - Cost estimates based on the detailed design; and
  - Financial analysis based on the revised cost estimation and toll policy.
- Bid Assistance
  - Preparation of bidding documents, assistance for RHD to select the Contractor: bid evaluation; award of the contract; contract negotiation; and finalizing the contract documents.
- Construction Supervision
  - Supervision of Works comprising aforementioned three components of bridge rehabilitation and construction;
  - Guidance on Operation and Maintenance measures (Preparation of Manual, Training plan, and others) for RHD officials and outsourcing;
  - Guidance on Weigh bridge and its Control for outsourcing, and;
  - Capacity building for Operation and Maintenance.
- Safeguards Assistance
  - Environmental and Social Considerations (updating, implementing, and facilitating the Resettlement Action Plan (RAP) , Environmental Management Plan (EMP), and the Environmental Monitoring Plan (EMoP), and other relevant considerations)
- Safety Considerations (Complying with Safety policy based on JICA policy)
- HIV/AIDS prevention
- Dispute Board (DB) assistance
- Transfer of Technology

- Others
  - Assistance in implementation of Information Campaign and Publicity (ICP) Program, and PR of the Project

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**APPENDIX 16.**  
**ECONOMIC AND FINANCIAL EVALUATION**

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APPENDIX 16 ECONOMIC AND FINANCIAL EVALUATION

A.16.1 Economic Analysis

A.16.1.1 Methodology

The methodology for economic analysis is adopted as follows:

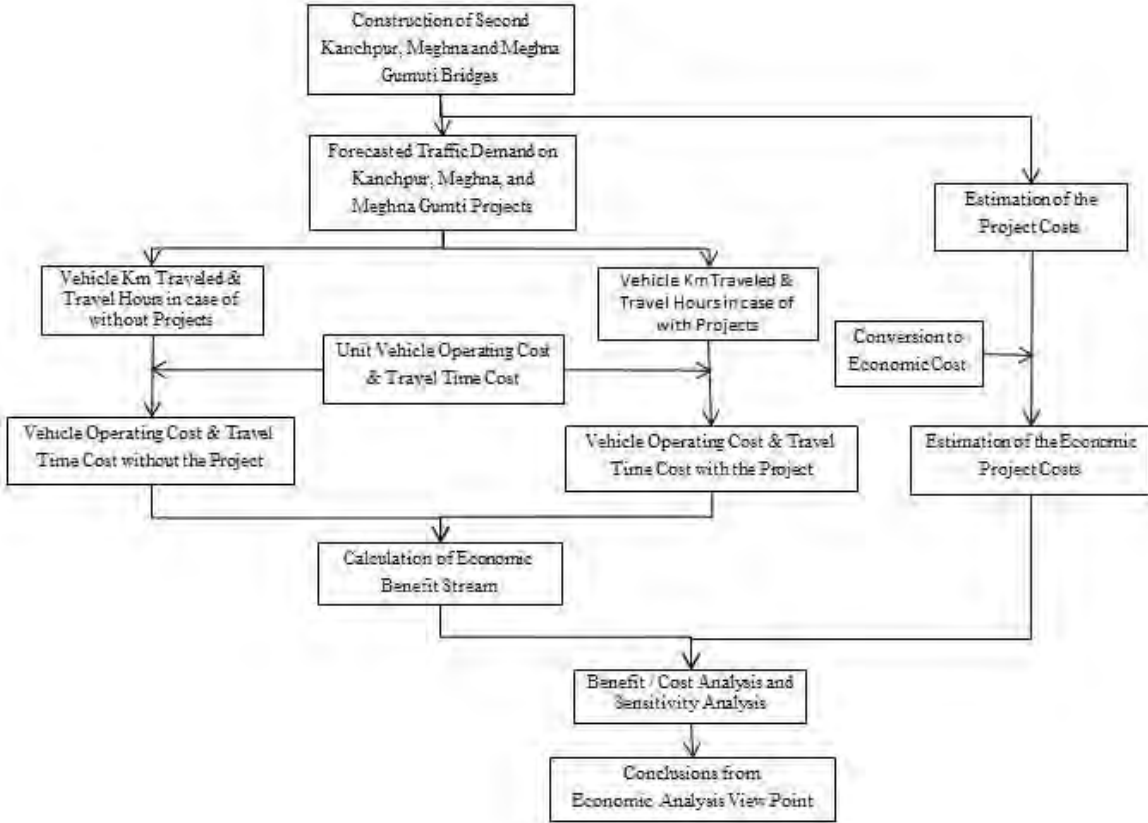


Figure A.16.1 Procedure for Economic Analysis

## A.16.1.2 Benefit Calculation

### (1) Input Data

Table A.16.1 Input Data and calculation formula used for travel time and VOC

No.	Item	Abbrevia-tion	Unit	Input /Output	Formula	Notes
1	Daily traffic volume	$TV_D$	PCU/day	○	Input data	Traffic demand forecasting
2	Hourly variation	$TC_H$	%	○	Input data	Traffic count survey
3	Hourly traffic volume	$TV_H$	PCU/hour		$TV_H = TV_D \times TC_H$	
4	Traffic capacity	$RC_{H/1}$	PCU/hour/lan e	○	Input data	Calculated by service level
5	Number of lanes	L	Number	○	Input data	
6	Road capacity	$RC_H$	PCU / hour		$RC_H = RC_{H/1} \times L$	
7	Hourly congestion degree	$CD_H$	-		$CD_H = TV_H / RC_H$	
8	Travel speed	$TS_H$	km/h		$TS_H = 104 - 80 CD_H$	
9	Average Travel Speed	ATS	Km/h		$ATS = \Sigma (TS_H \times TC_H)$	
10	Road length	RL	Km	○	Input data	Downstream from bridge on NH 1
11	Travel Time	$TT_H$	Min		$TT_H = RL / TS \times 60 \times TV_H$	
12	Unit $VOC_H$	$UVCH$	BDT/km		$UVCH = 0.003 TS_H^2 - 0.3706 TS_H + 18.799$	
13	VOC by hour	$VC_H$	BDT		$VC_H = UVCH \times RL \times TV_H$	
14	Total VOC	TVOC	BDT		$TVOC = \Sigma (TS_H \times TC_H)$	
15	Unit TTC	UTTC	BDT/hour	○		
16	TCC	TCC	BDT		Output	
17	Accident cost	ACC	BDT		Output	
18	Riprap cost	RRC	BDT		Output	
19	Discount rate	DR	%	○	12 %	
20	Annualized factor	AF	Days/year	○	1 year = 340day	
21	Economic construction cost	ECC	BDT	○		
22	Economic O&M cost	EOC	BDT	○		

## (2) Step 1 : Calculation of Travel Time and VOC

The travel time and VOC is computed as following excel file.

Excel File A.16.1.1: Travel Time and VOC Calculation

Travel Time and VOC Calculation									
2020	1.Traffic Volume		4. Capacity		8. QV Formula	10.Length	12.VOC Formula		
W/O Project	100,123	PCU/Lane	1,700	a	-80	14.08	a	0.0083	
		No. of Lane	2	b	104		b	-1.005	
							c	50.422	
	2.Hourly Distribution	3.Traffic Volume	6. Road Capacity	7. Congestion Degree	8. Travel Speed	10.Average Travel Speed	11.Travel Time	12.UVOC	13.VOC
600 - 700	0.0317	3,170	3,400	0.9322	29.4	0.93	758.37	28.0	156,402.3
700 - 800	0.0301	3,012	3,400	0.8859	33.1	1.00	640.20	26.2	139,106.3
800 - 900	0.0453	4,533	3,400	1.3333	8.0	0.36	3,989.33	42.9	342,389.6
900 - 1000	0.0465	4,655	3,400	1.3692	8.0	0.37	4,096.52	42.9	351,589.2
1000 - 1100	0.0460	4,606	3,400	1.3546	8.0	0.37	4,052.99	42.9	347,853.6
1100 - 1200	0.0480	4,809	3,400	1.4145	8.0	0.38	4,232.11	42.9	363,226.7
1200 - 1300	0.0679	6,798	3,400	1.9995	8.0	0.54	5,982.52	42.9	513,458.3
1300 - 1400	0.0500	5,006	3,400	1.4724	8.0	0.40	4,405.44	42.9	378,103.1
1400 - 1500	0.0474	4,749	3,400	1.3968	8.0	0.38	4,179.19	42.9	358,685.2
1500 - 1600	0.0507	5,076	3,400	1.4929	8.0	0.41	4,466.74	42.9	383,364.3
1600 - 1700	0.0456	4,564	3,400	1.3423	8.0	0.36	4,016.26	42.9	344,700.9
1700 - 1800	0.0427	4,275	3,400	1.2574	8.0	0.34	3,762.26	42.9	322,900.8
1800 - 1900	0.0427	4,271	3,400	1.2563	8.0	0.34	3,758.71	42.9	322,596.7
1900 - 2000	0.0440	4,409	3,400	1.2968	8.0	0.35	3,879.90	42.9	332,997.5
2000 - 2100	0.0357	3,572	3,400	1.0506	20.0	0.71	1,260.27	33.7	211,694.0
2100 - 2200	0.0354	3,546	3,400	1.0429	20.6	0.73	1,213.58	33.3	207,573.1
2200 - 2300	0.0343	3,438	3,400	1.0112	23.1	0.79	1,047.73	31.6	191,423.9
2300 - 2400	0.0375	3,756	3,400	1.1047	15.6	0.59	1,692.45	36.7	242,913.0
2400 - 1:00	0.0415	4,157	3,400	1.2227	8.0	0.33	3,658.37	42.9	313,985.1
1:00 - 2:00	0.0387	3,879	3,400	1.1408	12.7	0.49	2,143.80	39.0	266,011.7
2:00 - 3:00	0.0393	3,930	3,400	1.1559	11.5	0.45	2,400.88	39.9	276,287.8
3:00 - 4:00	0.0359	3,598	3,400	1.0583	19.3	0.69	1,310.33	34.1	215,925.3
4:00 - 5:00	0.0314	3,143	3,400	0.9244	30.0	0.94	736.41	27.7	153,329.8
5:00 - 6:00	0.0317	3,169	3,400	0.9321	29.4	0.93	758.03	28.0	156,355.1
Total	1.0000	100,123	81,600	1.2270		13.21	68,442.38	916.2	6,892,873.3

Benefit Calculation									
2020	1.Traffic Volume		4. Capacity		8. QV Formula	10.Length	12.VOC Formula		
W/ Project	117,202	PCU/Lane	1,900	a	-80	14.08	a	0.0083	
Road to be Improved		No. of Lane	6	b	104		b	-1.005	
							c	50.422	
	2.Hourly Distribution	3.Traffic Volume	6. Road Capacity	7. Congestion Degree	8. Travel Speed	10.Average Travel Speed	11.Travel Time	12.UVOC	13.VOC
600 - 700	0.0317	3,170	11,400	0.2780	80.0	2.28	278.92	23.1	129,094.4
700 - 800	0.0301	3,012	11,400	0.2642	80.0	2.17	265.08	23.1	122,687.4
800 - 900	0.0453	4,533	11,400	0.3977	72.2	2.94	442.11	21.1	168,549.8
900 - 1000	0.0465	4,655	11,400	0.4083	71.3	2.98	459.43	21.0	171,774.5
1000 - 1100	0.0460	4,606	11,400	0.4040	71.7	2.97	452.35	21.0	170,461.4
1100 - 1200	0.0480	4,809	11,400	0.4219	70.3	3.04	481.94	20.8	175,903.0
1200 - 1300	0.0679	6,798	11,400	0.5963	56.3	3.44	850.21	20.1	241,089.1
1300 - 1400	0.0500	5,006	11,400	0.4391	68.9	3.10	511.75	20.6	181,284.2
1400 - 1500	0.0474	4,749	11,400	0.4166	70.7	3.02	473.07	20.9	174,284.4
1500 - 1600	0.0507	5,076	11,400	0.4452	68.4	3.12	522.58	20.5	183,220.8
1600 - 1700	0.0456	4,564	11,400	0.4003	72.0	2.95	446.42	21.1	169,357.2
1700 - 1800	0.0427	4,275	11,400	0.3750	74.0	2.84	406.74	21.5	161,794.6
1800 - 1900	0.0427	4,271	11,400	0.3747	74.0	2.84	406.20	21.5	161,689.7
1900 - 2000	0.0440	4,409	11,400	0.3868	73.1	2.90	424.85	21.3	165,284.4
2000 - 2100	0.0357	3,572	11,400	0.3133	78.9	2.53	318.58	22.8	143,380.1
2100 - 2200	0.0354	3,546	11,400	0.3110	79.1	2.52	315.51	22.9	142,681.2
2200 - 2300	0.0343	3,438	11,400	0.3016	79.9	2.47	303.04	23.1	139,787.8
2300 - 2400	0.0375	3,756	11,400	0.3295	77.6	2.62	340.57	22.4	148,251.9
2400 - 1:00	0.0415	4,157	11,400	0.3647	74.8	2.80	391.13	21.7	158,722.8
1:00 - 2:00	0.0387	3,879	11,400	0.3402	76.8	2.68	355.63	22.2	151,467.8
2:00 - 3:00	0.0393	3,930	11,400	0.3448	76.4	2.70	362.06	22.1	152,813.6
3:00 - 4:00	0.0359	3,598	11,400	0.3156	78.7	2.55	321.69	22.8	144,082.8
4:00 - 5:00	0.0314	3,143	11,400	0.2757	80.0	2.26	276.59	23.1	128,014.8
5:00 - 6:00	0.0317	3,169	11,400	0.2780	80.0	2.28	278.88	23.1	129,078.0
Total	1.0000	100,123	273,600	0.3659		65.99	9,685.32	523.9	3,814,756.0

Notes:   Input Data   : Output Data   Parameters in formula

**(3) Step 2: Calculation of TTC, VOC, ACC and RRC**

TTC, VOC, ACC and RRC can be calculated as following file:

Excel File A.16.1.2 Benefit Calculation

Benefit Calculation						
Unit TTC		149.70				
<b>Plan 1: Road to be Improved</b>						
		Travel Time	TTC	VOC	ACC	RRC
2020	W/O	68,442.38	10,245.825	6,892.873		
	W/	9,685.32	0	3,814.756		
	Benefit		10,245.825	3,078.117		
	Annualized		340	340	1.0	276.9
	Yearly		3,483.6	1,046.6	1.0	276.9
					Total	4,808.0
<b>Plan 2: Road not to be Improved</b>						
		Travel Time	TTC	VOC	ACC	RRC
2020	W/O	68,442.38	10,245.825	6,892.873		
	W/	12,502.20	1,871.579	4,026.078		
	Benefit	55,940.19	8,374.246	2,866.796		
	Annualized		340	340	1.0	276.9
	Yearly		2,847.2	974.7	1.0	276.9
					Total	4,099.9
<b>Plan 1: Road to be Improved</b>						
		Travel Time	Travel Time Cost	VOC	ACC	RRC
2025	W/O	111,425.72	16,680.430	9,683.206		
	W/	14,221.11	2,128.900	4,686.936		
	Benefit		14,551.530	4,996.270		
	Annualized		340	340	1.6	276.9
	Yearly		4,947.5	1,698.7	1.6	276.9
					Total	6,924.8
<b>Plan 2: Road not to be Improved</b>						
		Travel Time	TTC	VOC	ACC	RRC
2025	W/O	111,425.72	16,680.430	9,683.206		
	W/	23,321.56	3,491.237	5,760.078		
	Benefit	88,104.16	13,189.193	3,923.128		
	Annualized		340	340	1.6	276.9
	Yearly		4,484.3	1,333.9	1.6	276.9
					Total	6,096.7

**(4) Step 3 Economic Cost and OM Cost**

- **Escalation factor:** Price inflation was not taken into account for either construction cost or operation/maintenance cost.
- **Administrative cost, VAT and import duty:** Imposition of value added tax and import duty was excluded.
- **Standard conversion factor:** Standard conversion factor (0.85)<sup>1</sup> is applied to the price of non-tradable goods and services.
- **Land acquisition cost and compensation cost:** Resettlement cost estimated in the Resettlement Action Plan (RAP) is used in the economic and financial analysis.
- **Stream of construction and operation/maintenance costs** are set up in each Bridge based on the Project implementation schedule.
- **Operation and maintenance cost** consists of three: routine maintenance, periodic maintenance and toll levying cost.

<sup>1</sup> “Project Appraisal Framework” Transport Sector Coordination Wing, Planning Commission, 2005



Table A.16.1.2 Economic Operation and Maintenance Cost

**1) Economic and Financial Cost Estimation**  
**(a) Annual Fund Requirement**

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**(b) Economic and Financial Cost Estimation**

Confidential

**(c) Economic Cost Estimation**

Confidential

**2) Economic and Financial Operation and Maintenance Cost**  
**(a) Base Operation and Maintenance Cost of Kanchpur Bridge**

Confidential

**(b) Base Operation and Maintenance Cost of Meghna Bridge**

Confidential

**(c) Base Operation and Maintenance Cost of Gumti Bridge**

Confidential

**(d) Economic Operation and Maintenance Cost**

Confidential

## **(5) Benefit Cost Stream**

Cost-benefit stream can be shown in the following excel file. This benefit cost stream is computed as discounted cost -benefit stream. And the following economic indicators are calculated:

- Economic internal rate of return (EIRR)
- Net present value (NPV)
- Cost benefit rate (CBR)

Excel File A.16.1.3:

Confidential

Excel File A.16.1.4:

Confidential



## A.16.2 Financial Analysis

The project revenue can be calculated based on the following input:

Table A.16.2.1 Input Data for Financial Analysis

No.	Item	Abbrevia-tion	Unit	Input /Output	Formula	Notes
1	Daily traffic volume	TV <sub>D</sub>	Vehicle/day	○	Input data	Traffic demand forecasting
2	Toll Rate	TR	BDT/vehicle	○	Input data	Traffic count survey
3	Toll Revenue	TR	BDT		TR = TV <sub>D</sub> x TR	
4	Discount rate	DR <sub>F</sub>	%	○	8%	
5	Financial cost	FC	BDT	○		
6	O & M cost	OMC	BDT	○	Financial O/M cost consists of routine maintenance, periodic maintenance, toll operation and other operation costs	
7	Annualized factor	AF	Days/year	○	340 days/year	

### (1) Calculation of Toll Revenue

The toll revenue can be calculated as follows:

$$TR = TV_D \times TR$$

Where: TV<sub>D</sub> : Daily traffic volume in terms of vehicle

TR: Toll rate per vehicle

### (2) Financial Construction Cost and OM Cost

- **Escalation factor:** Price inflation is not taken into account for either construction costs or operation/maintenance cost.
- **Tax and import duty:** Those taxes are included.
- **Resettlement cost:** Resettlement cost estimated in the Resettlement Action Plan (RAP) is used in the economic and financial analysis.
- **Operation and maintenance cost** consists of three: routine maintenance, periodic maintenance and toll levying cost.
- **Implementation schedule** is adopted for same as Table 16.1.1 in main report.

Table A.16.2.2 Financial Project Cost Stream by Bridges

Confidential

Table A.16.2.3 Financial Operation and Management Cost by Bridges

Confidential

Confidential

Excel File A.16.2.2 Cash Flow of Cost and Toll Revenue

Confidential

Excel File A.16.2.2 Cash Flow of Cost and Toll Revenue

Confidential

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**APPENDIX 17.**  
**EIA REPORT**

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**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
ROADS & HIGHWAYS DEPARTMENT (RHD), ROADS DIVISION  
MINISTRY OF COMMUNICATION (MOC), PEOPLE'S REPUBLIC OF BANGLADESH**

**PREPARATORY SURVEY FOR  
DHAKA-CHITTAGONG NATIONAL HIGHWAY NO.1  
BRIDGE CONSTRUCTION AND REHABILITATION PROJECT**

**DRAFT FINAL REPORT  
OF  
ENVIRONMENTAL IMPACT ASSESSMENT**

**SEPTEMBER 2012**

**ORIENTAL CONSULTANTS CO., LTD.  
KATAHIRA & ENGINEERS INTERNATIONAL**







## Oriental Consultants Co., Ltd.

CONSULTING ENGINEERS

Date : September 20, 2012

Ref. No. OCDAC-RHD010

Attn:  
Mr. Md. Saidul Hoque  
Additional Chief Engineer  
Bridge Management Wing  
Roads and Highways Department  
Sarak Bhaban, Ramna  
Dhaka-1000

Ref.: "PREPARATORY SURVEY FOR DHAKA-CHITTAGONG NATIONAL  
HIGHWAY NO.1 BRIDGE CONSTRUCTION AND REHABILITATION PROJECT".

**Subject: Submission of draft final report on EIA**

Dear Mr. Hoque,

We are pleased to submit herewith the Draft Final Report (5 hard copies) on Environmental Impact Assessment (EIA) prepared for the "Preparatory Survey for Dhaka-Chittagong National Highway No.1 Bridge Construction and Rehabilitation Project".

The report contents the executive summary of study, the main report consisting of 9 chapters and the annexes. The EIA is prepared on the basis of proposed engineering works, highlighting the potential environmental impacts, necessary mitigation measures and environmental management plan for each of the identified impacts. And also be informed that the draft final of EIA report is fully revised considering with valuable comments and queries received from 'JICA advisory committee' and Roads and Highways Department. Therefore, we would like to request you please proceed an approval process at DOE with this draft final report.

We wish to express grateful acknowledgement to the personnel of Roads and Highways Department (RHD) and also to officials of the Ministry of Communications, Government of Bangladesh for their assistance extended to the Study Team.

Yours faithfully,

Dr. Masaaki Tatsumi  
Project Team Leader,  
Oriental Consultants Co., Ltd.,  
Tokyo, Japan.

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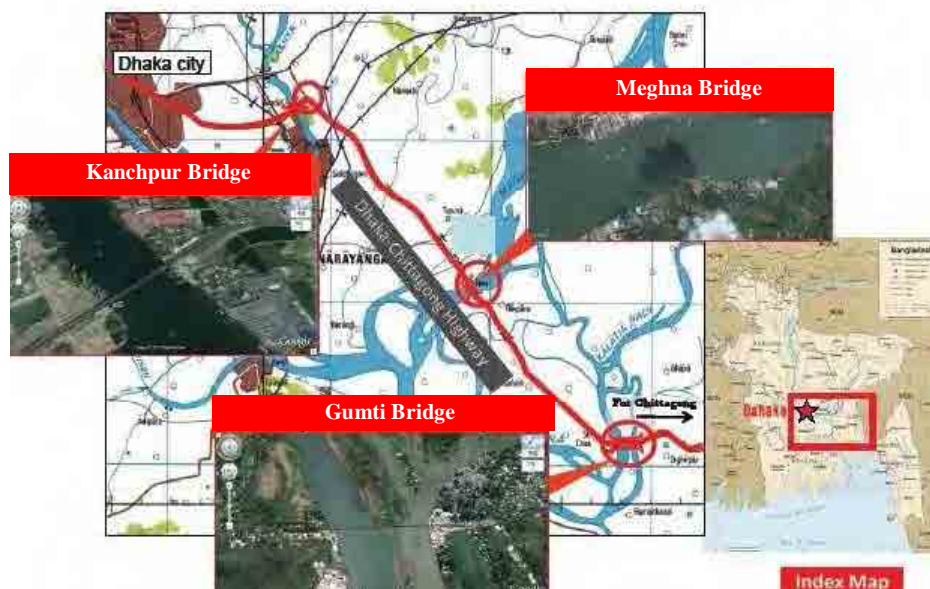
# Executive Summary

## Introduction

The Government of Bangladesh (GoB) has undertaken a project to construct three bridges on NH-1 (Dhaka-Chittagong Road) i.e. Kanchpur, Meghna and Gumti including rehabilitation of the existing bridges through the Roads and Highways Department (RHD) under the Ministry of Communications (MOC) with financial assistance from the Japan International Cooperation Agency (JICA). The project involves construction of new bridges parallel to the existing bridges with embankment and surrounding facilities. The length of the bridges are Kanchpur Bridge 400 m, Meghna Bridge 930 m and Gumti Bridge 1,410 m respectively. The overall objective of the Project is to mitigate the increasing traffic demand of National Highway No.1 (NH-1), which can be made by;

- i. Construction of new 2<sup>nd</sup> Kanchpur Bridge, 2<sup>nd</sup> Meghna Bridge and 2<sup>nd</sup> Gumti Bridge together with approach road respectively.
- ii. Rehabilitation of existing Kanchpur Bridge, Meghna Bridge and Gumti Bridge

The general description of those three bridges are as follow:



Locations of 3 bridges

The outline of project is summarized as:

		Kanchpur Bridge	Meghna Bridge	Gumti Bridge
Construction of new bridge	Length m	396.5	930	1,410
	Width m	18.4	17.75	17.75
	Navigation clearance m	Horizontal: 61m Vertical: 12.2m	Horizontal: 75m Vertical: 18m	Horizontal: 75m Vertical: 7.5m
Rehabilitation of existing bridges	Length m	396.5	930	1,410
	Width m	14.64	9.2	9.2
	Navigation clearance m	width: 61m height: 12.2m	width: 75m height: 18m	width: 75m height: 7.5m
Pier	Number	5 pier	11 pier	16 pier
	Foundation type	Steel pipe sheet	Steel pipe sheet	Steel pipe sheet

		pile	pile	pile
	Foundation width m	31.3m x 8.5m	32.44m x 14.97m	29.95m x 13.73m
	Maximum pile depth m	33m	42m	70m
Access to bridge	Length m	300m in Dhaka side and 300m in Chittagong side	500m in Dhaka side and 500m in Chittagong side	700m in Dhaka side and 300m in Chittagong side
	Maximum thickness of embankment m	7m in Dhaka side and 12m in Chittagong side	10m in Dhaka side and 9m in Chittagong side	7m in Dhaka side and 6m in Chittagong side

Area and material necessary are shown :

		Kanchpur Bridge	Meghna Bridge	Gumti Bridge	Total
Land to be used (all land in inside RHD land)	Road and Road m2	31,000	39,000	39,000	109,000
	Construction yard m2	3,000	25,000	22,000	50,000
	Temporary road m2	9,000	10,000	9,000	28,000
	Total area m2	43,000	74,000	70,000	187,000
Construction material used	Soil m3	47,000	39,200	32,800	119,000
	Sand ton	17,300	37,400	43,200	97,900
	Crushed stone ton	13,100	30,900	34,500	78,500
	Cement /ton	3,300	9,800	10,000	23,100
	Re-bar ton	1,100	3,300	3,400	78,000
	Steel ton	8,900	29,500	56,600	95,000
Manpower and equipment (tentative)	Manpower People/month	8,000	30,000	55,000	93,000
	Trucks No. x day	Trucks:1,000 Concrete mixing car: 1,900	Trucks:2,700 Concrete mixing car: 4,600	Trucks:5,100 Concrete mixing car: 5,600	Trucks:8,800 Concrete mixing car: 12,100
Waste to be generated	Type and amount m3	4,000	4,000	8,000	16,000

Construction schedule is tentatively proposed as:

	Kanchpur	Meghna	Gumti
Start of construction /rehabilitation	October 2016	October 2016	October 2016
End of construction	September 2019	February 2020	August 2020
End of rehabilitation	August 2020	January 2021	September 2021

### Legal and institutional frameworks of Environmental Impact Assessment

In accordance with Bangladesh laws, the project is classified as “red category” (equivalent to Category A in international donors’ safeguard guidelines). This means that full-scale Environmental Impact Assessment (EIA) is required in order to obtain Environmental Clearance Certificate (ECC).

EIA shall be implemented in accordance with not only the rules of Bangladesh Government but also to JICA Guidelines for Environmental and Social Considerations (April 2010). Information disclosure at EIA shall be implemented in accordance with JICA Guidelines.

Roads and Highway Department is the implementing agency of the project while Social and Environmental Circle (SEC) under RHD and Department of Environment (DOE) under the Ministry of Environment and Forest (MoEF) are the supervising agencies for environmental protection.

### **Alternative analysis**

The project, construction of 3 new bridges rehabilitation of 3 existing bridges, is a key importance to secure the availability of NH-1 all year round without any delay of transportation service between Dhaka and Chittagong as is the primarily national income compared to any alternatives of transportation modes and routes.

Locations of new bridges were studied in the views of feasibility such as social impact, environmental impact and cost etc. and the following locations are found to be most feasible respectively:

Bridges	The most feasible route
New Kanchpur Bridge	:Downstream of the existing bridge
New Meghna Bridge	:Upstream of the existing bridge
New Gumti Bridge	:Downstream of the existing bridge

### **Baseline data**

From natural environment point, an endangered species River Dolphin is observed when it passes Meghna and Gumti Bridges. Noise generally exceeds the environmental standards of WHO in daytime in most of the surrounding project areas whereas it comes down almost less than 70 dB in nighttime except for roadside. Meghna river is famous for changing its route very frequently. Especially around Meghna and Gumti Bridges, it seems that the stream line shows almost the same profile. Therefore, it is supposed that river shore line around Meghna and Gumti Bridges is stable with respect to morphological view point.

From social environment point, while there is no fisherman in Kanchpur Bridge site, there are more or less ten in Meghna and Gumti Bridge site respectively. From the traffic volume of NH-1, the amount of CO<sub>2</sub> emission in 2010 was estimated as 1,000,000 ton per year in NH-1: about 35,000 vehicles/year, and about 3% of total emitted in Bangladesh.

### **Initial Environmental Examination**

Initial Environmental Examination was made (1) to screen, or in another word, to pick up possible environmental impacts and (2) to scope or, in another word, propose the study approach to evaluate the degree of impacts and plan mitigation measures.

Scoping was implemented for following items:

- 1) Involuntary resettlement
- 2) Local economies, such as employment, livelihood, etc.
- 3) Land use and utilization of local resources
- 4) Social institutions such as social infrastructure and local decision-making institutions
- 5) Existing social infrastructures and services
- 6) Poor, indigenous, or ethnic people
- 7) Misdistribution of benefits and damages
- 8) Local conflicts of interest
- 9) Cultural heritage
- 10) Accident
- 11) Infectious diseases such as HIV/AIDS
- 12) Gender
- 13) Children's rights
- 14) Bank erosion and scouring
- 15) River transportation
- 16) Hydrological condition

- 17) Fauna and flora
- 18) Global warming
- 19) Air pollution
- 20) Water pollution
- 21) Soil pollution
- 22) Waste
- 23) Noise and vibration
- 24) Ground subsidence
- 25) Offensive odor
- 26) Bottom sediment
- 27) Landscape

Study approaches, where applicable, are:

- Existing data collection
- Discussion with expert
- Site reconnaissance
- Monitoring/ sampling/ laboratory analysis
- Numerical analysis

**Prediction of impact**

On these 27 items, baseline survey, project impact prediction and, if impact is considered either negligible or severe, environmental management planning including monitoring plan was established as bellow.

### Summary of EMP ( Before Construction )

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures
<b>SOCIAL ENVIRONMENT</b>		
1) Involuntary Resettlement	Severe: Households and people are influenced	<ul style="list-style-type: none"> <li>• Proper resettlement action Plan (RAP)</li> <li>• Provide adequate compensation in time to PAPs</li> </ul>
2) Local Economies such as employment, livelihood etc.	Severe: Shop owners, employees, cultivators, properties and plantation owners are influenced	<ul style="list-style-type: none"> <li>• All direct income loss must be adequately compensated within the RAP</li> <li>• Income loss can be mitigated by providing alternative job opportunities for PAPs.</li> </ul>
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	<ul style="list-style-type: none"> <li>• Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction</li> </ul>
4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation	<ul style="list-style-type: none"> <li>• Proper resettlement action Plan (RAP)</li> <li>• Provide adequate compensation in time to PAPs</li> </ul>
6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	<ul style="list-style-type: none"> <li>• Prepare RAP involving the following measures                             <ul style="list-style-type: none"> <li>- Define the displaced persons and criteria for determining their eligibility for compensation</li> <li>- Establish external monitoring committee consists of the third party</li> </ul> </li> <li>• For poor people, proponent activities improving surface water condition and making groundwater available shall be implemented</li> </ul>
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	<ul style="list-style-type: none"> <li>• Prepare RAP involving the following measures                             <ul style="list-style-type: none"> <li>- Assessed compensation will base on the market price</li> <li>- Payment will be carried out before resettlement</li> </ul> </li> <li>• Establish external monitoring committee consists of the third party</li> </ul>
8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	<ul style="list-style-type: none"> <li>• Clear information about the needs of labor (number and qualification) should be provided with local people.</li> <li>• The job skills and the priority for the affected people shall be taken into account and the workers can be chosen..</li> </ul>

RHD- Road & Highways Department, NGO-Non Government Organization, DoE- Department of Environment, PAP- Project Affected Person

### Summary of EMP ( During Construction )

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures
<b>SOCIAL ENVIRONMENT</b>		
1) Involuntary Resettlement	Severe: Households and people are influenced	<ul style="list-style-type: none"> <li>• Proper resettlement action Plan (RAP)</li> <li>• Provide adequate compensation and assistance in time to PAPs</li> </ul>
2) Local Economies such as employment, livelihood etc.	Severe: Shop owners, employees, cultivators, properties and plantation owners are influenced	<ul style="list-style-type: none"> <li>• All direct income loss must be adequately compensated within the RAP</li> <li>• Income loss can be mitigated by providing alternative job opportunities for PAPs.</li> </ul>
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	<ul style="list-style-type: none"> <li>• Plantation area and part of fish pond which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction</li> </ul>
4) Social institutions	Moderate: Social	<ul style="list-style-type: none"> <li>• Proper resettlement action Plan (RAP)</li> </ul>

such as social infrastructures and decision-making institutions	institutions are affected by relocation and noise	<ul style="list-style-type: none"> <li>• Provide adequate compensation in time to PAPs</li> <li>• Periodical maintenance of construction vehicles</li> <li>• Installation of sound insulation</li> </ul>
5) Existing social infrastructures and Services	Moderate: Social service utilities are located underground in the affected area	<ul style="list-style-type: none"> <li>• Proper detailed design is going to be done and the utilities line will be diverted before starting the construction activity.</li> </ul>
6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	<ul style="list-style-type: none"> <li>• Prepare RAP involving the following measures <ul style="list-style-type: none"> <li>- Define the displaced persons and criteria for determining their eligibility for compensation</li> <li>- Establish external monitoring committee consists of the third party</li> </ul> </li> <li>• For poor people, proponent activities improving surface water condition, making groundwater available and enhancing their job skill shall be implemented</li> <li>• Prepare RAP involving the following measures <ul style="list-style-type: none"> <li>- Assessed compensation will base on the market price</li> <li>- Payment will be carried out before resettlement</li> </ul> </li> <li>• Establish external monitoring committee consists of the third party</li> </ul>
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	<ul style="list-style-type: none"> <li>• Clear information about the needs of labor (number and qualification) should be provided with local people.</li> <li>• The job skills and the priority for the affected people shall be taken into account and the workers can be chosen..</li> </ul>
8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	<ul style="list-style-type: none"> <li>• Follow Health and Safety Management Plan (HSMP ) rules and regulations designated by contractors</li> </ul>
10) Accident	Moderate: Construction workers can have harmful and critical troubles	<ul style="list-style-type: none"> <li>• An HIV-AIDS awareness campaign via approved service provider shall be implemented</li> </ul>
11) HIV/AIDS-	Moderate: Transmission of disease by inflow of migrant workers	<ul style="list-style-type: none"> <li>• Monitoring of payment to workers by the contractor shall be implemented not to allow payment gaps between male and female.</li> </ul>
12) Gender	Moderate: Salary gap between genders	<ul style="list-style-type: none"> <li>• Regular monitoring of sites to guide contactors and their related firms to discourage child labor.</li> <li>• When the child labor will be detected, necessary and decisive actions to the violating firms are implemented.</li> </ul>
13) Children's right	Moderate: A bunch of children come and work in construction site	<ul style="list-style-type: none"> <li>• Some assistance for parents of working child</li> <li>• -Provision of illumination night time around anchorages</li> </ul>
15) River Transportation	Moderate: Congestion of vessels generates any collision	

#### **NATURAL AND ECOLOGICAL ENVIRONMENT**

17) Fauna and flora	Moderate: Wildlife including River Dolphin is affected by the construction using steel piles	<ul style="list-style-type: none"> <li>• Any illegal discharge of waste water, leaked oil shall be prohibited</li> <li>• Construction development area shall be fixed, not to develop or cut trees out of project area</li> <li>• Monitor to both upstream and downstream side will be conducted from the bridge surface</li> <li>• If dolphin is observed around project site, piling works and vessels should keep being suspended until the dolphin passes over.</li> <li>• Night lightning in construction should be restricted to the construction site.</li> </ul>
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#### **ENVIROMNTAL POLLUTION**

19) Air Pollution	Moderate: Dust rising from unpaved road and others	<ul style="list-style-type: none"> <li>• Good maintenance and operation of equipment and vehicles</li> <li>• Use environmentally-friendly material</li> </ul>
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	during construction	<ul style="list-style-type: none"> <li>• Spraying water to suppress the dust rising</li> <li>• Cover entire load with tarpaulin to prevent the load from being blown.</li> <li>• Good maintenance of material</li> <li>• Monitoring and regular meeting for air quality</li> </ul>
20) Water Pollution	Moderate: Pile driving, mud water from earthwork, domestic waster liquid from worker's camp, and oil leaking from construction vessel	<ul style="list-style-type: none"> <li>• Generated construction sludge by pile driving, concrete plant and asphalt plant is treated by silt basin and remaining sludge is disposed at designated dumping site</li> <li>• Impermeable wall shall be used with cast-in-place pile</li> <li>• Turbid water from construction work area is treated in silt basin for satisfying water quality standard and drain away to the nearest drainage or river</li> <li>• Domestic water is treated by septic tank for satisfying water quality standard and drain away to the nearest drainage or river.</li> <li>• Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers.</li> <li>• Waste oil shall be stored without leaking before legal disposal process.</li> <li>• Refuelling place to equipment/ vehicles shall be concreted floor</li> <li>• Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence</li> <li>• Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly</li> <li>• Batteries containing liquid inside shall be kept on impervious place to prevent battery liquid that contains hazardous heavy metals leaks and percolate into sub-ground</li> <li>• To be on the safe side, study on groundwater will be implemented by the consultant during detailed design stage in order not to cause adverse impact on surrounding wells.</li> </ul>
21) Soil pollution	Moderate: leakage of oil, and borrow can contaminate soil	<ul style="list-style-type: none"> <li>• Disposal at designated dumping site</li> <li>• Soil quality Testing</li> <li>• Disposal of waste oil without leakage</li> <li>• Refueling place having concreted floor</li> <li>• Preserved in the tank surrounded with concrete fence</li> <li>• Equipment and vehicles are properly maintained</li> <li>• Batteries containing liquid inside shall be kept on impervious place</li> </ul>
22) Waste	Moderate: Generation of construction sludge and domestic waste	<ul style="list-style-type: none"> <li>• Minimize volume to use silt basin before disposing</li> <li>• Segregate waste to minimize waste material</li> <li>• Disposed in designated dumping site instructed by the section handling waste</li> <li>• Recycled as possible with consideration of soil property.</li> </ul>
23) Noise and Vibrations	Moderate: Noise and vibration from construction machines and vehicles	<ul style="list-style-type: none"> <li>• Periodical maintenance .of construction vehicles</li> <li>• Installation of sound insulation cover on boundary near residential area</li> </ul>
25) Offensive Odor	Moderate: open burning of construction waste, improper treatment of human liquid waste, exhausted smoke from heavy equipment etc.	<ul style="list-style-type: none"> <li>• Prohibition of open burning</li> <li>• Proper treatment of camp waste</li> <li>• Proper maintenance of heavy equipment.</li> </ul>
26) Bottom sediment	Moderate: Waste dumped into rivers can contaminate river bed	<ul style="list-style-type: none"> <li>• Construction contractor will be obliged to no dumping of waste into the river</li> </ul>

RHD- Road & Highways Department, NGO-Non Government Organization, DoE- Department of Environment, PAP- Project Affected Person

### Summary of EMP ( During Operation )

Environmental Impact/Issue	Severity of Impacts	Adverse	Mitigation Measures
<b>SOCIAL ENVIRONMENT</b>			
10) Accident	Moderate: Traffic accident occurred		• Provision of traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc
<b>ENVIRONMENTAL POLLUTION</b>			
16) Hydrological condition	Severe: hydrological condition was affected by scouring		• Steel Pipe Sheet Pile (SPSP) foundation has been selected ; the size and depth of the SPSP foundation shall be designed that the riverbed scouring will not create any threatening to overall bridge stability.
23) Noise and vibration	Moderate: a forecasted value exceeds a standard one.		• Securement of buffer zone around 100m as noise decay distance (land utilization guide by RHD and local authority)

RHD- Road & Highways Department, NGO-Non Government Organization, DoE- Department of Environment, PAP- Project Affected Person

### Environmental Management

Environmental management plan is presented in the previous table. The monitoring plan proposed is:

#### Costs for environmental management and monitoring

Component	Stage	Item	Unit	Unit Cost (BDT)	Quantity	Total Costs (BDT)
<b>Enhancement of environment (A)</b>						
17) Fauna and flora and Landscape	27) During Operation	Plantation of native tree species including maintenance for three years	Nos.	500	1,800	900,000
17) Fauna and flora and Landscape	27) During Operation	Maintenance including monitoring of survival of plants	LS	100,000	1	100,000
Enhancement of environment (A)						<i>1,000,000</i>
<b>Environmental management cost (B)</b>						

1) Involuntary Resettlement	Before Construction	Compensation for impact	-	(69,638,734)	-	-
	During Construction	Compensation for impact	-	ditto	-	-
2) Local Economies such as employment, livelihood etc.	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
3) Land use and utilization of local resources	Before Construction	Proper occupation	-	ditto	-	-
	During Construction	Proper occupation	-	ditto	-	-
4) Social institutions such as social infrastructures and	Before Construction	Compensation for impact	-	ditto	-	-

decision-making institutions	During Construction	Compensation for impact	-	ditto	-	-
5) Existing social infrastructures and services	During Construction	Construction for diversion	-	ditto	-	-
6) Poor, indigenous, or ethnic people-	Before Construction	Compensation for impact Activities improving surface water condition, making groundwater available and enhancing their job skill	-	ditto	-	-
	During Construction	Compensation for impact Activities improving surface water condition, making groundwater available and enhancing their job skill	-	ditto	-	-
7) Maldistribution of benefits and damages	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact.	-	ditto	-	-
8) Local conflicts of interest	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
10) Accident	During Construction	Ensuring that HSMP works right on the track	-	Included in construction cost	-	-
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	Included in construction cost	-	-
11) HIV/AIDS	During Construction	HIV campaign	Times	30	100,000	3,000,000
12) Gender	During Construction	Monitoring of the gaps between male and female	-	Included in RAP cost	-	-
13) Children's right	During Construction	Prevention activities to inhibit children's labor	-	ditto	-	-
15) River Transport	During Construction	Watch boat, watch man, sign boards etc	-	Included in construction cost	-	-
16) Hydrological condition	During Operation	Inspection of river bottom condition for scouring	-		-	-
17) Fauna and flora	During Construction	Restoration of construction development area	-	Included in construction cost	-	-
19) Air pollution	During Construction	Implement dust suppress plan and routine mitigation measure shall be taken to emitting equipments.	-	Included in construction cost	-	-
	During Operation	Inspection of road side air condition	-	Included in Monitoring cost	-	-
20) Water pollution	During Construction	Installation of silt basin and septic tank. Proper maintenance of equipment and vehicles. Removal of arsenic.	-	Included in construction cost	-	-
	During Operation	Inspection of river surface water condition	-	Included in Monitoring cost	-	-

21) Soil pollution	During Construction	Disposal at designated dumping site. Proper maintenance of equipment and vehicles.	-	Included in construction cost	-	-
	During Operation	Inspection of soil condition	-	Included in Monitoring cost	-	-
22) Waste	During Construction	Collection, transportation and dumping of waste at authorized dumping sites. Minimization of volume and recycling.	-	Included in construction cost	-	-
23) Noise and Vibration	During Construction	Periodical maintenance of construction vehicles and installation of sound insulation cover	-	Included in construction cost	-	-
	During Operation	Securement of buffer zone around 100m as noise decay distance	-	Included in Monitoring cost	-	-
25) Offensive odor	During Construction	Proper treatment of camp waste Proper maintenance of heavy equipment.	-	Included in construction cost	-	-
26) Bottom sediment	During Construction	Proper treatment in order to prevent waste from being dumped into the river.	-	Included in construction cost	-	-
27) Landscape	Before and During Construction	Inspection of landscape from vessel mooring station	-	Included in Monitoring cost	-	-
Environmental management cost (B)						3,000,000
<b>Monitoring (C)</b>						
1) Involuntary Resettlement	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
2) Local Economies such as employment, livelihood etc.	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
3) Land use and utilization of local resources	Before Construction	Proper occupation	-	Included in RAP cost	-	-
	During Construction	Proper occupation	-	Included in RAP cost	-	-
4) Social institutions such as social infrastructures and decision-making institutions	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
5) Existing social infrastructures and Services	During Construction	Construction for diversion	-	Included in RAP cost	-	-
6) Poor, indigenous people or ethnic minority	Before Construction	Compensation for impact Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	-	Included in RAP cost	-	-
	During Construction	Compensation for impact Direct survey in the field by interviews with the	-	Included in RAP cost	-	-

		poor people in order to ensure that groundwater is available for them..				
7) Maldistribution of benefits and damages	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
8) Local conflicts of interest	Before Construction	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	-	Included in RAP cost	-	-
	During Construction	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	-	Included in RAP cost	-	-
10) Accident	During Construction	Ensuring that HSMP works right on the track	-	Included in the construction cost	-	-
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	Included in the construction cost	-	-
11) HIV/AIDS	During Construction	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	-	Included in the EMP cost	-	-
12) Gender	During Construction	Direct survey in the field by interviews with the women in order to ensure that there is no any gaps between man and women.	-	Included in the construction cost	-	-
13) Children's right	During Construction	Visual inspection, of children's laborer	-	Included in the construction cost	-	-
15) River Transport	During Construction	Giving adequate illumination	-	Included in the construction cost	-	-
16) Hydrological condition	During Operation	Inspection of river bottom condition for scouring	-	Included in the construction cost	-	-
17) Fauna and flora	During Construction	Restoration of construction development area and Counting the number of River Dolphin	-	Included in the construction cost	-	-
19) Air pollution	During Construction	Measurement of SPM, NOx, SO2, CO and inspection of brick, bitumen and cement facilities (spot check)	Set	33	75,000	2,475,000
	During Operation	Measurement of SPM,NOx,SO2,CO	Set	3	750,000	2,250,000
20) Water Pollution	During Construction	Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As	Set	33	10,000	330,000
	During Operation	Measurement of pH, EC, Turbidity, DO, Coliform,	Set	6	10,000	60,000

		BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As				
21) Soil pollution	During Construction	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	-	Included in the construction cost	-	-
	During Operation	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	Set	6	50,000	300,000
22) Waste	During Construction	Inspection of waste disposal sites and construction camps	-	Included in the construction cost	-	-
23) Noise	During Construction	Visual inspection to ensure that good standard equipment is in use and sound insulation cover is installed.	Set	15	20,000	300,000
	During Operation	Measurement of noise dB(A)	Set	3	20,000	60,000
25) Offensive odor	During Construction	Odor inspection to ensure harmful odor is not released from equipments and waste	-	Included in the construction cost	-	-
26) Bottom sediment	During Construction	Bottom sampling of Cd, Pb, As, oil, grease and so forth	-	Included in the construction cost	-	-
27) Landscape	Before and During Construction	Vessel mooring station for 2 times at 3 sites	Set	6	50,000	300,000
<b>Monitoring Costs (C)</b>						<i>6,075,000</i>
<b>Environmental training (D)</b>						
Environmental Training	During Operation	Orientation Workshop and follow up training program for capacity building/ institutional development program of SEC	LS	1	1,000,000	1,000,000
<b>Environmental Training Costs (D)</b>						<i>1,000,000</i>
<b>Total (A+B+C+D)</b>						<b>11,075,000</b>
<b>Contingency @ 10%</b>						<b>1,107,500</b>
<b>Grand Total</b>						<b>12,182,500</b>

## **Public participation**

Three stakeholder meetings were held: (1) the 1<sup>st</sup> stakeholders' meeting for TOR discussion in 15<sup>th</sup> March 2012, (2) the 2<sup>nd</sup> stakeholders' meeting for supplementary to the 1<sup>st</sup> public consultations regarding RAP and EIA draft in 1<sup>st</sup> August 2012, and (3) the 3<sup>rd</sup> stakeholders' meeting for supplementary to the 2<sup>nd</sup> public consultations regarding RAP and EIA draft in 1<sup>st</sup> September 2012.

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\*PIU Officers who concurrently serve in charge of Resettlement & EMP will be conveniently and collectively called as "resettlement unit (RU) in this Report

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## LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
ACE	Additional Chief Engineer
APD	Additional Project Director
ADB	Asian Development Bank
BRTA	Bangladesh Road Transport Authority
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
BNBC	Bangladesh National Building Code
BOD <sub>5</sub>	Biochemical Oxygen Demand
CITES	Convention on International Trade in Endangered Species
COD	Chemical Oxygen Demand
DoE	Department of Environment
DPHE	Department of Public Health Engineering
dB	Decibel
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
ECC	Environmental Clearance Certificate
ECA	Ecologically Critical Areas
EMP	Environmental Management Plan
EC	Electric Conductivity
FAP	Flood Action Plan
FGD	Focus Group Discussion
GOB	Government of Bangladesh
GOJ	Government of Japan
HIV	Human Immunodeficiency Virus
HSMP	Health Safety Management Plan
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
IARC	International Agency for Research on Cancer
JICA	Japan International Cooperation Agency
MOEF	Ministry of Environment and Forest
NEMAP	National Environmental Management Action Plan
NO <sub>x</sub>	Oxides of Nitrogen
OP	Operational Policy
ODA	Oversees Development Agency
PD	Project Director
PRA	Participatory Rapid Appraisal
Pb	Lead
PWD	Public Works Datum
PM	Particulate Matter
RAP	Resettlement Action Plan
RHD	Roads and Highways Department
SEC	Social Environment Circle
SPM	Suspended Particulate Matter
SO <sub>2</sub>	Sulphur di Oxide
STI	Sexually Transmitted Infection
TSS	Total Suspended Solids
TDS	Total Dissolved Solids
WB	World Bank
WARPO	Water Resource Planning Organization
WQS	Water Quality Standards
WHO	World Health Organization

## **CHAPTER 1 INTRODUCTION**

### **1.1 Project Background**

The National Highway No.1 (NH-1), namely, Dhaka-Chittagong Highway, is the lifeline for economy of Bangladesh with a capacity of 25,000 Passenger Car Unit (PCU) per day on 2-lane section and 60,000 PCU per day on 4-lane section. The NH-1 will be a part of the Asian Highway that connects with neighboring countries. On this highway, existing Kanchpur, Meghna and Gumti Bridges are major structures, which are the only way to cross Shitalakshya, Meghna and Gumti rivers. But, these bridges, constructed in the year of 1977, 1991 and 1995, respectively, are being deteriorated for several years. Consequently, they need urgent rehabilitations. In addition, the existing bridges were designed and constructed according to the outdated design standard. Therefore, these existing bridges may necessitate seismic retrofitting to withstand earthquake excitations in accordance with current codes.

According to the traffic survey conducted in this study (conducted in February and March, 2012), the NH-1 almost exceeded its traffic volume capacity to 78,000 PCU counted on Kanchpur Bridge and 73,300 PCU on Meghna and Gumti Bridges. Recently, the Government of Bangladesh has decided to widen the NH-1 into 4 lanes in order to mitigate excess traffic volume and remove traffic bottlenecks. But, these existing 2-lane bridges are becoming a critical bottleneck for traffic movement through the NH-1. It is obvious the existing 2-lane bridges will fail to cope with increased traffic volume of the NH-1 and cause serious traffic congestion. Therefore, the construction of new 2<sup>nd</sup> Kanchpur, 2<sup>nd</sup> Meghna and 2<sup>nd</sup> Gumti Bridges are becoming an essential issue.

## **1.2 Scope of the EIA**

The EIA report was prepared on the basis of proposed engineering works, field investigations, stakeholder consultation, primary and secondary data collection, screening of all baseline environmental parameters, environmental quality baseline monitoring, and review of other similar project reports in Bangladesh. The study was taken up during March – August, 2012. The EIA covers the general environmental profile of the Project area including physical, ecological, environmental, social, cultural and economic resources. Baseline environmental monitoring was carried out on water (surface and ground), air, noise, soil and sediment quality measurements. The EIA includes an overview of the potential environmental impacts and their severity, and proposes necessary mitigation measures and environmental management plan for each of the identified impacts. Two rounds of public consultations were conducted as part of the EIA.

The EIA report in its present format as per the TOR (Annex-1) and specified terms and conditions in the DoE letter no. DoE/Clearance/5150/2012/31 7/2002/900 dated 23/05/2012 (Annex-1), has been prepared for obtaining the Environmental Clearance Certificate (ECC) from the Government of Bangladesh (GOB).

## **1.3 Methodology**

The methodology used for this study is based on the procedures described in Environmental Guidelines, (Volume 1) published by RHD and the other relevant regulation of Bangladesh as well as “JICA Guidelines for Environmental and Social Considerations” (April 2010).

Methodology adopted for completion of the EIA study of bridges is as follows:

- Scoping workshop organisation with various stake holders at the beginning of the Project preparation activities;
- Reconnaissance survey was taken up to collect baseline information in devised formats;
- Analysis of collected data was carried out;
- Documentation of baseline conditions was done by doing on site environmental monitoring;
- Analysis and assessment of various alternatives was taken up;
- Identification and assessment of various impacts was done;
- Formulation of mitigation, and avoidance measures was done for identified impacts;
- Community consultations were carried out;

- Preparation of standalone environmental management plans (EMPs), for both the bridges, has been done.

#### **1.4 Organization of the Report**

The remaining part of this report has been organized as follows:

- Chapter 2. Project Description: contains the components of the project, project location, technical features of bridges, sourcing of resources for implementation and proposed schedule of project implementation
- Chapter 3. Policy, Legal, and Administrative Framework: explains the present legal and institutional frameworks of Bangladesh related environment and their challenges
- Chapter 4. Baseline Environmental Condition: Explains the general description and background of physical resources, ecological resources, environmental quality baseline, social and cultural profile, and economic activities
- Chapter 5. Alternative Study: examines the necessity of the project and their most feasible routes for three bridges respectively
- Chapter 6. Initial Environmental Examination: describes about possible project impacts, study approach and mitigation measures presumed.
- Chapter 7. Environmental Impacts: predicts the negative project influences induced by the implementation of project
- Chapter 8. Environmental Management Plan: proposes feasible mitigation measures to the project impacts
- Chapter 9. Public Participation: addresses the consultation, group discussion and stakeholders' meeting held

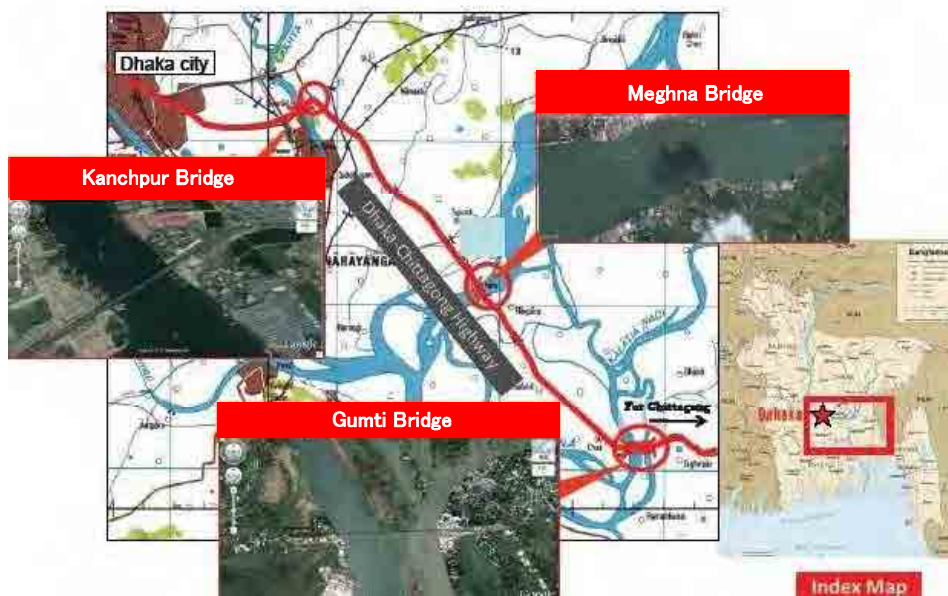
In the EIA, it is noted that the resettlement issues are discussed mainly in the separate volume “Resettlement Action Plan (RAP)” and, in the EIA, is not much mentioned.

## Chapter 2 PROJECT DESCRIPTION

The overall objective of the Project is to meet the increasing traffic demand of National Road No.1 (NH-1), which can be made by

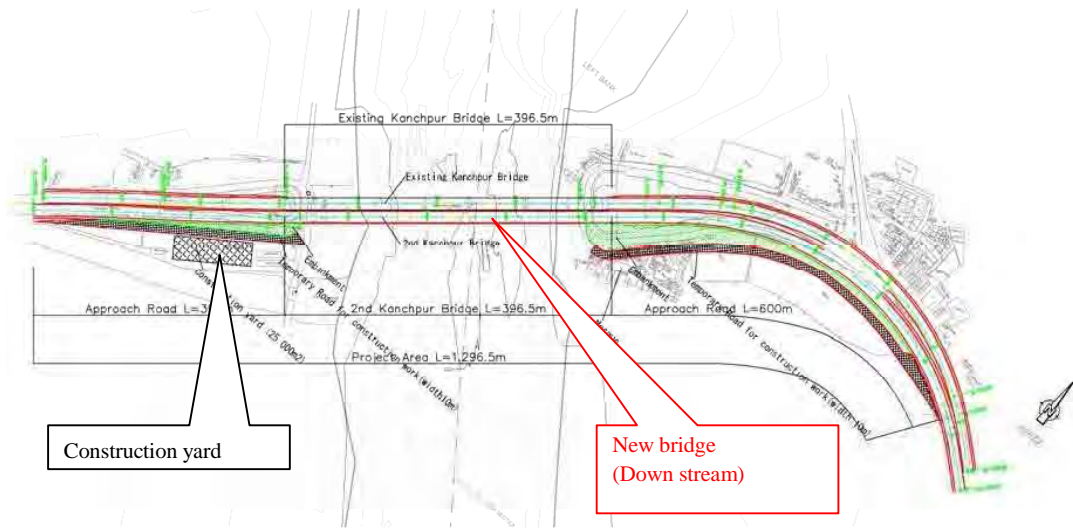
- Construction of new 2<sup>nd</sup> Kanchpur Bridge, 2<sup>nd</sup> Meghna Bridge and 2<sup>nd</sup> Gumti Bridge together with approach embankment road respectively.
- Rehabilitation existing Kanchpur Bridge, Meghna Bridge and Gumti Bridge

Location of the project is shown in Figure 2.1.



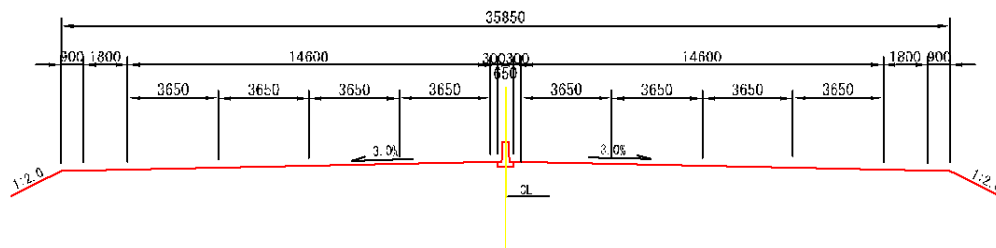
**Figure2.1 Locations of the three Bridges**

Figures from 2.2 to 2.7 indicate the locations of new and existing bridges together with construction yards.

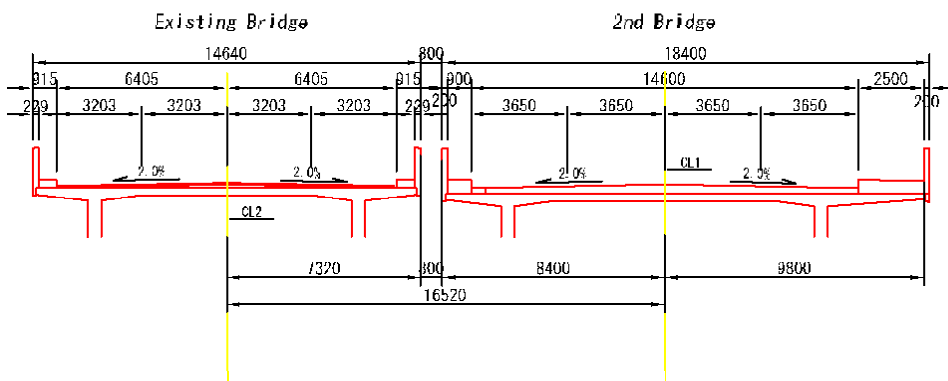


**Figure 2.2 Locations of New and Existing Kanchpur Bridge with Construction Yards**

**Cross Section - Approach Road**



**Cross Section - Bridge**

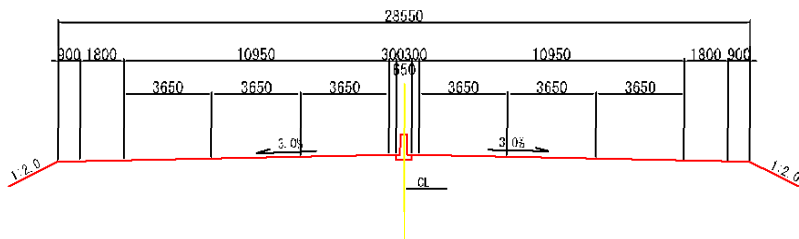


**Figure 2.3 Typical Cross Sections of New and Existing Kanchpur Bridge**

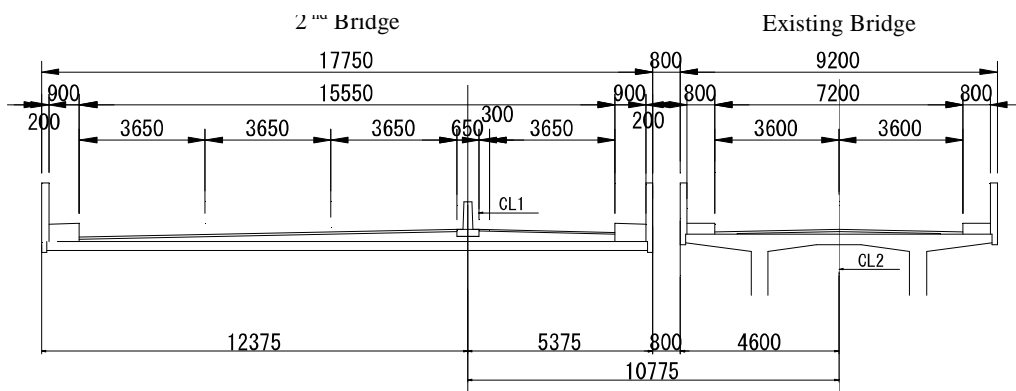


**Figure 2.4 Locations of New and Existing Meghna Bridge with Construction Yards**

**Cross Section - Approach Road**



**Cross Section - Bridge**



**Figure 2.5 Typical Cross Section of New and Existing Meghna Bridge**

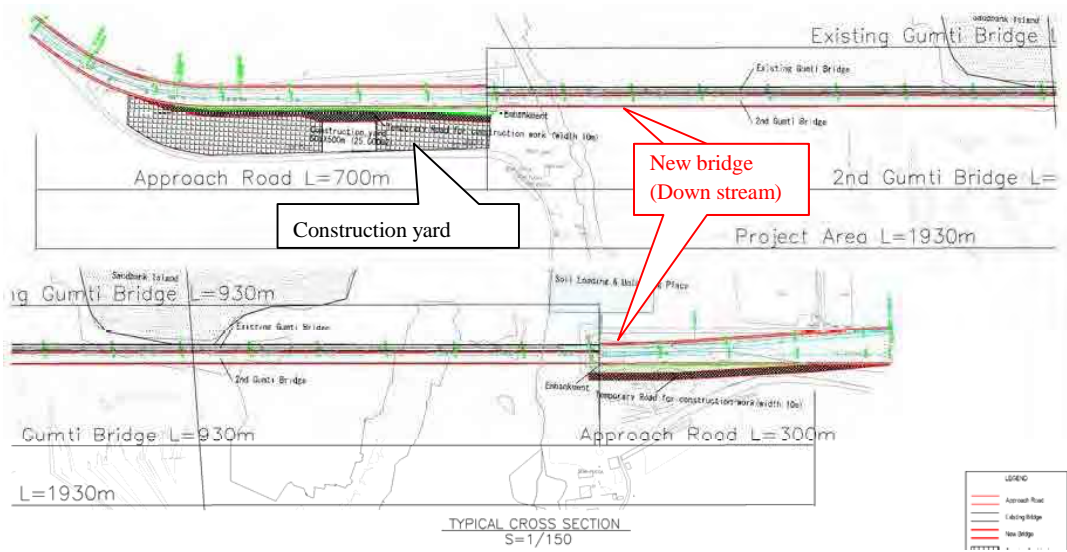
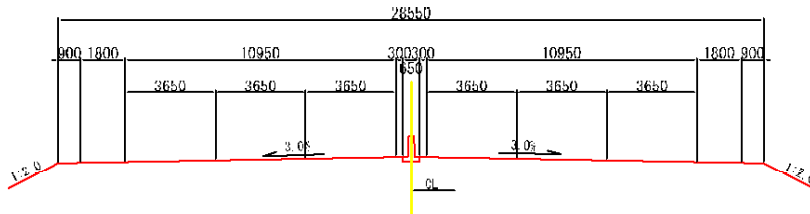


Figure 2.6 Locations of New and Existing Gumti Bridge with Construction Yards

### Cross Section - Approach Road



### Cross Section - Bridge

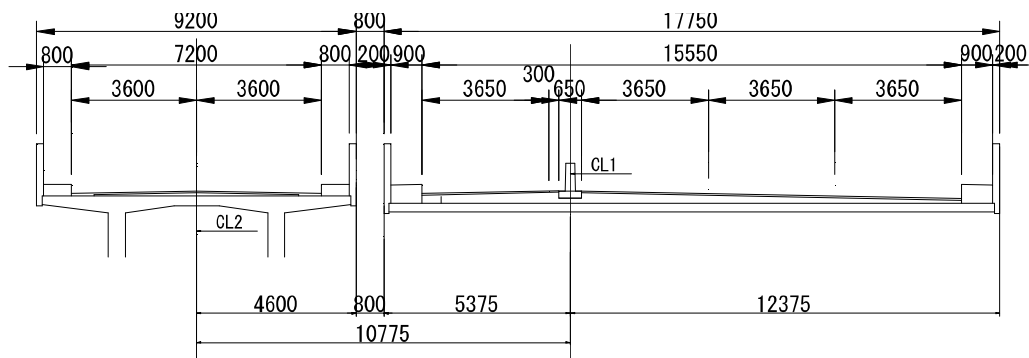


Figure 2.7 Typical Sections of New and Existing Gumti Bridge



Outline of bridges are summarized in Table 2.1.

**Table 2.1 Outline of the Project**

Description		Unit	Kanchpur Bridge	Meghna Bridge	Gumti Bridge
new bridges	Superstructure		Narrow box girder with weathering steel		
	Length	m	396.5	930	1,410
	Width	m	18.4	17.75	17.75
	Navigation clearance	m	width: 61 height: 12.2	width: 75 height: 18	width: 75 height: 7.5
Foundation	Number		5 pier	11 pier	16 pier
	Foundation type		Steel pipe sheet pile/ Bored pile	Steel pipe sheet pile/ Bored pile	Steel pipe sheet pile/ Bored pile
	Foundation width	m	31.3 x 8.5	32.44 x 14.97	29.95 x 13.73
	Maximum pile Length	m	33	42	70
existing bridges	Length	m	396.5	930	1,410
	Width	m	14.64	9.2	9.2
	Navigation clearance	m	width: 61 height: 12.2	width: 75 height: 18	width: 75 height: 7.5
Approach Road	Length	m	300m in Dhaka side and 300m in Chittagong side	500m in Dhaka side and 500m in Chittagong side	700m in Dhaka side and 300m in Chittagong side
	Maximum height of embankment	m	7m in Dhaka side and 12m in Chittagong side	10m in Dhaka side and 9m in Chittagong side	7m in Dhaka side and 6m in Chittagong side

Source: Study team

Construction camps are installed within the construction yards as shown in Figures 2.2, 2.4 and 2.6 respectively. All contractor camps will be provided with accommodation, office facilities, kitchen and provision for general domestic and sanitary waste disposal, equipment lay-down yard, laboratory facilities etc, and other structures and improvements found necessary. Provision for site storm drainage and erosion control will be in the form of ditches, paving of the ground surface and of perimeter drains.

**Table 2.2 Material to be used and Waste to be Generated**

		Unit	Kanchpur Bridge	Meghna Bridge	Gumti Bridge	Total
Land to be used (all land inside RHD land)	Approach Road	m2	31,000	39,000	39,000	109,000
	Construction yard	m2	3,000	25,000	22,000	50,000
	Temporary road	m2	9,000	10,000	9,000	28,000
	Total area	m2	43,000	74,000	70,000	187,000
Construction material used	Soil	m3	47,000	39,200	32,800	119,000
	Sand	ton	10,000	26,000	30,000	66,000
	Crushed stone	ton	9,300	24,000	28,000	61,300
	Cement	ton	2,000	6,800	7,000	15,800
	Re-bar	ton	1,000	2,700	3,600	73,000
	Steel	ton	7,000	31,000	37,000	75,000
Manpower and equipment (tentative)	Manpower	People/month	8,000	30,000	55,000	93,000
	Trucks	number	1,000	2,700	5,100	8,800
	Concrete mixing car	number	1,900	4,600	5,600	12,100
Waste to be generated	Soil waste	m3	5,000	4,000	11,000	20,000

※embankment material, fine aggregate (sand), and coarse aggregate (gravel) used through the project are not supposed to be taken from river and rock quarry, but to be purchased from vendors.

Source: Study team

General views comparing existing and new bridges are presented in Annex-3

As shown above, numbers of piers are reduced for new bridges at Kanchpur while numbers of pier are same at Meghna and Gumti.

Construction schedule is presumed as follows;

**Table 2.3 Construction Schedule (Tentative)**

	Kanchpur Bridge	Meghna Bridge	Gumti Bridge
Start of construction / rehabilitation	October 2016	October 2016	October 2016
End of construction	September 2019	February 2020	August 2020
End of rehabilitation	August 2020	January 2021	September 2021

## **CHAPTER 3 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK**

Regulatory requirements toward protection and conservation of environment and various environmental resources and also toward protection of social environment from adverse impact of projects and activities associated with them have been enunciated by the Government of Bangladesh as well as financiers. Pertinent among these requirements are summarized as under.

### **3.1 Applicable Environmental Legislation in Bangladesh**

#### National Environmental Policy, 1992

Bangladesh has adopted a national environmental policy in 1992 aimed at sustainable development. The policy sets out the basic framework for environmental action together with a set of broad sectoral guidelines for action. Key elements of the policy are:

- Maintaining ecological balance and ensuring sustainable development of the country through protection and conservation of the environment
- Protecting the country from natural disasters
- Identifying and regulating all activities that pollute and destroy the environment
- Ensuring environment-friendly development in all sectors
- Ensuring sustainable and environmentally sound management of the natural resources
- Maintaining active association, as far as possible, with all international initiatives related to environment.

With regard to the transport sector the environmental policy aims at prevention of pollution and degradation of resources caused by roads and inland waterways transport. The policy mentions that EIA should be conducted before projects are undertaken.

#### National Environment Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) builds on the National Environmental Policy and was developed to address specific issues and management requirements during the period 1995-2005. The plan includes a framework within which the recommendations of a National Conservation Strategy are to be implemented. NEMAP was developed with the following objectives

- Identification of key environmental issues affecting Bangladesh
- Identification of actions necessary to halt or reduce the rate of environmental degradation

- Improvement of the natural environment
- Conservation of habitats and bio-diversity
- Promotion of sustainable development
- Improvement of the quality of life of the people

#### Environment Conservation Act, 1995

This Act authorizes the Department of Environment (DoE) to undertake any activity to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The department is the regulatory body and enforcement agency of all environmental related activities. The act includes amongst others addresses the following main issues:

- Declaration of Ecologically Critical Areas;
- Procedure for obtaining Environmental Clearance Certificates;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Environmental regulations for development activities;
- Standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Acceptable limits for discharging and emitting waste;
- Formulation of environmental guidelines to control and mitigate environmental pollution, conservation and improvement of environment.

#### Environment Conservation Rules, 1997

The Environment Conservation Rules provide a first set of rules under the Environment Conservation Act, 1995. These provide amongst others standards and guidelines for:

- Categorization of industries and development projects, including roads and bridges on the basis of actual and anticipated pollution load;
- Requirement for undertaking Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA), as well as formulating an Environmental Management Plan (EMP) according to categories of industries/development projects/activities;
- Procedure for obtaining environmental clearance;
- Environmental quality standards for air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhausts;
- In Schedule -1, Projects/ activities are classified into four categories: Green, Orange A, Orange B and Red based on its location and impact on environment, “construction/reconstruction/expansion of bridge (length 100 meter and above)” is classified as Red in No.68.

#### Environmental Guidelines (Volume 1), 2004

This guideline was designed by The Roads and Highways Department (RHD) in Bangladesh and provides a broad picture of what procedures should be followed for environmental assessment and management. Also it focuses specifically on the activities and requirements of RHD and do not necessarily represent sector guidelines, and set a framework for the development of associated social guidance documents such as social and resettlement action plans. The brief composition is:

- Environmental Legislation and Institutional Procedures
- Good Environmental Practice in RHD
- Environmental Assessment of RHD Projects
- Initial Environmental Examination (IEE)
- Environmental Impact Assessment (EIA)
- The Need For and Scope of an Environmental Management Plan
- Environmental Management of Day To Day Activities

#### EIA Guidelines For Industry, 1997

This guideline has been prepared by DoE on the basis of the work done by various types of industry projects as well as on the requirements of the Environment Conservation Rules (1997). Owing to this, this guideline specifically covers industry projects and shows how the EIA for industry projects in Bangladesh should be implemented. The brief composition is:

- Introduction to EIA in Bangladesh
- Criteria for locating industrial plants
- Steps involved in conducting IEE
- Steps involved in conducting EIA
- Review of an EIA report

All requisite clearance from the DoE shall be obtained prior to commencement of civil work. RHD will proceed with the application for clearance in due course.

#### Other Relevant Legislation in Bangladesh

There are a number of other laws and regulations applicable which are relevant for the project. These are the following, see Table 3.1

**Table 3.1 Other Relevant Legislations Applicable**

Act/Law/Ordinance	Brief Description	Responsible Agency
Environment Court Act, 2000 and subsequent amendments in 2002	Describes environment related legal proceedings	Ministry of Environment and Forest (MOEF)
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Bangladesh Road Transport Authority (BRTA)
The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules 1973	Rules for removal for wrecks and obstructions	Bangladesh Water Transport Authority
Water Supply and Sanitation Act, 1996	Regulate the management and control of water supply and sanitation in urban areas	Ministry of Local Government, Rural Development and Cooperatives
The Ground Water Management Ordinance 1985	Describe the management of ground water resources and licensing of tube wells	Upazilla Parishad
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Regulates the protection of forests reserves, protected forests and village forests	Ministry of Environment and Forest
The Private Forests Ordinance Act, 1959	Deals with the conservation of private forests and afforestation of wastelands.	Ministry of Environment and Forest
Bangladesh Wild Life (Preservation) Act, 1974	Describes the preservation of wildlife sanctuaries, parks, reserves	Ministry of Environment and Forest
The Protection and Conservation of Fish Act 1950 subsequent amendments in 1982	Deals with the protection/ conservation of fishes in Government owned water bodies	Department of Fishery
The Embankment and Drainage Act 1952	Describes the protection of embankments and drainage facilities	Ministry of Water Resources
The Antiquities Act 1968	Describes the preservation of cultural heritage, historic monuments and protected sites.	Department of Archaeology.
The Land Acquisition Act, 1894 and The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Describes procedures and provides guidelines to acquisition and requisition of land	Ministry of Land
Bangladesh Labour Law, 2006	Deals with the occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions	Ministry of Labour.

### **National Strategy for Waste Management**

The strategy for solid waste management is essential in order to minimize the environmental, social and economical problems. To minimize these problems, recently the GoB has taken some initiatives and accordingly in December 2010, the Department of Environment under Ministry of Environment and Forest has formulated a national '3R' strategy for waste management in a

draft form. It is the latest strategy which will take time to implement globally. For the bridge project, the '3R' strategy shall be followed to minimize the solid waste impact on environment. The concept of this strategy is minimizing waste impacts in terms of quantity or ill-effects, by reducing the quantity of waste products with simple treatments and recycling the wastes by using it as resources to produce same or modified products. The principle of '3R' is stated as reducing waste, reusing and recycling resources and products.

- Reducing means choosing to use with items with care to reduce the amount of waste generated.
- Reusing involves the repeated use of items or parts of items which still have usable aspects
- Recycling means the use of waste itself as resources.

#### **Waste Dumping Site Selection and Approval Process**

As is said above the Nation '3R' strategy for waste management is in draft form, not implemented yet for any practical project and not becoming so familiar to users, therefore it may need some clarifications on rules regulation and how it can be practicable. In '3R' strategy, no specification is clearly mentioned on how to select the dumping site and how to get the concerned authority's approval on implementation. Therefore, to recover this gap in rules and regulation on solid waste dumping management, it may need to follow up some rules regulations which are generally followed in Bangladesh. As a general rule, the contractor shall develop a waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, soil-bentonite slurry, food waste etc.) prior to commencing of construction and submit to Executive Agency (RHD) for approval. This plan shall include the detailing of dumping site selection and how to get the local Government /authority's approval before dumping. In this regard, some guidelines for contractors on dumping site selection and how to get the concerned authority's approval are stated as below.

#### **Dumping site selection criteria**

- Ensure the selection of appropriate dumping sites which are 500 m (minimum) away from any inhabited areas
- Ensure that the sites are not located near any Marshy or low lying area
- Ensure that the Ground Water level sufficiently deep to avoid ground water contamination
- Ensure that no drinking water sources (surface or ground water) are located within 500 m radius of the facility
- Ensure that the soil is not permeable

Authority approval

The Contractor along with RHD and City/Municipal/ Pourashava authority will find out the probable land and provide suitable design for proper functioning of waste dumping site.



## Bangladesh and International standards in for environment

### **Air Quality Standards**

#### **Bangladesh standards**

The standards for the air in Bangladesh shall be determined in accordance with standards specified in Schedule-2 (Environmental Conservation Rule-1997).

**Table 3.2 Standards for Air**

(Density unit:  $\mu g / m^3$ )

Sl. No.	Categories of Area	Suspended Particulate Matters (SPM)	Sulphur-dioxide	Carbon Monoxide	Oxides Nitrogen
a.	Industrial and mixed	500	120	5000	100
b.	Commercial and mixed	400	100	5000	100
c.	Residential and rural	200	80	2000	80
d.	Sensitive	100	30	1000	30

Notes:

(1) At national level, sensitive area includes monuments, health center, hospital, archeological site, educational institution, and government designated areas.

(2) Industrial units located in areas not designated as industrial areas shall not discharge pollutants which may contribute to exceeding the standard for air surrounding the areas specified at Sl. nos. c and d above.

Suspended Particulate Matter means airborne particles of a diameter 10 micron or less.

**Table 3.3 Standards for Emission from Motor vehicles**

Parameter	Unit	Standard Limit
Black Smoke	Hartridge Smoke Unit (HSU)	65
Carbon Monoxide	gm/k.m. percent area	24 04
Hydrocarbon	gm/k.m. ppm	02 180
Oxides of Nitrogen	gm/k.m. ppm	02 600

## International standards

**Table 3.4 Ambient Air Quality Standards**

Parameter	IFC/WB <sup>1</sup> guidelines ( $\mu\text{g} / \text{m}^3$ )	Bangladesh guidelines <sup>2</sup> ( $\mu\text{g} / \text{m}^3$ )
SPM	-	200 (8 hr average)
PM <sub>10</sub>	150 (24 hour average)	50 (Annual average) 150 (24 hour average)
PM <sub>2.5</sub>	75 (24 hour average)	15 (Annual average) 65 (24 hour average)
SO <sub>2</sub>	125 (24 hour average)	365 (24 hour average) 80 (Annual average)
NO <sub>2</sub>	200 (1 hour average)	100 (Annual average)
Pb	-	0.5 (Annual average)

Note:

<sup>1</sup>New version of the World Bank Group EHS Guidelines for General Environmental Guidelines, April 2007

<sup>2</sup>Ministry of Environment and Forest, Notification related Environment Conservation Rules, 1997, Schedule 2,

16<sup>th</sup> July 2005

## Water Quality Standards

### Bangladesh standards

The standards for the water in Bangladesh shall be determined in accordance with standards specified in Schedule-3 (Environmental Conservation Rule-1997).

**Table 3.5 Inland Surface Water Quality Standards**

Best Practice based classification	Parameter			
	pH	BOD mg/l	DO mg/l	Total Coliform number/100
a. Source of drinking water for supply only after disinfecting:	6.5-8.5	2 or less	6 or above	50 or less
b. Water usable for recreational activity :	6.5 – 8.5	3 or less	5 or more	200 or less
c. Source of drinking water for supply after conventional treatment :	6.5 – 8.5	6 or less	6 or more	5000 or less
d. Water usable by fisheries:	6.5 – 8.5	6 or less	5 or more	---
e. Water usable by various process and cooling industries :	6.5 – 8.5	10 or less	5 or more	5000 or less
f. Water usable for irrigation:	6.5 – 8.5	10 or less	5 or more	1000 or less

Notes:

1. In water used for pisciculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water -2250  $\mu$ mhos/cm (at a temperature of 25<sup>o</sup>C; Sodium less than 26%; boron less than 0.2%.

**International standards**

**Table 3.6 Water quality standard (EHS)**

Pollutant	General EHS guideline of IFC (Indicative Values for Treated Sanitary Sewage Discharges a)
pH	6-9
BOD	30
COD	125
SS	150
n-hexane (mineral oil)	-
n-hexane (animal and vegetable fats)	10
Residual chlorine	-
Phenols	-
Copper	-
Zinc	-
Dissolved iron	-
Dissolved manganese	-
Chromium	-
Cadmium	-
Total cyanogen	-
Total coliform bacteria	400MPN <sup>6</sup> /100ml
Nitrogen	10 MPN <sup>6</sup> /100ml
Phosphorus	2 MPN <sup>6</sup> /100ml

Source: ① IFC, 2007, Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINE

## Noise Standards

### Bangladesh Standards

The standards for Noise in Bangladesh shall be determined in accordance with standards specified in Schedule-4 (Environmental Conservation Rule-1997) which is revised by GOB in 2006 and published as gazette form.

**Table 3.7 Noise Standards**

SL. No.	Category of areas	Standards determined at dBase unit	
		Day	Night
a.	Silent zone	50	40
b.	Residential area	55	45
c.	Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purpose)	60	50
d.	Commercial area	70	60
e.	Industrial area	75	70

Notes:

1. The time from 6 am to 9 pm is counted as daytime
2. The time from 9 pm to 6 am is counted as night time
3. Area up to a radius of 100 m around hospitals or educational institutions or special institutions/ establishments identified / to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.
4. The standards shown in the table are based on revised data published by GoB in September 2006 as a gazette (Regd. No. DA-1)

### International standards

**Table 3.8 Noise quality standard (EHS guideline)**

Receptor	One hour Laeq (dB)	
	Daytime (07:00 - 22:00)	Nighttime (22:00 - 07:00)
Residential, institutional and educational	55	45
Industrial and commercial	70	70

Source: IFC.2007.Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINE

**Table 3.9 Noise quality standard (WHO)**

Specific Environment	Critical health effect(s)	LA <sub>eq</sub> [dB]	Time base [hours]	LA max fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors Inside bedrooms	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	During Class	-
Pre-school Bedrooms, indoors	Sleep disturbance	30	Sleeping time	45
School, playground outdoor	Annoyance (external source)	55	During Play	-
Hospital, Ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, Treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial, shopping and traffic areas, indoors and Outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/ Earphones	Hearing impairment (free-field value)	85 # 4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140 # 2
	Hearing impairment (children)	-	-	140 # 2
Outdoors in parkland and conservation areas	Disruption of tranquility	# 3		

#1: as low as possible;

#2: peak sound pressure (not LAmax, fast), measured 100 mm from the ear;

#3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low;

#4: under headphones, adapted to free-field values

## Project Waste Standards

### Bangladesh Standards

The standards for waste in Bangladesh shall be determined in accordance with standards specified in Schedule-10 (Environmental Conservation Rule-1997).

**Table 3.10 Standards for Waste From Industrial Units or Projects Waste**

Sl. No.	Parameter	Unit	Inland Surface Water	Public Sewer at secondary treatment plant	Irrigated Land
1.	Ammoniacal Nitrogen (N molecule)	mg/l	50	75	75
2.	Ammonia (free ammonia)	"	5	5	15
3.	Arsenic (As)	"	0.2	.05	0.2
4.	BOD <sub>5</sub> 20°C	"	50	250	100
5.	Boron	"	2	2	2
6.	Cadmium (Cd)	"	0.05	0.5	0.5
7.	Chloride	"	600	600	600
8.	Chromium (total Cr)	"	0.5	1.0	1.0
9.	COD	"	200	400	400
10.	Chromium (hexavalent Cr)	"	0.1	1.0	1.0
11.	Copper (Cu)	"	0.5	3.0	3.0
12.	Dissolved Oxygen (DO)	"	4.5-8	4.5-8	4.5-8
13.	Electrical Conductivity	micro mho/cm	1200	1200	1200
14.	Total Dissolved Solids (TDS)	mg/l	2,100	2,100	2,100
15.	Fluoride (F)	"	7	15	10
16.	Sulfide (S)	"	1	2	2
17.	Iron (Fe)	"	2	2	2
18.	Total Kjeldahl Nitrogen (N)	"	100	100	100
19.	Lead (Pb)	"	0.1	1.0	0.1
20.	Manganese (Mn)	"	5	5	5
21.	Mercury (Hg)	"	0.01	0.01	0.01
22.	Nickel (Ni)	"	1.0	2.0	1.0
23.	Nitrate (N molecule)	"	10.0	undetermined	10.0
24.	Oil & grease	"	10	20	10
25.	Phenol compounds (C <sub>6</sub> H <sub>5</sub> OH)	"	1.0	5	1
26.	Dissolved Phosphorus (P)	"	8	8	10
27.	Radioactive materials:	As determined by Bangladesh Atomic Energy Commission.			

28.	pH		6-9	6-9	
29.	Selenium	mg/l	0.05	0.05	0.05
30.	Zn (Zn)	"	5.0	10.0	10.0
31.	Total dissolved solid	"	2,100	2,100	2,100
32.	Temperature	Centi- grade			
	Summer		40	40	40
	Winter		45	45	45
33.	Total Suspended Solid (TSS)	mg/l	150	500	200
34.	Cyanide (CN)	"	0.1	2.0	0.2

Notes:

- (1) These standards shall be applicable to all projects other than those specified under the heading "Standards for sector-wise industrial effluent or emission".
- (2) Compliance with these standards shall be ensured from the moment and industrial unit starts trial production, and in other cases, from the moment a project starts operation.
- (3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environment conditions of a particular situation.
- (4) Inland Surface Water means drains/ponds/tanks/ water bodies/ ditches, canals, rivers, springs and estuaries.
- (5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.
- (6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.
- (7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.



### Relevant National Policies

During recent years a number of national policy documents have been prepared and where accepted by GOB. These policy initiatives, strategies and plans all emphasize consideration of the environment and natural resources in order to achieve sustainable development. A summary of the major relevant policy documents prepared is given in Table 3.11. It is relevant to mention that GOB has prepared a National Strategy for Accelerated Poverty Reduction showing its strong commitment to achieving the Millennium Development Goals as defined by the UN. While the Government has made important strides towards achieving these targets, this report highlights a number of sources of environmental degradation that merit greater emphasis, not only to bring Bangladesh closer to achieving its targets but also to contribute to the removal of environmental constraints to poverty reducing growth.

**Table 3.11 Relevant Major Policies**

Policy	Brief Description	Responsible Agency
National Land Transport Policy (2004)	New roads and major improvements will be subjected to an EIA, Funding will be provided for mitigation measures, Environmental (design) standards for new roads	Road & Highways
The National Water Policy (1999)	Protection and restoration of water resources; Protection of water quality, including strengthening regulations concerning agro-chemicals and industrial effluents Sanitation and potable water Fish and Fisheries; Participation of local communities in water sector development	Ministry of Water Resources
National Land Use Policy (2001)	The policy deals with land uses for several purposes including agriculture, housing, forestry, industrialization, railways and roads. The plan identifies land use constraints in these sectors.	Ministry of Land
National Forest Policy and Forest Sector Review(1994,2005)	Afforestation of 20% land; Bio-diversity of the existing degraded forests; Strengthening of agricultural sector Control of global warming, desertification, control of trade in wild birds and animals Prevention illegal occupation of the forestlands, tree felling	Ministry of Environment and Forest
National Biodiversity Strategy and Action plan (2004)	Conserve, and restore the biodiversity of the country; Strategy and Action - Maintain and improve environmental stability of ecosystems; Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations; Guarantee safe passage, and conservation of globally endangered migratory species, especially birds and mammals in the country; Stop introduction of invasive alien species, genetically modified organisms and living modified organisms.	Ministry of Environment and Forest (MOEF)
National Fisheries Policy (1998) and Inland Capture Fisheries Strategy (2004)	Preservation, management and exploitation of fisheries and resources in inland open water; Fish cultivation and management in inland closed water; Prawn and fish cultivation in coastal areas; Preservation, management and exploitation of sea fishery	Ministry of Fisheries and Livestock

Policy	Brief Description	Responsible Agency
	resources	
National Agricultural Policy, 1999	The policy deals with programs to make the nation self-sufficient in food through increased production of all crops and I to ensure a dependable food security system	Ministry of Agriculture
Draft Wetland Policy, 1998	Establishment of principles for sustainable use of wetland resources; Maintenance of existing level of biological diversity; Maintenance of the functions and values of wetlands Promotion and recognition of the value of wetland functions in resource management and economic development	Ministry of Environment and Forest
Bangladesh Climate - Change Strategy and Action Plan (2008)	Establishment of six strategic pillars for action, including (1) food security, social protection and health, (2) disaster management, (3) protective infrastructure, (4) research and knowledge management, (5) Decreased carbon development, and (6) capacity building and institutional strengthening. A first list of 37 programs is identified.	Ministry of Environment and Forest

### Occupational Health and Safety

During construction, the project will confirm the labor laws, for occupational and health related rules as outlined in Table 3.12.

**Table 3.12 Relevant Occupational Health and Safety Laws and Rules**

Title	Overview
Bangladesh Labor Act 2006	Provides for safety of work force during construction period. The act provides guidance of employer's extent of responsibility and the workmen's right to compensation in case of injury caused by accident while working.
Water Supply and Sewerage Authority Act 1996	The act calls for ensuring water supply and sewerage system to the public, preservation of system, and other related health and environmental facilities for the community.
Labor Relations under Labor Laws, 1996 (Revisions to scattered Acts and Ordinances to formulate a unified code)	General concerns during the project implementation state that the project manager must recognize labor unions.
Public Health Emergency Provisions) Ordinance, 1994	Calls for special provisions with regard to public health. In case of emergency, it is necessary to make special provisions for preventing the spread of disease, safeguarding the public health, and providing adequate medical service, and other services essential to the health of respective communities and workers during construction-related work.
Bangladesh Factory Act, 1979	Workplaces provisions: these Act and Labor Laws require medical facilities, first aid, accident and emergency arrangements, and childcare services to be provided to the workers at workplace.
The Employees State Insurance Act, 1948	Health, injury, and sickness benefit should be paid.
The Employer's Liability Act, 1938	Covers accidents, risks and damages with respect to employment injuries
Maternity Benefit Act, 1950	Framed rules for female employees, who are entitled to

Title	Overview
	various benefits for maternity.

Source: Bangladesh Government Rules and Regulation book

### International Treaties

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions signed by GoB is shown in Table 3.13

**Table 3.13 Relevant International Treaties, Conventions and Protocols Signed by Bangladesh**

Treaty or Convention	In	Brief Description	Responsible Agency
On Protection of birds, Paris	1950	Protection of birds in wild state	Department of Environment/Department of Fisheries
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	Department of Environment/Ministry of Shipping
Ramsar Convention	1971	Protection of wetlands	Department of Environment/Department of Fisheries
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	Department of Archaeology
CITES Convention (Washington)	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	Department of Environment/Department of Fisheries
Bonn Convention	1979	Conservation of migratory species of wild animals	Department of Environment/Department of Fisheries
Prevention and Control of Occupational hazards (Geneva)	1974	Protect workers against occupational exposure to carcinogenic substances and agents	Ministry of Health and Family Welfare
Occupational hazards due to air pollution, noise & vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	Ministry of Health and Family Welfare
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	Ministry of Health and Family Welfare
Occupational Health Services (Geneva)	1985	To promote a safe and healthy working environment	Ministry of Health and Family Welfare
Vienna convention	1985	Protection of ozone layer	Department of Environment/Ministry of Environment and Forest
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	Ministry of Communication

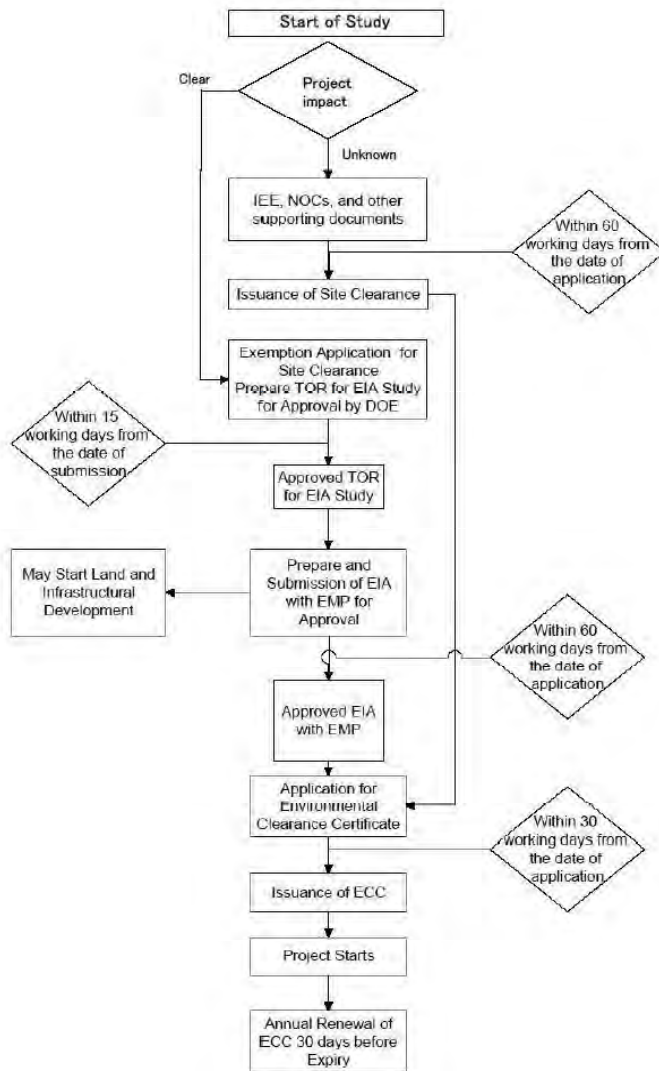
Convention on oil pollution (London)	1990	Legal framework and preparedness for control of oil pollution	Department of Environment/Ministry of Shipping
London Protocol	1990	Control of global emissions that deplete ozone layer	Department of Environment/Ministry of Environment and Forest
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	Department of Environment/Ministry of Environment and Forest
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	Department of Environment/Ministry of Environment and Forest
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	Department of Environment/Ministry of Environment and Forest
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of	Department of Environment/Ministry of Environment and Forest

### 3.2 Environmental Impact Assessment

#### Category of Project

Under the Environmental Conservation Rules (1997) a classification system was established for development projects and industries on basis of the location, the size and the severity of potential pollution. There are four categories of projects: green, orange A, orange B and red with respectively no, minor, medium and severe environmental impacts. For the red category of projects a full EIA is required. All regional and national highway, railway and bridge projects of over 100 m length fall in the red category. The orange B category includes feeder and district roads and bridges under 100 m length.

The Proposed Bridge Construction and Rehabilitation project on Dhaka-Chittagong National Highway (NH-1) with a length of more than 100 m clearly falls under the red category of projects. The Environmental Impacts Assessment should include the prediction, evaluation and mitigation of environmental impacts caused, based on the characteristics of project, and an Environmental Management Plan (EMP) shall be prepared. The approval of the EIA and EMP is required before submitting an application for an Environmental Clearance Certificate (ECC). The procedure is shown in Figure 3.1.



**Figure 3.1 Steps to be followed for Environmental Clearance Certificate for Red Category Project<sup>1</sup>**

<sup>1</sup> After EIA for Padma Multipurpose Bridge 2010

### The Japan International Cooperation Agency Policy

JICA environmental Guidelines which is applied to the Project is “Guidelines for Environmental and Social Considerations” (April 2010).

The JICA Guidelines confirm that project proponents are undertaking appropriate environmental and social considerations, through various measures, so as to prevent or minimize the impact on the environment and local communities which may be caused by the projects for which JICA provides funding, and not to bring about unacceptable effects. It will thus contribute to the sustainable development of developing regions. In its confirmation of environmental and social considerations, JICA places importance on dialogue with all involved partners (e.g. the host country, local governments, borrowers and project proponents) regarding environmental and social considerations. Transparent and accountable processes, as well as active participation of key stakeholders (e.g. local residents and local NGOs affected by the project) in all stages of the project are highly considered. The JICA Guidelines are formulated in reference to the World Bank Operational Policy.

The JICA Guidelines provide following four categories of projects as per its environmental classification system.

- Category A: A proposed project is classified as Category A if it is likely to have significant adverse impact on the environment. Borrowers and related parties must submit Environmental Impact Assessment (EIA) reports. For projects that will result in large-scale involuntary resettlement, basic resettlement plans must be submitted. EIA and other reports need to be submitted through the borrower before the JICA environmental reviews.
- Category B: A proposed project is classified as Category B if its potential adverse environmental impact is less adverse than that of Category A projects.
- Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impact.
- Category FI: A proposed project is classified as Category FI if it satisfies all of the following:
  - JICA’s funding of the project is provided to a financial intermediary etc.;
  - the selection and assessment of the actual sub-projects is substantially undertaken by such an institution only after JICA’s approval of the funding and therefore the subprojects cannot be specified prior to JICA’s approval of funding (or assessment of the project); and
  - Those sub-projects are expected to have potential impact on the environment.

The Project, as per the above categorization, falls under Category A for the purpose of environmental investigations. Final EIA report approved by DoE needs to be laid open

for public inspection at the JICA headquarter 120 days before a loan agreement for category A projects.

### Gaps between Environmental Regulations of GOB and the JICA Guidelines

There are gaps about categorization process, necessity of alternative study and information disclosure as shown in Table 3.14.

**Table 3.14 Major Gaps between Environmental Regulations of GOB and the JICA Guidelines**

Aspect of Operational Framework	JICA	GOB	Harmonized Operational Framework
Environmental Policy and Regulations	JICA Guidelines for Environmental and Social consideration, April 2004	<ul style="list-style-type: none"> <li>● Environment Conservation Act (1995)</li> <li>● Environment Conservation Rules (1977)</li> <li>● EIA guidelines on Industrial projects</li> </ul>	—
Alternatives	Environmental impact must be assessed and examined from the earliest possible planning stage. Alternatives studies shall be made to avoid or minimize adverse impact must be examined and incorporated into the project plan.	ECA (1995) and ECR (1997) do not explicitly ask for identification and assessment of alternatives.	Alternative study shall be made to minimize the project impact
Consultation	In projects, especially can have adverse effects on environment, information on projects needs to be known at early stage and stakeholders, such as local people, should be adequately consulted. The consultation result needs to be considered in projects. (Holding consultations is highly desirable, especially at scoping stage and when the draft report is being prepared)	No public disclosure is required as per ECR. Although there are descriptions recommending public participation in EIA, any detailed regulations for local consultation are not laid down.	To implement public consultation accordingly throughout the preparation and implementation stages of the Project. During preparation of the EIA report, consultations were implemented at scoping stage and when the draft report was prepared.
Disclosure of EIA report	It is needed that EIA report is disclosed to projected countries and local people, and stakeholders, such as local people, can access to the report all the time. Also, allowance for copying the report is needed. JICA discloses EIA reports 120 days prior to concluding agreement documents.	There is no regulation for the time of EIA disclosure.	Setting up the time of EIA disclosure can guarantee people to access to the report.



### 3.3 Environmental Institutional Framework

Table 3.15 provides the public organizations that have a role in environment sector. While some of major institutions that have direct role in managing natural resources.

**Table 3.15 Functions of Major Organizations in Environmental Sector**

<b>Organization</b>	<b>Current Function</b>
Planning Commission	Responsible for the preparation of development plans and allocating funds to individual Ministries responsible for implementing specific projects. Authorized to supervise and coordinate cross-sectoral and inter-ministerial activities affecting the use of natural resources and the environment
Department of Environment	Technical arm of the Ministry is responsible for environmental planning, management, monitoring and enforcement.
Department of Agricultural Extension	Responsible for extension of new technologies, to farmers at the field level
Water Resources Planning Organization (WARPO)	Responsible for water resource management
Department of Fisheries	Managing fisheries resources
Department of Livestock	Works for improvement of livestock resources and production
Bangladesh Water Development Board (BWDB)	Project planning and implementation; flood control and watershed management; salinity control; maintaining water channels for transportation; regulating water channels
Roads and Highway (RHD)	Constricting and maintaining primary and secondary roads
Department of Public Health Engineering (DPHE)	Rural and urban water supply and sanitation
Water Supply and Sewerage Authorities (WASA)	Construction and upkeep of potable water supply, sewerage and storm drainage in major cities
Bangladesh Inland Water Transport Authority	River conservancy work, including river training for navigation and meteorological information, including river charts; hydraulic survey; programming for dredging and reviving dead or dying water bodies; developing, maintaining, and operating inland river ports; developing rural water transport.
National Herbarium	Surveys and authenticates locally used genetic resources, taxonomic identification of floral species.
Livestock Research Institute	Conduct research production of livestock
Bangladesh Bureau of Statistics	Environmental statistical data compilation

Sources: Country Environmental Analysis Bangladesh, July 2004, ADB

Local government institutions like Union Parishad, Upazila Parishad, and Zila Parishad have been vested with a wide range of development functions including planning for the provision of general physical infrastructure such as roads, culverts, bridges, potable water supplies, flood

control, and irrigation infrastructure. Local Government Ordinances mandate Union Parishad and Upazila Parishad to coordinate development activity implemented by Government and Non-Government Organizations by their territorial and functional jurisdiction.

Followings are description about key organization related:

#### Department of Environment

The primary institution for environmental management in Bangladesh is the Department of Environment (DoE), under the Ministry of Environment and Forest (MoEF). The DoE is the authority with the mandate to regulate and enforce environmental management, and the setting and enforcement of environmental regulations. The Department was created in 1989 to ensure sustainable development and to conserve and manage the environment of Bangladesh. Creating public awareness on environmental management and legal obligations are needed for this. The following Policy, Acts and Rules facilitate the activities of the Department:

- Environment Policy, 1992;
- Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002;
- Environment Conservation Rules, 1997 and subsequent amendments in 2002 and 2003;
- Environment Court Act, 2000 and subsequent amendments in 2002

The principal activities of the DoE are

- Defining Environmental Impact Assessment (EIA) procedures and issuing environmental clearance permits - the latter being legal requirements before proposed projects can proceed to implementation;
- Providing advice or taking direct action to prevent degradation of the environment;
- Pollution control, including the monitoring of effluent sources and ensuring mitigation of environmental pollution;
- Setting the Water Quality Standard (WQS) for particular uses of water and for discharges to water bodies; and
- Declaring Ecologically Critical Areas (ECAs) where the ecosystem has been degraded to a critical state.

#### The Forestry Department

It is responsible for Sensitive Area protection in four types of legally protected areas - wildlife sanctuaries, game reserves, reserved forests and natural forests).

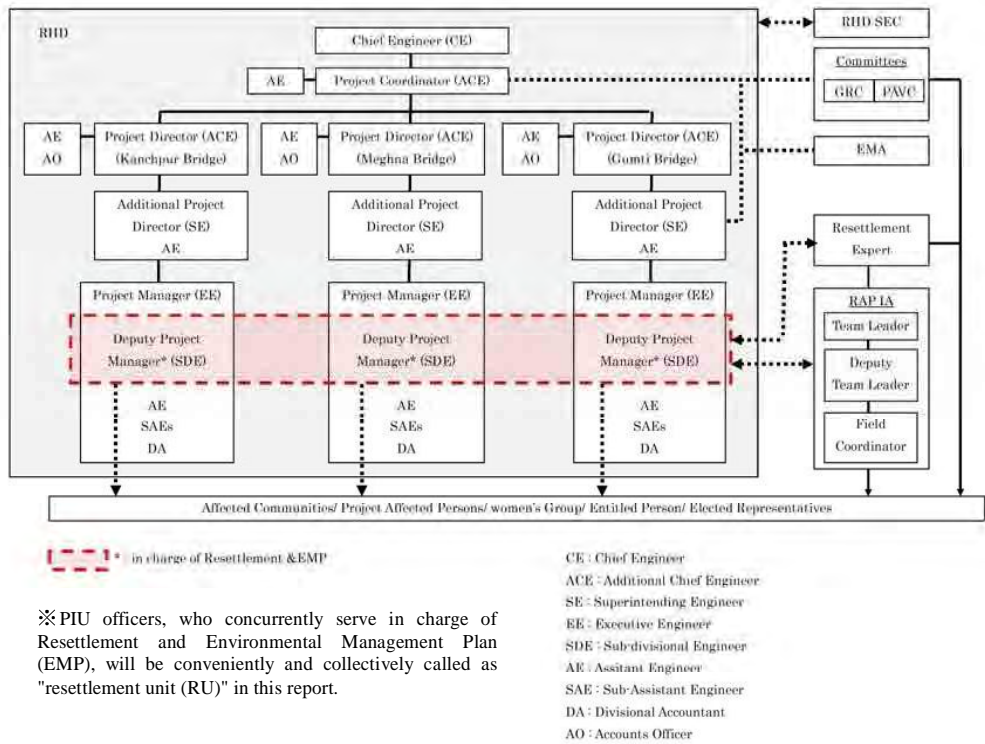
### Roads and Highways Department (RHD)

Under the Ministry of Communications, RHD has the responsibility for construction and maintenance of all national and regional highways. RHD also has a significant fleet of ferries operating on the main highway system in locations where there are no road bridges. Project Implementation Unit (PIU) of construction stage and of design and tender stage are shown in Figure 3.2 and 3.3 respectively.

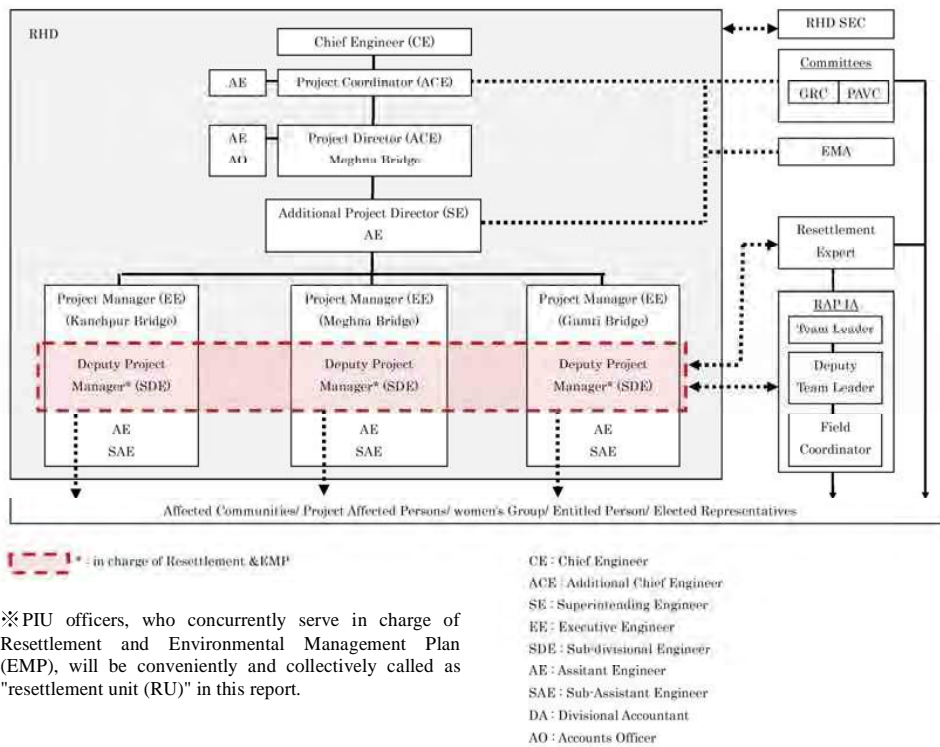
As shown in the chart, RHD, within its Technical Services Wing, has established a Social and Environment Circle (SEC), which comprises an Environmental Division and a Social Division. The objective of the Circle is to ensure that all RHD works and projects are executed in accordance with appropriate environmental and social standards and practices. Tree planting on RHD road alignments is the responsibility of the Arboriculture Circle and road safety issues are the responsibility of the Road Design and Safety Circle. Both of these circles are within the Technical Services Wing of RHD are shown in the chart.

On site, RHD are primarily responsible for ensuring contractors to implement best environmental practice on site. RHD officers supervising contracts (and consultants where employed by RHD) should review and monitor the contractor's performance in relation to the EMP. Particular responsibilities include:

- Promoting environmental best practice in all day-to-day project activities.
- Contributing to the development of clauses about environmental standards for consultants' TOR, of contract conditions and of environmental management plan for contractors.



**Figure 3.2 PIU of construction stage**



**Figure 3.3 PIU of design and tender stage**

#### Inter-institutional Coordination

Regular liaison should be maintained between officers of the RHD SEC and the DoE officer with the responsibility for overseeing Environmental Assessment for the communications sector. This is particularly crucial to ensure that the Environmental Clearance Certificate (ECC) applications are filed in sufficient time such that delay in project implementation does not occur. Any delays that result in a construction contractor being prevented from mobilizing at the commencement of the dry season can have very serious cost implications for a project. It is thus imperative that a good working relationship is maintained between the relevant staff of RHD and DoE.

## CHAPTER 4 BASELINE ENVIRONMENTAL CONDITION

### 4.1 General

This chapter describes (1) conditions of sites in general and then (2) key items which were discussed in the scoping.

The primary objective in this chapter is for providing an environmental baseline that potential impacts at the construction and operation phases of the three new bridges can be compared in chapter 7. Baseline data includes an inventory of physical, ecological and socio-economic parameters. Covering these aspects, data has been compiled for:

- Land Environment (topography, geology, seismology and soils);
- Water Environment (water resources, water quality);
- Air Environment (meteorology, air quality);
- Noise Environment (noise levels);
- Ecological Environment
- Socio-economic Environment

Baseline data for the study area was collected using the following methods:

- Published Literature (Physiography, Geological and Hydrological Survey Report for three new bridges, Preparation of Maps)
- Primary Survey
- Laboratory Analyses
- Local people consultation
- Organizational Visit

Organization visited:

Professor, Department of Geography and Environment Dhaka University  
Professor, Department of Geology Dhaka University  
Assistant Professor Dhaka University  
Chairman, Department of Zoology Dhaka University  
Director General Geological Survey of Bangladesh, Ministry of Energy and Mineral Resources  
Head, Department of Environmental Science State University of Bangladesh, Dhaka  
Director, Soil Research development Institute, Mrittika Bhaban, Dhaka  
Executive Director CEGIS, Gulshan 1, Dhaka  
Chief Executive CARINAM, Center for Advanced Research in, Natural Resources Management,

The influence area (impact zone) for the EIA covers 0.5km from the bridge center line for each Bridges and 1 km on either side of the road alignment in order to include sufficient coverage of the receiving environment of the impacts of the Project.

#### 4.1.1 Climate

##### Temperature

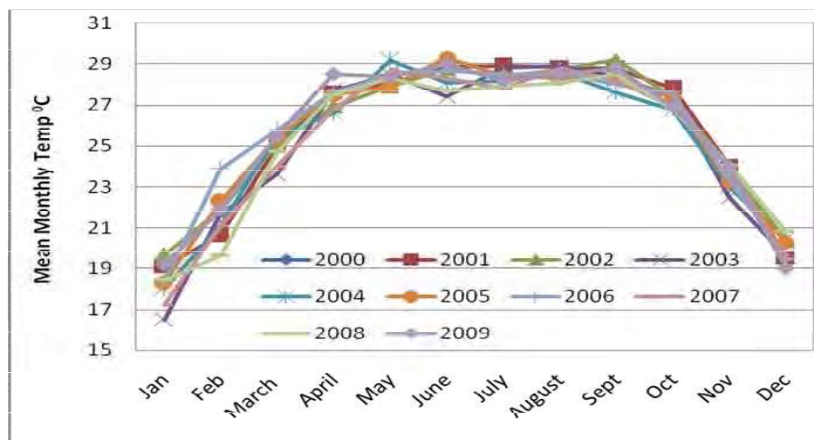
Meteorological stations (of Bangladesh Meteorological Department, BMD) located closest to the Project areas are: Dhaka and Comilla. Weather data from these two stations is collected from 2000 to 2009. Locations of these stations are presented in Figure 4.1.



**Figure 4.1 Locations of Monitoring Stations**

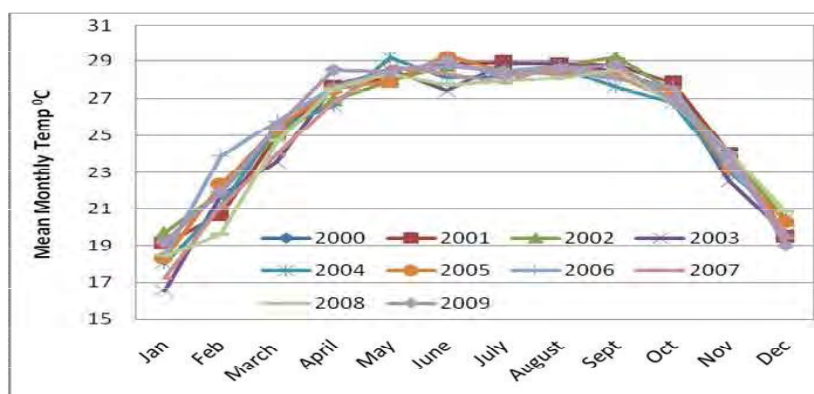
Mean monthly temperature data of Dhaka Station is given in Figure 4.2. January is the coldest month with average monthly temperature of about 17°C, while April to October is the hottest month with average monthly temperatures ranging from 28 to 31°C.





**Figure 4.2 Mean Monthly Temperatures in Dhaka Station**

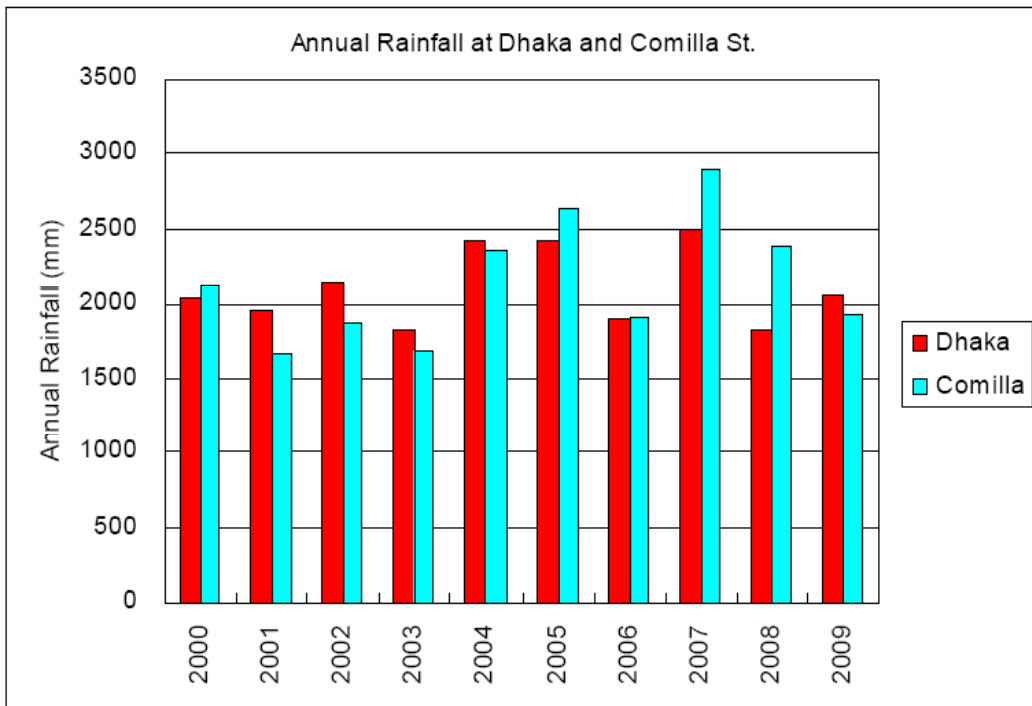
Distribution of mean monthly temperature of Comilla Station for last ten years is given in Figure 4.3. Mean monthly temperature data of Comilla Station varies in the range of 16.5 – 29.3°C. January is the coldest month having average minimum temperature of 12.1°C. The average maximum temperature occurs in the month of May being 32.5°C.



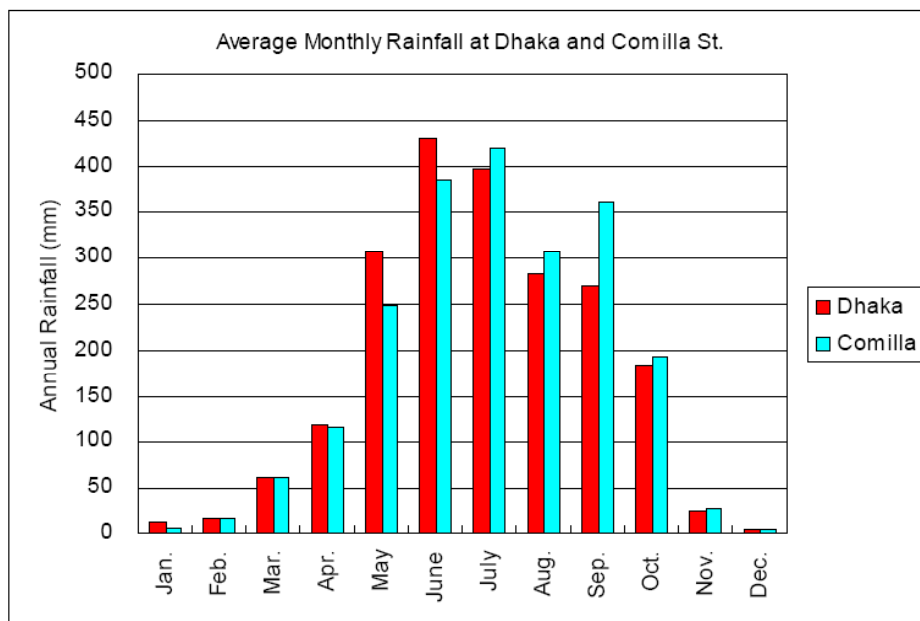
**Figure: 4.3 Mean Monthly Temperatures in Comilla Station**

Rainfall

According to monthly rainfall data from 2000 to 2009, average annual rainfall is about 2100 - 2200 mm/yr at Dhaka and Comilla Station. Normally rainy season starts from May and ends in October, especially there is heavy rainfall in June and July in comparison to other months, which is about 400 mm/month. Dry season lasts from November to April.



**Figure 4.4 Annual Rainfall at Dhaka and Comilla Meteorological Station**



**Figure 4.5 Average Monthly Rainfall at Dhaka and Comilla Meteorological Station**

### Humidity

In Dhaka, the maximum relative humidity varies from 94- 100% in winter months but the maximum range varies from 94-99% in other months. The minimum humidity ranges from 13 -24% in winter months and this varies from 11- 16 % in the months of March- May. The figure varies from 31- 54% in summer and rainy months from June to October.

In Comilla, the maximum relative humidity varies from 98- 100% in winter months but the maximum range varies from 97-100% in other months. The minimum humidity ranges from 16 -23% in winter months and this varies from 22- 26 % in the months of March- May. The figure varies from 31- 66% in summer and rainy months from June to October. .

### Wind Speed and Direction

In Dhaka, it is recorded that that the wind speeds mostly remain in the range of 8 – 10 knot<sup>1</sup>/hr. occasionally rising to 15knot /hr. But in the winter months it remains in the range of 2-7 knot/hour occasionally rising to 9 knots/.hr. The highest speed is recorded as 20 knots/ hr. in the month of September, 2007 in a north westerly direction.

In Comilla, it is recorded that that the wind speeds mostly remain in the range of 2 – 4.5 knots/hr. occasionally rising to 8.5 knots /hr. But in the winter months it remains in the range of 1.8-4 knots/hour occasionally rising to 6.8 knots/.hr.

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<sup>1</sup> 1 knot/hr. = 0.45m/second

#### **4.1.2 Physiography and Soils**

##### Kanchpur Bridge

The Project area is known as Modhupur tract. There are compact clays, previously called Pleistocene clays, but now called Modhupur clay. These clays have been uplifted tectonically.

The flood plain sediments occupy the south of the study area. These clays are overlaying by sediments deposited on the old Meghna floodplain. This flood plain has, in turn, been partially buried by sediment deposited by Brahmaputra River.

Soils of the project impact area are mainly old Brahmaputra and old Meghna flood plain deposits. Flood plain soils generally show a pattern of friable silt loams or silt clay loams on the ridges and clays in the basins. Some clays are commonly dark gray but others flood plain soils are mainly mid gray and finely mottled yellow and brown. Because of these mottling, soils of the old Brahmaputra and old Meghna flood plain have an overall yellow-brown or olive brown appearance. The majority are neutral to moderately alkaline in reaction.

##### Meghna and Gumti Bridge

Physiographically, the Meghna site is located on the flood plain of the Meghna. Gazaria Upazlia is located between two channels of the Meghna River. On the eastern side is the Daudkandi Ghat Channel and on the western side is the Meghan Ghat Channel of the Meghna River. At present, there are bridges over both the channel – Gumti Bridge over the Daudkandi Ghat Channel and Meghna Bridge over the Meghna Ghat Channel. However, since the construction of bridges on these channels, the Daudkandi Ghat Channel has become less active and more silting is taking place in the passage. Gazaria town is located further east of the proposed project site, on the bank of the Fuldi River. General elevation of the proposed project site varies from about 8 m to 10 m PWD (Public Works Datum) .

As the Gazaria Upazila is located between two channels of the Meghna River, it has been suggested that the whole area is a Char (Island - channel bar). However, review of the geology of the area tends to suggest that the Meghna River possibly encountered some obstruction (major clay beds) up stream of Sonargoan (in the north) and diverted part of its flow southeastwards through channels of other streams of the area. The other stream channels could be the older channel of the Tista River and the Katalia Nadi. Ultimately, this diverted flow assumed the name of the Meghna River. However, part of the eastern channel of the Meghna river is still known as Katalia Nadi in Homna Upazial. Indication from old maps and literature review suggests that the landform of the area is more than 100 years old. However, some of the

land on the extreme south and southeast of Bausia may be younger.

Soil of the area is grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey flood plain soil. Top soils are strongly acidic and sub-soils slightly acidic to slightly alkaline. General fertility level is medium with low nitrogen and organic matter.

#### **4.1.3 Geology**

About Kanchpur Bridge, the project area is known as Modhupur tract. There are compact clays, previously called Pleistocene clays, but now called Modhupur clay. These clays have been uplifted tectonically.

Soils of the project impact area are mainly old Brahmaputra and old Meghna flood plain deposits. Flood plain soils generally show a pattern of friable silt loams or silty clay loams on the ridges and clays in the basins. Some clays are commonly dark gray but others flood plain soils are mainly mid gray and finely mottled yellow and brown. Because of these mottling, soils of the old Brahmaputra and old Meghna flood plain have an overall yellow-brown or olive brown appearance. The majority are neutral to moderately alkaline in reaction.

About Meghna and Gumti Bridge areas, physiographically, the Meghna site is located on the flood plain of the Meghna. Gazaria Upazlia is located between two channels of the Meghna River. On the eastern side is the Daudkandi Ghat Channel and on the western side is the Meghna Ghat Channel of the Meghna River. At present, there are bridges over both the channel – Gumti Bridge over the Daudkandi Ghat Channel and Meghna Bridge over the Meghna Ghat Channel. However, since the construction of bridges on these channels, the Daudkandi Ghat Channel has become less active and more silting is taking place in the passage. Gazaria town is located further east of the proposed project site, on the bank of the Fuldi River. General elevation of the proposed project site varies from about 8 m to 10 m PWD .

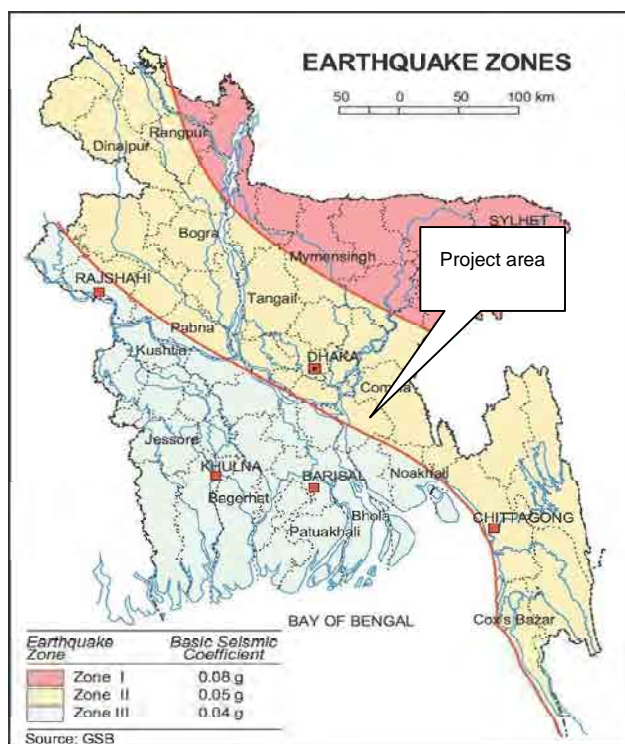
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River is still known as Katalia Nadi in Homna Upazial. Indication from old maps and literature review suggests that the landform of the area is more than 100 years old. However, some of the land on the extreme south and southeast of Bausia may be younger.

Soil of the area is grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey flood plain soil. Top soils are strongly acidic and sub-soils slightly acidic to slightly alkaline. General fertility level is medium with low nitrogen and organic matter.

### Seismicity

According to BNBC (1993), Bangladesh has three seismic zones with moderate and low seismic activity. The Project area falls in Zone II, i.e. medium intensity seismic zone of the country. No major earthquake has been reported in the project area in recent years or recent past. It is understood that seismic risk at the project area is of medium intensity. Development taking into consideration the seismic co-efficient would not pose a major constraint to development of the project. The seismic zones of Bangladesh are depicted in Figure 4.6 for reference.



**Figure 4.6 Earthquake Zones of Bangladesh**

#### **4.1.4 Surface Water Resources**

##### Shitalakshya River

Kanchpur Site is part of the Shitalakshya River system, which ultimately connected to other surrounding main rivers such as Balu, Daleshwari, Buriganga and led to Meghna river system. Shitalakshya River system is connected by large number of tributaries which are flowing water from the surrounding rivers system and is also connected with small canals. The main sources of water flows in these rivers are rainfall during the wet season. Both stream velocity and water levels remain high in the wet season, which drops down significantly in the dry season. The highest water level observed is 5.5m in wet season and in dry season they were 0.6m. Velocities estimated are 1.3 m/s in wet season and 0.2m in dry season. Data sources are edited BWDB observation data by Study Team

Beside rivers and canals, the other surface water sources are ponds/tanks and few natural depressions in and around the project area similarly to other parts of the country. This area also receives sufficient amount of rainfall. There are some low agricultural lands which are seasonally flooded and used as fish culture.

There is rise in water level with commencement of monsoon rainfall from May/June till September/October. Tidal influence reduces with monsoon flooding.

##### Meghna River

The Meghna River is one of the longest rivers in Bangladesh. It originates from the Barrack River passing through Assam Province of India and finally enters into Bangladesh near Zakiganj Thana of Sylhet district in the name of the Surma River. The Barrack River has been bifurcated at the point Zakiganj in the name of 1) The Surma and 2) The Kushiara. The united courses of these rivers in the downstream near Habiganj the river system flows southward in the name of the Meghna. The Meghna meets the old Brahmaputra near Bhairab passes through the present Meghnaghat and flows into the Bay of Bengal again meeting with the Padma River at the downstream of Chandpur. Many people (45% of the total population of Bangladesh) residing in the flood plain of the Meghna live on fishing, in-land trading activities on the Meghna including a substantial contribution to the agricultural production system of the entire river basin. The highest water level observed is 5.6m in wet season and in dry season they were 1.1m. Velocities estimated are 1.5m/s in wet season and 0.2 m/s in dry season.

##### Gumti-River

Gumti River is one of the branches of Meghna River. The highest water level observed is 5.8m

in wet season and in dry season they were 0.9m. Velocities estimated are 1.7m/s in wet season and 0.2m/s in dry season.

#### Groundwater resources

The Project area belongs to the hydro-geological unit II Holocene Deltaic and flood Plains. Ground water is available in plenty and water table does not go beyond suction limit throughout the year. Groundwater is available at shallow depth for which most of the tube wells are sunk in the depth 40-200 ft. Water is available in the tube wells round the year. The water of shallow layer contains lot of iron and is contaminated with Arsenic in several areas.

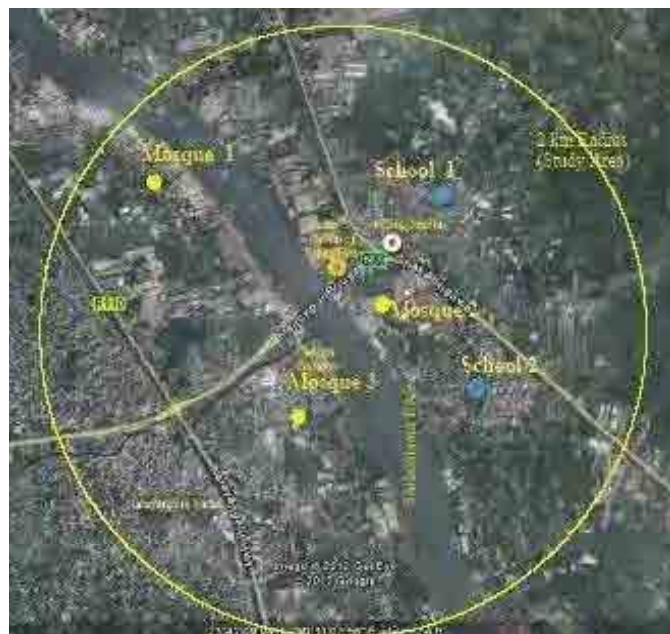
### **4.1.5 Land Use Pattern**

#### 1) Land Use Pattern

##### Kanchpur Bridge

Existing land use within 5km surrounding project site was determined by on screen digitizing and extensive ground truthing GPS (Global Positioning System). The study area is mostly occupied with heavy industries such as Siddhirganj power plant complex, Adamjee EPZ complex, Silo project within industrial zone including some small industries distributed within Adamjee EPZ campus and scattered around the project area. In addition, there is a massive settlement in the residential area adjacent to industrial installations.

Figures from 4.7 to 4.9 present Google maps around the sites respectively.



**Figure 4.7 Land Use Map at Kanchpur Bridge Site**



### Meghna Bridge

There are no agricultural land and crop field available in the project influence area. The Project area has monoculture tree plantation, and homestead-based agro-forestry. Within a three-kilometer radius of the project site are numerous industrial and commercial developments that comprise the burgeoning industrial area of Narayanganj.



**Figure 4.8 Land Use Map at Meghna Bridge Site**

### Gumti

There is a little bit of agricultural area which is seasonal. Those agricultural areas just beside the river and char land (island), where farmer can grow crops only in one season (dry season, November to April, ) while it sinks below water in wet season, May to October.



**Picture 4.1 Views of Char agriculture**



**Figure 4.9 Land Use Map at Gumti Bridge Site**

**2) Land use and utilization of local resources**

Kanchpur Bridge Site, within 5km from the bridge is mostly occupied with heavy industries such as Siddhirganj power plant complex, Adamjee EPZ complex, Silo project within industrial zone including some small industries distributed within Adamjee EPZ campus and scattered around the project area. In addition, there is a massive settlement in the residential area adjacent to industrial installations.

About Meghna Bridge and Gumti Bridge Sites, there are no agricultural land and crop field available in the Project area except on Chars in Gumti River. The Project area has monoculture tree plantation, and homestead-based agro-forestry. Within a three-kilometer radius of the

project site are numerous industrial and commercial developments that comprise the burgeoning industrial area of Narayanganj.

Fishes are major sources of protein for nationals. As for local resources, fishes as Table 4.1 are available in the fish markets in Meghna and Gumti Sites respectively.

**Table 4.1 Fishes available in Local Fish Markets**

SL #	Types of Fish Landed in the fish Landing and Marketing Centers in 1 <sup>st</sup> Quarter		Source	Average Quantity (kg/day)*	Average Price (BDT/kg)
	Scientific Name	Local Name	Open Water		
<b>Landing Center: Tetul tala (Meghna)</b>					
1.	<i>Labeo rohita</i>	Rui	R,C	40	150-200
2.	<i>Catla catla</i>	Katla	R,C	40	100-150
3.	<i>Cirrhina mrigala</i>	Mrigel	R,	20	100-150
4.	Not available	Baila	R,C	60	60-75
5.	<i>Pangasius Suchii</i>	Pangus			
6.	<i>Gudusia Chapra</i>	Chapila	R,C	40	70-80
7.	<i>Channa Sstriatus</i>	Shol	R,C	20	120-150
8.	<i>Eutropiichthys vacha</i>	Bacha	R,C	10	80-100
9.	<i>Pangasius pangasius</i>				
10.	<i>Puntius species</i>	Puti	R,C	60	70-80
11.	<i>Mastacemelus species</i>	Baim	R,C	10	80-100
12.	<i>Corica sobrona</i>	Kaski			
13.	<i>Mystus tengara</i>	Tengra	R,	15	70-80
14.	<i>Labeo bata</i>	Bata			
15.	<i>Amblypharyngodon mola</i>	Mola	R,C	20	50-65
16.	<i>Wallago attu</i>	Boal	R,	10	150-200
17.	<i>Channa punctatus</i>	Taki	R,C	20	80-90
18.	<i>Mystus aor</i>	Aire	R,	20	200-230
19.	<i>Mystus cavasius</i>	Gulsha Tengra	R,C	5	100-120
20.	<i>Tenualosa ilisha</i>	Ilish	R,	20	250-300
21.	<i>Macrobracium Species</i>	Chingri	R,C	10	80-300
22.	<i>Apocryptes Species</i>	Chewa	R,C	20	60-70
23.	<i>Chanda species</i>	Chanda	R,C	20	70-80
24.	<i>Mystus tengra</i>	Bujuri	R,C	5	80-90
25.	<i>Clupisoma garua</i>	Gaura			
26.	<i>Labea calbasu</i>	Calbaus			
27.	<i>Poa pama</i>	Poa	R ,C	25	65-75
28.	<i>Heteropneustes fossilies</i>	Shing	R ,C	15	90-95
29.	<i>Labeo rohita</i>	Nala	R ,C	30	60-70
<b>Landing Center: Baidyer Bazar (Gumti)</b>					
1.	<i>Labeo rohita</i>	Rui	R,C	20	150-200
2.	<i>Rita rita</i>	Reda	R,	10	250-300
3.	<i>Catla catla</i>	Katla	R,C	25	150-200
4.	<i>Cirrhina mrigala</i>	Mrigel	R,C	20	150-200
5.		Baila	R,C	30	80-100

6.	<i>Pangasius Suchii</i>	Pangas	R	15	250-300
7.	<i>Gudusia Chapra</i>	Chapila	R,C	30	80-90
8.	<i>Channa Striatus</i>	Shol	R,C	30	150-200
9.	<i>Eutropiichthys vacha</i>	Bacha	R,C	15	80-90
10.	<i>Pangasius pangasius</i>	Pangas	R	20	200-250
11.	<i>Puntius species</i>	Puti	R,C	30	70-80
12.	<i>Glossogobius giuris</i>				
13.	<i>Mastacemelus species</i>	Baim	R,C	15	120-150
14.	<i>Corica sobrona</i>	Katcki	R,C	25	70-80
15.	<i>Mystus tengara</i>	Tengra	R,C	10	100-120
17.	<i>Amblypharyngodon mola</i>	Mola	R,C	20	60-75
18.	<i>Wallago attu</i>	Boal	R,	40	200-250
19.	<i>Channa punctatus</i>	Taki	R,C	20	70-80
20.	<i>Mystus aor</i>	Aire	R,	25	300-350
21.	<i>Mystus cavasius</i>	Gulsha Tengra	R,C	10	120-130
22.	<i>Tenualosa ilisha</i>	Hilsa	R	500	120
23.	<i>Macrobracium Species</i>	Chingri	R,C	80	350-400
24.	<i>Apocryptes Species</i>	Chewa	R,C	25	70-80
25.	<i>Chanda species</i>	Chanda	R,C	20	60-70
26.	<i>Mystus tengra</i>	Bujuri	R,C	15	70-80
27.	<i>Clupisoma garua</i>	Garua	R,C	10	80-90
28.	<i>Labeo calbasu</i>	Baus	R,C	20	70-90
29.	<i>Not available</i>	Vada	R ,C	10	100-120
30.	<i>Not available</i>	Fali	R,C	15	150-200
31.	<i>Not available</i>	Taki	R ,C	35	80-90
32.	<i>Not available</i>	Shing	R ,C	40	130-150

Note:R= Meghna River, P= Pond, C= Canal  
Source: Study team

Locations of fish markets around Meghna Bridge and Gumti Bridge sites are show in Figure from 4.10 to 4.11 which includes very minor scale fish market as are not shown in the above table.



Figure 4.10 Location of Fish Markets in Meghna Bridge Site



Figure 4.11 Locations of Fish Markets at Gumti Bridge Site

Number of fishermen who resides projects site are less than 10 respectively for Meghna Bridge and Gumti Bridge sites. They come from far away since the markets at Meghna Bridge and Gumti Bridge sites are the major markets around. There is no fisherman at Kanchpur Bridge site.

#### 4.1.6 Water Use

The river port at Narayanganj is a major inland port and trading center. Various developments in the region continue to increase this port's importance to cargo ships, fishing boats, passenger boats, and trawlers. The Shitalakshya and Meghna River, and connecting waterways, will be relied upon for heavy construction equipment transportation as well as being used for power station cooling and general water uses. The construction contractor will only use groundwater for the provision of potable water during the construction phase.

#### 4.1.7 Hydrological condition

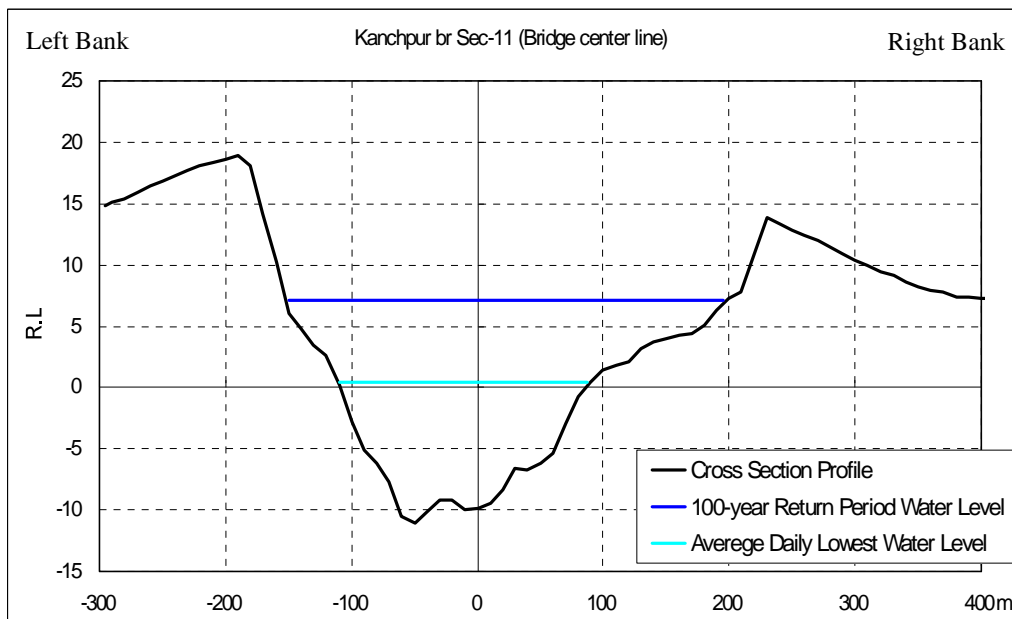
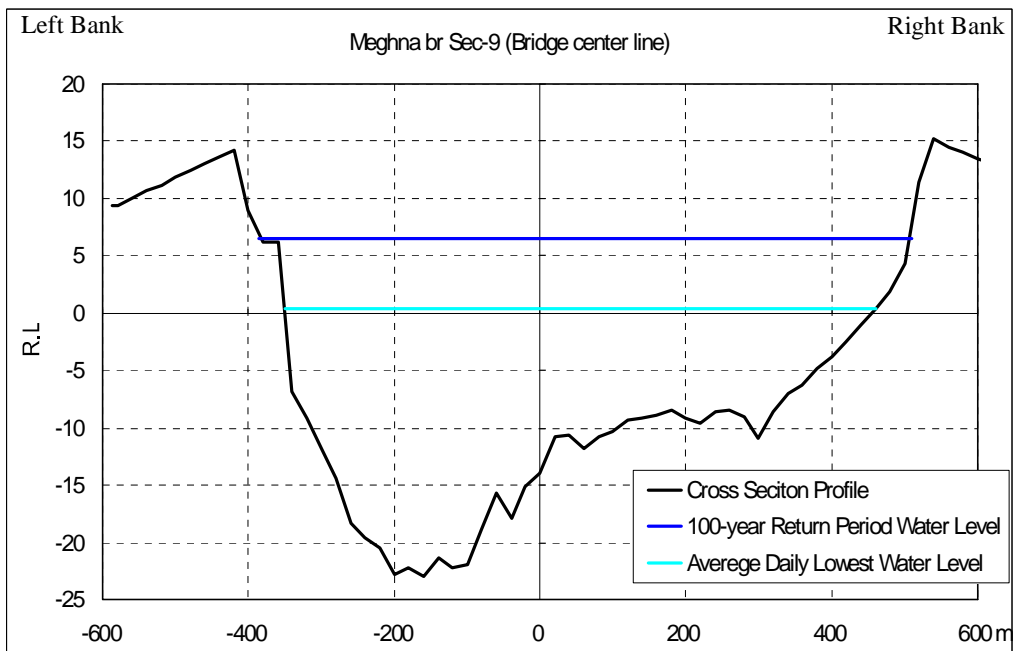


Figure 4.12 Shitalakshya River Section at Kanchpur Bridge

**Table 4.2 Hydrological Conditions of Shitalakshya River at Kanchpur Bridge**

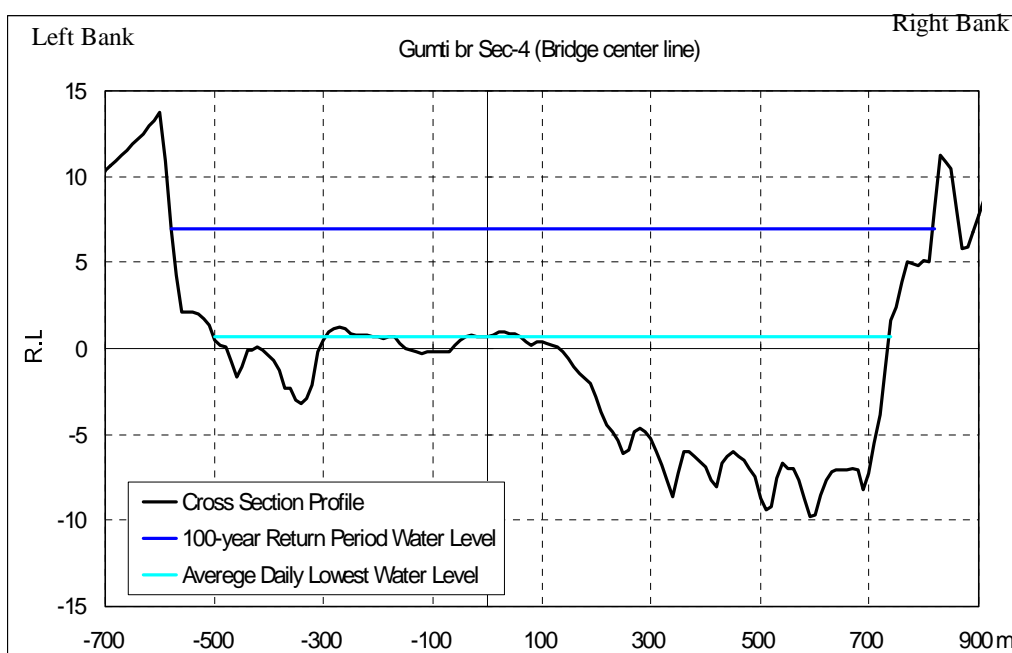
	Water Level [R.L.m]	Cross Section Stream Area [m <sup>2</sup> ]	Average Velocity [m/s]	Cross Section Discharge [m <sup>3</sup> /s]
100-year Return Period	7.05	3311.6	1.05	3,480
Average Daily Lowest	0.40	1459.3	0.20	292



**Figure 4.13 Meghna River Section at Meghna Bridge**

**Table 4.3 Hydrological Conditions of Meghna River at Meghna Bridge**

	Water Level [R.L.m]	Cross Section Stream Area [m <sup>2</sup> ]	Average Velocity [m/s]	Cross Section Discharge [m <sup>3</sup> /s]
100-year Return Period	6.56	15443.4	0.98	15,200
Average Daily Lowest	0.39	10231.6	0.20	2,046



**Figure 4.14 Gumti River Section at Gumti Bridge**

**Table 4.4 Hydrological Conditions of Gumti River at Gumti Bridge**

	Water Level [R.L.m]	Cross Section Stream Area [m <sup>2</sup> ]	Average Velocity [m/s]	Cross Section Discharge [m <sup>3</sup> /s]
100-year Return Period	6.94	12812.9	0.98	12,600
Average Daily Lowest	0.63	4477.8	0.20	896

## 4.2 Protected Areas

Based on Bangladesh Wildlife Preservation Order, 1973 Protected Areas (PAs) is classified into national parks, wildlife sanctuaries, game reserves and private game reserves.

Bangladesh has 34 nationally designated protected areas covering approximately 2,705 km<sup>2</sup>, which is 1.88 percent of land area of the country, and the areas are 17 national parks and 17 wildlife sanctuaries.

A detailed list of these areas is provided in the Table 4.5. A map showing the Project site and PAs are given in Figure 4.15.



The objectives of managing these PAs : (1)to preserve breeding places and habitats of flora and fauna, (2)to protect communities and ecosystems, (3)to maintain natural processes, and (4)to provide facilities for research, education and recreation.

The nearest nature reserve, Bhawal National Park, is located 45km away from Kanchpur Bridge of the north Project site.

The ecological status of Bhawal National Park is said as follows:

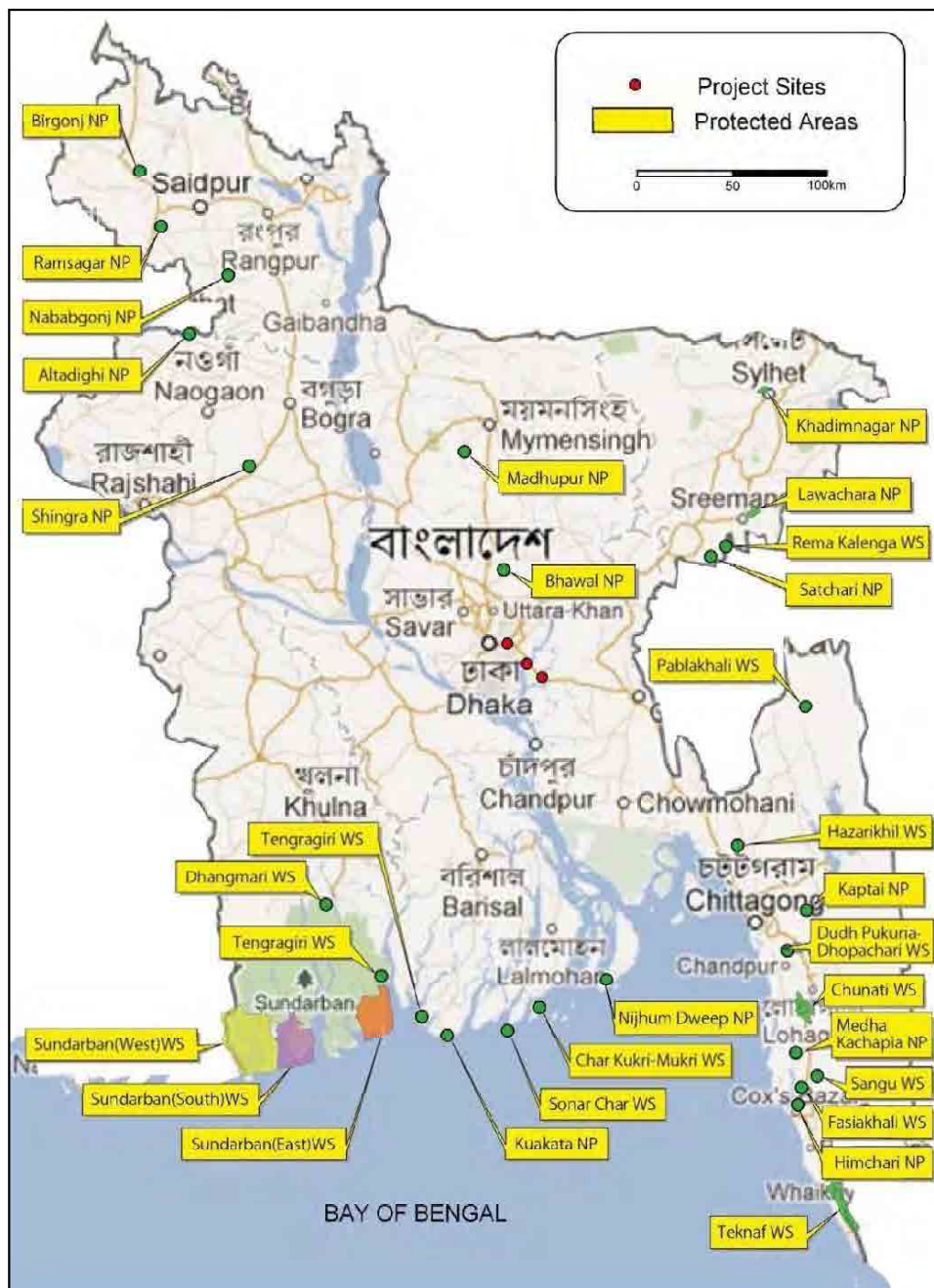
"(IPAC) STATE OF BANGLADESH'SFOREST PROTECTED AREAS'S2010 INTEGRATED PROTECTED AREA CO-MANAGEMENT"

“Approximately 10 species of mammals, 6 species of amphibians, 9 species of reptiles and 39 species of birds are found in the park. Civet, Mongoose, Fox, Jungle Cat, Wild Boar and Hare are the main mammals. Monitor lizard, Snake, Python and Tortoise are the main reptiles. Nearly 220 species of plants are being recognized in the PA area, among which are 24 species of climbers, 27 species of grasses, 105 species of herbs, 3 species of palms, 19 species of shrubs and 43 species of timber trees . ”

**Table 4.5 PAs of Bangladesh**

Sl.	Protected Areas	Habitat Types	Location	Area(ha)	Established (Extended)
<b>A. NATIONAL PARKS (IUCN category V)</b>					
01	Modhupur NP	Deciduous Forest	Tangail	8,436.00	1962(24/2/1982)
02	Bhawal NP	Deciduous Forest	Gazipur	5,022.00	1974(11/5/1982)
03	Himchari NP	Mixed Evergreen	Cox's Bazar	1,729.00	15/2/1980
04	Lawachara NP	Mixed Evergreen	Moulvibazar	1,250.00	7/7/1996
05	Kaptai NP	Wetland	Chittagong Hill Tracts	5,464.00	9/9/1999
06	Ramsagar NP	Wetland	Dinajpur	27.75	30/4/2001
07	Nijhum Dweep NP	Mangrove Forest	Noakhali	16,352.23	8/4/2001
08	Medha Kachapia NP	High Hill Mixed Forest	Cox's Bazar	395.92	8/8/2008
09	Satchari NP	Evergreen	Habigonj	242.91	15/10/2005
10	Khadimnagar NP	Mixed Evergreen	Sylhet	678.80	13/4/2006
11	Baraiyadhala NP		Chittagong	2,933.61	06/04/2010
12	Kuakata NP		Patuakhali	1,613.00	24/10/2010
13	Nababgonj NP		Dinajpur	517.61	24/10/2010
14	Shingra NP		Dinajpur	305.69	24/10/2010
15	Kadigarh NP		Mymensingh	344.13	24/10/2010
16	Altadighi NP	Sal Deciduous Forest	Naogaon	264.12	24/12/2011
17	Birgonj NP		Dinajpur	168.56	24/12/2011
<b>B. WILDLIFE SANCTUARIES (IUCN category IV)</b>					
18	Sundarban (East) WS	Mangrove Forest	Bagerhat	31,226.94	1960(6/4/1996)
19	Pablakhali WS	High Hill Mixed Forest	Chittagong Hill Tracts	42,087.00	1962(20/9/1983)
20	Char Kukri-Mukri WS	Char land & Mangrove Forest	Bhola	40.00	19/12/1981
21	Chunati WS	Mixed Evergreen Forest	Chittagong	7,763.97	18/3/1986
22	Rema-Kalenga WS	Mixed Evergreen Forest	Hobiganj	1,795.54	7/7/1996
23	Sundarban (South) WS	Mangrove Forest	Khulna	36,970.45	6/4/1996
24	Sundarban (West) WS	Mangrove Forest	Satkhira	71,502.10	6/4/1996
25	Fasiakhali WS	Mixed Forest	Cox's Bazar	1,302.43	11/4/2007
26	Duch Pukuria-Dhopachari WS	Tropical Evergreen and Semi-Evergreen	Chittagong	4,716.57	6/4/2010
27	Hazarikhil WS	Tropical Evergreen and Semi-Evergreen	Chittagong	1,177.53	6/4/2010
28	Sangu WS		Bandarban	2,331.98	6/4/2010
29	Teknaf WS		Cox's Bazar	11,615.00	1983(24/3/2010)
30	Tengragiri WS	Coastal Mangrove Plantations	Barguna	4,048.58	24/10/2010
31	Dudhmukhi WS		Bagerhat	170.00	29/1/2012
32	Chadpai WS		Bagerhat	560.00	29/1/2012
33	Dhangmari WS		Bagerhat	340.00	29/1/2012
34	Sonarchar WS	Coastal Mangrove Plantations	Patuakhali	2,026.48	24/12/2011

Source : Forest Department (<http://www.bforest.gov.bd/index.php/protected-areas>)



Source : PAs of Bangladesh: A Visitor's Guide, Nishorgo, PAs Management Program, MoEF, Forestry Department, 2006

**Figure 4.15 PAs of Bangladesh**

### 4.3 Ecological Resources

For baseline survey of present ecosystem around the sites, 2 experts (natural environmentalists) and with 3 enumerators made site reconnaissance within 2km radius from the bridges from 21st to 23<sup>rd</sup> June survey and 4<sup>th</sup> to 7<sup>th</sup> July survey together with interview to 10s of locals including fishermen. As a result, existing species observed were recorded.

Experts consultation made are:

DoE: Ph.D. Hafiza khatun, Professor, Department of Geography and Environment, Dhaka University

Fish and ecological expert : Kazi Farhed Iqbal, Head, Department of Environmental Science, State University of Bangladesh, Dhaka

Dolphin expert : Dr. S. M. A. Rashid, Chief Executive of CARINAM, Center for Advanced Research in Natural Resources and Management, Md.Istiaq Sobhan, RhD, Programme Coordinator IUCN Bangladesh

**Table 4.6 Suggestions Obtained from Experts and Response**

Expert	Suggestion
DOE	<ul style="list-style-type: none"> <li>- Generally, impact to the environment by the construction of Bridges is tolerable.</li> <li>- Do not dump any waste into river</li> <li>- Safety for river transportation during construction shall be taken into account</li> </ul>
Fish and ecological expert	<ul style="list-style-type: none"> <li>- Important species around the Project sites</li> <li>- Fishing activities</li> </ul>
Dolphin expert	<ul style="list-style-type: none"> <li>- Since River Dolphin prefers the river having plenty of curves, orders and sand banks, there is possibility that it lives around Meghna and Gumti Bridges.</li> <li>- Do not build an enclosing bund and the bund can prevent River Dolphin from running for spawning.</li> <li>- Although River Dolphin is almost blind, it is vulnerable to strong light and there is need to pay attention to the intensity of construction light at night.</li> <li>- Because the life of River Dolphin depends on sound wave, it should be avoided that it gets frightened at noise when it passes the Project sites. Its auditory perception is so decent that it can hear some sound generated far place. From this, there is doubt if halt of piling has effect on it.</li> <li>- Do not allow passing construction vessels to interrupt the way of River Dolphin.</li> <li>- As River Dolphin chiefly feeds benthic animal, river bottom and water quality should not be contaminated.</li> <li>- The suitable water depth for River Dolphin's habitat is more than 10 meters.</li> </ul>

### 4.3.1 Flora

Homestead vegetation at the Project site is in well condition and bearing the important of plant community in terms of diversity. Most of the houses are vegetated by local cultivated plants and a big portion of the coverage occupied by wild shrubs and herbs. Common planted tree species are Aam (*Mangifera indica*), Kathal (*Artocarpus heterophyllus*), Tal (*Borassus flabelifer*), Sissoo (*Swietenia sissoo*), Supari (*Areca catechu*), Mehogani (*Swietenia mahagoni*), Kola (*Musa sp*), Boroi (*Zizyphus mauritiana*), Narikel (*Cocos nucifera*) and Supari (*Areca catechu*) occupied the top canopy. Among the shrubs Kachu (*Colocasia esculenta*) is the most common of all species. This type of vegetation have a major contribution for meeting food, fodder, medicine, fuel and other household requirements to the local people. Homesteads vegetation also supports good shelter for many wildlife species. There is no act affecting to vegetation, during both construction and operation.

Types of crops on the char are very common species such as wheat, paddy, beans etc.

All of the plant species on the table 4.7 are not regarded as preserved species by domestic rules.

**Table 4.7(1) Plant Species with Habitat Distribution, Abundance and Usage**

Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare

IUCN status: VU – Vulnerable, NT – Near Threatened, LC – Least Concern

SL#	Scientific Name	Family	Local Name	Local Status	IUCN Status	Usage	Habit
<b>Plant species in Kanchpur Bridge surrounding area</b>							
1.	<i>Azadirachta indica</i>	Meliaceae	Nim	C	LC	Timber and medicine	Tree
2.	<i>Dalbergia sissoo</i>	Fabaceae	Sissoo	C	VU	Timber and fuelwood	Tree
3.	<i>Mangifera indica</i>	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
4.	<i>Musa paradisiaca</i> var. <i>sapientum</i>	Musaceae	Kala	VC	LC	Fruit	Shrub
5.	<i>Psidium guajava</i>	Myrtaceae	Peyara	C	LC	Fruit	Shrub
6.	<i>Swietenia mahagoni</i>	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
7.	<i>Syzygium cumini</i>	Myrtaceae	Kaloram	C	LC	Fruit	Tree
8.	<i>Zizyphus mauritiana</i>	Rhamnaceae	Baroi	C	LC	Fruit	Tree
9.	<i>Mimosaceae</i> <i>Albizia</i>	Mimosaceae	Sil Koroi	C	LC	Timber and fuelwood	Tree
10.	<i>Syzygium samarangense</i>	Moraceae	Jamrul	R	LC	Fruit and fuelwood	Tree
11.	<i>Cynodon dactylon</i>	Gramineae	Durba	VC	LC	Grass	Herb
12.	<i>Colocasia esculenta</i>	Araceae	Kachu	C	LC	Vegetable	Herb
13.	<i>Caesalpiniae</i> <i>Delonix</i>	Caesalpinaceae	Krishnachura	C	LC	Ornamental and fuelwood	Tree

Data source: Study team using International Union for Conservation of Nature (IUCN) classification system

**Table 4.7(2) Plant Species with Habitat Distribution, Abundance and Usage**

Plant species in Meghna Bridge surrounding area							
1.	<i>Aegle marmelos</i>	Rutaceae	Bel	R	LC	Fruit and Medicine	Tree
2.	<i>Areca catechu</i>	Palmae	Supari	VC	LC	Fruit and Timber	Tree
3.	<i>Artocarpus heterophyllus</i>	Moraceae	Kathal	C	LC	Fruit, Timber and fuelwood	Tree
4.	<i>Azadirachta indica</i>	Meliaceae	Nim	C	LC	Timber and medicine	Tree
5.	<i>Borassus flabelifer</i>	Palmae	Tal	R	LC	Fruit, wood and Timber	Tree
6.	<i>Carica papaya</i>	Caricaceae	Papay	C	LC	Fruit	Shrub
7.	<i>Cocos nucifera</i>	Palmae	Narikel	VC	LC	Fruit and Fuelwood	Tree
8.	<i>Litchi chinensis</i>	Sapindaceae	Lichu	C	LC	Fruit	Tree
9.	<i>Mangifera indica</i>	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
10.	<i>Psidium guajava</i>	Myrtaceae	Peyara	C	LC	Fruit	Shrub
11.	<i>Swietenia mahagoni</i>	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
12.	<i>Syzygium cumini</i>	Myrtaceae	Kaloram	C	LC	Fruit	Tree
13.	<i>Zizyphus mauritiana</i>	Rhamnaceae	Baroi	C	LC	Fruit	Tree
14.	<i>Cynodon dactylon</i>	Gramineae	Durba	VC	LC	Grass	Herb
15.	<i>Colocasia esculenta</i>	Araceae	Kachu	C	LC	Vegetable	Herb
16.	<i>Acacia auriculiformis</i>	Mimosaceae	Akashmoni	C	LC	Timber	Tree
17.	<i>Albizia lebbek</i>	Mimosaceae	Kalo koro	C	LC	Timber	Tree
18.	<i>Averrhoa carambola</i>	Averrhoaceae	Kamranga	C	LC	Fruit	Tree

Data source: Study team using IUCN classification system

Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare

IUCN status: VU – Vulnerable, NT – Near Threatened, LC – Least Concern

**Table 4.7(3) Plant Species with Habitat Distribution, Abundance and Usage**

Plant species iGuti Bridge surrounding area							
1.	<i>Aegle marmelos</i>	Rutaceae	Bel	R	LC	Fruit and Medicine	Tree
2.	<i>Anthocephalus chinensis</i>	Rubiaceae	Kadom	C	LC	Timber and fuelwood	Tree
3.	<i>Areca catechu</i>	Palmae	Supari	VC	LC	Fruit and Timber	Tree
4.	<i>Artocarpus heterophyllus</i>	Moraceae	Kathal	C	LC	Fruit, Timber and fuelwood	Tree
5.	<i>Averrhoa carambola</i>	Averrhoaceae	Kamranga	C	LC	Fruit	Tree
6.	<i>Azadirachta indica</i>	Meliaceae	Nim	C	LC	Timber and medicine	Tree
7.	<i>Bombax ceiba</i>	Bombacaceae	Shimul	C	LC	Cotton and Fuelwood	Tree
8.	<i>Borassus flabelifer</i>	Palmae	Tal	R	LC	Fruit, wood and Timber	Tree
9.	<i>Carica papaya</i>	Caricaceae	Papay	C	LC	Fruit	Shrub
10.	<i>Cassia fistula</i>	Leguminosae	Badarlathi / Sonalu	R	LC	Ornamental and Medicine	Tree
11.	<i>Citrus grandis</i>	Rutaceae	Jambura	C	LC	Fruit	Tree
12.	<i>Cocos nucifera</i>	Palmae	Narikel	VC	LC	Fruit and Fuelwood	Tree
13.	<i>Dalbergia sissoo</i>	Fabaceae	Sisso	C	LC	Timber and fuelwood	Tree
14.	<i>Litchi chinensis</i>	Sapindaceae	Lichu	C	LC	Fruit	Tree
15.	<i>Mangifera indica</i>	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
16.	<i>Musa paradisiaca</i> var. <i>Sapientum</i>	Musaceae	Kala	VC	LC	Fruit	Shrub
17.	<i>Phoenix sylvestris</i>	Palmae	Khejur	C	LC	Fruit and Fuelwood	Tree
18.	<i>Psidium guajava</i>	Myrtaceae	Peyara	C	LC	Fruit	Shrub
19.	<i>Swietenia mahagoni</i>	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
20.	<i>Syzygium cumini</i>	Myrtaceae	Kalojam	C	LC	Fruit	Tree
21.	<i>Terminalia catappa</i>	Combretaceae	Katbadam	R	LC	Fruit	Tree
22.	<i>Zizyphus mauritiana</i>	Rhamnaceae	Baroi	C	LC	Fruit	Tree
23.	<i>Mimosaceae</i> <i>Albizia</i>	Mimosaceae	Sil Koro	C	LC	Timber and fuelwood	Tree
24.	<i>Syzygium samarangense</i>	Moraceae	Jamrul	R	LC	Fruit and fuelwood	Tree
25.	<i>Caesalpiniae</i> <i>Delonix</i>	Caesalpinaceae	Krishnachura	C	LC	Ornamental and fuelwood	Tree
26.	<i>Feronia jambheri</i>	Rutaceae	Jamir Lebu	C		Fruit	Shrub
27.	<i>Elaeocarpus floribundus</i>	Elaeocarpaceae	Jalpai	C	LC	Fruit	Tree
28.	<i>Cynodon dactylon</i>	Gramineae	Durba	VC	LC	Herb	
29.	<i>Colocasia esculenta</i>	Araceae	Kachu	C	LC	Herb	
30.	<i>Acacia auriculiformis</i>	Mimosaceae	Akashmoni	C	LC	Timber	Tree
31.	<i>Albizia lebbeck</i>	Mimosaceae	Kalo koro	C	LC	Timber	Tree
32.	<i>Eucalyptus teriticornis</i>	Myrtaceae	Eucalyptus	C	LC	Timber	Tree
33.	<i>Feronia limonia</i>	Rutaceae	Kothbel	C	LC	Fruit	Tree
34.	<i>Feronia jambheri</i>	Rutaceae	Jamir lebu	C		Fruit	Shrub

Data source: Study team using IUCN classification system

Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare

IUCN status: VU – Vulnerable, NT – Near Threatened, LC – Least Concern

Plant Species diversity: A total of 34 homestead species of 18 Families were listed in the three bridges area. Of which 21 are fruit producing, 11 timbers, 10 are fuel wood and 4 are medicinal. However, this list is not full and some of the species are uses for multiple purposes such as flavor for cooking, medical uses traditional treatment and coloring of cloths. It is found that Rutaceae, Palmae and Myrtaceae families rank top of the list and are represented by 5, 4 and 3 species respectively. Homestead flora consists of both native and exotic species and some of them are naturalized. There is no precious species within 2km from the Project site because of the following results: (1) primary survey, (2) consultation with local people and experts, (3) published literature.

### 4.3.2 Fauna

#### Avi-fauna (Bird)

The surroundings of the Project area are not ecologically good condition for resident birds; no migratory birds come in this area ever recorded. A total of about 9 bird species were observed within the Project area.

All bird is terrestrial bird species were observed within the project area. House Crow, Indian Pond Heron and Common Myna in Table4.8 were observed in the Kanchpur, Meghna, Gumti Bridge surrounding area respectively. Beside the Meghna, Gumti River there are some villages and some bird's species were observed in these villages and here are more species observed than other two Project area. House Crow (*Corvus splendens*), Striated Heron (*Butorides striata*), Common Myna (*Acridotheres tristis*), Oriental Magpie-Robin (*Copsychus saularis*) species are common in these Project area.

There is no governmental institute who implements monitoring of ecosystem. Year round ecological survey is done by private environmental consultancy firm. As a specific project, the ecologist will observe birds and implement Focus Group Discussions (FGD) with local people to ensure these species availability in those areas.

**Table 4.8 List of Bird at the Sites**

Birds species in Kanchpur bridge surrounding area									
SL#	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species		
							Primary Survey	Local consultation	people Published Literature
1	<i>Corvus splendens</i>	House Crow	Pati Kak	LC	CR	LC	√ Seen		
2	<i>Ardeola grayii</i>	Indian Pond Heron	Deshi Kanibok	LC	CR	LC	√ Seen		
3	<i>Acridotheres</i>	Common Myna	Bhat	LC	CR	LC	√		



4	tristis Copsychus saularis	Oriental Magpie-Robin	Shalik Udoi Doel	LC	CR	LC	Seen	√	
Birds species in Meghna bridge surrounding area									
SL#	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species		
							Primary Survey	Local people consultation	Published Literature
1	Corvus splendens	House Crow	Pati Kak	LC	CR	LC	√ Seen		
2	Acridotheres tristis	Common Myna	Bhat Shalik	LC	CR	LC	√ Seen		
3	Passer domesticus	House Sparrow	Pati Chorui	LC	CR	LC		√	
4	Copsychus saularis	Oriental Magpie-Robin	Udoi Doel	LC	CR	LC	√		
5	Columba livia	Common Pigeon	Gola Paira	LC	CR	LC		√	
6	Ardeola grayii	Indian Pond Heron	Deshi Kanibok	LC	CR	LC	√ Seen		
Birds species in Gumti bridge surrounding area									
SL#	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species		
							Primary Survey	Local people consultation	Published Literature
1	Corvus macrorhynchos	Large-billed Crow	Dar Kak	LC	CR	LC		√	
2	Corvus splendens	House Crow	Pati Kak	LC	CR	LC	√ Seen		
3	Ardeola grayii	Indian Pond Heron	Deshi Kanibok	LC	CR	LC	√ Seen		
4	Acridotheres tristis	Common Myna	Bhat Shalik	LC	CR	LC	√ Seen		
5	Alcedo atthis	Common Kingfisher	Pati Machranga	LC	CR	LC		√	
6	Passer domesticus	House Sparrow	Pati Chorui	LC	CR	LC		√	
7	Copsychus saularis	Oriental Magpie-Robin	Udoi Doel	LC	CR	LC	√ Seen		
8	Columba livia	Common Pigeon	Gola Paira	LC	CR	LC		√	

Data source: Study team using IUCN classification system

### Amphibians

Within the study site the number of amphibian population is low and not in abundance. The amphibians are the major components of their respective biological ecosystems, both as predator and prey. They are the valuable part of the biotic community, and have not received as much attention as birds and mammals, but they do play an important role in the balance of nature. In the project area 1, 2, 4 amphibian species were observed in the Kanchpur, Meghna and Gumti Bridge surrounding area respectively. Common Toad (*Duttaphrynus melanostictus*) is common in the Project areas.

**Table 4.9 List of Amphibians at the Sites**

Amphibian in Kanchpur Bridge surrounding area									
SL#	Scientific Name	English Name	Local Name	Family	IUCN Status	Local Status	Occurrence of species		
							Primary Survey	Local people consultation	Published Literature
	<i>Duttaphrynus melanostictus</i>	Common Toad	Kuno Bang	Bufoidea	LC	CR	√		
Amphibian in Meghna Bridge surrounding area									
1	<i>Duttaphrynus melanostictus</i>	Common Toad	Kuno Bang	Bufoidea	LC	CR	√		
2	<i>Fejervarya limnocharis</i>	Cricket Frog	Jhijhi Bang	Dicroglossidae	LC	C		√	
Amphibian in Gumti Bridge surrounding area									
1	<i>Duttaphrynus melanostictus</i>	Common Toad	Kuno Bang	Bufoidea	LC	CR	√		
2	<i>Euphlyctis cyanophlyctis</i>	Skipper Frog	Kotkoti Bang	Dicroglossidae	LC	C		√	
3	<i>Fejervarya limnocharis</i>	Cricket Frog	Jhijhi Bang	Dicroglossidae	LC	C		√	
4	<i>Hoplobatrachus tigerinus</i>	Indian Bull Frog	Sona bang	Dicroglossidae	LC	C	√		

Data source: Study team using IUCN classification system

Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern

### Reptiles

During study, it has been found that the reptilian population (number of the individuals) was low because the Project surrounding area commonly industrial zone. There are only on turtle population were found because habitat and habitat niche is being destroyed by the local people for rapid urbanization and drastic changes in type of land use.

The Project areas are very poor in biodiversity. Common reptiles that were found within the area are Brooks House Gecko (*Hemidactylus brookii*), Bengal Monitor (*Varanus bengalensis*), and Checkered Keelback (*Xenochropis piscator*)

As a result of interview with the crocodile experts (Dr. S. M. A. Rashid, and Md. Istiak Sobhan), it is said that there is no brackish water crocodile around the sites.

**Table 4.10 List of Reptile at the Sites**

Reptile in Kanchpur Bridge surrounding area

SL#	Scientific Name	English Name	Local Name	Family	IUCN Status	Local Status	Occurrence of species		
							Primary Survey	Local people consultation	Published Literature
	Hemidactylus brookii	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
	Varanus bengalensis	Bengal Monitor	Gui Shap	Varanidae	LC	CR		√	
	Xenochropis piscator	Checkered Keelback	Dhora Shap	Colubridae	LC	C		√	
Reptile in Meghna Bridge surrounding area									
1	Pangshura tectum	Indian Roofed Turtle	Kori/Hali Kasim	Bataguridae	-	C		√	
2	Hemidactylus brookii	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
3	Varanus bengalensis	Bengal Monitor	Gui Shap	Varanidae	LC	CR		√	
4	Xenochropis piscator	Checkered Keelback	Dhora Shap	Colubridae	LC	C		√	
Reptile in Gumti Bridge surrounding area									
1	Pangshura tectum	Indian Roofed Turtle	Kori/Hali Kasim	Bataguridae	-	C		√	
2	Hemidactylus brookii	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR		√	
3	Varanus bengalensis	Bengal Monitor	Gui Shap	Varanidae	LC	CR		√	
4	Xenochropis piscator	Checkered Keelback	Dhora Shap	Colubridae	LC	C		√	
5	Hemidactylus frenatus	Common House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
6	Enhydris enhydris	Common Smooth Water Snake	Painna Shap	Colubridae	LC	CR		√	

Data source: Study team using IUCN classification system

Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, LC- Least Concern, LR- lower Risk

## Fish

Meghna and Gumti Rivers are a major source of fish species. These rivers meet major part of fishing demand of the country.

A comprehensive survey from the Meghna Estuaries area in Bangladesh was made at the delta and floodplain fishery (FAP 17 1994; ODA 1997). In total for the whole freshwater sector 98 species were recorded the lowland sites at Meghna River showed considerable similarities with communities dominated by cyprinids, particularly major carp species and catfishes. A distinction can be made between main channel migratory species, such as the major carps and the floodplain resident species that are often small and have accessory respiratory systems and prolific reproduction.

**Table 4.11: List of fish in Shitalakshya, Meghna and Gumti Rivers**

Fish Species in Kanchpur Bridge area ( Shitalakshya river and Market survey)				
SL#	Scientific Name	Local Name	Common English name	IUCN status
1	<i>Labio rohita</i>	Rui	Rohu	LC
2	<i>Catla catla</i>	Catla	Katla	LC
3	<i>Mystus vitatus</i>	Tangra	Striped dwarf Catfish	LC
4	<i>Puntius ticto</i>	Puti	Ticto Barb	LC
5	<i>Lepidosephalus guntia</i>	Gutum	Guntia Loach	LC
6	<i>Ompok pabda</i>	Pabda	Pabo catfish	LC
7	<i>Channa panchtatus</i>	Taki	Spotted snakehead	LC
8	<i>Barbonymus gonionotus</i>	Sorputi	Olive Barb	LC
9	<i>Anabus Testudineus</i>	Koi	Climbing Perch	LC
10	<i>Oreochromis mossambicus</i>	Tilapia	Mozambique tilapia	LC
11	<i>Hypophthalmichthys Molitrix</i>	Silver carp	Silver carp	LC
12	<i>Pangasius pangasius</i>	Pangas	Yellowtail catfish	LC
13	<i>Rita rita</i>	Rita	Rita	LC
14	<i>Sperata seenghala</i>	Air	Giant river-catfish	LC
15	<i>Channa striata</i>	Shol	Snakehead murrel	LC
16	<i>Macrobrachium rosenbergii</i>	Galda chingri	Tiger prawn	LC
Fish Species in Meghna Bridge area ( Meghna river and Market survey)				
SL#	Scientific Name	Local Name	Common English name	IUCN status
	<i>Puntius ticto</i>	Puti	Ticto Barb	LC
	<i>Labio rohita</i>	Rui	Rohu	LC
	<i>Catla catla</i>	Catla	Katla	LC
	<i>Mystus vitatus</i>	Tangra	Striped dwarf Catfish	LC
	<i>Barbonymus gonionotus</i>	Sorputi	Olive Barb	LC

	<i>Anabus testudineus</i>	Koi	Climbing Perch	LC
	<i>Channa striata</i>	Shol	Snakehead murrel	LC
	<i>Macrobrachium rosenbergii</i>	Galda chingri	Tiger prawn	LC
	<i>Oreochromis mossambicus</i>	Telapia	Mozambique tilapia	LC
	<i>Hypophthalmichthys Molitrix</i>	Silver carp	Silver carp	LC
	<i>Pangasius pangasius</i>	Pangas	Yellowtail catfish	LC
	<i>Rita rita</i>	Rita	Rita	LC
	<i>Sperata seenghala</i>	Air	Giant river-catfish	LC
	<i>Lepidosephalus guntia</i>	Gutum	Guntia Loach	LC
	<i>Ompok pabda</i>	Pabda	Pabo catfish	LC
	<i>Channa panchtatus</i>	Taki	Spotted snakehead	LC
	<i>Tenualosa ilisha</i>	Illish	Hilsa shad	LC
	<i>Wallago attu</i>	Boal	Wallago	LC
	<i>Awaous guamensis</i>	Baila	-	LC
	<i>Labeo bata</i>	Bata	Bata	LC
	<i>Salmostoma bacaila</i>	Chela	Large razorbelly minnow	LC
	<i>Pseudapocryptes Elongates</i>	Chewa	-	LC
	<i>Chitala chitala</i>	Chitol	Clown Knifefish	LC
	<i>Mystus cavasius</i>	Kabashi Tengra	Gangetic mystus	LC
	<i>Sicamugil cascasia</i>	Kechhki	Yellowtail mullet	LC
	<i>Ailiichthys punctata</i>	Kajuli	Jamuna ailia	LC
	<i>Catla catla</i>	Katol	Catla	LC
	<i>Amblypharyngodon mola</i>	Mola	Mola carplet	LC

Fish Species in Gumti Bridge area (Gumti river and Market survey)

SL#	Scientific Name	Local Name	Common English name	IUCN status
1	<i>Labio rohita</i>	Rui	Rohu	LC
2	<i>Puntius ticto</i>	Puti	Ticto Barb	LC
3	<i>Catla catla</i>	Catla	Katla	LC
4	<i>Mystus vitatus</i>	Tangra	Striped dwarf Catfish	LC
5	<i>Barbonymus gonionotus</i>	Sorputi	Olive Barb	LC
6	<i>Anabus testudineus</i>	Koi	Climbing Perch	LC
7	<i>Channa striata</i>	Shol	Snakehead murrel	LC
8	<i>Macrobrachium rosenbergii</i>	Galda chingri	Tiger prawn	LC
9	<i>Oreochromis mossambicus</i>	Telapia	Mozambique tilapia	LC
10	<i>Hypophthalmichthys Molitrix</i>	Silver carp	Silver carp	LC
11	<i>Pangasius pangasius</i>	Pangas	Yellowtail catfish	LC
12	<i>Rita rita</i>	Rita	Rita	LC
13	<i>Sperata seenghala</i>	Air	Giant river-catfish	LC
14	<i>Lepidosephalus guntia</i>	Gutum	Guntia Loach	LC
15	<i>Ompok pabda</i>	Pabda	Pabo catfish	LC
16	<i>Channa panchtatus</i>	Taki	Spotted snakehead	LC

17	Tenualosa ilisha	Ilish	Hilsa shad	LC
18	Wallago attu	Boal	Wallago	LC
19	Awaous guamensis	Baila	-	LC
20	Labeo bata	Bata	Bata	LC
21	Salmostoma bacaila	Chela	Large razorbelly minnow	LC
22	Pseudapocryptes Elongates	Chewa	-	LC
23	Chitala chitala	Chitol	Clown Knifefish	LC
24	Mystus cavasius	Kabashi Tengra	Gangetic mystus	LC
25	Sicamugil cascasia	Kechhki	Yellowtail mullet	LC
26	Aillichthys punctata	Kajuli	Jamuna ailia	LC
27	Catla catla	Katol	Catla	LC
28	Amblypharyngodon mola	Mola	Mola carplet	LC
29	Macrognaathus aculeatus	Tara baim	Lesser spiny eel	LC
30	Pisodonophis cancrivorus	Snake eel	Longfin snake-eel	LC
31	Parambassis ranga	Ranga chanda	Indian glassy fish	LC
32	Cirrhinus cirrhosus	Mrigol	Mrigal	LC
33	Ompok pabda	Modhu pabda	Pabdah catfish	LC
34	Pseudolaguvia ribeiroi	Kani tengra	Painted catfish	LC
35	Labeo calbasu	Kalibaus	Orange-fin labeo	LC
36	Notopterus notopterus	Foli/Chitol	Bronze featherback	LC
37	Gudusia chapra	Chapila	Indian River Shad	LC

Data source: Study team using (IUCN classification system)

Among above, Hilsa is the nation-wide and the most popular fish because it is reasonable enough to get and is rich in protein. It is caught around lower Meghna River, namely downstream of Padma River, and the project does not affect the local people to fish it.

### Mammals

Among the mammals, total 6 species were recorded, of which 3, 5, 6 species were found in Kanchpur, Meghna, Gumti Bridge surrounding respectively. River Dolphin (*Platanista gangetica*) is an IUCN red list threatened species are found in the project areas as endangered species. Common mammals that were found within the area are Dormer's Bat (*Scotozous dormeri*), House Rat (*Rattus rattus*), House Mouse (*Mus musculus*) only other than livestock.

**Table 4.12 List of Mammals at the Sites**

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, LC-Least Concern

Mammals in Kanchpur Bridge surrounding area						
Sl. No.	Scientific Name	Common Name	IUCN status	Occurrence of species		
				Primary Survey	Local people consultation	Published Literature
	Scotozous dormeri	Dormer's Bat	LC		√	
	Rattus rattus	House Rat	LC	√		
	Mus musculus	House Mouse	LC		√	
Mammals in Meghna Bridge surrounding area						
1	Scotozous dormeri	Dormer's Bat	LC		√	
2	Rattus rattus	House Rat	LC	√		
3	Mus musculus	House Mouse	LC		√	
4	Suncun murinus	House shrew	LC		√	
5	Platanista gangetica gangetica	River Dolphin	EN		√	
Mammals in Gumti Bridge surrounding area						
1	Scotozous dormer	Dormer's Bat	LC		√	
2	Rattus rattus	House Rat	LC	√		
3	Mus musculus	House Mouse	LC		√	
4	Suncun murinus	House shrew	LC		√	
5	Vulpes bengalensis	Bengal fox	LC	√		
6	Platanista gangetica	River Dolphin	EN		√	

Data source: Study team using IUCN classification system

### River Dolphin

It is noted that the endangered species, river dolphin is observed passing Meghna and Gumti Bridges frequently. South Asian River Dolphin (*Platanista gangetica*) is an IUCN red list threatened species are found in the Project areas as endangered species (EN) by IUCN (International Union for Conservation for Nature).

Since the river dolphin was observed by local, further study was implemented including other experts<sup>2</sup> meetings, data research etc. As a result, the status of river dolphin is as follows in Bangladesh<sup>3</sup>

#### **Academic name:**

*Platanista gangetica* (roxburgh, 1801)

<sup>2</sup> Ph.D.Mr. S. M. A. Rashid, Chief Executive of CARZINAM, Center for Advanced Research in Natural Resources and Management, Ph.D. Iqbal, Head of Environmental Science, the State University (No specialist was available from IUCN)

<sup>3</sup> After Asiatic Society, *Fauna and flora in Bangladesh*, 2009

**English name:** South Asian River Dolphin, (River Dolphin hereafter)

Blind River Dolphin

**Local name:** Shushuk

Ilucchum

Sishu

Nadir Shushuk

Hoom

**Description:**

Body is robust and soft, with a flexible neck, often characterized by a constriction or crease. Head small, with a rounded melon bisected by a shallow longitudinal ridge in front of the blowhole. Blow hole is a slit on top of the head that runs along the long axis of the animal's body. It's most striking feature is the long, narrow snout or rostrum, which can be as much as one fifth of its body length, laterally compressed, broadens at the tip where it is slightly thickened, sometimes upwardly curved in females. It is proportionally longer in females than in the males. Belly of young animals are lighter and often have a pinkish cast. Female adults are up to 2.6 and males 2.2m long, weighing 110kg. New born animal measures 70-90 cm in length.

**Habits:**

Being blind, the animal proves with its sensitive snout for food in the bottom mud. The diet consists of primarily fish and crustaceans. Vision is almost useless in the much turbid river environment. The River Dolphin breathes every three minutes. It may undergo local migrations, is curious and inoffensive, and travels and feeds in schools of three to ten or more although often alone or in pairs. Mostly they comfortably move 10m below the water surface. The shushuk is believed to have navigated 30km/day and, as a simple arithmetic calculation, they can migrate as much as 1,000km a year.

They can find food with help of an extremely sophisticated noise detecting system (bisonar).

**Habitat:**

River dolphin can be tolerable to stay in some concentration of brackish water but not in pure sea water. Generally occur alone or in clusters in counter current downstream of channel convergences and sharp meanders, and upstream and downstream of mid-channel islands. They prefer turbid, deep, meandered, strong and deep stream. They are very sensitive to strong light since they are almost blind. Most active time is 9-10a.m. and Afternoon in general.

**Breeding:**

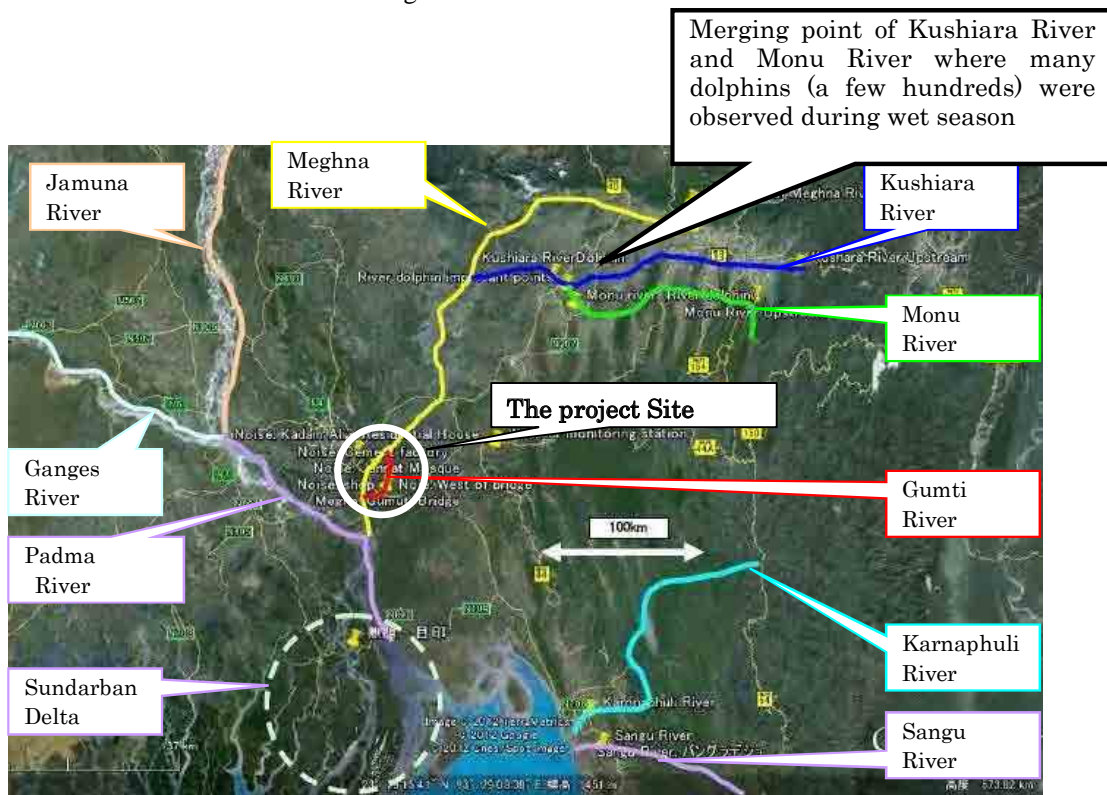
High season for breeding is March to June although they can breed any season throughout year if sufficient environment such as enough depth/ is secured. They bear 1 only. It takes 10 months until the baby gets matured. Life expectancy is 30-50 years. The breeding area, same as living area, is the corner of the river, merging points of rivers where is turbid with mud, enough food



and oxygen, with rapid stream and sufficient water depth much deeper than 10m.

**Distribution:**

It occurs in the Ganges, Brahmaputra, Meghna, Karnaphuli, and Sangu River Systems and their tributaries in India, Bangladesh, Nepal etc, below an elevation of 250m. Relatively high density is reported recently in the Virkramshila Gangetic Dolohin Sunctury in India and in the lower Sangu River in southeast Bangladesh (south to Chittagong). They are also in good number in Sundarbans delta. A map of historical distribution, chaired by 19<sup>th</sup> century British naturalist John Anderson in 1879, show Shushuks<sup>4</sup> occurring throughout Ganges-Brahmaputra-Meghna and Karnaphuli River Systems in 1879, stated that the distributing range of river dolphin was only limited downstream or increasing salinity in deltas and upstream by rocky barriers or insufficient water. Their distribution has shrunk considerably since then, largely due to river development, which has blocked river dolphin movement and degraded their habitat. The locations of rivers are indicated in Figure 4.16.



**Figure 4.16 Rivers and Area where River Dolphin is Commonly Observed**

**Ecological role:**

Shushuks (local name of South Asian River Dolphin) are vulnerable to changes in their habitat

<sup>4</sup> South Asian River Dolphin in local name

and could potentially be used to monitor the ecological effect of hydrologic and oceanographic changes brought by declining of fresh water flows and sea-level rising. They are visible symbols of the need for wise maintenance of aquatic resources

**Status:**

There is no good overall abundance estimate for river dolphins. The total world population has been crudely estimated as 4,000. River dolphins are threatened in Bangladesh from the effects of dams, large embankment schemes, dredging, fisheries by catch, direct hunting water pollution and ship traffic.

**Distribution of within Shitalakshya, Meghna and Gumti Rivers:**

No river dolphin was observed in Shitalakshya River having Kanchpur Bridge. Both banks of Shitalakshya are much developed and river water has been deteriorated for River dolphin to stay. There are supposed to be some river dolphins in Meghna River System including Meghna and its branches of Gumti River, Kushiara River and Monu River. It is reported that many river dolphins were observed while breeding season at the merging point of Kushiara River and Monu River, some 200km upstream from Meghna Bridge Sire, where river is meandering and water quality is turbid with many fishes and strong flow and is like to be one of the major habitats but not confirmed. Although conditions are clear in which River Dolphin prefer to stay in the views of food and habit they prefer, the actual location of their habitat is not confirmed. Site reconnaissance by the exerts and hearing from 10 locals at the Meghna and Gumti Sites, River Dolphins seem passing through these Bridge sites sometimes based on the observation from the bank and Bridges in wet season when enough waters are there in the river

**4.4 Environmental Quality**

Environmental quality baseline monitoring was conducted in two rounds survey programs to cover both dry and wet seasons. Parameters for baseline quality monitoring are chosen based on the requirements of national air, noise and water quality standards and as well as the expert consultations. The following parameters are measured:

Surface Water Quality: pH, Turbidity, BOD5, COD, TDS, TSS, DO, NH3-N, Total Coliform, and oil and grease.

Ground Water Quality: pH, Turbidity, Mn, Fe, As, Electrical Conductivity, Chloride as Cl

Air Quality: SPM, PM2.5, PM10, SOx, NOx, Lead

Soil Quality (River bed and Top soil): Lead, Cadmium, Arsenic, Organic content, Mercury, Cromium+6, Pesticides Residual Test for Agricultural chemical

Noise Quality: 4 sets of continuous hourly average for day and night time

1) Air pollution

Air Quality was measured both at dry and wet season respectively at three Bridges. Locations of samplings are presented in Figures from 4.17 to 4.19 and results were summarized in Table 4.13. Locations were selected based on the land used patterns (industrial, residential, commercial areas etc.) as are defined in Environmental Conservation Rules 1997.



Figure 4.17 Locations of Samplings for Chemical Analyses at Kanchpur Bridge

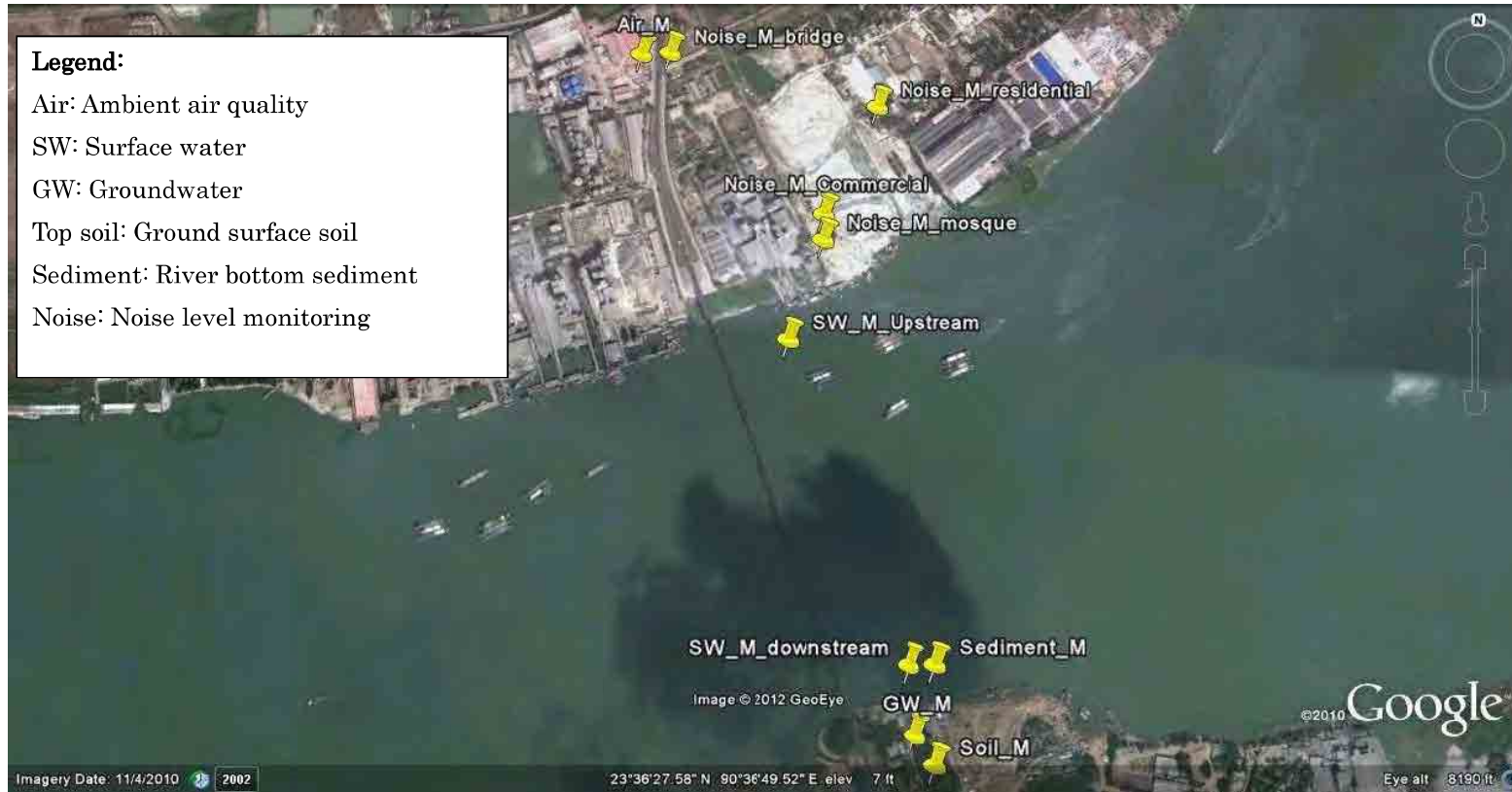


Figure 4.18 Locations of Samplings for Chemical Analyses at Meghna Bridge



Figure 4.19 Locations of Samplings for Chemical Analyses at Gumti Bridge

**Table 4.13 Results of Ambient Air Quality Analysis**

Unit: microgram/m<sup>3</sup>,

Season	Kanchpur		Meghna		Meghna- Gmuti		Japanese Standard	WHO	Environmental Conservation Rules, 1997 (Bangladesh)			
	Dry	Wet	Dry	Wet	Dry	Wet			Industrial area	Commercial and mix areas	Residential and rural areas	Sensitive area
Sampling date	8/5/2012	16/7/2012	8/5/2012	16/7/2012	9/5/2012	17/7/2012						
SPM	714	1,013	1,041	1,530	339	607	100	-	500	400	200	100
PM2.5	94	160	144	197	61	86	-	10	65			
PM10	193	270	317	510	131	170	-	20	150			
SO2	96	191	60	110	55	80	110	20	120	100	80	30
NO2	70	160	56	90	50	74	80	40	100	100	80	30
Pb	0.63	0.55	0.38	0.33	0.27	0.25	-	-	0.5			

■ : Exceeding Standards

Note: Standard applied is as industrial area for Kanchpur and Meghna, Sites. Gumti Bridge Site is categorized as commercial area based on the surrounding conditions of economic activities

As shown in the above table, followings are noted:

- Suspended Particulate Matter (SPM) is much higher than the standard.
- PM2.5 and PM10 also very high
- Sulphate Dioxides (SO<sub>2</sub>) sometimes exceeds the standard.
- Nitrogen Dioxides (NO<sub>2</sub>) is within the standard.
- Lead (Pb) is within standard except Kanchpur Site.
- Main source of NO<sub>2</sub> and SPM may be the emission from vehicles.
- Numerous number of

Background values, estimated as of location far away from road without impact from vehicles' emission are estimated<sup>5</sup> as Table 4.14.

**Table 4.14 Estimation of Air Pollution at Background**

Pollutant	Background estimated µg/cm <sup>3</sup>	Industrial area	Commercial and mix areas	Residential and rural areas	Sensitive area
SPM	846	500	400	200	100
SO <sub>2</sub>	98	120	100	80	30
NO <sub>2</sub>	74	100	100	80	30

Source: Study team

As shown above, SPM exceeds all standards. SO<sub>2</sub> is not acceptable as (1) Residential and rural area, and (2) Sensitive area. NO<sub>2</sub> is not accepted only as Sensitive area and acceptable as (1) Industrial area, (2) Commercial and mix, and (3) Residential and rural area.

## 2) Water pollution

A series of water sampling for surface water and groundwater and analyses on the samples were implemented for 3 bridges respectively. 2 litter of water was sampled in jar and immediately sealed, kept in shadow and transported to laboratory for analyzing. Testing method follows the method recommended by Environmental Protection Agency of United States (USEPA).

### Surface water

Surface water was measured in dry season (May 2012) and wet season (July 2012) at upstream and downstream of existing bridges at respective sites. Table 4.15 presents the results of surface water analyses.

<sup>5</sup> Road Environment Institute, *Manual for road impact assessment*, 2007



**Table 4.15 Results of Surface Water Analysis**

**Unit: mg/L**

River water	Shidarakya				Meghna				Gumti				Environmental Conservation Rule 1997 (Bangladesh)					
	Upstream		Downstream		Upstream		Downstream		Upstream		Downstream		Source of drinking water after disinfection	Recreation purpose	Source of water after conventional treatment	Fishery	Industry use	Irrigation use
Location	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet						
Season																		
Date	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012						
pH	7.0	8.2	7.0	8.4	6.7	7.2	6.7	7.1	6.7	7.3	6.6	7.1	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Turbidity NTU	85	158	12	123	35	10	28	6	12	8	53	3	-	-	-	-	-	-
DO mg/L	0.3	3.2	0.1	4.1	4.2	6.3	4.7	6.7	4.4	5.8	4.4	6.7	>6	>5	>6	>5	>5	>5
Total Coliform CFU/100ml	10,000>	>10,000	10,000>	>10,000	200	8	520	21	540	10>	1040	10>	50>	200>	>5,000	-	>5,000	>1,000
TDS mg/L	468	2305	570	1810	85	72	76	54	72	47	108	87	-	-	-	-	-	-
TSS mg/L	153	248	16	123	29	13	28	11	25	9	40	12	-	-	-	-	-	-
COD mg/L	59	84	47	128	8	6	7	8	8	6	8	5	-	-	-	-	-	-
BOD5 mg/L	20	12	10	19	3	1	3	1	1	1	3	1	2>	3>	6>	6>	10>	10>
NH4-N mg/L	9.6	3.5	9.5	1.2	0.3	0.1	0.5	0.1	0.27	0.1>	0.3	0.1	-	-	-	-	-	-
Oil and grease Mg/L	4.7	2.8	5.1	3.9	3.8	0.8	4.1	0.7	6.2	0.1	5.3	0.1	0.01	-	-	-	-	-

: Exceeding Standards

Although the standard/ evaluation to be taken is determined by the user of river water, based on the table above, followings are noted:

- pH is not much changed between seasons in three rivers
- Turbidity in wet season increases in Shidalakshya River while it decreases in Meghna and Gumti Rivers
- Dissolved Oxygen (DO), in wet season, recovers to reasonable level in Shitalakshya River while it improves in Meghna and Gumti Rivers
- Total coliform is quite high in Shitalakshya River.
- Total Dissolved Solid (TDS) is beyond the standard value in Stalakhya River in wet season.
- Ammonium nitrogen, NH<sub>4</sub>-N, is high while they are within the standard as drinking water at Meghna and Gumti Rivers.
- Total Suspended Solid is almost every time beyond the standard as drinking water.
- COD and BOD decrease in wet season probably due to the increase of discharge.
- Oil and grease concentrations are always beyond acceptable limit in all rivers

Water quality of Shitalakshya River is estimated as so deteriorated by human's activities since:

- High concentration of Total Coliform probable due to discharge of human liquid waste into river without treatment
- High concentration of COD and BOD which indicates many raw material including above waste before oxidization/decomposition discharged and as the result of very low dissolved oxygen concentration as difficult for fish to live in
- High concentration of Ammonia Nitrogen probably from human waste
- High concentration of oil and greases as untreated effluents from factory

Due to its high Total Coliform concentration, Shitalakshya River water is not suitable for any use. As for water qualities Meghna and Gumti Rivers, they are similar and are much better than Shitalakshya River since Total Coliform concentration and COD/BOD are somewhat tolerable as other than drinking water in Bangladesh Standard except oil and grease contents.

#### Groundwater

The groundwater is necessary for daily life of local people and, among all as drinking water in most area where pipeline water is not available. The dependency ratios on well are 75% at Kanchpur, while they are 95-100% at Meghna and Gumti Bridge sites.

At the Project site, well are dug in settlement and used for drinking by local people. The qualities of groundwater tested are shown in Table 4.16.

**Table 4.16 Results of Groundwater Analyses**

Unit: mg/L

Location	Kanchpur	Meghna	Gumti	Bangladesh	WHO
Date of sampling	5/5/2012	5/5/2012	5/5/2012	Drinking water	Drinking water
pH	6.7	6.8	6.8	6.5-8.5	6.5-8.5
EC $\mu$ S/m	824	553	646	-	(2,000 by EPA)
Turbidity	24.7	28.7	43.1	10>	5>
Chloride	75	27	23	150-600	250>
Total hardness	248	238	222	200-500	500>
Iron	2.0	2.5	3.6	0.3-1.0	0.3>
Manganese	0.053	0.840	1.156	0.1>	0.4>
Arsenic	0.052	0.075	0.079	0.05>	0.01>

☐ : Exceeding Standards

As shown in the above table, the concentrations of Iron, Manganese and Arsenic of groundwater are higher than standards in almost all cases.

In three Bridges, concentrations of Arsenic are always not satisfying drinking water standards of Bangladesh and WHO. Arsenic is classified by IARC<sup>6</sup> in Group 1 (carcinogenic to human) while Iron and Manganese are not so harmful. Arsenic concentration in groundwater in recent deposits (10,000 year or younger) and it is considered as natural origin (geological reason), and not by human activity.

### 3) Noise and vibration

#### Noise

Noise was measured at road sides (10m away from edge of car lane) for 24 hours and at other areas for daytime and night time of limited hours only, such as industrial area, residential area, commercial area and religious area which are located away from the road so that no impact from the project is expected but just as background data. Results are presented in Table 4.17. Locations of monitoring are presented in Figures from 4.20 to 4.22.

<sup>6</sup> International Agency for Research on Cancer

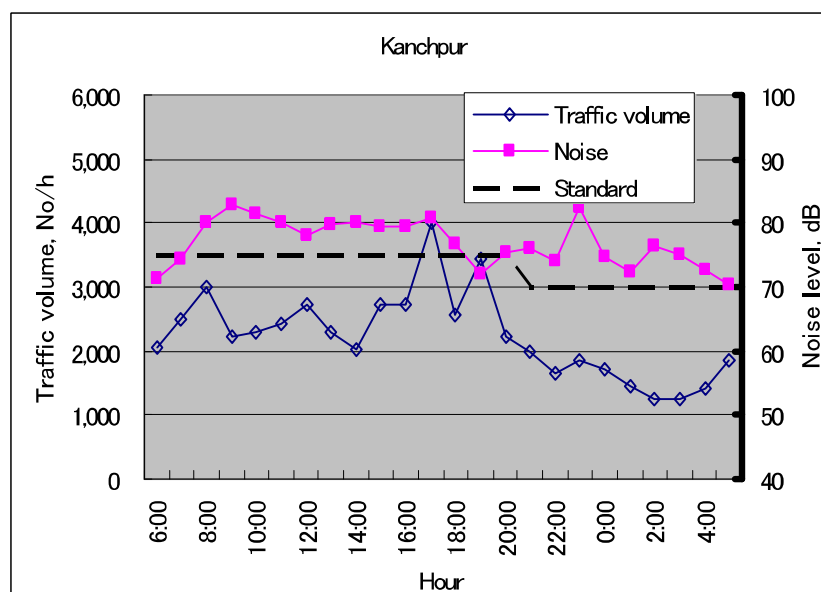
**Table 4.17 Noise Monitored**

		Unit	Roadside	Industrial area	Residential area	Commercial area	Religious area	Hourly traffic volume, No/Hour
Daytime	Standard	dB	70*	75	60	70	45	-
	Kanchipur	Distance from NH-1 m	10	-	200	70	150	2,481
		dB	79	-	62	76	58	
	Meghna	Distance from NH-1 m	10	260	440	-	270	1,449
		dB	74	72	55	-	58	
	Gumti	Distance from NH-1 m	10	130	160	-	160	1,524
dB		71	-	58	68	60		
Night	Standard	dB	70*	70	50	60	35	-
	Kanchipur	dB	75	-	59	62	64	1,602
	Meghna	dB	66	67	70	-	66	1,195
	Gumti	dB	69	-	55	61	58	1,443

\*WHO Guidelines for noise at traffic place

As shown in the table, in the most area, noise exceeds environmental standards in daytime. In night time noise level comes down almost less than 70 dB except roadside.

Figures from 4.20 to 4.22 indicate hourly traffic volume, noise and environmental standard versus hour respectively in three Bridges taken in May 2012. As show in these figures, in almost all time noise is above the environmental standard at Kanchpur Bridge site.



**Figure 4.20 Noise and Hourly Traffic Volume at Kanchipur**

At Meghna Bridge site, noise is acceptable range for all time.

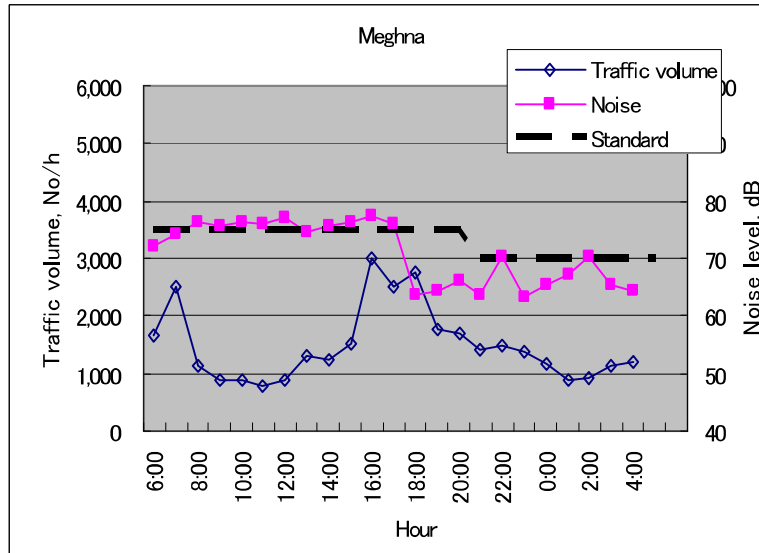


Figure 4.21 Noises and Hourly Traffic Volume at Meghna Bridge

At Gumti Bridge Site, noise may be acceptable in daytime while it exceeds the standard in night time.

In general, noise levels measured do not reflect traffic volume. The reason is considered the use of car horn is related especially in day time.

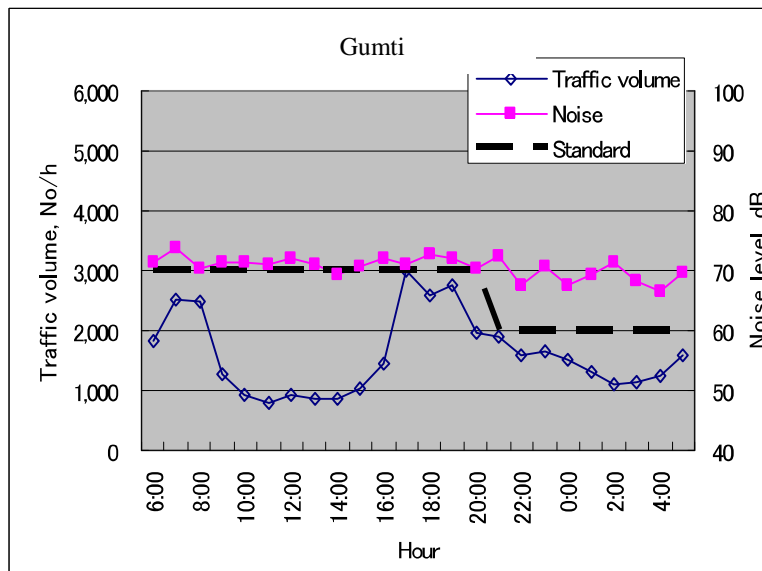


Figure 4.22 Noise and Hourly Traffic Volume at Gumti Bridge

## Vibration

In March 2012, vibration was monitored and the maximum vibration level, even if at the road side, was less than 60dB as is regarded satisfactory level in international standard and further monitoring was cancelled.

### 4) Soil pollution

Surface soils on the ground around three bridges were sampled and analyzed respectively. Because Bangladesh does not have any standard for soil pollution, the standards in Canada, the United States and Japan are used here for evaluation. The results of primary survey are satisfied with those all of the three standards and it can be said that there is no soil pollution in project site.

**Table 4.18 Results of Surface Soil Analysis**

Unit: mg/kg dry soil

	Location			Guidelines <sup>7</sup>		
	Kanchpur	Meghna	Gumti	CCME <sup>8</sup>	US EPA <sup>9</sup>	Japan <sup>10</sup>
Arsenic As	1.8	2.4	2.7	-	-	150
Cadmium Cd	0.10	0.07	0.09	0.822	850	150
Chromium Cr	18	25	28	87	850	-
Lead Pb	3.6	3.6	9.2	600	400	150
Mercury Hg	0	0	0	50	510	15
Ignition loss	2,200	2,800	2,700	-	-	-

## 4.5 Socioeconomic Resources

### 4.5.1 Demography

The selected three Bridges are located in three districts i.e. Narayanganj, Munshiganj and Comilla. The following Table shows the detail location of Bridges.

**Table 4.19 Locations of Bridges**

<sup>7</sup> Soil Environment Center,1999 and Commercial Law Institute,1999

<sup>8</sup> CCME- The Canadian Council of Ministers of the Environment have adopted these guideline numbers as the Canadian Soil Quality Guidelines for the Protection of Environment and Human Health- Industrial Land Use (1999)

<sup>9</sup> US EPA- The United States Environmental Protection Agency (USEPA), adopted these guidelines number as their Risk Based Screening Levels for Industrial Land Use , 1996

Name of the Bridge	Side	District	Upazila	Union
Kanchpur Bridge	Dhaka	Narayanganj	Siddhirganj	Shimrail,
	Chittagong		Sonargaon	Kanchpur
Meghna Bridge	Dhaka	Narayanganj	Sonargaon	Pirojpur
	Chittagong	Munshiganj	Gazaria	Baliakandi
Gumti Bridge	Dhaka	Munshiganj	Gazaria	Baushia
	Chittagong	Comilla	Gazaria Daudkandi	Daudkandi

Some selective demographic variables of the Focus area along the Bridge location are shown in Table 4.20.

**Table 4.20 Selective Demographic Variables of Focus Area along the Bridge location**

Parameters	Focus area			
	Narayanganj Sadar	Sonargaon	Gazaria	Daudkandi
Area (sq. km)	100.74	171.66	130.92	13.18
No. of Household	188,400	60,800	26,559	6,258
Avg. Household size	4.7	5.02	5.2	4.63
Population	886,600	305,640	138,108	29,001
Density(per sq. km)	8,801	1,781	1,055	2,200
Sex Ratio**	82	94	87	91
Literacy % (7 years+)	49	28	54	49

Source: Bangladesh Population Census, Community Series, 2001;  
 \*\*-. (Number of Female per 100 Male)

The Socioeconomic survey covers 338 households (67.74%) Meghna Bridge, 142 households (28.46%) in Kanchpur Bridge and 19 households (3.81%) in Gumti Bridge area. A total of 2241 people are found in 499 surveyed households (household size is 4.49), of which 52.07% are males and 47.93% are females. The table 4.21 below presents the total number households and people surveyed in three bridges.

**Table 4.21 Bridge Area Wise Distribution of Households and Population by Sex**

Name of the Bridge	HH		Male		Female		Total population	
	No.	%	No.	%	No.	%	No.	%
Kanchpur	142	28.46	282	12.58	286	12.76	568	25.35
Meghna	338	67.74	836	37.30	746	33.29	1582	70.59
Gumti	19	3.81	49	2.19	42	1.87	91	4.06
Total	499	100	1167	52.07	1074	47.93	2241	100

Source: Study team , 2012

#### 4.5.2 Religion

Distribution of surveyed population by religion under the Project area is presented in Table 5.22. It is found that about 96.70% (2167) surveyed population belong to Islam religion and remaining 3.30% (74 people) belong to Hindu (Sanatan) religion by faith. In the Kanchpur Bridge project area 100% of the surveyed population found Muslim, while in the Meghna Bridge area 96.27% and 3.73% of the surveyed population found Muslim and Hindu respectively. According to the survey a large number (16%) of Hindu population were found in Gumti Bridge area.

**Table 4.22 Surveyed Population by Religion**

Religion	Kanchpur Bridge		Meghna Bridge		Gumti Bridge		Total	
	Population	Percentage	Population	Percentage	Population	Percentage	Population	Percentage
Islam	568	100	1,523	96.27	76	83.52	2,167	96.70
Hindu	0	0	59	3.73	15	16.48	74	3.30
Total	568	100	1,582	100	91	100	2,241	100

Source: Study Team, 2012.

#### 4.5.3 Education Level

About 19% of the total surveyed population is found illiterate. However, some of the illiterate population can sign their names only. Out of 19% illiterate people, the males are 9.06% while the females are 9.77%. It is found that 31.59% of the people have gone to primary schools while 27.76% have education between class six and class ten. Only 5.35% and 3.17% of the people have completed Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) level education respectively. Only 1.16% of the people have obtained Bachelor degree while 0.22% of the people have obtained Master degree. However, 0.22% of the people found Hafez-E-Quran. Details about the status of education of the male and female people are shown in Table 4.23.



**Table 4.23 Distribution of Population by Education Level under the Project Area**

Education level	Male		Female		Total	
	Number	%	Number	%	Number	%
1 TO 5	354	15.80	354	15.80	708	31.59
6 TO 10	317	14.15	305	13.61	622	27.76
SSC	74	3.30	46	2.05	120	5.35
HSC	47	2.10	24	1.07	71	3.17
BA	19	0.85	7	0.31	26	1.16
MA	4	0.18	1	0.04	5	0.22
Hafez-E-QurAn	5	0.22	0	0.00	5	0.22
Child	144	6.43	118	5.27	262	11.69
No Schooling	203	9.06	219	9.77	422	18.83
Total	1167	52.07	1074	47.93	2241	100

*Source: Study Team, 2012*

Remark:

1 to 5:Grades of school

6 to 10:Grades of school

SSC: Secondary School Certificate

HSC: Higher Secondary Certificate

BA: Bachelor Degree

MA: Master Course

Hefez-E-QurAn Course

Child: before Grade 1(elementary school)

#### 4.5.4 Character of the population

An overwhelming number of population under the Project area is housewives (24.01%) followed by business person(14.86%), daily wage laboring occupation (5.62%),service/employment (5.04%), overseas employment (1.25%), pulling rickshaw and van (1.16%), others (1.07%) and drivers (0.98%).It is found that 24.94%, 11.65%, 4.69% and 3.61% of the population are students, children, unemployed and old people respectively. Details about Character of the male and female population are shown in Table 4.24.

**Table 4.24 Distribution of the People by Occupation under the Entire Project Area**

Occupation	Male		Female		Total	
	No.	%	No.	%	No.	%
Student	284	12.67	275	12.27	559	24.94
Housewife	0	0.00	538	24.01	538	24.01
Business	330	14.73	3	0.13	333	14.86
Child	143	6.38	118	5.27	261	11.65
Day labor	114	5.09	12	0.54	126	5.62
Service	81	3.61	32	1.43	113	5.04
Unemployed	73	3.26	32	1.43	105	4.69
Old people	37	1.65	44	1.96	81	3.61
Overseas service	26	1.16	2	0.09	28	1.25
Rickshaw/Van Polar	25	1.12	1	0.04	26	1.16
Others	17	0.76	7	0.31	24	1.07
Driver	21	0.94	1	0.04	22	0.98
Disabled	5	0.22	2	0.09	7	0.31
Agriculture	5	0.22	1	0.04	6	0.27
Tailor	1	0.04	5	0.22	6	0.27
Doctor	2	0.09	1	0.04	3	0.13
Fisherman	2	0.09	0	0	2	0.09
Mason	1	0.04	0	0	1	0.04
Total	1,167	52.07	10,74	4,793	2,241	100

Source: Study Team, 2012.

#### 4.5.5 Income and Poverty Dimensions

##### 1) Income and Poverty Dimensions

As per the Statistical Year Book of Bangladesh 2005, average household size is 5.13 and 40.94% of households earn less than BDT 60,000 per year. Average annual income and

expenditure of these households are BDT 24,648.00 and BDT 32,072.00 respectively. Table 4.25 shows that as per this survey, each of 53 households (10.62%) in the entire project area earn less than BDT 60,000.00 per year. Considering the economic condition of the project area, scope of work and level of income, these 53 households may be considered as ultra-poor and each of 185 households (37.07%) within the range of BDT 60,001.00 to 120,000.00 is poor. It should be mentioned that each of 261 households (52.30%) earn above BDT 120,000.00 is non-poor.

It is found in the Kanchpur Bridge area that each of 21 households (16.90%) earn income less than BDT 60,000 per year. These households are considered as extremely poor. Each of 59 affected households (41.55%) earns income ranging from BDT 60,001 and 120,000 per year which households are considered as the poor. On the contrary, each of 59 affected households (41.55%) earns income above BDT 120,001 is considered to be the non-poor.

It is found in the Meghna Bridge area that each of 24 households (7.11%) earn income less than BDT 60,000 per year. These households are considered as extremely poor. Each of 120 households (35.50%) earns income ranging from BDT 60,001 and 120,000 per year. These households are considered as the poor households. On the contrary, each of 194 households (57.40%) earns income above BDT 120,001 is considered to be non-poor.

It is found in the Gumti Bridge area that each of 5 households (26.31%) earn income less than BDT 60,000 per year. These households are considered as extremely poor. Each of 6 households (31.58%) earns income ranging from BDT 60,001 and 120,000 per year. These households are considered as the poor households. On the contrary, each of 8 households (42.11%) earns income above BDT 120,001 is considered to be non-poor.

## **2)Local economies such as employment, livelihood etc.**

There are many daily wage workers in each site for unloading dredged sand from barges and loading on the delivery trucks. The number of these workers can reach to 300 in total of three sites. In each sites, there are small shops illegally installed within RHD land and making small business to the sand carrying workers. Their daily income is BDT 300 only in the maximum. Locations of their working places are shown in Figures 4.23(1) to 4.23(3).

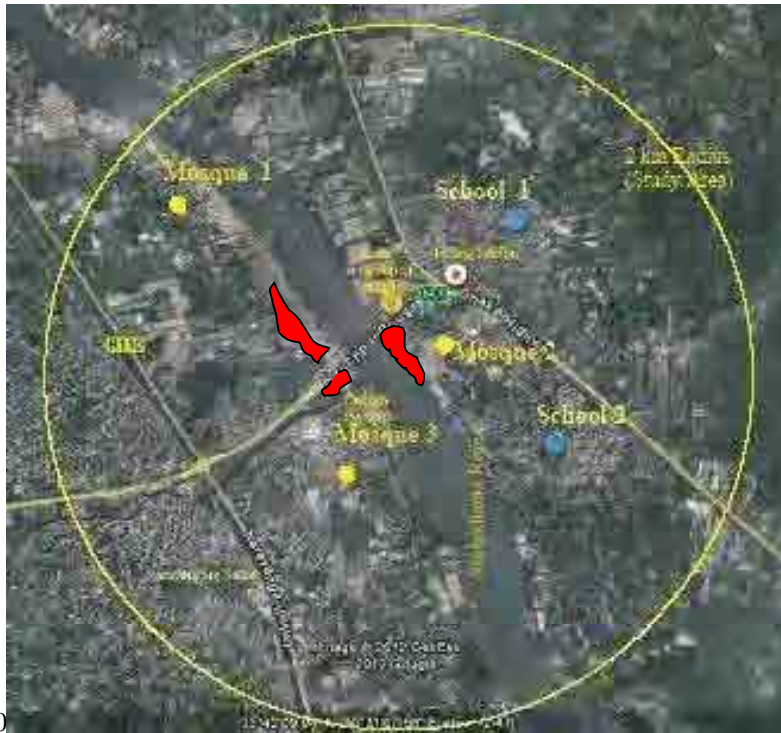
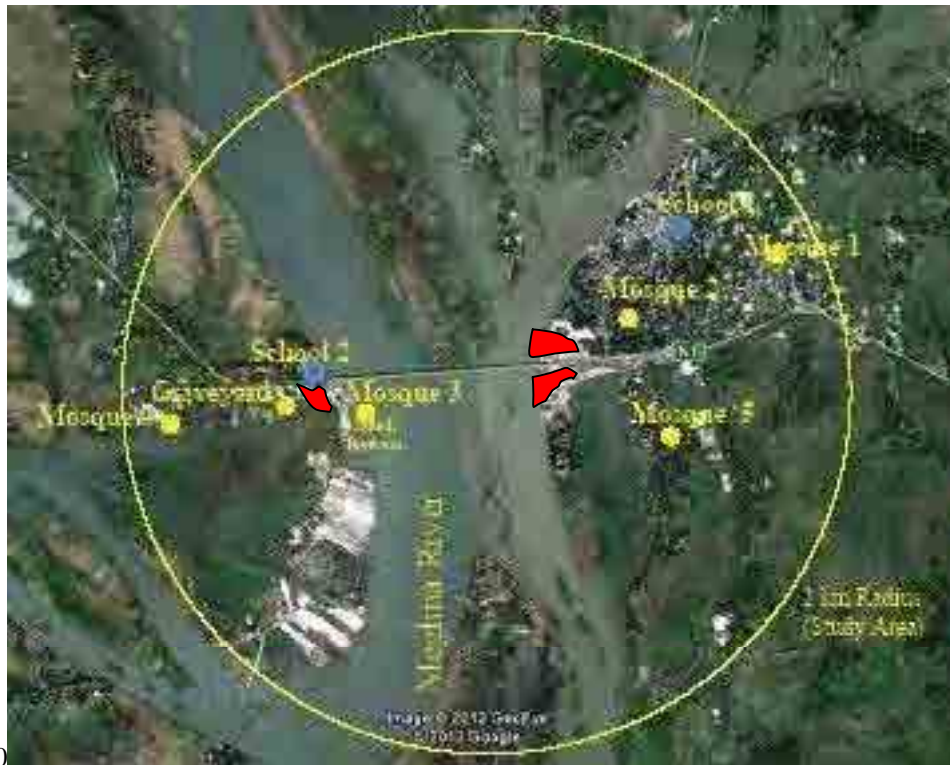


Figure 4.23(1) Location (red colored) of Sand loading/unloading workers working at Kanchpur Site



Figure 4.23(2) Location (red colored) of Sand loading/unloading workers working at Meghna Site



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**Figure 4.23(3) Location (red colored) of Sand loading/unloading workers working at Gumti Site**

On the Chars at Gumti Bridge Site, it is noted that some crop are planted, grown and harvested. The number of crop per below existing bridge is worth about 4 persons in the harvest season (dry season) .



**Figure 4.24 Chars (sand bar island) at Gumti Bridge Site**



**Picture 4.2 Views of Char agriculture**

#### **4.5.6 Yearly Household Expenditure**

Table 4.25 shows almost similar trend on yearly household expenditure compared to income in Kanchpur, Meghna and Gumti areas. In Kanchpur Bridge area, each of 40% of the households has yearly expenditure above BDT 120,000. Each of 29% of the households has yearly expenditure ranged from BDT 60,001 to BDT 90,000. Each of 8% of the households has yearly expenditure within BDT 30,000. In Meghna Bridge area, each of 52% of the households has yearly expenditure above BDT 120,000. It is found that each of 20.41% of the households has yearly expenditure ranged from BDT 90,001-BDT 120,000. Each of 20% of the households has

yearly expenditure ranged from BDT 60,001-BDT 90,000. Each of 2.07% of the households has yearly expenditure within BDT 30,000. In the Gumti Bridge area, each of 47.37% of the households has yearly expenditure above BDT 120,000. Each of 21% of the households has yearly expenditure ranged from BDT 60,001-BDT 90,000 and each of another 21% of the households has yearly expenditure ranged from BDT 30,001-BDT 60,000.

#### 4.5.7 Access to Electricity

In Kanchpur Bridge area, out of 142 households, 128 households (90.14%) have electricity supplied from national grid. In Meghna Bridge area, out of 338 households, 281 households (83.13%) have electricity access of which 80.47% are supplied from national grid while 2.66% are from solar energy. In Gumti Bridge area out of 19 households, 14 households (73.68) have electricity access of which 52.63% are supplied from national grid while 21.05% are from solar energy by themselves

**Table 4.25 Distribution of Households by Yearly Expenditure in Kanchpur, Meghna and Gumti Bridge areas**

Yearly Expenditure level	Kanchpur		Meghna		Gumti		Total	
	No.	%	No.	%	No.	%	No	%
Up to TK 30,000	11	7.75	7	2.07	0	0.00	18	3.61
30,001-60000	13	9.15	20	5.92	4	21.05	37	7.41
60,001-90,000	41	28.87	66	19.53	4	21.05	111	22.24
90,001-120,000	20	14.08	69	20.41	2	10.53	91	18.24
Above 120,000	57	40.14	176	52.07	9	47.37	242	48.50
Total	142	100	338	100	19	100	499	100

Source: Study team, 2012

#### 4.5.8 Social institutions such as social infrastructures and decision-making institutions

Table from 4.26 represent locations of existing social infrastructures for sites respectively. Sensitive facilities such as school and mosques are away from the bridge and road

**Table 4.26 Distances from the NH-1 to the Sensitive Facilities**

**Unit: meter**

	Series No	Kanchpur	Meghna	Gumti
Mosque	1	1,500	200	200
	2	80	150	100
	3	300	-	100
	4	-	-	180
	5	-	-	300

School	1	300	200	100
	2	200	200	120
Grave yard	1	-	-	50

Source: Study team, 2012

#### 4.5.9 Health Care Facility

There are several categories health care facilities in the Project surrounded areas such as hospital, clinic, rural dispensary, etc. within the reach of the people. These are mostly found within 5 km except Government Hospital in Kanchpur Bridge area. In other Bridge areas the scenario is almost similar. Details on health care facilities and distance from their residence in the Kanchpur Bridge project, the Meghna Bridge project and the Gumti Bridge project areas are shown in Table 4.27.

**Table 4.27 Distance of Healthcare Center**

Name of the Bridge	Healthcare center	Up to 1 km		1 to 3 km		3 to 5 km		Above 5 km		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Kanchpur	Government Hospital	2	1.41	1	0.70	1	0.70	138	97.18	142	100
	Upazila Health complex	3	2.07	19	13.10	65	44.83	58	40.00	145	100
	Private Hospital	105	74.47	24	17.02	7	4.96	5	3.55	141	100
	Rural healthcare center	135	97.12	2	1.44	2	1.44	0	0.00	139	100
	Family care center	122	84.72	5	3.47	2	1.39	15	10.42	144	100
Meghna	Government Hospital	2	0.59	2	0.59	4	1.18	330	97.63	338	100
	Upazila Health complex	3	0.89	21	6.21	81	23.96	233	68.93	338	100
	Private Hospital	84	24.85	98	28.99	31	9.17	125	36.98	338	100
	Rural healthcare center	266	79.17	13	3.87	31	9.23	26	7.74	336	100
	Family care center	237	70.33	23	6.82	2	0.59	75	22.26	337	100
Gumti	Government Hospital	0	0.00	1	5.26	2	10.53	16	84.21	19	100
	Upazila Health complex	1	5.26	2	10.53	12	63.16	4	21.05	19	100
	Private Hospital	3	15.79	13	68.42	2	10.53	1	5.26	19	100
	Rural healthcare center	15	78.95	4	21.05	0	0.00	0	0.00	19	100
	Family care center	18	90.00	2	10.00	0	0.00	0	0.00	20	100

Source: Study Team, 2012

#### 4.5.10 Educational Institutions

A lot of educational institutions are found in the Project area mostly schools, colleges and Madrasah. There is no University in the project area. The educational institutions are mainly located within 5 km except Universities. Islamic religious institutions such as Madrasah and Maktob are also found a bit more in number in the project area. It is found that overwhelming percentages of primary schools, non-formal education, *madrassa* and *Maktob* are located within



1 kilometer distance in the Kanchpur Bridge, the Meghna Bridge and the Gumti Bridge area. Available educational institutions in the Kanchpur Bridge, Meghna Bridge and Gumti Bridge project and distance from the residence shown in Table 4.28.

**Table 4.28 Distance of Educational Institutes**

Name of Bridge	Educational institute	Up to 1 km		1 to 3 km		3 to 5 km		>5 km		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Kanchpur	University	0	0.00	1	0.71	3	2.13	137	97.16	141	100
	College	45	32.14	46	32.86	43	30.71	6	4.29	140	100
	High School	93	66.43	43	30.71	4	2.86	0	0.00	140	100
	Primary School	128	93.43	9	6.57	0	0.00	0	0.00	137	100
	Non-formal Education	133	97.08	3	2.19	0	0.00	1	0.73	137	100
	Madrasah	129	96.27	4	2.99	1	0.75	0	0.00	134	100
	Maktob	103	100	0	0.00	0	0.00	0	0.00	103	100
Meghna	University	0	0.00	0	0.00	1	0.30	337	99.70	338	100
	College	6	1.77	37	10.91	12	36.58	172	50.74	339	100
	High School	201	59.47	111	32.84	17	5.03	9	2.66	338	100
	Primary School	326	96.74	10	2.97	0	0.00	1	0.30	337	100
	Non formal Education	318	99.07	2	0.62	0	0.00	1	0.31	321	100
	Madrasah	326	98.49	3	0.91	0	0.00	2	0.60	331	100
	Maktob	258	99.61	1	0.39	0	0.00	0	0.00	259	100
Gumti	University	0	0.00	0	0.00	0	0.00	19	100	19	100
	College	0	0.00	0	0.00	13	68.42	6	31.58	19	100
	High School	3	15.79	14	73.68	2	10.53	0	0.00	19	100
	Primary School	19	100	0	0.00	0	0.00	0	0.00	19	100
	Non formal Education	19	100	0	0.00	0	0.00	0	0.00	19	100
	Madrasah	19	100	0	0.00	0	0.00	0	0.00	19	100
	Maktob	15	100	0	0.00	0	0.00	0	0.00	15	100

Source: Study Team, 2012

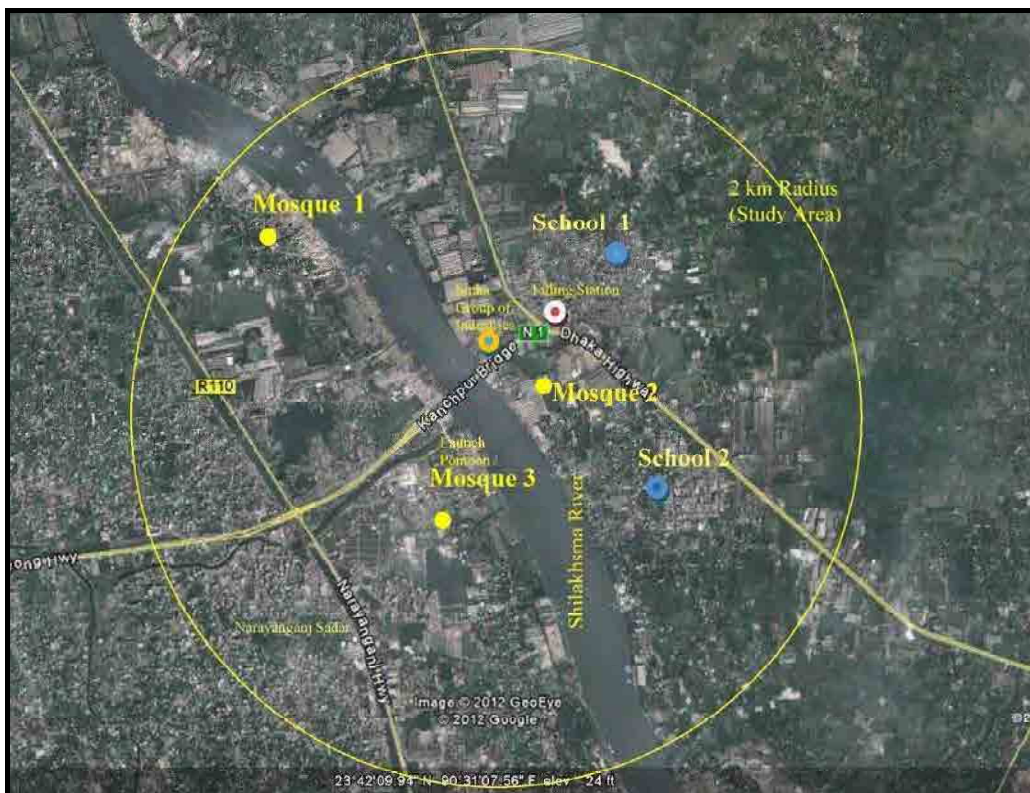
#### 4.5.11 Archeological, Historical and Cultural Sites

There are no archaeological sites within the Project site. There are some historical places in the Sonargaon Pourashava (4km away from Meghna Site). The pourashava is a rich treasure of archaeological treasures. It was once the capital of Isha Khan one of Bhuiyans of Bengal. The present important sites are Bangladesh Lokshilpa Museum, Galdi Shahi Masjid and Historic Panam city. All of them are far away, located more than 100km, from the bridge alignment. Since all archaeological and historical places are far from the bridge sites, it is irrelevant to

discuss any aspects of impact over the places due to the project.

Besides few mosques, Dorga<sup>11</sup>, graveyard exists on both sides of the bridge, there are no other cultural or potential sites around the Project area.

Figures from 4.25 to 4.27 present Google maps around the sites respectively.

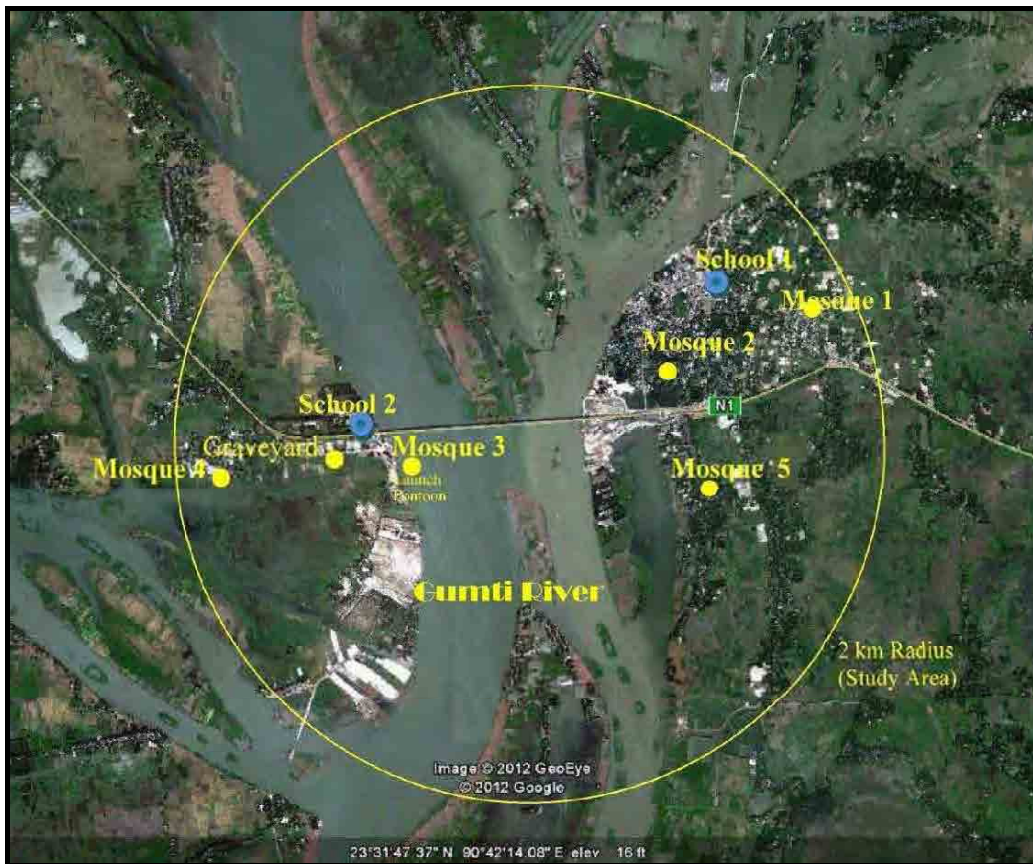


**Figure 4.25 Land Use Map at Kanchpur Bridge**

<sup>11</sup> Dorga means Mazar. It is the grave of the religious leader



**Figure 4.26 Land Use Map at Meghna Bridge**



**Figure 4.27 Land Use Map at Gumti Bridge**

The main essence of cultural outlook of Bangladesh is the predominance of Islam in the society but people in the Project sites maintain good understanding amongst the various cultural groups. The villages are homogenous and most of the populations are Muslim with few others belonging to Hindu religion. People live here with amity, amid variance in their financial capabilities symmetrical to other rural areas of Bangladesh.

**1) Cultural heritage**

Figure 4.28 indicates the location of cultural heritage and the nearby cultural heritage, Goaldi Mosque at Goaldi in Sonargaon, is located 1 km away from NH-1. Thus, there is not any adverse impact to the heritage.

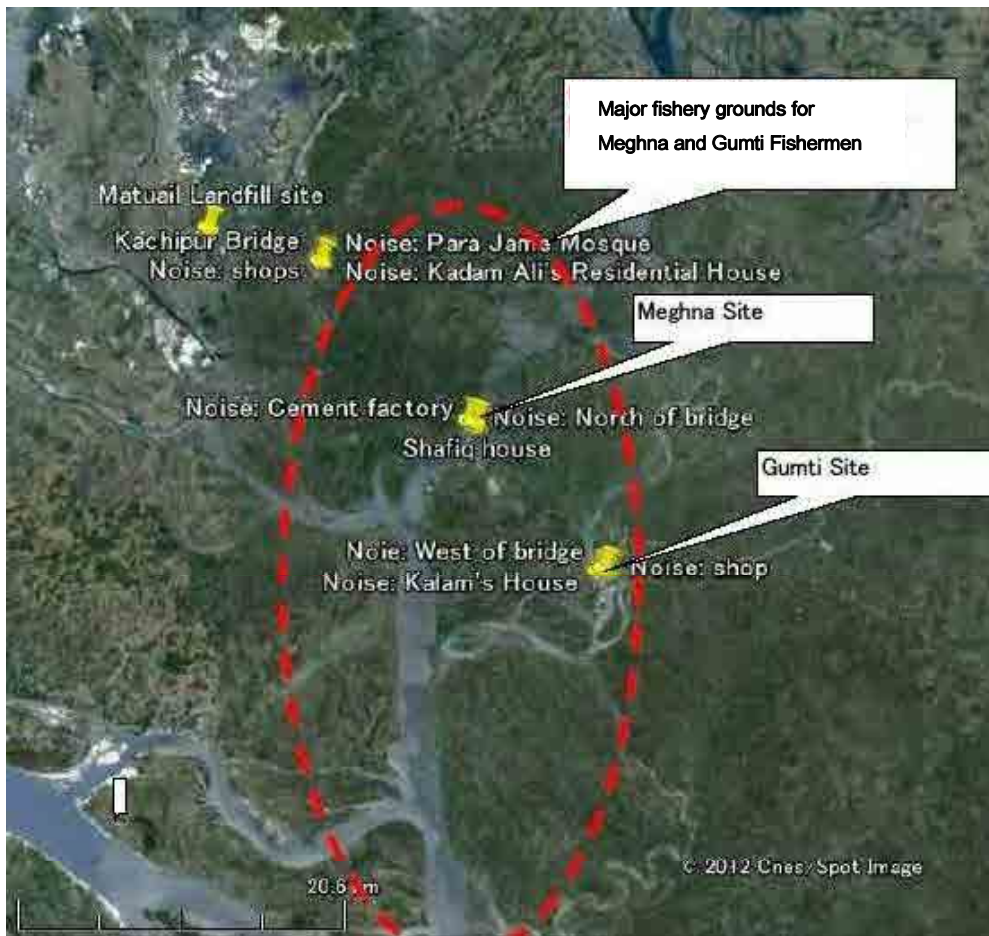


**Figure 4.28 Location of nearby Cultural Heritage**

#### **4.5.12 Fishermen Community**

In Fishermen Community, three types of fishers namely full-time fisher, part-time fisher and subsistence fishers were present in the Study Area. Full-time fishers were mostly Hindu, Part-time fishes were Muslin and Subsistence fishers were mostly local villagers of the Study Area. While there is no fisherman in Kanchpur Bridge site, there are generally 10 fishermen in both Meghna and Gumti Bridge site respectively. Actually, several boats having approximately a total of 10 fishermen in both bridges were observed in primary survey (Meghna Bridge: 4<sup>th</sup> April 2012, Gumti Bridge: 11<sup>th</sup> April 2012).

They stay in the settlements along old national road, not far from the rivers. Types of fishes they catch are carp, cat fish and snake-head etc. and are detailed in Table 4.1 in the first section. Major fishery ground is indicated as below:



**Figure4.29 Major fishing grounds**

Most of the fish traders of the Project area were Muslims. Communal harmony between Muslims and Hindu fisher communities was present. They caught fish in the same fishing grounds located in Meghna Riverine tract, its associated canals and seasonal flood plains. In the Project area, average family size of full-time fishermen family was about 6 and the annual income of this group ranged from BDT 15,000- 105,000. Most of the full-time fishermen have fishing gears and crafts. Food intake was usually 2 meals a day. The average literacy rate of the fishermen community was found 21%. Part-time fishers worked as helpers in the fishing units. During off-season, they were engaged in various agricultural and house hold activities.

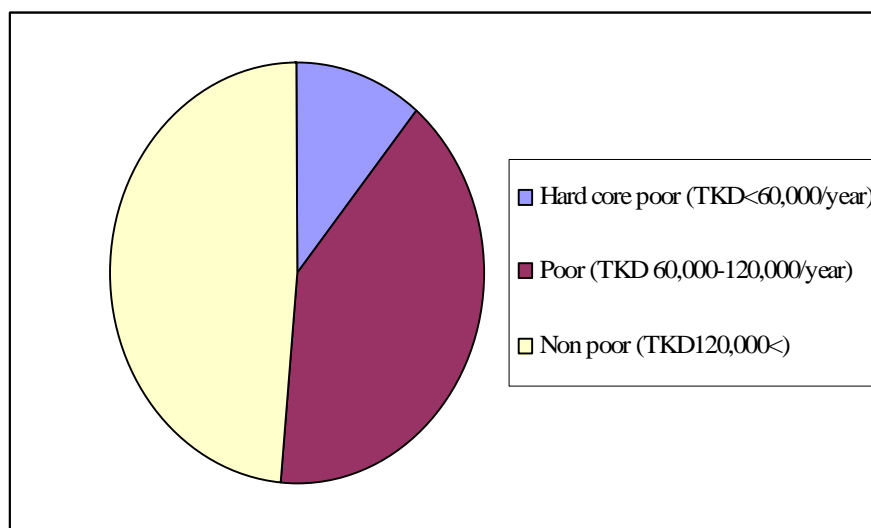
3 major Fish Landing & Marketing Centers were surveyed along with seasonal variation of catch in order to know the total quantity of each of different species of fish caught in the Project

area and landed in these centers. The names of these centers are Baidyer Bazar, Meghnaghat East and Tetuitala. In these centers, only kaccha houses were present for the Aratdars. There were no fish preservation facilities in these centers. Fish are sold on open sky. Operational duration of these centers was 5 a.m. to 8 a.m. for each day. Average weight of the total fish landed in these landing centers per day was within the range of 500-1000 kg depending on the season. In peak season, daily fish landing sometimes went up to 2000 kg<sup>12</sup>.

No Fish Preservation facilities were found to exist in the fish landing centers during inspection visit to the respective centers. The landing centers were not hygienically maintained. There were 6/7 ice-plants exist in the Project area. The total production capacity of ice in these plants was about 200kg/day. The fish traders of these centers followed the conventional technique of fish preservation to prevent the immediate spoilage of fish by washing, icing and finally packing the fish in bamboo baskets and wooden boxes for distribution in the marketing channel.

#### 4.5.13 Poor, indigenous people or ethnic minority

According to socio-economic survey at the sites, half of them (51%) are classified as poor with yearly income less than 120,000 BDT.



**Figure 4.30 Income of Households at the Project sites**

There is about 3% of Hindu people is there while 97 % is Islam according to the national

<sup>12</sup> Baseline Fisheries Study, AES Meghna ghat, June 2002

census. In our census performed for displaced people, 3 families are found to be Hindi.

No indigenous people<sup>13</sup> are present at the site, although 3% of population is Hindu (2 households affected by the project) while 95% is Muslim in all areas around the Project sites. The rest 2% is Christian etc. including local religions. There is no Hindu Shrine around.

#### 5.4.14 Accident

##### On land traffic accident

Presently land traffic accident reported between Gumti and Kanchpur are as:

**Table 4.29 Estimation of Accidents Rate**

	Fatal accidents case	Non fatal accidents case	Total case	Yearly average case	Distance x average yearly traffic volume, 100 million km · nos/ year	Accident rate, Nos/100 million km nos · year
1998-2006	98	34	132	16	No available	No available
2007-2008	26	6	32	16	No available	No available
2009-2011	11	1	12	6	4	1.4

Remark: NH-1 between Kanchpur and Gumti Bridge

As show in the above table, number of cases become reducing.

##### River transport accident

Accidents of river transportation vessels in 2009 were 201 cases, in which, 10 cases were recorded in Shitalakshya River while 2 in Meghna River. The types of accidents are:

<sup>13</sup> As per definition of World Bank OP4.20 Indigenous People



**Table 4.30 Occurrence of Accidents by Cause (1975-2009)**

Sr No	Cause of Accident	Frequency	Percent
1.	Bottom Hull Damage	2	1.0
2.	Capsize	1	.5
3.	Collision	109	54.2
4.	Foggy Weather	9	4.5
5.	Fouling	1	.5
6.	Grounding	2	1.0
7.	High Tide	1	.5
8.	Overloading	50	24.9
9.	Rap with Electric Wire	1	.5
10.	Storm	21	10.4
11.	Tornado	4	2.0
	<b>Total</b>	<b>201</b>	<b>100.0</b>

Source: BRAC University, *Riverine Passanger cessel disaster in Bangladesh, 2009*

Collision is the highest cause of accidents between ships.

#### **4.5.15 HIV/AIDS**

Although total ratio of people with HIV is far less than 0.1% presently, the number is steadily being increased due to infection from<sup>14</sup>:

- Injection drug users
- Overseas migrant workers returned

The ratios of people with HIV at the Unions of sites are unknown.

#### **4.5.16 Gender**

The majority of women in the project area live within the confines of the household; an arena still thoroughly regulated by custom and devotion to domestic work and the raising of children. *Purdah*, in the form of strict veiling, is not strongly observed in the area, although women lack mobility and expeditions outside the home usually require

<sup>14</sup> UNICEF, *HIV and AIDS in Bangladesh*

permission from the head of the household. There is a strong tradition of female modesty, based upon the perceived requirements of Islam.

Given the sensitive nature of interactions with village women, a Bangladesh female sociologist conducted both field interviews and a focus group session with potentially women. The field interviews and focus group feedback confirmed the expectation that women have important roles in the agrarian cycle. Women are particularly involved in the care of kitchen gardens, seeds and seed beds, and the processing of paddy when it is brought in from the fields. These functions are undertaken in the home and women of the affected households say they did not visit the *char* area during the period of cultivation. Women do not claim to have a role in family decision-making, but their knowledge of the crop cycle and fishing arrangements indicate that their role is important, informal albeit .

#### **4.5.17 Children's right**

In Bangladesh it is not allowed for children's labor under 18 years old. According to the national wide baseline survey<sup>15</sup>, children labor in Bangladesh is serious as:

- Of the total estimated number of child workers is about 500,000 at least or about 33.5 % of workforce of 2 million in focused enterprises such as fish drying, restaurant, rickshaw pulling, carpentry, metal works, brick breaking, welding, laundry work and so on.
- The ages of child workers are 10 – 14 in 50% and 15-17 in 48%
- About 45% of child workers could not attend school, while illiteracy rate is about 40%. They work to help the livelihood of their family. The occupations of parents are rickshaw pulling at the highest proportion and day labor secondly.

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<sup>15</sup> Bangladesh Bureau of Statics, *Baseline survey for determining hazardous child labor sectors in Bangladesh, 2005*

#### **4.5.18 Waste**

There is no collection system about solid waste produced from houses at rural area in Bangladesh. Domestic liquid waste is treated at cesspit which will percolate into sub-ground and can affect groundwater.

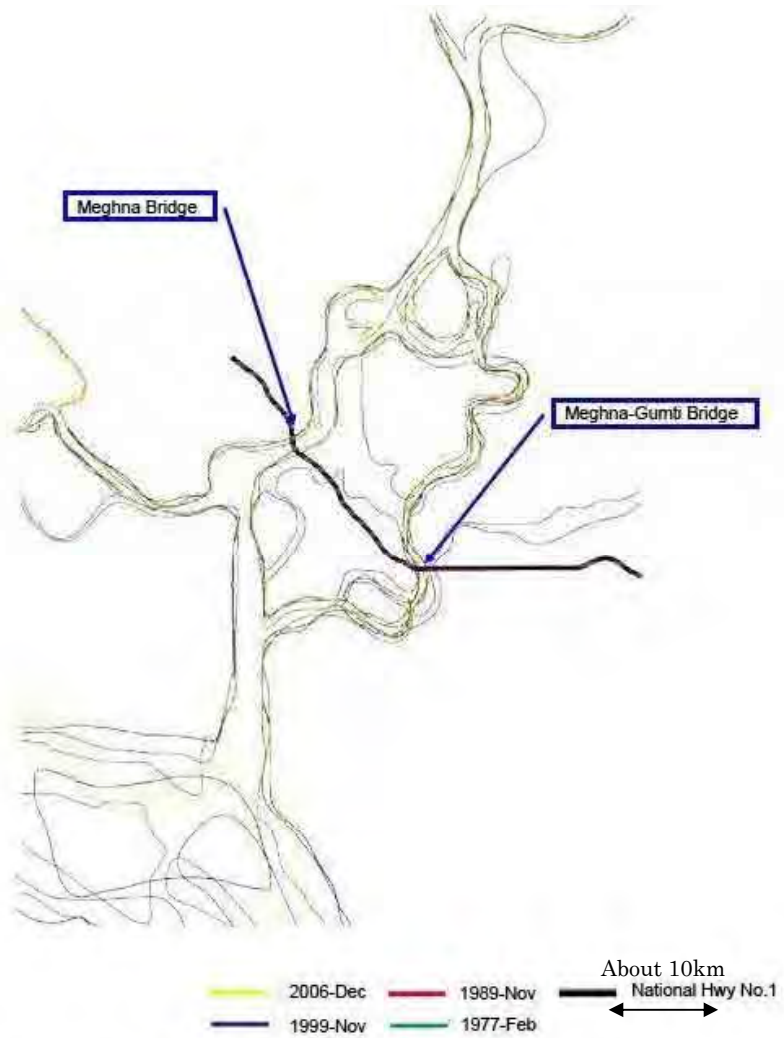
As are common practice to treat construction waste, including concrete sludge, contractor will select the proposed dumping site the following.

- Ensure appropriate site selection for new dumping sites and ensure that a minimum of 500 m from any inhabited areas;
- Ensure that the site is not located in Marshy or low lying area
- Ensure that the Ground Water level sufficiently deep to avoid ground water contamination
- Ensure that no drinking water sources (surface or ground water) are located within 500 m radius of the facility
- Ensure that the soil is not permeable

#### **4.6 Bank erosion and scouring**

##### Bank erosion

Meghna River is famous for changing its river route very frequently. Figure 4.31 shows that the course of Meghna River is morphing by year and accordingly, the channel width changes depending on river discharge. Especially around Meghna and Gumti Bridges, it seems that the stream line shows almost the same profile. Therefore, it is supposed that river shore line around Meghna and Gumti Bridges is stable with respect to morphological view point.



Source: JICA Study Team

**Figure 4.31 Change of River Banks**

Scouring

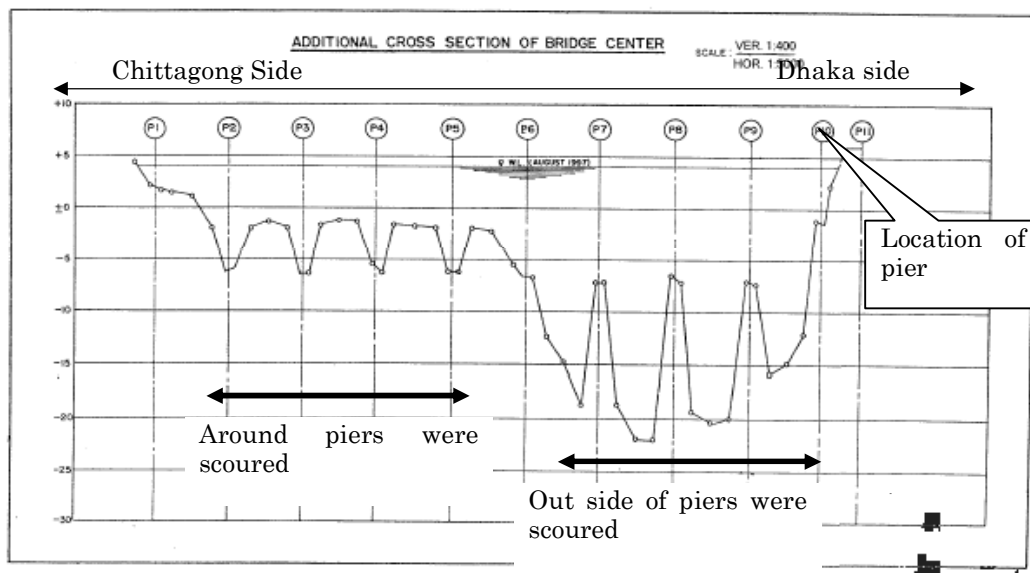
River bed scouring around the piers can be expected based on the fact that serious scouring have been taken place in. Table 4.31 presents the Maximum depths of scouring taken place in the past.

**Table 4.31 Depths of Scouring Caused in the Past**

	Kanchpur	Meghna	Gumti
Maximum scouring taken placed in the past, m	0	18	5

Source: Study team

Figure 4.32 presents the river section of Meghna revealed in 1998.



Data source: JICA, *Rehabilitation of embankment of Meghna Bridge*, 1998

**Figure 4.32 Results of Scouring took place at Meghna Bridge**

As shown in the above figure, scouring of 18 m was caused at the river bed in the maximum. However it is noted that river bed scouring took place just around piers in Chittagong Side while riverbed was scoured except around the pier in Dhaka Side. It is likely that riverbed its self is being widely eroded due to the lack of supply of river bed material, probably due to over exploit of river sand by human activity.

Over exploitation of riverbed sand is a serious social issue and is focused in the newspaper as below.

Daily Star 20/2.02.21

# Sand lifting threatens 2 Thakurgaon bridges

QUAMRUL ISLAM RUBAIYAT, Thakurgaon

Ignoring threat to two important bridges over Tangon River in Thakurgaon town, contractors allegedly with the consent of the district administration are extracting sand from the river about 100 yards from the bridges to fill up the premises of an under-construction Liberation War memorial.

Vacuum in the river bed, caused by the sand lifting, poses threat to the

concrete bridge that serves as link between the district headquarters with four upazilas, said experts and local people.

A century-old iron bridge near Art Gallery More in the town is also affected due to the callous act, they said.

During a visit on Saturday morning, this correspondent saw sand lifting was going on from the Tangon River, around 100 yards from the middle of the concrete bridge with a local-made dredger.

The district administration took initiative to build a Liberation War memorial on the bank of Tangon River near Art Gallery More in Thakurgaon municipality area with the help of local NGO Eco Social Development Organisation last year.

Water Resources Minister Ramesh Chandra Sen laid the foundation stone of the memorial on March 26 last year.

Following allocation of 16 tonnes of rice meant for Test Relief to fill up the

premises of the monument, Mahmud Hasan Raju, convener of a project committee, started filling up the ground with a local-made dredger a few days ago.

When contacted, Raju said, 'We are extracting sand from the river with a light dredger with the consent of the district administration. It will not harm the bridge as we dug only five feet deep.'

Replying to a query he said the sand lifting work is going on under a project committee and he is the convener of it, but he failed to tell who the other members of the committee are.

Nejrat Deputy Collector Asim Mollah told this correspondent, 'We told the contractors to take sand from the upper portion of the river.'

When contacted, Sub-Divisional Engineer of Roads and Highways Department Ishid Hossain said over cell phone, 'I am not yet aware of the matter. The pillars of the concrete bridge might be affected if sand lifting creates a hole near the bridge. It may also affect embankments of the river. We will see the matter.'

It would better to fill up the premises of the monument by bringing sand from the river manually. Instead of dredging, he added.



PHOTO: STAR

Lifting of sand from Tangon River in Thakurgaon town continues to pose a threat to the concrete bridge, only 100 yards away.

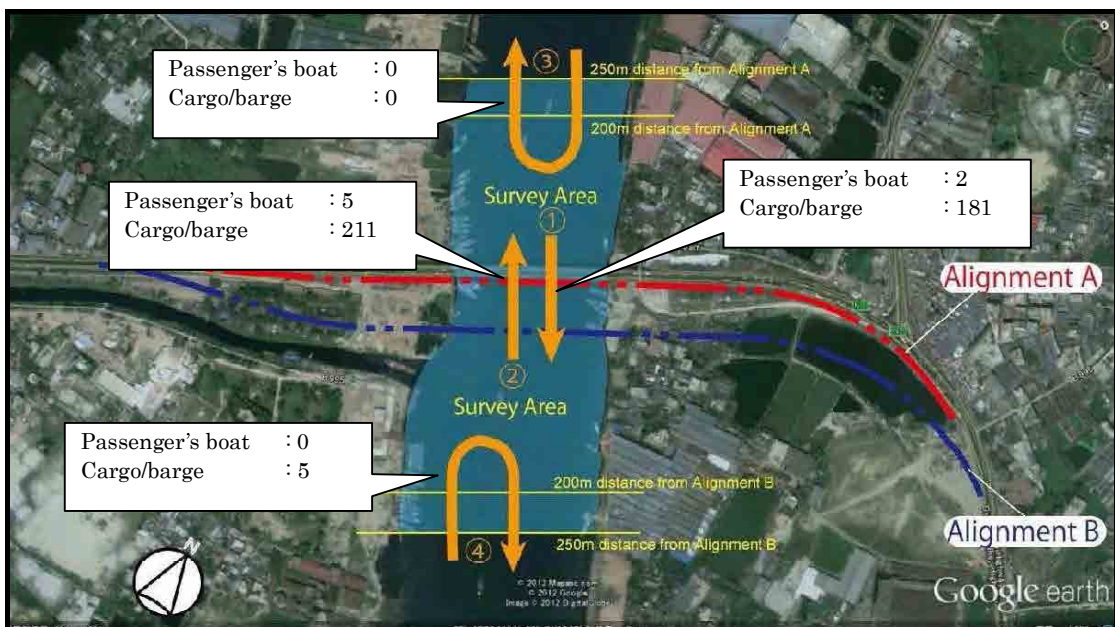
Figure 4.33 An Article Presented in the Newspaper about River Sand Exploit

## 4.7 River transportation

The river port at Narayanganj is a major inland port and trading center. Various developments in the region continue to increase this port's importance to cargo ships,

fishing boats, passenger boats, and trawlers. The Shitalakshya and Meghna River, and connecting waterways, will be relied upon for heavy construction equipment transportation as well as being used for power station cooling and general water uses.

River traffic survey was implemented between 7-18 hours in 3<sup>rd</sup> April at Kanchpur Bridge, 4<sup>th</sup> April at Meghna Bridge and 10<sup>th</sup> to 11<sup>th</sup> in April at Gumti River. The results are summarized and presented in Figures from 4.34 to 4.36. In the figures, arrows represent the direction of vessels going to. The returning arrow means the vessel does not pass the bridge but deliver people/ material to the ferry terminal/ stockpiles. Length of passengers' boat is at most 30m or less while the cargo/ barges are 55m in the maximum.



**Figure 4.34 Number of Passing Vessels in Day Time at Kanchpur Bridge**

As shown in the above figure at Kanchpur Bridge, major vessels observed are cargos and barges. Passengers' boat was almost not observed. Number of vessels passing the bridge and going downstream or upstream is about 400 respectively.

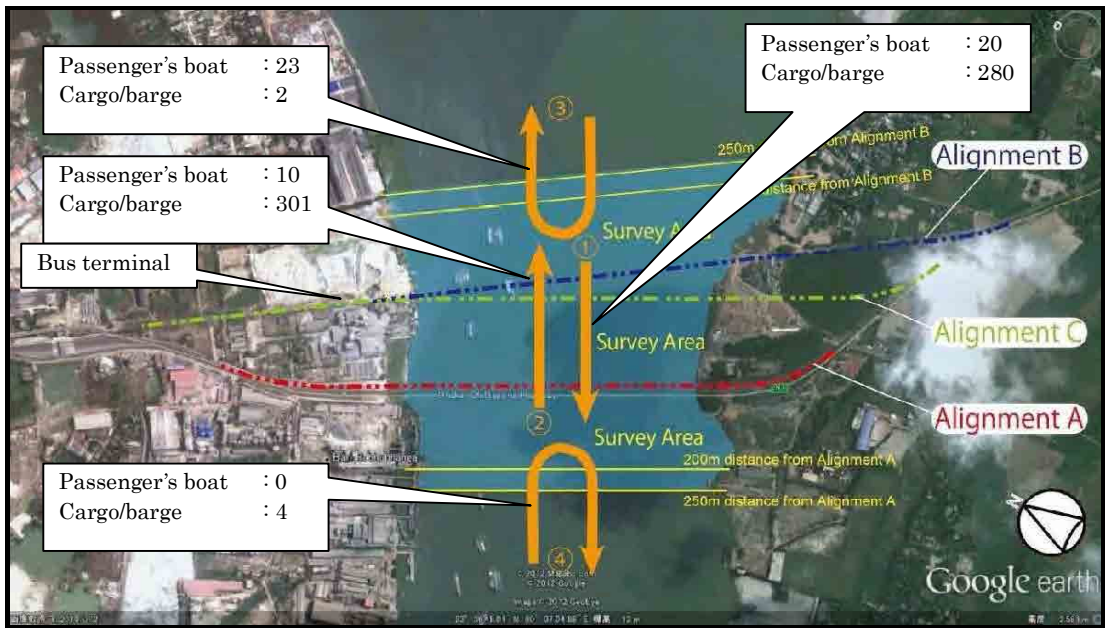


Figure 4.35 Number of Passing Vessels in Day Time at Meghna Bridge

At Meghna Bridge as shown above, 20 passengers' boats were observed that deliver customers from upstream villages to the bus terminal bound for Dhaka.

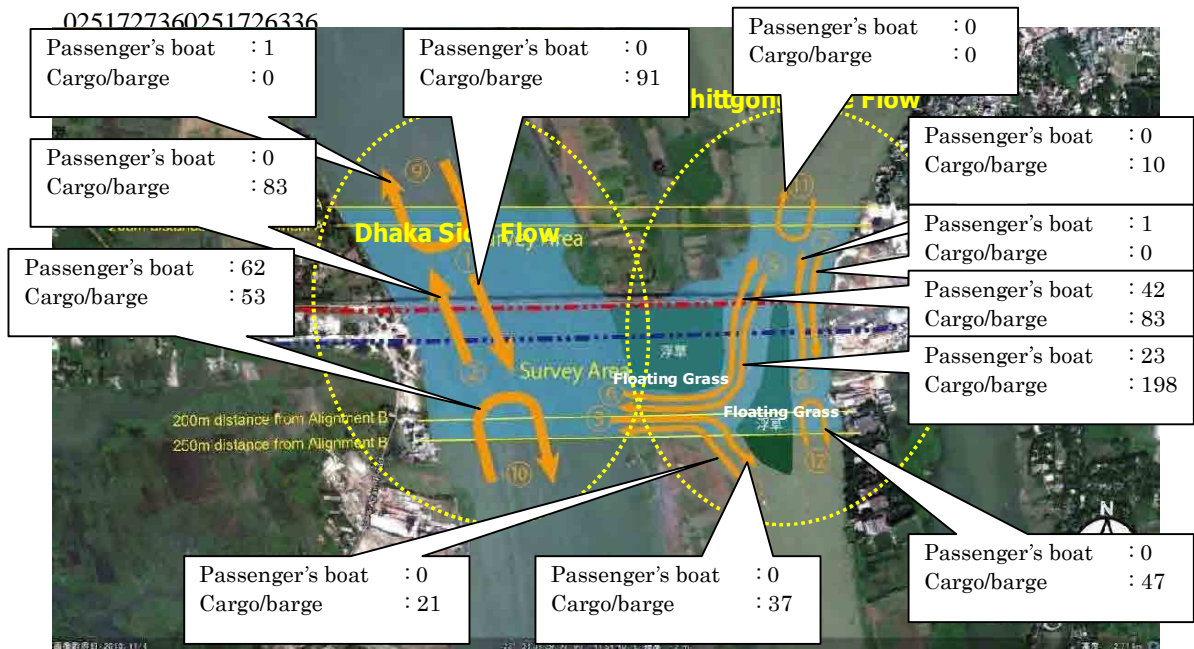


Figure 4.36 Number of Passing Vessels in Day Time at Gumti



In Gumti, there are about 130 passengers' boats going through Chars in the river. Many cargo/ barges take same route as passengers' boat.

River passenger vessel disaster caused in 2009 is reported as

**Table 4.32 River Passengers Boat Accidents in 2009**

River	Accident number
All rivers in Bangladesh	205
Shitalakshya River	10
Meghna River	1
Gumti River	0

Source: BRAC University, *River passenger vessel disaster in Bangladesh: Option for mitigation and safety*, 2009

About 40 passengers' boats are observed at daytime, coming from upstream/downstream to the Bridges for bus terminals at Meghna Bridge Site and Gumti Bridge Site respectively. No passengers' were observed at Kanchpur Site. The boats arrive at any places and facilities such as quay or pontoon are not required.



**Picture 4.3 Passengers' Boats Arrived**

#### 4.8 Global warming

It is estimated that 88cm<sup>16</sup>, in the maximum, a rise of mean seawater level within this century. Global warming is a critical issue for Bangladesh due to its dependency on river water for agriculture and vulnerability to Tsunami due to lowness of ground level. The amount of emission of Carbon Dioxides in 2010 was estimated as 1,000,000 ton per year emitted based on the traffic volume of NH-1, About 35,000 vehicles/year, and is about 3% of total emitted in Bangladesh.

#### 4.9 Ground subsidence

There is no evidence or trace of ground surface subsidence around all the sites. The results of subsoil investigation indicate that there is no soft ground as would cause a long term consolidation subsidence after construction.

#### 4.10 Offensive odor

Offensive odor can be generated from cesspit or incineration of solid waste. Locals do not that present odor level is as serious environmental problem by local people.

#### 4.11 Bottom sediment

River bottom sediments were sampled at the location, where many vessels are being moored and analyzed in three rivers respectively and the results are summarized in Table 4.33. International guidelines are taken since there is no standard for sediment pollution in Bangladesh. As shown in the table, contamination by heavy metals, arsenic, Cadmium, Chromium, Lead and Mercury are within guidelines and considered as no polluted. The organics content is also acceptable. .

**Table 4.33 Results of Sediment Analysis**

Unit: mg/kg dry soil

	Location			Guidelines, criteria or classification
	Kanchpur	Meghna	Gumti	USEPA Guide -line
Arsenic As	2.1	0.9	4.2	33
Cadmium Cd	0.8	<0.002	0.1	4.98
Chromium Cr	9	6	20	111
Lead Pb	3.6	3.6	9.2	128
Mercury Hg	0	0	0	1.06
Loss on ignition (Organics content)	6,700	2,000	4,300	-

1. Consensus-based freshwater sediment quality guidelines, US EPA, 2000

<sup>16</sup> ADB, EIA for Padma Bridge, 2010

#### **4.12 Landscape**

There is no landscape issue at the Project sites according to the group discussion for local people.