

Table 6.3 Results of scoping at Gumti Bridge Site

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / Construction	During During Operation	
1	Involuntary resettlement	A	A	D	Loss of approximately 40 residential houses and small shops	-	Census Asset inventory -
2	Local economics, such as employment, livelihood, etc.	A	A	D	Loss of approximately 20 small shops Some restrictions to sand carrying work	-	Socio-economical survey and group discussion
3	Land use and utilization of local resources	D	D	D	Impact on part of fishing place, timber industry and agriculture	-	Study of current land use
4	Social institutions such as social infrastructure and local decision-making institutions	B	B	D	-		-
5	Existing social infrastructures and services	D	D	D			
6	Poor, indigenous, or ethnic people	A	A	D	Relocation of approximately 40 poor and landless families and small shops	-	Group discussion
7	Misdistribution of benefits and damages	B	B	B	Relocated families may become poorer while the remaining families can have the project benefit		Socio-economical survey and group discussion
8	Local conflicts of interest	B	B	B	Local conflicts may take place by the misdistribution of benefits and damages		Socio-economical survey and group discussion
9	Cultural heritage	D	D	D	Appeared to be no cultural heritage around	-	Appeared to be no cultural heritage around
10	Accident	B	B	B	Construction accident during construction	Traffic accident	Study and analysis of construction accident during construction and traffic accident
11	Infectious diseases such as HIV/AIDS	B	B	C	Inflow of workers with HIV into camp	-	Study of present condition of HIV
12	Gender	B	B	C	Female laborers may be discriminated in wage at construction site	-	Study of present condition of gender gaps

No.	Item	Rating			Potential impact description			Study methodology
		Overall	Before / During Construction	During Operation	Before Construction / During	During Operation		
13	Children's rights	B	B	C	Children's labor	-	Study of present condition of children's labor	
14	Erosion and scouring	A	C	A	Deep scour of river bottom around pier's foundations and river bank erosion may be caused by installation of embankment road for construction and abutments		Hydrological analysis	
15	River transportation	B	B	B	Construction vessels may obstacle passing vessels	New pier foundations may obstacle passing vessels	Construction vessels may obstacle passing vessels	
16	Hydrology	B	B	B	Flood can be caused by installation of embankment road for construction and abutments		Hydrological analysis	
17	Biota and Ecosystem	B	B	C	Impact on precious species	-	Hearing study	
18	Global Warming	C	C	C	CO2 emission from construction equipment	An increase in CO2 emission from passing vehicles	Estimation of the amount of emission Prediction of the amount of emission	
19	Air Pollution	B	B	C	Emission of air pollutant from construction equipment	An increase in emission of air pollutant from passing vehicles	Chemical analysis of air pollution Prediction of future density	
20	Water Contamination	B	B	D	Release of construction turbid water without treatment into river Disturbance of river bottom by installation of pier foundation	-	Chemical analysis of present water quality Estimation and prediction of amount of suspended solid by installation of pier foundation	
21	Soil Pollution	B	B	D	Leakage of asphalt and gasoline	-	Soil sampling and analysis for pollution Prediction of leakage in construction	
22	Waste	B	B	D	Illegal dumping of construction solid waste	-	Prediction of amount of generated construction waste	
23	Noise and Vibration	B	B	C	Noise and vibration of construction equipment	Noise and vibration of passing vehicles	Measurement of noise and vibration Prediction of future noise and vibration	

No.	Item	Rating			Potential impact description			Study methodology
		Overall	Before / During Const- ruction	During Operatio n	Before Construction	During	During Operation	
24	Ground Subsidence	C	D	C			Ground subsidence of buildings and surrounding facilities	Study of current condition of soft ground distribution by boring
25	Odor	C	C	C	Odor from emitted gases by construction equipment and open burning of waste			Study of a cause and a resource of offensive odor
26	Bottom Sediment	C	C	D	-	-		Sampling and chemical analysis of bottom sediments
27	Landscape	C	C	C	View of bridges and embankments during construction	View of bridges and embankments during operation		Hearing from local residents

6.3 Study Approach Proposed

Study approaches employed, where applicable, are:

- Existing data collection
- Discussion with expert
- Site reconnaissance
- Monitoring/ sampling/ laboratory analysis
- Numerical analysis (Formula presented in Annex 2)

Policy, Legal, and Administrative Framework:

This is to clarify the roles, limits and challenges of environmental rules and organization related. For this purpose, it is required to collect information and analyze legal framework, such as a National Environmental policy, National Environmental Management Plan, Environmental Conservation Act and Rule etc and institutional framework related to environment, such as Department of Environment, a Social and Environmental Circle of RHD.

Alternative Study and feasible route selection:

This is to clarify the necessity/priority of the project and, then, to propose the most feasible routes for three bridges respectively. For that purpose, a national master plan, traffic policy master plan and road master plan available are studied and, in the view of national priority, economy and technique, the necessity of project is evaluated comparing with other modes of transportation, such as railway and water transport together with the case when project be not implemented (zero option). By this, benefits of the project are emphasized to understand the necessity of the project to get smooth approval from stakeholders. Once the project is found to be most prioritized, then, most feasible routes are studied, in the view of construction /maintenance costs, technical issues such as flood, bank erosion and river bed scouring, social and environmental issues such as number of relocated houses/ shops, present river transportation safety, fauna and flora, pollution etc whatever affected.

Baseline presentation, impact prediction and migration measures planning

This is to clarify the present environmental and social conditions of the Project sites, together before the construction be started, for the purpose to estimate the changes of environmental and social conditions by the implementation of the project. Then, to minimize impacts, mitigation measures shall be established. Table 6.2 summarizes indicators for to present the baseline information and the indicators predicted. Mitigation measures are planned to reduce the degree of impact predicted.

Table 6.4 Study items and methods

No.	Item	Baseline description based on	Study methods
1	Involuntary resettlement	- No of household and shops a the site	- Counting number of APs physically or economical whichever and their loss - Compensations/ assistances necessary
2	Local economics, such as employment, livelihood, etc.	- Economic activities (shop, fishery, agriculture, laboring work) as may be lost	- Income loss

No.	Item	Baseline description based on	Study methods
3	Land use and utilization of local resources	- Areas of agricultural land, plantation plot, sand stocking pile area as may be affected	- Change of land use during construction and after operation
4	Social institutions such as social infrastructure and local decision-making institutions	- Location from the NH-1 of public facilities such as school, mosque as may be affected	- Change of situation of public facilities such as school, mosque as may be affected
5	Existing social infrastructures and services	- Situation of ferry terminal etc as may be affected	- Change of situation of ferry terminal etc as may be affected
6	Poor, indigenous, or ethnic people	- Number of poor, indigenous and ethnic minority families	- Number of poor, indigenous and ethnic minority families in the APs
7	Misdistribution of benefits and damages	- Number of cases of misdistribution	- Increase of number of cases of misdistribution
8	Local conflicts of interest	- Number of cases of local conflict	- Increase of number of cases of local conflict
9	Cultural heritage	- Confirmation of cultural heritages nearby located if any - Distribution of heritages in the district	- No impact since there is no heritage as may be affected.
10	Accident	- Traffic volume (yearly) and number of traffic accidents	- Increase of number of traffic accidents - Generation of construction accident
11	Infectious diseases such as HIV/AIDS	- Number of HIV patients in the upazila/district - General situation of HIV in Bangladesh	- Possibility of increase of HIV patient
12	Gender	- Gender issues	- Enlargement of gender gap such as wage discrimination between man and woman
13	Children's rights	- Situation of children's labor in Bangladesh	- Exploit of children at the site as construction workers
14	Erosion and scouring	- Bank erosion - River bottom scouring	- Intensification of bank erosion and river bottom scouring
15	River transportation	- Types and volume of passing vessels	- Accidents of vessels
16	Hydrology	- Water level - Discharge - Velocity	- Increase of water level, velocity or change of flow direction
17	Biota and Ecosystem	- Important species -	- Possibility of threat to important species
18	Global Warming	- Emission of CO2 -	- Increased amount of emission of CO2
19	Air Pollution	- NO2, SO2 and SPM as Bangladesh standard, and PM10 and PM2.5 as world wide concerns sampled along the roadside	- Increase of pollutants emitted
20	Water Contamination	- Basic index (pH, DO), Turbidity, Eutrophication (BOD, COD, NH4), Sanitary (Coliform), Industrial effluent (oil and grease), sampled up and down streams during dry (low water) and wet (high water) seasons	- Increase of pollutants in effluence
21	Soil Pollution	- Heavy metals on the land where contamination is suspect	- Possibility of soil pollution during construction
22	Waste	- Present sanitary conditions	- Possibility of waste dumping during construction

No.	Item	Baseline description based on	Study methods
23	Noise and Vibration	- Noise at roadsides (10m away from car lane) where the houses is located for 24 hours	- Possibility of increase of noise
24	Ground Subsidence	- Presence of soft deposit	- Possibility of long term ground subsidence
25	Odor	- Present situation	- Possibility of increase of offensive odor especially during construction
26	Bottom Sediment	- Heavy metals sampled from river bed where vessels are being moored and contamination can be expected	- Possibility of contamination of bottom sediment
27	Landscape	- Opinion about the views	- Opinion about the views

Public Participation

Public participation includes:

- Socioeconomic survey
Socioeconomic survey is held including, usually 50-100% of directly affected (relocated) people and 20% of indirectly affected people around the site in the minimum. Livelihood, life level, income, marital status, education level etc are inquired door to door.
- Group discussion
Group discussion involves 8-10 participants at most to discuss about common issues among the “focus group” invited at the meeting. Focus groups cover vulnerable people (poor, landless, old and disabled), fishermen, sand loading/unloading labors etc.
- Stakeholders’ meeting
This is held two times(the phase of scoping and of draft report) for all stakeholders including affected people, project implementation agencies, environmental protection organization, local governors, universities, donors, mass media etc. The purposes are:
 - (1) Dissemination of project information
 - (2) Presentation of environmental impacts and mitigation measures
 - (3) Opinion, comment and recommendation collection

CHAPTER 7 ENVIRONMENTAL IMPACTS

7.1 Impact Identification

An environmental impact is defined as any change to an existing condition of the environment. Findings of the assessment are presented according to site preparation, construction and operation phases. The impacts will be determined as significant, positive or negative, direct or indirect, long term or short term.

The EIA study, based on the screening and scoping of IEE study, review of proposed civil works, review of similar environmental assessment reports, baseline monitoring and stakeholder consultations, has identified 27 major environmental and social concerns that are expected from the project (Table from 6.1 to 6.3). The impacts are broadly classified into following 4 rating during preconstruction, construction and operation stage:

- Social Environment
- Natural Environment
- Ecological Environment
- Environmental Pollution

This chapter describes the rating and environmental impacts caused by the project both tentatively during construction and permanently during operation.

7.2 Project Impact to Key 27 Items

1) Involuntary resettlement

Before/During Construction

Severe

A total of 208 affected households and 768 affected people (Residential house owner : 107 households and 445 people, residential tenant : 98 households and 313 people and residential & shop owner: 3 households and 10 people) have been identified through a series of resettlement survey. It is likely to have significant adverse impact on this item since more than 200 resettlers are predicted.

Detailed data is indicated in the resettlement action plan report.

During Operation

No impact is expected

2) Local economies such as employment, livelihood, etc

Before/During Construction

Severe:

A total 66 shop owners (61 shop owners and 5 tenant shop owners), 28 employees, 5 fish pond cultivators, 2 companies properties and 1 plantation owner will be affected by the project. Detailed data is indicated in the Resettlement Action Plan report.

In addition, about 300 daily labors who are engaged in river sand unloading from sand carrier and loading on delivery trucks on the banks are there in the sites. However the impact to them by the project is considered as negligible since:

- Large open spaces are still remained there even if some spaces are lost by the project
- Sand carrier (barges) can moor to any place on the banks.
- Labors can unload from the barges and can tentatively pile at any open spaces.
- The delivery trucks can come to this stock pile and labor can upload on the truck there
-

There are generally 10 fishermen in both Meghna and Gumti Bridge site respectively. They would have some adverse impacts on fishing by changes of water quality and hydrological condition through construction.

There are some crops to grow and harvest just below Gumti Bridge. The number of crop there is worth approximately 4 persons in the harvest season (dry season).

During Operation

Negligible

No impact is expected since water quality or hydrological condition is not affected (or worsen) by the project.

3) Land use and utilization of local resources

Before/During Construction

Moderate:

Plantation area on Chittagong Side Bank at Meghna Site and an aqua culturing household is affected by the Project. The fish pond's area is approximately 183,000 m² and the reclaimed area would be 5,500 m², which is approximately 30 % of the total area (183,000 m²).



Figure 7.1 Locations of Fish Pond Affected (in Kanchpur Bridge Site only)

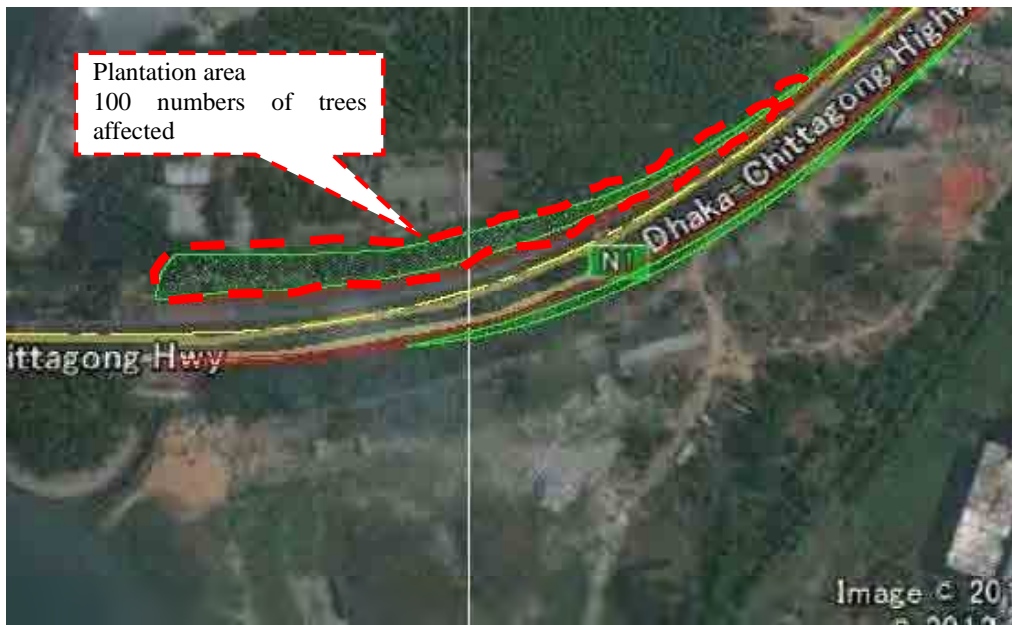


Figure 7.2 Location of Plantation Area (in Meghna Bridge Site Only)

During Operation

No impact is expected

4) Social institutions such as social infrastructures and decision-making institutions

Before/During Construction

Moderate:

Possible impact considered for social institution is (1) relocation, (2) disturbance by pollution such as noise.

During construction, noise from the construction area and operation of construction machines will be generated. However construction time and period is limited, thus it is not likely to give serious impact on this item.

During Operation

Negligible:

No social institute such as school and mosque is to be relocated. Although one mosque is located 70m away from the planned carriage way of NH-1 in Kanchpur site, predicted noise level is 72 dB(A) (daytime) and it is within the standard level of Industrial Area.

Additionally one college is located in Gumti Site 130m away from the planned road.

Predicted noise is 69 dB(A) (daytime) and it is not exceeding standard level of Commercial area, thus project does not disturb activities at school and mosque.

5) Existing social infrastructures and services

During Construction

Moderate:

While no social infrastructures, such as school, hospital, bus terminal and so forth, exist in the affected area, social service utilities such as power, water, drainage and communication line are located underground in the affected area. Hence, construction adversely has some impacts on such social service utilities.

During Operation

No impact is expected

6) Poor, indigenous people or ethnic minority

Before/During Construction

Severe:

There are not any indigenous people in the project affected area.

However about 40% of the population interviewed is classified as poor with yearly income of less than BDT 120,000. If they are displaced without compensation as per Bangladesh rules, their livelihood and life levels will be extremely worsen.

During Operation

No impact is expected

7) Maldistribution of benefit and damages

Before/During Construction

Severe:

Displaced people may suffer from losing their shelter (residential house), business access (small kiosk) and social network (relationship with families/ neighbor/ friends) generally at all bridge sites. Some suffers for loss of plantation at Meghna Bridge Site.

During Operation

No impact is expected

8) Local conflict of interest

Before/During Construction

Moderate:

Due to employment opportunity will be increasing during construction; candidates of construction workers may have some conflicts between communities.

During Operation

No impact is expected

9) Cultural heritage

Before/During Construction

Negligible:

No cultural property exists around the sites (4km away from Meghna Bridge Site.)

During Operation

No impact is expected

10) Accident

During Construction

Moderate:

There can be some sorts of accidents during construction as below:

- Bridge construction requires works in elevated place such as work on the top of pier, girders and so on and falling down is critical.
- Handling a large amount of paints containing some volatile materials may not good for human health.
- Heavy equipments can bring on various significant accidents.
- The groundwater having arsenic from wells can have a hazardous impact on the locals.
-

During Operation

Moderate:

Based on the data of traffic accidents caused between Kanchpur Bridge and Meghna Bridge, assuming that the ratio of traffic accident per vehicle number per day is same, the traffic accidents in the future can be estimated as below:

Table 7.1 Prediction of Traffic Accidents in the Future

	2012	2022	2032
Vehicles No./day	35,000	60,000	100,000
Number of Traffic accident	4	8	12

Note) Calculated based on statistical data (4.1 accident / 10 millions vehicle kilometer)

11) Infectious Diseases such as HIV/AIDS

During Construction

Moderate:

During Construction, in general, a lot of migrant workers flow into the sites, who may have the possibility with HIV/AIDS (1-2 person assuming 0.1%¹ of 1,500 worker) and the disease can spread among local people.

During Operation

No impact is expected

12) Gender

During Construction

Moderate:

The ratio of discrimination cases between genders by the Project is not known. However many women workers are required during construction, not only as daily catering at workers camps but also as unskilled construction workers during construction. In these cases, discrimination of salary between genders can be caused.

During Operation

No impact is expected

13) Children's right

During Construction

Moderate:

More than 33% of laborer in Bangladesh is children and it is highly possible that a bunch of children come and work in construction site.

¹ Ratio of HIV patient per population in Bangladesh, assumed as maximum

14) Bank erosion

Before/During Construction

No impact is expected

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.

During Operation

Negligible:

Based on the numerical analysis, construction of bridge will not cause bank erosion because hydrological change, such as increasing of water level by the construction of new piers is negligible.

15) River transportation

During Construction

Moderate:

During construction, many construction barges, 10 to 20, will be brought to the sites. Risk of collision of passing vessels such as passengers' boat, cargo, barges with piers and construction vessels can be increased by the congestion of vessels at the sites.

During Operation

Negligible:

Since location of new piers of the bridges will be constructed approximately 10m offset from existing piers, thus vessels and passenger's boat will be able to pass same route.

16) Hydrological condition

Before/During Construction

No impact is expected

During Operation

Totally Severe:

-Change of water level

Negligible:

Water flow direction doesn't change or water level doesn't rise by construction of piers in the riverbed.

The increasing of water level by the construction of the new piers is estimated as Table 7.4. As shown in the table, the increments are almost 2cm only at three bridges, as can be negligible range compared to the rise of water level as high as 8m in flood season from dry season in the maximum.

Table 7.2 Prediction of Water Level Rises by the New Bridges

Symbol/ formula	Factor	Kanchpur	Meghna	Gumti
Q	Discharge in the maximum, m ³ /s	3,480	15,200	12,600

C	Shape factor of pier	0.9	0.9	0.9
b1	Width of river, m	400	930	1410
t	Width of pier, m	14.6	9	9
n	Number of pier	5	10	16
b2=b1-t*n	Net width of pier, m	327	840	1266
H1	Water depth at upstream corner of the pier in wet season, m	13	18	12
$x = \frac{Q^2}{2/9.8*(1/C^2/(H1-x)^2 - 1/b1^2/H1^2)}$	Increment of water table by the installation of pier, m	0.02	0.022	0.015

Reference: Japan Institution of Construction Engineering, 2009

From groundwater point, the groundwater level will hardly change because the construction activity does not use groundwater, but river water, and the groundwater is just used for portable water of construction workers, the poor and so on. Thus, there is hardly change of groundwater level and the wells, located around the site, have the stable water level.

Scouring

Severe:

Foundation of new bridge will be combined with that of existing bridge and, as a result, the scouring depth becomes deep to 11m from river bed. Thus appropriate bridge construction technology and periodic maintenance should be followed.

Table 7.3 Depths of Scouring Made in the Past and Depths can be Caused in 100 years' Period Return in the Future

	Kanchpur	Meghna	Gumti
Maximum scouring taken placed in the past, m	0	18	6
Maximum scouring maybe taken place in the future, m	8	4	7

Data source: Study team

Details of estimation are discussed in the engineering report of separate volume (Preparatory Survey Report for Dhaka-Chittagong National Highway No.1 Bridge Construction and Rehabilitation Project Report 2012).

Back water

No impact is expected

17) Fauna and flora

During Construction

Moderate:

Wildlife habitats in the Project area are very limited. This is due to the natural environment in this area being already under stress from human habitation, agriculture,

grazing, navigation and other human activities. There is no acts affecting to vegetation, during both construction and operation. River dolphin is observed in the project area and picked up as a key species from the view of natural environment consideration. However, it seems that the Meghna and Gumti river is a secondary habitat based on interview with experts² and literature survey. Their main habitat is merging point Kushiara River and Monu River the Meghna where more than 200km away from the Project site. (see Figure 4.16) Thus it is not likely to give serious impact to this species. However moderate impacts on the wildlife including above River Dolphin will be imposed by ①driving hundreds of steel piles into riverbed causing vibration and noise, ②passing construction vessels, and ③night lighting.

During Operation

Negligible:

Activities which give negative impact to wildlife including River Dolphin are not expected during operation, thus no impact is expected.

18) Global warming

During Construction

Negligible:

Although construction machines and vehicles generate greenhouse gases, quantities of generated gases do not give serious impact and negligible on this item.

During Operation

No impact is expected (but positive impact is expected):

Amount of emission of Carbon Dioxides (CO₂) based on the increase of vehicles are estimated as Table 7.4 In the table, Emission from construction vehicles/equipments is negligible compared to the number of passing vehicles daily.

² Dr. S. M. A. Rashid, Chief Executive of CARINAM, Center for Advanced Reserch in Natural Resources and Management, Ph.D. Nd.Istiaq Sobhan,PhD.Programme Coordinator IUCN Bangladesh

Table 7.4 Amount of CO₂ Emitted from Vehicles³

		Ton/year		
		2012	2022	2032
Vehicles No./day presumed		35,000	60,000	100,000
Average vehicle velocity presumed km/h	With project,	50	40	30
	Without project	40	30	20
Carbon Dioxides emission Ton/year	With project,	579,500	1,093,750	2,063,000
	Without project	638,000	1,237,750	2,456,000

Note) Formulation is attached in Annex 2

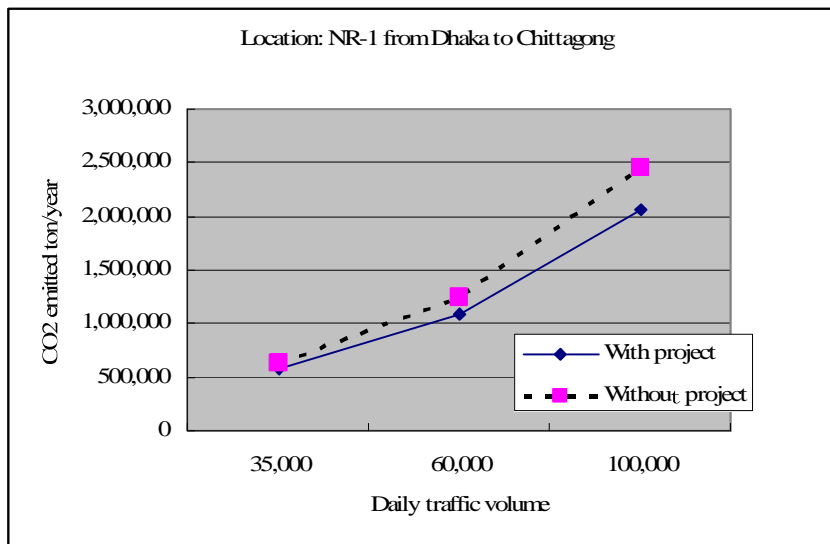


Figure 7.3 Amount of CO₂ Emitted in Prediction

As shown, the vehicle number is estimated as sharply increased, while the average velocity decreases due to narrow bridges without project in 2022 and 2032 respectively. As the results, the amount of CO₂ emitted will increase accordingly in those times since the CO₂ emitted is in proportion to the fuel consumed. However by the implementation of project, the driving velocity of vehicles improves compared to the case without project in the future and then emitted CO₂ are not so much as the case of without project since the amount of fuel consumption improves by increased driving velocity. Thus, by the implementation of the project, the amount of CO₂ emission will be decreased as is in favor to prevent global warming issue.

³ Environmental Information Science Center³,1999

19) Air pollution

During Construction

Moderate:

The air may be tentatively polluted due to:

- Dust arisen from unpaved road, sand/ earth stock pile by wind
- Emission from heavy equipment/ trucks

During Operation

No impact is expected (but positive impact is expected):

In Bangladesh, most vehicles are run by Compressed Natural Gas (CNG) and no pollutant except Nitrogen Dioxides (NO₂), as of one tenth of gasoline fuel, is emitted. So, other than that, no air pollution is caused by increase of traffic volume in the future about Suspended Particular Matters (SPM) and Sulfur Dioxides (SO₂).

Total amount of NO₂ emission was estimated based on the increase of vehicle number and then velocity. Table 7.5 presents the results of estimation.

Table 7.5 Estimation of NO₂ Emitted

			2012	2022	2032
Vehicles No./day			35,000	60,000	100,000
Average vehicle velocity km/h	With project,		50	40	30
	Without project		40	30	20
Nitrogen dioxides emission ton/year	With project	From vehicle	38.5	78.8	161.0
		From Construction equipment	1.2	0	0
	Without project	From vehicle	45.5	96.3	199.5

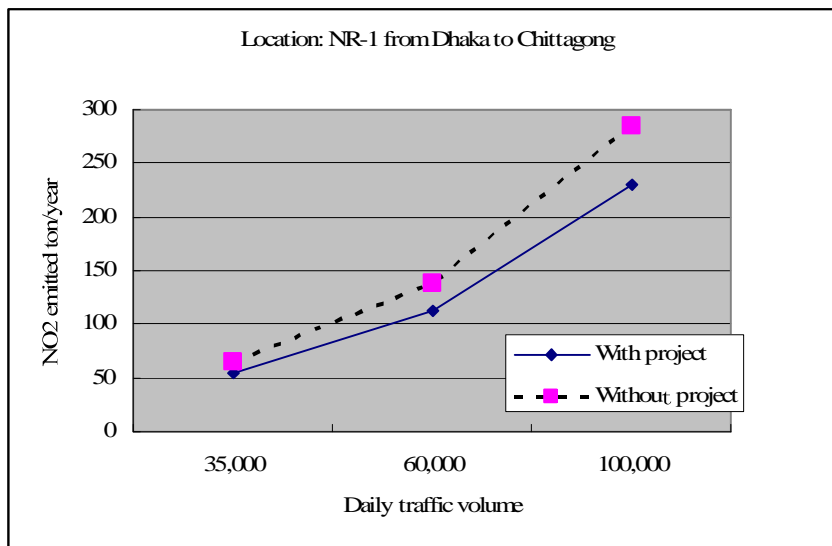


Figure 7.4 Estimation of NO2 Emitted Yearly

As shown in the table and the figure above, amount of air pollutant, when the Project is implemented (With project), is decreased compared when project is not implemented (Without project).

Next, concentration of NO₂ at the Project site along the road is estimated and is shown in Figure 7.5

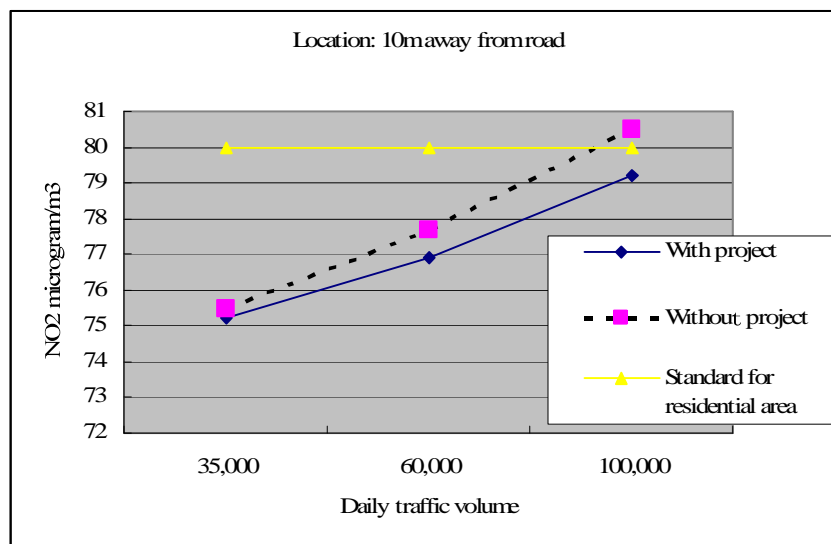


Figure 7.5 Concentration of NO₂ Estimated

NO₂ concentration is also estimated to be still within the standard of residential area if the Project is implemented until traffic volume reaches to 100,000 in the year of 2032.

As a conclusion about air pollution caused by the Project during operation, following is noted:

- Presently, SPM measured along the road is about 800 microgram/m³ which is more than 500 microgram/m³ as of industrial area standard. It is assumed that current high SMP Concentration is mainly from many brick kilns and cement factories in the Project area, not traffic exhaust. However quantity of generated SPM from vehicles will be increased in conjunction with increase of traffic volume.
- SO₂ exceeds at Kanchpur Bridge site only and is also not emitted from CNG run vehicles. No impact is caused by the increase of the traffic volume as well.
- NO₂ is emitted a little (one tenth) of gasoline run vehicles from CNG run vehicles. Concentration of NO₂ is within the standard of residential area until 2032 if the project is implemented. If the project is not implemented, it slightly exceeds the standard.

20) Water pollution

During Construction

Totally Moderate:

Surface water

In this project, surface water pollution will be minimized because Steel Pipe Sheet Pile (SPSP) foundation is supposed to be used and its high impermeability does not basically allow turbid water by construction to come out. Despite the above minimized impact, some surface water pollutants can adversely cause water pollution.

About the causes of surface water pollution, followings are considered:

Table 7.6 Pollutants and Their Possible Sources

Pollutants		Sources of pollutants			
		Pile driving in the river	Mud water from earthwork for approach embankment while rainy season	Domestic waste liquid from worker's camp	Oil leaking from construction vessel
a	Suspended Solid (SS)	Possible source	Possible source	Possible source	-
b	Biochemical Oxygen Demand (BOD)	-	-	Possible source	-
c	Ammonium	-	-	Possible source	-

	nitrogen (NH4-N)				
d	Coliform	-	-	Possible source	-
E	Oil and greases	-	-	-	Possible source

For each pollutant, qualitative/quantitative studies are made as:

a. Suspended Solid (SS)

Increment of SS in river water is estimated based on the volume of soils which is push out into river water by the installation of steel pipe sheet piles for piers. Table 7.7 indicates the estimation by pier construction.



Picture 7.1 Example of Steel Pipe Sheet Pile Foundation

Table 7.7 Estimation of increase of Suspended Solid (SS) in the River Water by Pier Construction

a	Width	m	31.3	32.44	29.95
b	Length	m	8.5	14.97	13.73
c	Perimeter length: 2(a+b)	m	79.6	94.82	87.36
d	Driven depth	m	33	48	70
e	Soil dissolved out per pier : c*d	m ³	2,627	4,551	6,115
f	Duration of construction (8 hours/ day)	days	225	225	225
g	Number of pier constructed at the same time	No	3	3	3
h	Dissolved rate of soil volume	m ³ /s	0.0012	0.0021	0.0028
i	Water content of soil		60%	60%	60%
j	Dissolved rate of soil volume	m ³ /s	0.0005	0.0008	0.0011
k	Dry unit weight of soil	ton/m ³	2.7	2.7	2.7
l	Dissolve rate of soil weight	ton/s	0.0013	0.0022	0.0030
m	River flow in dry season	m ³ /s	292	2,046	3,703
n	SS in the current River : l/m	mg/l	4.45	1.08	0.81
o	Present SS in dry season	mg/l	16-153	28-29	72-108
p	SS for construction period in dry season	mg/l	20-157	29-30	73-109

Note: SS (mg/l) was assumed as equal to Turbidity (NTU)

Amount of surface soils washed away by rain can be estimated as⁴:

$$Y = 0.023X^{1.2}$$

Where:

Y: Soil washed out by rain (ton/ha/year)/1,000,000

X: Rainfall (mm/year) × Maximum possible SS (mg/l)

Table 7.8 presents the results estimated.

Table 7.8 Estimation of Increment of SS by Wash Out of Surface Soil by Rain

Maximum rain fall assumed, mm/year	Possible maximum SS mg/l	Soils washed out by rain ton/ha/year	Construction Area*, ha	Total weight of soil washed out, ton/year	Strength of soil weight washed out by rain, ton/s	Increment of SS, mg/l	Presents SS in three rivers mg/l
2000	10000	1.327	10	13.3	0.0000004	0.0005	11-85

*100m width with a total of 1,000m length of approach road on banks were assumed as a source of muddy water while raining.

Data source: study team

As shown in the above table, the increment of SS by earthwork can be practically zero.

Therefore, mud water generated running off from embankment during construction can be acceptable and no measure is necessary to take for mud water during construction. However in rainy day, earthwork shall not be done to minimize.

Table 7.9 estimates the increment of SS by the discharge into river of domestic liquid waste from workers' camp.

Table 7.9 Estimation of SS Increment by Discharge of Domestic Liquid Waste from Worker's Camp

	Unit	Kanchpur	Meghna	Gumti
Effluent unit of SS*	g/person/day	28	28	28
Number of worker	Person	500	500	500
Concentration	mg/l	91	91	91
Total SS	g/day	14000	14000	14000
Discharge in wet season	m ³ /s	3,480	15,200	12,600

⁴ "The estimate method of soil loss with relation to rainfall" (2001 Eisaburo HIGA/ Okinawa Prefectural Institute of Health and Environment)

Discharge in dry season	m ³ /s	292	2,046	3,703
Increment of concentration at wet season	mg/l	0.00001	0.00001	0.00001
Increment of concentration at dry season	mg/l	0.00022	0.00003	0.00004
Present TSS in wet season	mg/l	579-2,305	54-72	47-82
Present TSS in dry season	mg/l	16-153	28-29	72-108

Source: Environmental Information Science Center, 1999
Data source: study team

As shown in the above table, the increment of SS by the discharge of liquid waste from workers camp is also practically zero. An effluent standard of SS in domestic liquid waste is specified as 100mg/l in the maximum and the estimated concentration of SS is within this standard.

Table 7.10 Total Amount of SS Estimated to be Increased in the River Waters in the Maximum

Causes	Maximum increment of SS, mg/l
Installation of piers in the river	1.7
Mud water from earthwork	0.0005
Liquid waste from workers' camp	0.0002
Total	Practically 1.7

Data source: Study team

Thus, at most 2 mg/l can be increased during construction, as is negligible range compared to the present concentration of SS, 10-80mg/l.

b. BOD

BOD estimated to be increased by the Project is considered by domestic liquid waste from workers camp only. Table 7.11 predicts the increment.

Table 7.11 Estimation of Increase of BOD in the River Water by Domestic Liquid Waste from Worker's Camp

		Kanchpur	Meghna	Gumti
Effluent unit of BOD	g/person/day	45	45	45
Number of worker	Person	500	500	500
Total BOD	g/day	22500	22500	22500
Concentration	mg/l	146	146	146
Discharge in wet season	m ³ /s	3500	12700	10400
Discharge in dry season	m ³ /s	750	4700	4000
Increase of concentration at wet season	mg/l	0.00001	0.00001	0.00001
Increase of concentration at dry	mg/l	0.00035	0.00006	0.00007

season				
Present BOD concentration in wet season	mg/l	12-19	1	1-3
Present BOD concentration in dry season	mg/l	10-20	3	1-3

Data source: study team

As shown in the table, the increment 0.00035 mg/l as is negligible compared to the present concentration of 1.0 mg/l in the minimum. However, there is an effluent standard of BOD for sewage as 40 mg/l in the maximum and the concentration of BOD in effluent from camp, 45 mg/l, is estimated as beyond the effluent standard of 40mg/l, regardless the total amount. Therefore, domestic liquid waste from the camp can not be directly discharged into the river.

c. Ammonium nitrogen (NH₄-N)

NH₄-N is an important indicator of eutrophication of river caused by urbanization. Increment of NH₄-N is estimated based on the amount of domestic liquid waste generated from the workers' camp as shown in Table 7.12.

Table 7.12 Estimation of Increase of Total Nitrogen in the River Water by Domestic Liquid Waste

		Kanchpur	Meghna	Gumti
Effluent unit of Total Nitrogen T-N*	g/person/day	9	9	9
Number of worker	Person	500	500	500
Total T-N	g/day	9	9	9
Concentration of T-N	mg/l	29	29	29
Concentration of NH ₄ -N assumed as of T-N	mg/l	29	29	29
Discharge in wet season	m ³ /s	3500	12700	10400
Discharge in dry season	m ³ /s	750	4700	4000
Increase of concentration at wet season	mg/l	0.00001	0.00001	0.00001
Increase of concentration at dry season	mg/l	0.00007	0.00001	0.00001
Present NH ₄ -N in wet season	mg/l	1.2-3.5	0.1	0.1
Present NH ₄ -N in dry season	mg/l	9.6	0.3-0.5	0.3

Data source: study team

As shown in the table, amount of Total Nitrogen, including NH₄-N, is in the order of far negligible range, 0.00007 in the maximum, are predicted. Concentration of estimated T-N is within the effluent standard, 250 mg/l.

d. Coliform

The method to estimate Coliform concentration in sewage is yet established. Coliform is included in the domestic liquid waste very commonly. If the domestic liquid waste from workers' camp is directly discharged into the river, the river will be contaminated.

e. Oil and grease

It is very commonly observed that more or less of fuel oil is always leaking and floating around construction vessels moored on the water surface. Presently there is no way to predict the amount of oil leaking although the concentrations of oils and greases, 3-6 m/l, are already always higher than standards, 0.01 mg/l. Therefore, oil leaking can take place as usual during pier foundation construction.

Environmental impacts to surface water can be concluded as:

Table 7.13 Evaluation of activities as may pollute the surface water

	Environmental standard	Effluent standard	Total evaluation
Run off mud water	Accepted	-	Accepted
Domestic liquid waste from camp	Accepted	Not accepted	Not accepted
Leaked oil from vessels	Not accepted	Not accepted	Not accepted

Groundwater

Groundwater cannot be contaminated due to the Project activity which does not include the injection of large amount of cement or chemicals into the ground/groundwater.

During Operation

No impact is expected

21) Soil pollution

During Construction

Moderate:

Usually soil pollution by leaked petrol from pipe connection of ill-maintenance heavy equipment and storage tanks which are installed directly on the soil surface can cause oil leaking that result in pollution of subsoil and groundwater during construction.

Furthermore totally 119,000 m³ borrow is taken from surrounding areas for construction of embankment, such borrow may be contaminated by hazardous matter.

During Operation

No impact is expected

22) Waste

During Construction

Moderate:

Construction sludge by boring from underground and domestic waste from base camp is generated during construction. However, owing to the results of primary surveys (soil pollution and bottom sediment), construction sludge does not have high density of pollutants.

Estimated volume is shown below;

Table 7.14 Evaluation of activities as may pollute the surface water

Category of Waste	Generated location	Estimated volume	Remarks
Construction sludge	Borehole in the river	Total 5,500 m ³ Kanchpur: 1,300m ³ Meghna: 1,800m ³ Gumti: 2,400m ³	Contains bentonite. Bentnite is not hazardous matter, but it causes turbidity in the water
Domestic waste	Base camp site	450 ton/ 5 years/3 camps*	

* Estimation formulation: 200g/day/person X 500 workers for each camp=100kg/day=3 ton/month

During Operation

No impact is expected

23) Noise and vibration

During Construction

Moderate:

Construction noise and vibration will be caused from construction machines and vehicles. However, significant impact does not occur because of the below reasons.

a. Construction of bridge foundation and pier strengthening construction of existing bridge

Though huge noise is relatively generated through construction of bridge foundation and pier strengthening construction of existing bridge, the construction site is 40 meters away from residential area. This far distance does not give significant impact to residential area.

b. Embankment construction for construction road

The construction site is relatively near to residential area and the most nearby construction site from residential area is the Chittagong side of Kanchpur Bridge. However, low-noise construction vehicles will be used and construction work is not done at night. Moreover,

construction period is no more than 6 months. Hence, there would be not significant impact on residential area.

During Operation

Moderate:

A result of quantitative noise forecast is shown in Table 7.15, 7.16, and 7.17. In current time (2012), the nearest house or shop from the road is 10m away and the values of noise are shown with bold text on the three tables. On the other hand, in future time (2022), the nearest house or shop from the road would be 20m away and the values of noise are shown with bold text on the three tables.

According to the result, the forecasted value of 67 dB(A) at Gumti only exceeds the standard value of 60 dB(A). However forecasted value of 67 dB(A) in 2022 is less than the current measured value of 69 dB(A).

Thus, it is not likely to give significant impact to the nearest residents or shops.

Since it can be predicted that traffic jam decreases and traffic condition improves in 2022, car horn is not used as much as 2012 and the noise level could be lower than the forecasted value shown on the tables.

Table 7.15 Prediction of Noises in the Future (Kanchpur Bridge)

Year	Time	Forecasted Noise dB(A)					Standard Value*1	Land use	Evaluation
		10m Current Evaluated point*2	20m Future's Evaluated point*3	50m	100m	200m			
2012	Day	79	67	65	63	61	75	Industrial	Not satisfied
2022		82	70	67	65	62			Satisfied
2012	Night	75	64	62	61	61	70		Not satisfied
2022		78	66	63	62	61			Satisfied

Note1) Standard: Standard for Sound (Environmental Conservation Rules, 1997)

Note2) Current evaluated point in 2012: In front of house/shop

Note3) Future's evaluated point in 2022: In front of house / shop during operation

Table 7.16 Prediction of Noises in the Future (Meghna Bridge)

Year	Time	Forecasted Noise dB(A)					Standard Value*1	Land use	Evaluation
		10m Current Evaluated point*2	20m Future's Evaluated point*3	50m	100m	200m			
2012	Day	74	69	64	61	60	75	Industrial	Satisfied
2022		78	72	67	63	61			Satisfied
2012	Night	66	62	61	60	60	70		Satisfied
2022		68	64	61	60	60			Satisfied

Note1) Standard: Standard for Sound (Environmental Conservation Rules, 1997)

Note2) Current evaluated point in 2012: In front of house/shop
Note3) Future's evaluated point in 2022: In front of house / shop during operation

Table 7.17 Prediction of Noises in the Future (Gumti Bridge)

Year	Time	Forecasted Noise dB(A)					Standard Value*1	Land use	Evaluation
		10m Current Evaluated point*2	20m Future's Evaluated point*3	50m	100m	200m			
2012	Day	71	67	62	61	60	70	Commercial	Not satisfied
2022		73	68	63	61	60			Satisfied
2012	Night	69	65	62	61	60	60		Not Satisfied
2022		72	67	64	61	60			Not Satisfied

Note1) Standard: Standard for Sound (Environmental Conservation Rules, 1997)

Note2) Current evaluated point in 2012: In front of house/shop

Note3) Future's evaluated point in 2022: In front of house / shop during operation

Based on the noise monitoring/prediction, distributions of noise level were estimated as in Figures from 7.6 to 7.8

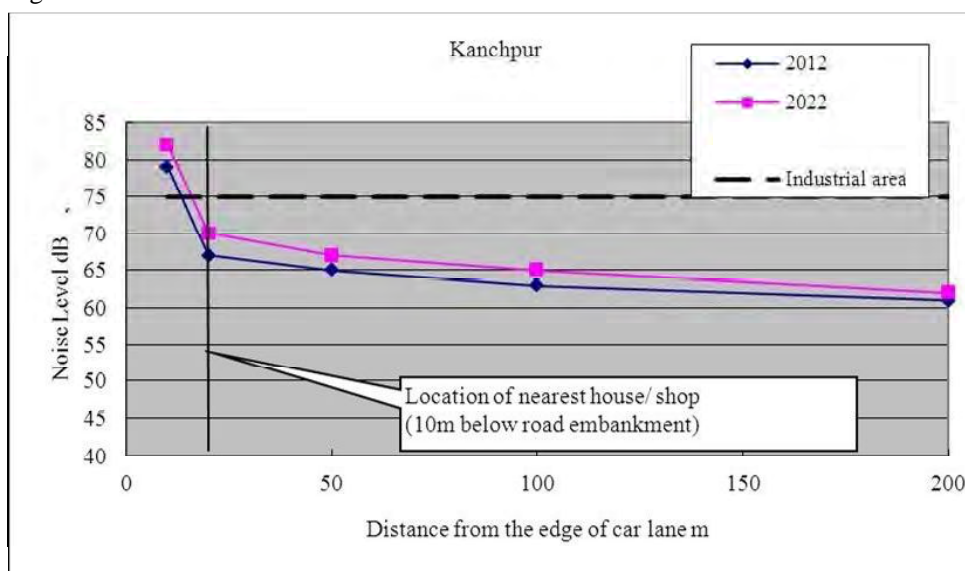


Figure 7.6 Noise versus Horizontal Distance at Kanchpur

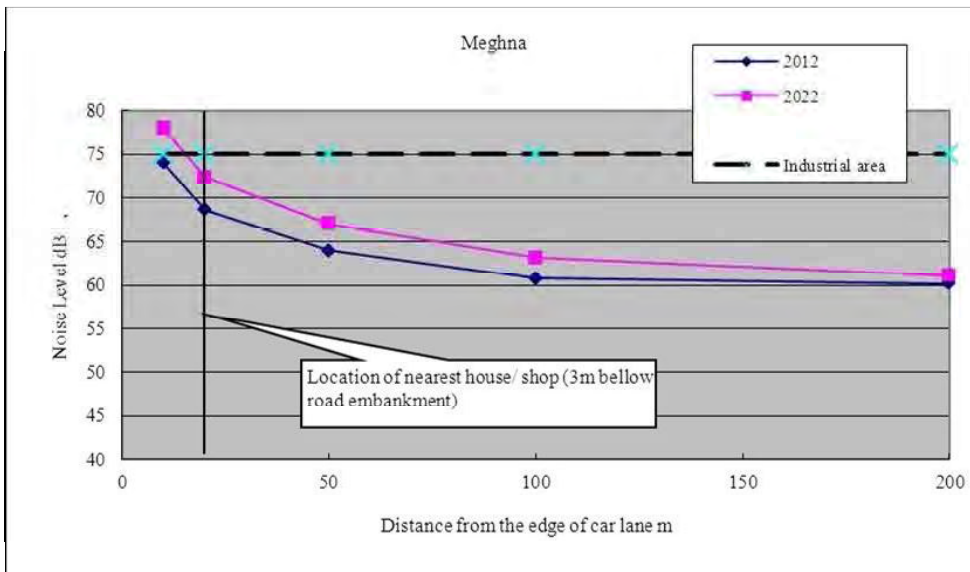


Figure 7.7 Noise versus Horizontal Distance at Meghna

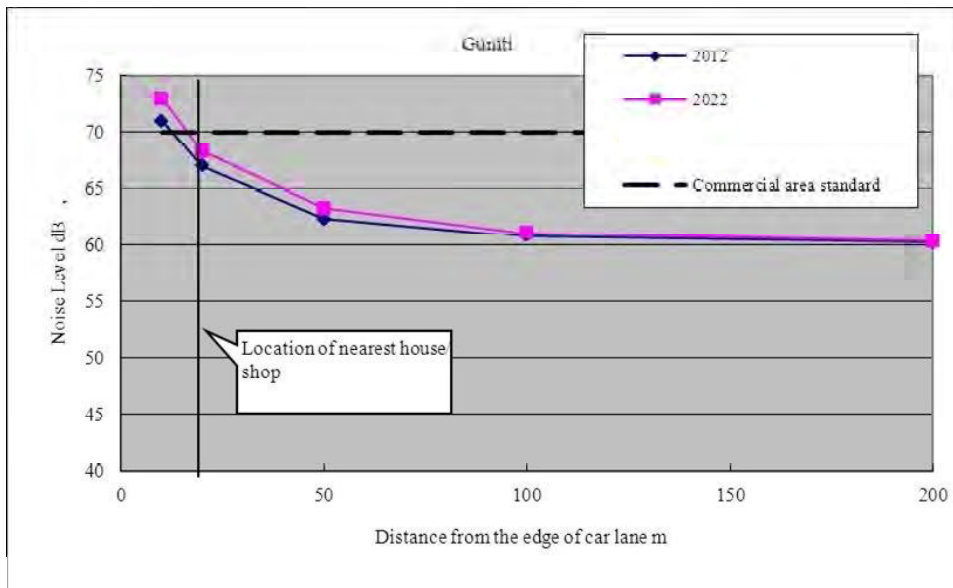


Figure 7.8 Noise versus Horizontal Distance at Gumti

24) Ground subsidence

During Construction and Operation

Negligible:

No long term subsidence is predicted since there is no clayey soft deposit as may cause long term consolidation settlement.

25) Offensive odor

Before/During Construction

Moderate:

Local people residing just beside the construction field/ camp may complain on open burning of construction waste, improper treatment of human liquid waste, exhausted smoke from heavy equipment etc.

During Operation

No impact is expected

26) Bottom contamination

During Construction

Moderate

River bed can be contaminated if waste is indiscriminately dumped into rivers. Among all, heavy metal contained in chemical paints and sludge in camp liquid waste can be accumulated in the river bottom.

During Operation

No impact is expected

27) Landscape

Before/During Construction

No impact is expected

During Operation

Negligible

Following are image photos for new Kanchpur Bridge and new Meghna Bridge respectively. As shown, since the height of new Bridges are same as existing bridges and new piers are also located parallel to existing piers, there is no major change in landscape of bridges.



**Figure 7.9 New bridge (imaged) and Existing Bridge (background)
at Kanchpur Bridge Site**



**Figure 7.10 New Bridge (imaged) and Existing Bridge (background)
at Meghna Bridge Site**

CHAPTER 8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Objective

The Environmental Management Plan (hereinafter, the Plan or EMP) aims to ensure the compliance of all activities undertaken during the construction and the operation of the Kanchpur, Meghna and Gumti bridge at Dhaka-Chittagong National Highway No.1 (NH-1) with the environmental safeguard requirements of JICA and the Government of Bangladesh. Furthermore, it aims at integrating the environmental components of the project with existing initiatives and programs in these fields. The plan consists of mitigation, monitoring and institutional measures to be taken during construction and operation to minimize adverse environmental impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures.

8.2 Environmental Management Measures Proposed

(1) Policy

During construction work, all the reasonable steps shall be taken to protect the environment both on and off sites and to limit the damage and nuisance to people and resulting from pollution, noise and others as the result.

The EMP holds details: (a) the measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts or to reduce them to acceptable levels; and (b) the actions needed to implement these measures. Basically, mitigation measure is prepared for the items that are concluded “severe” and “moderate” in chapter 7.

(2) Acknowledgement of laws and regulations

The contractor/engineers shall acknowledge the law, regulations and target set forth for the project of the Government of Bangladesh pertaining health, safety and environmental protection related to:

- Air pollution
- Water quality
- Prevention of social impact
- Noise and vibration
- Fuel and chemical storage
- Protection of historic and cultural heritage/activity

(3) Staffing with contractor's responsibilities

Environmental/safety/health officers are appointed whose responsibilities include:

- Assisting contractor to implement health, safety and environmental protection and management as set forth in the contract
- Undertaking day to day environmental management tasks
- Maintaining a site diary recording all relevant matters concerning environmental management including protection, control, audit, inspection and interviews.
- Regular checking and keeping records of all safety and protective apparatus, equipment and clothing provided and
- Organizing the orientation courses on safety and health for new comers, including provision of measures for awareness and prevention of Sexually Transmitted Infection (STI) and HIV/AIDS among all.

(4) Regular meeting with communities

Monthly meeting shall be held to explain the work progress and take any concern/complains about construction raised by the residents to mitigate.

(5) Reporting

Following reports shall be prepared, submitted and coordinated:

- Weekly environmental and safety reports, documenting the safety and environmental inspection/audit taken on a weekly basis
- Monthly summary of weekly inspection
- Accident report of workers or staff on site or off site whichever

(6) Environmental Management Plan

Table 8-1 summarizes the proposed environmental mitigation plans. The monitoring itself is implemented by the contractor, the RHD is in the first position to supervise the monitoring activities and evaluate the results except resettlement issue.

Table 8.1, 8.2, 8.3 summarizes ①the potential impacts which are to be controlled, ②the mitigation measures, ③construction stage, and ④ implementation and monitoring agency. This EMP is outlining a preliminary; detail EMP should be prepared during detail design stage.

Table 8.1 Summary of EMP (Before Construction)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures	Implementation and Monitoring Agency
SOCIAL ENVIRONMENT			
1) Involuntary Resettlement	Severe: Households and people are influenced	<ul style="list-style-type: none"> • Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
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"> • All direct income loss must be adequately compensated within the RAP • Income loss can be mitigated by providing alternative job opportunities for PAPs. 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	<ul style="list-style-type: none"> • Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation	<ul style="list-style-type: none"> • Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	<ul style="list-style-type: none"> • Prepare RAP involving the following measures <ul style="list-style-type: none"> - Define the displaced persons and criteria for determining their eligibility for compensation - Establish external monitoring committee consists of the third party • For poor people, proponent activities improving surface water condition and making groundwater available shall be implemented 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	<ul style="list-style-type: none"> • Prepare RAP involving the following measures <ul style="list-style-type: none"> - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency

8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	<ul style="list-style-type: none"> • Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen.. 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
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RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.2 Summary of EMP (During Construction)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures	Implementation and Monitoring Agency
SOCIAL ENVIRONMENT			
1) Involuntary Resettlement	Severe: Households and people are influenced	<ul style="list-style-type: none"> • Proper resettlement action Plan (RAP) • Provide adequate compensation and assistance in time to PAPs 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
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"> • All direct income loss must be adequately compensated within the RAP • Income loss can be mitigated by providing alternative job opportunities for PAPs. 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	<ul style="list-style-type: none"> • 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 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation and noise	<ul style="list-style-type: none"> • Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs • Periodical maintenance of construction vehicles • Installation of sound insulation 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
5) Existing social infrastructures and Services	Moderate: Social service utilities are located underground in the affected area	<ul style="list-style-type: none"> • Proper detailed design is going to be done and the utilities line will be diverted before starting the construction activity. 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency

6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	<ul style="list-style-type: none"> • Prepare RAP involving the following measures <ul style="list-style-type: none"> - Define the displaced persons and criteria for determining their eligibility for compensation - Establish external monitoring committee consists of the third party • For poor people, proponent activities improving surface water condition, making groundwater available and enhancing their job skill shall be implemented 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	<ul style="list-style-type: none"> • Prepare RAP involving the following measures <ul style="list-style-type: none"> - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	<ul style="list-style-type: none"> • Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen.. 	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
10) Accident	Moderate: Construction workers can have harmful and critical troubles	<ul style="list-style-type: none"> • Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors 	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
11) HIV/AIDS-	Moderate: Transmission of disease by inflow of migrant workers	<ul style="list-style-type: none"> • An HIV-AIDS awareness campaign via approved service provider shall be implemented 	Supervisor: RHD, Reviewer: Consultant, PAPs, Performer: Contractor
12) Gender	Moderate: Salary gap between genders	<ul style="list-style-type: none"> • Monitoring of payment to workers by the contractor shall be implemented not to allow payment gaps between male and female. 	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
13) Children's right	Moderate: A bunch of children come and work in construction site	<ul style="list-style-type: none"> • Regular monitoring of sites to guide contractors and their related firms to discourage child labor. • When the child labor will be detected, necessary and decisive actions to the violating firms are implemented. • Some assistance for parents of working child 	Supervisor: HD, Reviewer: Consultant, PAPs Performer: Contractor
15) River Transportation	Moderate: Congestion of vessels generates any collision	<ul style="list-style-type: none"> • -Provision of illumination night time around anchorages 	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
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"> • Any illegal discharge of waste water, leaked oil shall be prohibited • Construction development area shall be fixed, not to develop or cut trees out of project area • Monitor to both upstream and downstream side will be conducted from the bridge surface • If dolphin is observed around project site, piling works and vessels should keep being suspended until the dolphin passes over. • Night lightning in construction should be restricted to the construction site. 	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
ENVIROMNTAL POLLUTION			
19) Air Pollution	Moderate: Dust rising from unpaved road and others during construction	<ul style="list-style-type: none"> • Good maintenance and operation of equipment and vehicles • Use environmentally-friendly material • Spraying water to suppress the dust rising • Cover entire load with tarpaulin to prevent the load from being blown. • Good maintenance of material • Monitoring and regular meeting for air quality 	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor

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"> • 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 • Impermeable wall shall be used with cast-in-place pile • 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 • Domestic water is treated by septic tank for satisfying water quality standard and drain away to the nearest drainage or river. • Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers. • Waste oil shall be stored without leaking before legal disposal process. • Refuelling place to equipment/ vehicles shall be concreted floor • Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence • Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly • 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 • 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. 	Supervisor : RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
21) Soil pollution	Moderate: leakage of oil, and borrow can contaminate soil	<ul style="list-style-type: none"> • Disposal at designated dumping site • Soil quality Testing • Disposal of waste oil without leakage • Refueling place having concreted floor • Preserved in the tank surrounded with concrete fence • Equipment and vehicles are properly maintained • Batteries containing liquid inside shall be kept on impervious place 	Supervisor: RHD , DoE Reviewer: Consultant, PAPs Performer: Contractor

22) Waste	Moderate: Generation of construction sludge and domestic waste	<ul style="list-style-type: none"> Minimize volume to use silt basin before disposing Segregate waste to minimize waste material Disposed in designated dumping site instructed by the section handling waste Recycled as possible with consideration of soil property. 	Supervisor: RHD, DoE, Reviewer: Consultant, PAPs Performer: Contractor
23) Noise and Vibrations	Moderate: Noise and vibration from construction machines and vehicles	<ul style="list-style-type: none"> Periodical maintenance .of construction vehicles Installation of sound insulation cover on boundary near residential area 	Supervisor: RHD, DoE, Reviewer: Consultant, PAPs Performer: Contractor
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"> Prohibition of open burning Proper treatment of camp waste Proper maintenance of heavy equipment. 	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
26) Bottom sediment	Moderate: Waste dumped into rivers can contaminate river bed	<ul style="list-style-type: none"> Construction contractor will be obliged to no dumping of waste into the river 	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor

RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.3 Summary of EMP (During Operation)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures	Implementation and Monitoring Agency
SOCIAL ENVIRONMENT			
10) Accident	Moderate: Traffic accident occurred	<ul style="list-style-type: none"> Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc. 	Supervisor: RHD, Reviewer: NGO, PAPs Performer: Consultant, RHD
ENVIROMNTAL POLLUTION			
16) Hydrological condition	Severe: hydrological condition was affected by scouring	<ul style="list-style-type: none"> 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. 	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
23) Noise and vibration	Moderate: a forecasted value exceeds a standard one.	<ul style="list-style-type: none"> Securement of buffer zone as noise decay distance (land utilization guide by RHD and local authority) 	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor

RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Outline of environmental management plan for items recommended in JICA Guidelines are:

1) Involuntary Resettlement

A total of 274 households (972 people) will be relocated and 32 households (44 people) will be affected. It is likely to have significant adverse impact on this item since more than 200 resettlers are predicted. Thus appropriate compensation and livelihood restoration program is prepared in the resettlement action plan (RAP)

2) Local Economies such as employment, livelihood etc.

A total 66 shop owners (61 shop owners and 5 tenant shop owners), 28 employees, 5 fish pond cultivators, 2 companies properties and 1 plantation owner will be affected by the project. Thus appropriate compensation and livelihood restoration program is prepared in the RAP.

For fisherman, an investigation to clarify fish habitat is carried out and can tell where fish makes its habitat if fisherman has difficulty with fishing due to the change of fish habitat.

3) Land use and utilization of local resources

Although a plantation area and part of fish pond will be tentatively occupied before and during construction, it will be restored to original state and returned to the land owner after construction

4) Social institutions such as social infrastructures and decision-making institutions

For relocation, appropriate compensation and livelihood restoration program is prepared in the RAP. For noise from construction vehicles, periodical maintenance of the vehicles and installation of sound insulation are carried out.

5) Existing social infrastructures and Services

Detailed design is going to be done with the consideration of preventing social service utilities, such as power, water, drainage and communication line, from be affected. Then, the utilities line will be diverted before starting the bridge construction activity.

6) Poor, indigenous people or ethnic minority

There are not any indigenous people in the project affected area.

However about 40% of the population interviewed is classified as poor with yearly income of less than BDT 120,000. Thus appropriate compensation and livelihood restoration program is prepared in the RAP. For poor people, proponent activities improving surface

water condition, making groundwater available and enhancing their job skills shall be implemented.

7) Maldistribution of benefit and damages

Displaced people may suffer from losing their shelter (residential house), business access (small kiosk) and social network (relationship with families/ neighbor/ friends) generally at all bridge sites. Some suffers for loss of plantation at Meghna Bridge Site. Thus appropriate compensation and livelihood restoration program is prepared in the RAP report.

8) Local conflict of interest

Due to increased employment opportunity during construction, candidates of construction workers may have some conflicts between communities. Thus such job opportunities should be provided in fair way. Clear information about the needs of labor (number and qualification) should be provided with local people. The job skills and the priority for the affected people shall be taken into account and the workers can be chosen.

10) Accident

Construction safety and Health Plans

At all the time, precautions to maintain the health and safety of all workers shall be exercised. In collaboration with local health authorities, medical staff, first aids facilities, sick bay and ambulance service shall be available at the site all the times and suitable arrangement is made for all necessary welfare and hygiene requirements and prevention of epidemics. For this purpose, plans for construction safety and traffic safety shall be established before construction and operation in Health and Safety Management Plan (HSMP) by contractor.. For the preparation of HSMP, following is measures to be taken in the minimum,

- A health management officer at the site responsible for maintaining health and safety against accidents shall be appointed. This person shall be qualified for this responsibility and shall have the authority to issue instructions and take protective measures to prevent accidents
- Prepare the emergency response plan to deal with accidents and emergency
- Provide fully equipped first aid base in each construction camp
- Provide at least one clinic stationed with a nurse and a doctor every working day
- Establish mobile phone link with nearest hospitals
- Ensure safety, rescue and industrial health issues are given the first priority to all persons at the site.
- Train all workers in basic sanitation, health care, safety matters and specific hazard of the work

- Provide personnel protection equipment such as safety boots, helmet, gloves, protective cloths, goggles and ear protection in accordance with type the work he/she is engaged
- Provide clean and sufficient fresh water at construction site, camp, office, laboratory and workshop.
- Provide enough number of latrines with septic tanks at the site
- Provide a tentative waste dumping space is facilitated in each camp so that the garbage car can collect regularly.
- Ensure that the drains in the camp are sufficiently provided so that no standing water be generated
- Protect all employees from mosquito, rats and other pest bearings
- Ensure that critical operations which could lead to incidents with potential of severe loss are identified, assessed, evaluated and documented so that adequate control measures are taken.
- The safety of construction workers, nearby residents and road users should be taken into consideration during design process as well as the construction stage of the project. Training and protective equipment should be provided.
- Appropriate speed limits should be imposed to reduce the number and severity of accidents. To reduce the speed, hump shall be installed at the right places
- Examine the portable water from a well on a regular basis with considerations of arsenic amount.

Traffic safety after operation starts

For land traffic safety, provision of traffic sings, road mark, bump, zebra mark, guard rail/ poles, and curb stone etc. to protect vehicles and pedestrians, motor bike and auto rickshaws respectively for after operation.

During construction, the route of truck movement shall be predetermined around the site.

The flag person shall be arranged at the key points to prevent accidents based on the HSMP.

11) HIV/AIDS

An HIV-AIDS awareness campaign via approved service provider shall be implemented and other measures to reduce the risk of the transfer of the HIV virus between and among contractor's personnel and local community, to promote early diagnosis and to assist affected individuals. It is proposed,

- To conduct Information, Education and Consultation Communication (IEC) campaign at least every other months to all site staff, employees, and immediate local communication concerning the risks, dangers and impact and appropriate avoidance behavior with respect

to , of Sexually Transmitted Disease (STD) or Sexually Transmitted Infection (STI) in general and HIV/AIDS in particular,

- To provide male or female condoms for all staff and laborers as appropriate and
- To provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to dedicated national STI and HIV/AIDS program.

12) Gender

Monitoring of payment to workers by the contractor shall be implemented not to allow payment gaps between male and female. Environmental and Safety Officer of contractor shall check the payment book monthly and report to RHD if there is any salary gap between genders. Then, if RHD evaluates that there is need to redress, RHD implements any support.

13) Children's right

Child labor at the construction site during the project implementation shall be strictly prohibited since such practices are banned by both Bangladesh laws and JICA guidelines. The RAP Implementing Agency and RHD shall regularly monitor project sites to guide contractors and their related firms to discourage child labor. A contract between contractor and RHD shall include provisions for prohibition of child labor.

When the child labor will be detected, the RAP-IA shall immediately report to RHD and RHD shall take necessary and decisive actions including suspension and/or rescind of the contract (if the case is extremely malicious) to the violating firms based on the applicable laws and regulations of Bangladesh.

If root cause of the child labor originated from impoverished living standard of project affected families due to improper or insufficient relocation assistance, RHD, through RAP-IA, will provide the following assistance to parents of working child:

- (1) Support of sending children to school
- (2) Helping the parents with hunting for a job, including the one at the construction site
- (3) Mediation for micro credit loan
- (4) Introducing them to assistance organizations such as NGO and so forth

15) River transportation

River traffic shall be controlled during construction as:

- Provision of illumination at the night time around anchorages

16) Hydrological condition

This time the foundation of 4-lane new bridge will be unified with that of 2-lane existing

bridge, therefore it has a negative impact on riverbed scouring due to construction of the bridge substructure in a large scale and the scouring level is expected to be higher. Consequently, it requires to estimate design scouring level more accurately. The design scouring level shall be determined from a riverbed simulation model, which will be fully incorporated in the design of bridge foundation. As a countermeasure of riverbed scouring, the foundation type as Steel Pipe Sheet Pile (SPSP) foundation has already been selected. The size and depth of the SPSP foundation shall be designed so that the riverbed scouring will not create any threatening to overall bridge stability.

17) Fauna and flora

Following measures are required for the exiting fauna and flora species.

Any illegal discharge of waste water, leaked oil shall be prohibited. Thus the contractor shall store waste material before taking legal process.

Construction development area shall be fixed, not to develop or cut trees out of project area. Thus the contractor shall set up marking on the boundary of construction area and educate all related construction workers.

With regard to South Asian River Dolphin which is categorized as endangered species and observed in the project area, special care shall be taken as follows at Meghna and Gumti;

- Monitoring to both upstream and downstream side will be conducted from the bridge surface.
- If dolphin is observed around project site, piling works and vessels should keep being suspended until dolphin passes over.
- Night lightning during construction should be restricted to the construction site.

19) Air Pollution

To suppress the air pollution during construction, it is recommended:

- Good maintenance of equipment/vehicles to save fuels
- Prohibition of idling of vehicles/equipment
- Adaption of fuel saving equipment/vehicles and construction methods
- Prohibition of incineration of wood, paper and other waste
- Spraying water over not-surfaced embankment to suppress the rising of dust
- Ensuring that all trucks carrying dust raising material shall not be overloaded, provided with tarpaulin covering entire load not to blown by wind.
- Material is stock piled under sheltered area and covered with tarpaulin to prevent them

airborne

- Undertaking seasonal air quality monitoring around the sites
- Regular meeting shall be held with adjacent community to know if any problem I there about air pollution

20) Water pollution

Pile driving in the river, mud water from earthwork for approach embankment in rainy season, domestic waste liquid from worker’s camp and oil leaking from construction vessel & machines is predicted as water pollution sources during construction.

Following mitigation measures are prepared for them.

Table 8.4 Mitigation Measures by Pollution Source

Pollution source/Activities	Mitigation measure
1. Pile driving in the river	- Generated construction sludge does not disposed in the river. The sludge is treated by silt basin and remaining sludge is disposed at designated dumping site - Impermeable wall shall be used with cast-in-place pile
2. Earthwork at embankment	- 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
3. Domestic liquid water from workers camp	- Domestic water is treated by septic tank for satisfying water quality standard and drain away to the nearest drainage or river. -Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers.
4. Oil leaking from construction vessel and machines	- Waste oil shall be stored without leaking before legal disposal process. - Refueling place to equipment/ vehicles shall be concreted floor - Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence - Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly - 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
5. Turbid water from concrete plant	- Generated turbid water is treated by silt basin and remained sludge is disposed at designated dumping site
6. Turbid water from asphalt plant	- Generated turbid water is treated by silt basin and remained sludge is disposed at designated dumping site

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.

21) Soil pollution

Oil leaking and contaminated borrow may cause soil pollution in the project area. Thus, following measures shall be implemented during construction.

Generally, construction sludge by pile driving in the river does not contain hazardous matter, but the sludge causes turbid in the river. Thus, the sludge is disposed on legal process prescribed by local authority.

It is significant to consider original places of borrow to prevent soil pollution in the project area and the survey for original places will be carried out in detailed design.

Table 8.5 Mitigation Measures by Pollution Source

Pollution source/Activities	Mitigation measure
1. Pile driving in the river	- Generated construction sludge does not contain hazardous matter, thus the sludge is disposed at designated dumping site
1. Contaminated borrow for construction of embankment	- Soil quality Testing shall be done before utilization.
2. Oil leaking from construction vessel and machines	- Waste oil shall be stored without leaking before legal disposal process. - Refueling place to equipment/ vehicles shall be concreted floor - Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence - Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly - 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

22) Waste

Construction sludge by boring from underground and domestic waste from base camp is generated mainly during construction. Both of the waste is disposed in designated dumping site instructed by the section handling waste.

Following table is generated volume and mitigation measures to minimize impacts.

Table 8.6 Type of Waste and Disposal Process

Category of Waste	Generated location	Estimated volume	Mitigation Measures
Construction sludge	Borehole in the river (by pile driving)	Total 5,100 m3	- Minimize volume to use silt basin before disposing
Domestic waste	Base camp site	450 ton/ 5 years/3 camps	- Segregate waste to minimize waste material

Generated waste is recycled as possible with consideration of soil property.

23) Noise and Vibration

According to the result of noise forecast, the forecasted value of 67 dB(A) at Gumti exceeds the standard value of 60 dB(A). However, the forecasted value of 67 dB(A) in 2022 is less than the current measured value of 69 dB(A) in 2012. Thus, it is not likely to give

significant impact to the nearest residents or shops.

Additionally, construction noise and vibration will be caused from construction machines and vehicles. Because of the construction time and duration is limited, it is not likely to give significant impact to residential area.

Despite the above prediction, following mitigation measures should be implemented during construction and operation.

In terms of vibration, the value is negligible on the basis study made in Initial Environment Examination (IEE) of less than 60 dB in any areas as an international standard; hence, mitigation measure is not required.

Table 8.7 Mitigation Measures for Noise Pollution

Stage	Noise Source	Mitigation Measures
During Construction	Construction noise by construction machines and vehicles	- Periodical maintenance - Installation of sound insulation cover on boundary near residential area
During Operation	Traffic noise from carriage way	- Securement of buffer zone as noise decay distance (land utilization guide by RHD and local authority)

25) Offensive Odor

Construction contractor will undertake measures to prohibit open burning, and to ensure proper treatment of camp waste and proper maintenance of heavy equipment etc.

26) Bottom Contamination

Construction contractor will obliged to no dumping of waste into the river.

8.3 Institutional Arrangement

Implementation of the EMP including monitoring during construction is the responsibility of the contractor, supervised by PIU and the SEC.

1) The Project Director of RHD

With the assistance of SEC will be overall responsible for ensuring compliance of safeguard measures and will be reporting to the regulatory bodies and JICA certifying that relevant environmental safeguard measures have been complied with during project implementation. After operation, monitoring will become the work of PIU/ SEC.

2) The Social and Environmental Circle (SEC)

Headed by a Superintendent Engineer who has two Executive Engineers – one for Environment and one for Resettlement under him/her. The role of SEC includes:

- Monitoring progress of the project as per planned schedule of activities
- Exercising oversight over the implementation of environmental mitigation measures by the contractors
- Assisting the Site Engineers by providing appropriate environmental advise and solutions
- Documenting the experience in the implementation of the environmental process
- Preparing training materials and implementing programs in collaboration with the Consultant
- Maintaining interfaces with the other line departments / stakeholders
- Reporting to JICA and DOE on status of EMP implementation
- Preparing budget and maintaining records of expenditure

3) The Construction Supervision Consultant (CSC)

Will have in-house capacity to advise on and to supervise the implementation of the EMP during this project implementation. The CSC is expected:

- To prepare an Environmental Supervision Manual in the beginning of their contract to finalize the environmental supervision procedures including inspection, monitoring and reporting to be followed by all relevant parties during the implementation of the project.
- To liaise with PIU / SEC to ensure that Contractor complies with the requirements of various environmental safeguard measures through supervision, monitoring and reporting on the same.

- Efforts must be made by the Consultant to ensure that environmental mitigation and good-construction-practices are not only considered but actually implemented as integral component of each civil activity. It should be considered as day-to-day activity.
- Implementation of environmental safeguard measures needs team effort and as such the Team Leader will delegate the responsibilities to each member of the supervision team with respect to their core responsibilities. Besides, the Team Leader of the Consultant will nominate a senior level engineer for being directly responsible for implementation of stipulated safeguard measures, to establish accountability. He will provide guidance to the field staff of the Consultant and Contractor for implementing each of the activities as per the EMP. He will review Contractor's EMP, traffic management plan and safety plan. He will be responsible for record keeping, providing instructions through the Engineer for corrective actions, ensuring compliance of various statutory and legislative requirements and assist Engineer for submitting reports to PIU/ SEC. He will maintain a close coordination with the Contractor and PIU/ SEC for successful implementation with the environmental safeguard measures.

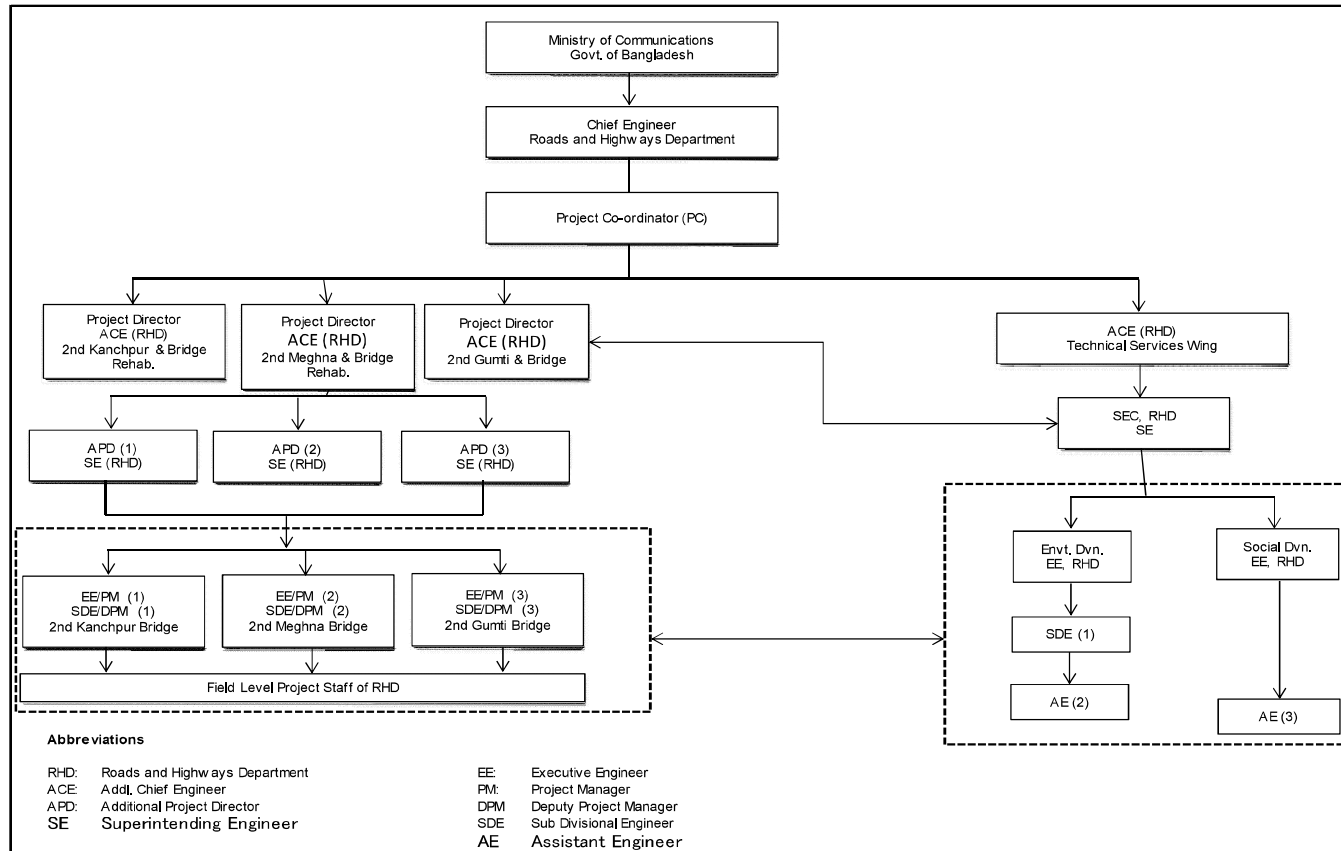
4) The contractors

Will undertake implementation of the environment measures, and will conduct periodic self-audits. The construction of the proposed bridge would be carried out by the qualified Contractors. Much of the EMP must be carried out by Contractors and those must be incorporated in the contract document. The role of consultant will include checking on conformity with the relevant clauses in construction contracts and national and international environmental legislation and regulations. Responsibilities of the Contractor in relation to environmental management will have to be elaborated during detail EMP preparation but must include the followings:

- The Contractor shall take all reasonable steps to protect the environment and avoid damage and nuisance arising because of his operations.
- The Contractor shall be responsible for the costs of cleaning up any environmental pollution resulting from his activities.
- The Contractor shall take adequate preventive measures against water, air, and soil pollution.
- The Contractor shall, at all times, maintain all sites under his control in a clean and tidy condition and shall provide appropriate and adequate facilities for the temporary storage of all wastes before disposal.
- The Contractor shall be responsible for the safe transportation and disposal of all wastes

- The Contractor shall be responsible for the provision of adequate sanitary facilities for the construction workforce.
- The Contractor shall make every reasonable effort to reduce noise nuisance caused by construction activities.

The proposed organizational set-up of three bridges for the implementation together with EMP implementation is shown in Figure 8.1.



- Figure 8.1: Organizational Framework for the EMP Implementation under the Project

8.4 Environmental Monitoring PLAN

8.4.1 Requirements for Monitoring Plan

Environmental monitoring is an essential tool for environmental management as it provides the basic information for rational management decisions.

The purpose of the monitoring program is to ensure that the envisaged purposes of the project are achieved and result in desired benefits to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring program be designed and carried out. Environmental Monitoring in the EMP for three bridges have been designed with the following objectives to:

- Measure the extent of expected or poorly quantified impacts;
- Ensure incorporation of Environmental Mitigation Measure during implementation of the proposed project;
- Observe effectiveness of Environmental Mitigation Measures;
- Ensure early detection of unexpected impacts and adoption of appropriate protection measures;
- Provide periodic reviews to observe adherence to Environmental Quality Standards (EQS) and adjust Environmental Mitigation Measures, if required; and
- Detect unacceptable level of impacts and adopt corrective measures.

8.4.2 Monitoring Plan

The monitoring program for the various performance indicators of three bridges are outlined in Table 8.8, 8.9 and 8.10.

Table 8.8 Environmental Monitoring Plan (Before Construction)

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
1) Involuntary Resettlement	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
2) Local Economies such as employment, livelihood etc.	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
3) Land use and utilization of local resources	Direct survey in the occupied area to see the condition	Quarterly	The occupied areas	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
6) Poor, indigenous people or ethnic minority	RAP monitoring plan is carried out. Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	Monthly or quarterly	Resettlement places, Construction sites	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
7) Maldistribution of benefits and damages	RAP monitoring plan is carried out.	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
8) Local conflicts of interest	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	Monthly or quarterly	Local residences, Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency

BOD=biochemical oxygen demand, DO=dissolved oxygen, NOx=Oxides of Nitrogen, SO₂=sulfur dioxide, SS=suspended solids, SPM=Suspended Particulate Matter,
RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.9 Environmental Monitoring Plan (During Construction)

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
1) Involuntary Resettlement	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
2) Local Economies such as employment, livelihood etc.	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
3) Land use and utilization of local resources	Direct survey in the occupied area to see the condition	Quarterly	The occupied areas	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	RAP monitoring plan is carried out.	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
5) Existing social infrastructures and Services	Direct survey in the field by interviews with the locals in order to ensure that social service utilities work as before.	Monthly	Construction sites	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
6) Poor, indigenous people or ethnic minority	RAP monitoring plan is carried out. Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	Monthly or quarterly	Resettlement places, Construction sites	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
7) Maldistribution of benefits and damages	RAP monitoring plan is carried out.	Monthly or quarterly	Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
8) Local conflicts of interest	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	Monthly or quarterly	Local residences, Resettlement places	Supervisor: RHD, EMA Reviewer: Consultant, EMA, IMA, PAPs Performer: RAP Implementing Agency
10) Accident	Ensuring that HSMP works right on the track	Every day or weekly	Construction sites	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
11) HIV/AIDS-	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	Quarterly	Construction sites	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
12) Gender	Direct survey in the field by interviews with the women in order to ensure that there is no any gaps between man	Quarterly	Construction sites	Supervisor :RHD, Reviewer: Consultant, PAPs

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
	and women.			Performer: Contractor
13) Children's right	Regular inspection of children's laborer	Quarterly	Construction sites	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
15) River Transportation	Giving adequate illumination	Every day	Around anchorages for construction barges	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
17) Fauna and flora	Counting the number of River Dolphin	Yearly	The both sides (upstream and downstream) of Meghna and Gumti Bridges within one side of 200m	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
19) Air Pollution	Measurement of SPM, NOx, SO2, CO	Monthly or after complaint	10 m offset from end of car lane for 3 bridges	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
	Inspection of brick, bitumen and cement facilities (spot check)	Monthly	Around the facilities	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
20) Water Pollution	(Surface water) Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil and Grease	Quarterly or after pollution event	Upstream and downstream near the construction vessels of 3 rivers respectively	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
	(Drinking water/ Groundwater for construction workers and the poor, etc.) Measurement of pH, fecal coliform, Fe and As	Monthly	(The location will be selected later with the consideration of the surrounding environment)	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
	(Turbid water from pile driving, concrete plant, and asphalt plant) Measurement of pH and SS	Weekly or monthly	The sites where pile driving is done and the plants are built	Supervisor: RHD, DoE Reviewer: NGO, PAPs Performer: Consultant,
21) Soil pollution	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	Beginning of earth filling works	At all project sites including construction yards, approach roads, bridge end facilities, etc.	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
22) Waste	Inspection of waste disposal sites and construction camps	Monthly	Designated dumping sites	Supervisor: RHD, DoE, Reviewer: Consultant, PAPs Performer: Contractor
23) Noise and Vibrations	Measurement of noise dB(A)	Monthly or after complaint	10 m offset from end of car lane for 3 bridges	Supervisor: RHD, DoE, Reviewer: Consultant, PAPs Performer: Contractor
	Visual inspection to ensure that good standard equipment is in use and sound insulation cover is installed.	Weekly	Construction sites	Supervisor: RHD, DoE, Reviewer: Consultant, PAPs Performer: Contractor

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
25) Offensive Odor	Odor inspection to ensure harmful odor is not released from equipments and waste	Weekly or monthly	Construction sites	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
26) Bottom sediment	Bottom sampling of Cd, Pb, As, oil, grease and so forth	Monthly	Construction sites	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor

BOD=biochemical oxygen demand, DO=dissolved oxygen, NOx=Oxides of Nitrogen, SO₂=sulfur dioxide, SS=suspended solids, SPM=Suspended Particulate Matter,
RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.10 Environmental Monitoring Plan (During Operation)

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
10) Accident	Ensuring traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc to be properly installed	Annually	Around the bridges	Supervisor: RHD, Reviewer: Consultant, PAPs Performer: Contractor
16) Hydrological condition	Inspection of river bottom condition for scouring	Annually	Around abutments	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
19) Air Pollution	Measurement of SPM, NOx, SO ₂ , CO	Monthly or after complaint	10 m offset from end of car lane for 3 bridges	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
20) Water Pollution	(Surface water) Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH ₄ -N, Oil and Grease	Quarterly	Upstream and downstream near 3 bridges respectively	Supervisor : RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor
23) Noise and vibration	Measurement of noise dB(A)	Quarterly	10 m offset from end of car lane for 3 bridges	Supervisor: RHD, DoE Reviewer: Consultant, PAPs Performer: Contractor

BOD=biochemical oxygen demand, DO=dissolved oxygen, NOx=Oxides of Nitrogen, SO₂=sulfur dioxide, SS=suspended solids, SPM=Suspended Particulate Matter,
RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

8.5 Implementation Schedule

Following are the key activities, which are to be performed at different phases of the project, as per the requirement of this EMP:

- Obtaining environmental Clearance from DoE
- Allocating Budget for environmental management
- Engaging agency for pollution monitoring
- Nominating Environmental and Safety Officer of Contractor
- Review and approval of Contractors' EMP, traffic management and safety plan
- Finalizing site/s and layout plan for construction camp incorporating environmental requirements
- Tree cutting
- Tree plantation
- Implementation of mitigation and enhancement measures
- Environmental Pollution Monitoring
- Environmental training

The EMP Implementation Schedule along with the responsibilities for each of the above-mentioned activities is given in Table 8.8. Arboriculture Circle of RHD or Forest Dept. may be assigned the task of compensatory plantation for which budget has been provided. The actual sequence will be decided by PIU during project implementation.

Table 8.11 Implementation Schedule

	Activity Description	Responsibility	Pre-Construction(month)		Construction (month)										Post-Construction(month)					
			1	2	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48	49-54	55-60	1	2	3	4	5	6
1	Environmental Clearance from DOE	RHD/SEC	■																	
2	Allocating Budget for Environmental Management	RHD		■																
3	Engaging Agency for Pollution Monitoring	RHD/SEC			■															
4	Mobilisation of Contractor's Environmental Officer	RHD/SEC/ Contractor			■															
5	Review and Approval of Contractors' EMP	SEC			■															
6	Finalising site and layout plan of construction camp	RHD/SEC/ Contractor			■															
7	Tree Cutting	Contractor			■															
8	Tree Plantation	RHD/ SEC													■					
9	Implementation of Mitigation Measures	RHD/ Contractor			■															
10	Environmental Pollution Monitoring	RHD/SEC/ Contractor			■															
11	Environmental Training	RHD/SEC			■															

8.6 EMP Cost Estimate

Budget for implementing various activities and mitigation measures proposed in this EMP have been estimated. The details of EMP budget are given in Table 8.12. The total budget for implementing EMP has been estimated as about TK 12 million. This EMP budget will form part of the total project budget. Cost of environmental protection works, which will be implemented by the contractor, shall be considered to be incidental to the corresponding item of main civil work for which Bill of Quantity (BoQ) has been given in the bid document and no separate payment shall be made.

Table 8.12 Environmental Management Budget

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

Enhancement of environment (A)

1,000,000

Environmental management cost (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 decision-making institutions	Before Construction	Compensation for impact	-	ditto	-	-
	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. Check for the amount 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	During Construction	Inspection of landscape from vessel mooring station	-	Included in Monitoring cost	-	-
Environmental management cost (B)						3,000,000
Monitoring (C)						
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 poor people in order to ensure that groundwater is available for them..	-	Included in RAP cost	-	-
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	Regular 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, BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As	Set	6	10,000	60,000
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
Monitoring Costs (C)						6,075,000
Environmental training (D)						
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
Environmental Training Costs (D)						1,000,000
Total (A+B+C+D)						11,075,000
Contingency @ 10%						1,107,500
Grand Total						12,182,500

CHAPTER 9 PUBLIC PARTICIPATION

9.1 Overview of Consultation Process

9.1.1 Background

The Executing Agency (EA) process included public participation, consultation and focus group discussions to help RHD achieve public acceptance of the Project. The views, needs and aspirations of the affected people as expressed during these consultations have been incorporated in the project design and the proposed mitigating measures with the objective to maximize benefits and minimize adverse social and environmental effects.

During the project preparatory stage, three tiered consultation meetings were conducted with the following objectives:

- **Expert Consultation:** Experts were consulted through individual and group meetings, including the Project Panel of Experts, selected individuals and organizations with professional knowledge of EIA processes. The meetings were conducted at a very early stage (EIA Scoping Stage) with the objective to identify people to be consulted, to brief stakeholders about the project components, and to discuss potential environmental impacts of the Project. The outcomes of those consultations were used to finalize the scoping framework and prepare the draft TOR for the EIA study
- **Focus Group Discussions (FGDs):** FGDs were conducted at various stages (EIA Scoping to the draft EIA disclosure) with the affected communities at various locations of three bridge sites. The purpose was to discuss specific issues, such as launch *ghat* displacement during construction, access to local roads from the bridge and approach roads, livelihood restoration, compensation and resettlement, community involvement and sustainable environmental management.
- **Public Consultation:** As per harmonized safeguard requirements of JICA Guidelines for Environmental and Social Considerations 2010, two public consultations were conducted for the Project as part of the environmental assessment procedure. The first public consultation was conducted at two locations during EIA TOR and scoping and the second public consultation was conducted at 3 locations to disclose draft EIA. The public consultations were conducted by the RHD, with assistance of Study Team involving a wide range of participants representing

affected persons, union and Upazila leaders, NGOs, and national and local government representatives. The public consultations were meant to achieve the following objective:

- to make the public aware of the project
- to ensure that the public was provided with opportunities to participate in the decision making process and to influence decisions that would affect them;
- to identify the widest range of potential issues about the Project as early as possible and in some cases, have those resolved;
- to ensure that government departments were notified and consulted early in the process; and
- to ensure a board range of perspectives were considered in any decision

9.1.2 Overview of the Consultation Meetings

The expert consultations were held in Dhaka during February – August 2012.

Eight FGDs were held or planned in various locations (2 at the Kanchpur bridge location of Dhaka end, 1 at the Kanchpur bridge location of Chittagong end, 1 at the Meghna bridge location of Dhaka end, 1 at the Meghna bridge location of Chittagong end, 2 at the Gumti bridge location of Chittagong end and 1 at the Gumti bridge location of Dhaka end) from February to August and will continue throughout the Project.

The first public consultations about TOR for EIA were held at Senpara near Kanchpur bridge and Tetuitala bazaar near Meghna bridge on 15th March 2012. The second public consultation was held in 1st August 2012. The outcomes of the consultations and discussions were positive, with participants convinced that the three new bridges will bring significant economic benefits to the region. Nonetheless, the participants suggested that mitigation measures be taken to preserve the environment and avoid any social disturbances.

9.1.3 Outlines of Consultation Meetings and Discussion

Expert Consultations

Consultations were conducted in Dhaka with professionals who had expert knowledge of Fisheries, wildlife, River ecology, morphology etc., and government officials responsible for reviewing the EIA and make decisions on environmental clearance. Table 9.1 gives the list of

experts consulted.

Table 9.1 List of experts consulted

Sl. No	Name	Position	Organization
1	Md. Shahjahan	Director (EIA Clearance)	Department of Environment, Agargaon, Dhaka
2	Dr. Hafiza Khatun	Professor, Department of Geography and Environment	Dhaka University
3	Dr. A.S.M. Woobaidullah	Professor, Department of Geology	Dhaka University
4	Mamun Chowdhury	Assistant Professor	Dhaka University
5	Moonira Akhter Chowdhury	Director General	Geological Survey of Bangladesh, Ministry of Energy and Mineral Resources
6	Dr. Md. Fazlur Rahman	Chairman, Department of Zoology	Dhaka University
7	Mr. Haque Mahbub Morshedi	Assistant Conservator	Wildlife and Nature Conservation Circle, Forest Department, Bangladesh
8	Sudhir Kumar Ghosh	Superintending Engineer, Ground Water Circle	Department of Public Health Engineering , Kakrail Dhaka
9	Dr. Firoz e Ahmed	Professor, Environmental Engineering Department	BUET, Dhaka
10	Kazi Farhed Iqbal	Head, Department of Environmental Science	State University of Bangladesh, Dhaka
11	Md. Khorshed Alam	Director,	Soil Research Development Institute, Mrittika Bhaban, Dhaka
12	Giasuddin Ahmed Chowdhury	Executive Director	CEGIS, Gulshan 1, Dhaka
13	Dr. S. M. A. Rashid	Chief Executive	CARINAM, Center for Advanced Research in, Natural Resources Management,
14	Md.Istiaq Sobhan,PhD	Program Coordinator	IUCN Bangladesh

The summary of expert consultations are shown as below:

Date: 15 February 2012

Consulted experts: Ph.D. Hafiza khatun, Geograph and Environment, Dhaka University

Comments	Reflection of the Comments to the RAP
Since informal residents, who are usually very poor, are displace by the project without compensation as per Bangladesh Rules, consideration has to be made.	Even if for landless people, following compensations are provided: <ul style="list-style-type: none"> - Structures and trees with replacement cost - Transfer and reconstruction of structures - Business restoration grant for 3 months (employer and employees) - Moving assistance for rentee - Grant for employees for loss of employment

	<ul style="list-style-type: none"> - Transition allowance for 3 months - Rental allowance for house/room renter - Sifting allowance for residents - Vulnerable allowance for poor and widowed - Job training
Information disclosure is very weak and please provide as much information to project affected people and stakeholders	Stakeholders meeting, group discussion, door to door consultation (census and socioeconomic survey) were implemented
Preference of affected for relocation shall be incorporated into RAP so far feasible	Request of “self-relocation” by the affected residents is incorporated to RAP according to the meetings held on 1st August 2012. It is noted at the meeting on 15th March held at the village along the Alternative Route C for Meghna Site, some of the possible affected residents requested that they want to move to nearby location or, if not possible, to change the alignment so that no need to move. Finally this Alternative was discarded and these residents have become no more affected people by the project.
Livelihood Impact	The Resettlement team will prepare a livelihood restoration plan including (1) business loss allowance for 3 months, (2) residential loss allowance for 3 months, and (3) provision of job training.
Social issues needs to be addressed such as conflict between migrated workers with local people, spread of communicable diseases such as skin, HIV/AIDS etc. due to migrant workers;	The contractor provides clear information on plans for project activities through public consultations. EMP is prepared for prohibiting exploit of local resources such as fire/ fruit wood, herbs, fish or tube well water by immigrant workers. Also, the seminar is planned for both immigrant workers and local residents to prevent the spread of STD/HIV.

Date: 15 February 2012

Consulted experts: Mr. Haque Mahub Morshedi, Assistant Conservator Wildlife and Nature Conservation.

Comments	Reflection of the Comments to the EIA/RAP
It was suggested that an emergency response plan must be prepared for accidents spills of petrochemicals	An emergency response plan will be prepared in the EIA
It was suggested to quantify sensitive species in three River and in project influence area.	Ecological survey was conducted within 2 km radius for each bridge alignment
Discussions were held on construction materials, quarries and sources, transport of construction materials and ship impact; impact of noise, vibration, dust and road crossings, roadside tree plantations (not at the inner curve sides), and road safety;	TOR of the EIA study considered a wide range of parameters and covered those commented items.
Suitable local tree plantation should be done such as Neem, Blackberry, Amlaki, Amla, Olive, Lychee, Mehogoni, Orjun, Raintree, Hortoki, Jackfruits, Akasmoni and Bohera. It was suggested that fuel trees should be avoided in the tree plantation plan, and	In case vegetation/plantation is required for certain area, trees shall be planted as recommended.

proportion of roadside trees should: 50% wood trees, 30% fruit trees and 20% medicine trees	
Environmental pollution such as air/dust and noise pollution will be there especially during construction. Air/dust can be reduced/eliminated by sprinkling water etc. & noise pollution by installing temporary noise barrier & not permitting noisy activities during night time	During construction, noise and air pollution including measures are taken by (1) maintenance/ prohibition of overloading of heavy equipment, (2) installation of tentative noise barrier for noise protection, and (3) canvas covering of stock piles and spraying of water during earth filling for dust suspension
Traffic congestion may occur especially at toll plaza. This issue should be addressed by developing a traffic management plan (e.g. road safety sign, skilled traffic police, etc.).	Proper traffic management will be considered.

Date: 15 February 2012

Consulted experts: Kazi Farhed Iqbal, Head, Department of Environmental Science, State University of Bangladesh

Comments	Reflection of the Comments to the EIA/ RAP
Special consideration should be given on mitigation measures for River bank erosion, global warming	As a conclusion of impact prediction, the streamline shows almost the same profile.
Effect, Hilsa migration. Consideration should be made to reduce the disturbance of fish movement by huge water transports (specially construction barges, dredgers etc) during construction	As a conclusion of impact prediction, River Dolphin is imposed by passing construction vessels. The mitigation measure is suspension of vessel movement.
Identify the impacts of geo bags on aquatic wild life	There is no known impact of geo-bags* on aquatic life based on other experience in Bangladesh. In case that the impacts are identified, it is desirable that geo-bags are installed. * Geo-bags: Geotextile Engineered Fabric Bags with high abrasion resistance. It is used for river bank protection and embankment strengthening.
Back water effect due to piers and RTWs; biodiversity such as fish, migratory birds etc.	As a conclusion of impact prediction, back water does not have an adverse effect on aquatic creatures.

Date: 27 July 2012

Consulted experts: Dr. S. M. A. Rashid, Chief Executive of CARINAM, Center for Advanced Research in Natural Resources Management,

Comments	Reflection of the Comments to the EIA/ RAP
Nature of River Dolphin and its mitigation measure:	Mitigation measure such as suspension of pile driving/ boat driving/ suppression of strong nighttime illumination

Focus Group Discussion

Discussions were held with the affected communities and businesses at Kanchpur Bridge,

Siddhirganj Municipality of Siddhirganj, Narayanganj (Dhaka end), at Chittagong end of the Kanchpur Bridge under Sonargaon Thana of Narayanganj district, at Meghna Bridge Dhaka end Sonargaon, Narayanganj, Jamaldi Bazaar Bus stand (Meghna Bridge, Chittagong end), Baliakandi, Gazaria, Munshiganj, at Bausia near Pakhir Mour, Gazaria, Munshiganj and at new Ferry ghat, Daudkandi, Comilla of Gumti (Chittagong end). Date, location and the number of participants of each discussion is listed in Table 9.2. The local people attended the focused group discussion meeting include truck drivers, sand and stone carrying laborers of ships and trucks, tea stall operators, grocery shop keepers, handicraft artisans, hotel managers and waiters, etc. Local NGO officers were also present in the meeting to know about the project so that they can plan about allocating loan for the potential displaced persons. The summary of focused group meeting (FGM) is shown in Table 9.3.

Table 9.2 Details of FGD Meetings

Sl.	Date	Location of the meeting	Participants	Category of participants
1	23.03.12	Kanchpur Bridge, (Dhaka end, near abutment of the existing bridge) Shimrail, Siddhirganj, Narayanganj	21	Shop owners, truck drivers and helpers, laborers, women businessmen, barge operators, etc
2	17.04.12	Kanchpur Bridge (Dhaka end), beside the abutment, Simrail, Siddhirganj, Narayanganj	20	Shop owners (both squatters and tenants), truck drivers and helpers, laborers, women businessmen, barge operators, etc
3	17.04.12	Kanchpur Bridge, (Chittagong end), Kanchpur union, Sonargaon, Narayanganj	21	Residential household heads, tenants, Shop owners (squatters and tenants), truck drivers and helpers, laborers, barge operators, etc
4	17.04.12	Gumti Bridge, (Chittagong end), Daudkandi Municipality Comilla	19	Residential household heads, Shop owners (squatters and tenants), truck drivers and helpers, laborers, barge operators, etc
5	17.04.12	Gumti Bridge, (Dhaka end), near Pakhir Morh, Baushia, Gajaria Upazila of Munshigan district	8	Coal businessmen, Shop owners (squatters), truck drivers and helpers, laborers, barge operators, etc
6	23.03.12	Meghna Bridge, (Dhaka end), Pirojpur union, Sonargaon, Narayanganj	19	Shop owners (squatters and tenants), laborers, etc.
7	17.04.12	Meghna Bridge (Chittagong end), Jamaldi Bazaar Bus stand, Baliakandi, Gazaria, Munshiganj	19	Shop owners (squatters and tenants), truck drivers and helpers, laborers, barge operators, etc
Total			127	

Table 9.3 Summary of Focussed Group Meeting

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
General perception about the project and the awareness about the proposed project.	Most of the participants are in favor of the project and have been made aware of the proposed project through the various surveys that have taken place	Acceptance of the project
Support of local people for	Almost everybody said that	The Consultants informed that during

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
the proposed project?	they will support the project and advised the Consultants to take precautions in the environmental mitigation to avoid the various impacts anticipated during the preconstruction, construction and operation stages of the project and to ensure protection of the natural water bodies of the areas.	the study, the design and layout of all infrastructures have been considered the anticipated adverse impacts. EMP covers specific measures to follow during the construction process in protecting natural water bodies
Impact of the project on water bodies, streams, wetlands, drainage system, etc.	By constructing the bridge, local flood flows will be blocked. Proper design will be required to avoid any localized flood.	Proper hydrological analysis will be considered (100 years design flood) to design the bridge and drainage structures. As a result, no impact is assumed on water body, streams, wetland (there is no wet land) and drainage system
Does the proposed Project create any problem with ambient air, noise quality, soil quality, or water quality?	Waste water discharge, Noise, vibration and dust will be major issues during construction and operation	Impact of the project upon ambient air, noise quality, soil quality, water quality has been assessed during draft EIA report. EMP has provided instructions limiting environmental qualities to comply with the standards and penalties for violations.
Land Acquisition and Resettlement	Land acquisition and resettlement will be the major issue. According to the participants, this can be mitigated through proper compensation and assistance to the affected persons	New land acquisition is not required for construction of the proposed bridges. As a result, overall impact on the community will be minimized. These bridges will be constructed in RHD land which was acquired for the existing bridges. Some residential houses, commercial enterprises and common properties are found within the proposed area those are required to be relocated before starting civil construction. As per JICA Environmental and Social considerations, in spite of lack of legal rights to the land all of the affected households/people would be paid compensation for structure including shifting allowance and reconstruction grants.
Any critical issue or concern by the local people regarding the project? Or Any criteria you would like to see considered during project design, construction and operation stage?	Respondents requested that environmental hotspots (like school, hospital, graveyard etc.) are avoided as much as possible Dust suppression, noise mitigation and road safety should be considered. Engineers should design the bridges in accordance with good engineering practices so as to improve water flow. .	Wish to minimize effects on common resources property. Dust suppression measures and noise mitigation are considered in the EMP. Proper hydrological analysis has been done to design the drainage structures.

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
Do you have any problem with the existing bridge?	Long journey times for travel	Dissatisfaction with existing condition of the road
Is the proposed project going to reduce accidents and provide better traffic system?	All the participants felt that the proposed bridge construction project will facilitate a better traffic system. However, it was felt that accidents might increase in number if a high standard of engineering design is not followed. Participants mentioned that safety measures are especially important for social institutions like schools, hospitals	Some concerns over safety, supporting design measures such as increased number of sign board, road mark, bump etc.
Protected areas (national parks protected forest, religiously sensitive sites, historical or archaeological sites), if any	The proposed bridge construction project do not pass any protected or ecological critical area. The area [passes with several commercial, industrial and residential areas	No concerns over the park, the nearest sites with terms of cultural or religious significance are far from the road. Bridges are designed to avoid most of those structures
Employment Status: Percentage of employment/unemployment /underemployment	Unemployment is common in the project area	Job chance and employment will be enhanced and promoted once the construction has been started.
Impact of the project on the aquatic environment	The livelihood of the fishermen community should be taken into consideration	As a conclusion of impact prediction, fishery is not affected and aquatic diversity remains same since water quality or hydrological condition is not affected (or worsen) by the project. By scouring, river bottom around piers may be deepened and this may increase/ strengthen the diversity of ecosystem.
Any river dolphin, whales, brackish water crocodile, or other important species may pass the bridges area	No river dolphin, whales, brackish water crocodile, or other important species pass the Kanchpur bridges area; but the people are seen fresh water river dolphin around 2 km area of the Meghna and Gumti Bridges. In the wet season it is seen almost every week in and around the bridge area	It is necessary to study and find river dolphin's habitat: breeding ground and movement path. As a consequence of impact prediction, river dolphin can pass Meghna and Gumti Bridges during construction. Following mitigation measures are planned. (1) piling suspension, (2) suspension of vessel movement, and (3) Minimum of night lighting on river.
If this bridges are improved, there may be large groups of workers living temporarily in the area, and construction operations that generate noise and dust. Are there any other issues about construction, including noise and dust that might worry you?	The respondents strongly welcome the bridge construction activities. Many observed that the measures are temporary and besides there will be more chances for local communities to be employed during construction, providing both skilled and unskilled labor. Participants did not mention any other problems which might bother them other then following basic safety rules.	Residents understand that construction impacts can be expected and do not have an issue with these, provided safety measures are taken.

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
Given that the new approach road will be wider and smoother, enabling higher driving speeds, what Road Safety Issues/measures would you propose?	Participants suggested signage (speed limits, warnings etc.), pedestrian crossings in front of social institutions and to ensure that there are footpaths along the road	Suggested signage and marking will be installed.

Besides the above issues, the social and resettlement issues are raised by the participants which are described in the RAP report separately.

Public Consultation

Three public consultations were held: (1) the 1st stakeholders' meeting for TOR discussion in 15th March 2012, (2) the 2nd stakeholders' meeting for supplementary to the 1st public consultations regarding RAP and EIA draft in 1st August 2012, and (3) the 3rd stakeholder's meeting for explanation of RAP and EIA draft final reports.

Implementations of meetings were disseminated as:

- Invitation letter were sent to stakeholders concerned
- Advertised in Newspapers in English and Bengali respectively
- Verbal explanation by Union Parishad Chairman to inform residents of shop keeper at the affected area for who are illiterate.
- Verbal announcement at Mosque

The brief overviews of 1st, 2nd and 3rd meeting are shown in table 9.4, 9.5 and 9.6. Additionally, the attendance sheets of 1st, 2nd and 3rd meeting are shown in Annex-4, Annex-5 and Annex-6 respectively.

Table 9.4(1) Brief Overview of the 1st Stakeholder's Meeting

Dates	15 March, 2012	
Time	10:30 am	2:30 pm
Venue	Open space along old NH-1 Shenpara, Kanchpur, Sonargaon, Narayangonj	Open space along old NH-1 Tetuitala Bazar, Meghnaghat, Baliakandi, Gazaria, Munshiganj
How accessible the venue was to the stakeholders	Meetings were held in the center of most probable settlements to be displaced by the project	
Method of notification	Invitation letters, advertisement on newspaper, mosque announcement and personal contact	
Method of consultation	Verbal explanation first in general by the host and individual question/ answer by the participants	

Language spoken	Bengali
Contents/agenda of the presentation	The goals and objectives of the project, relocation requirements, tentative timeline of project execution, roles and responsibilities of the stakeholders and project authorities, alternative design options, cut-off dates etc. were discussed in the meeting. The Social and Natural Environmental Engineers of the consultant team discussed the issues using flip chart and sought opinion of the participants on the project needs, probable impacts and mitigation measures.
Used documents/materials for the explanation	Flip-chart (shown yellow circle in below picture)

Table 9.4(2) Numbers of the Participants at the 1st Stakeholder's Meeting

Place	Kanchpur	Meghna / Gumti
Governmental Institutions	6 (2)	6 (2)
Local People	28 (0)	10 (0)
NGOs	0	0
Media	0	0
Consultant/Study Team	6 (0)	6 (0)
Total	40 (2)	22 (2)

* (Number of females) Females did not put signature on the attendants list although many were participated



1st Stakeholder's Meeting (Meghna / Gumti)

In 1st stakeholder's meeting, the comments from participants are about resettlement. Hence, the details of discussions are described in RAP.

Table 9.5(1) Brief Overview of the 2nd Stakeholder's Meeting

Dates	1 August 2012		
Time	2:30 pm	12:00 am	10:00 am
Venue	(Kanchpur Site) Shenpara, Kanchpur, Sonargaon, Narayangonj	(Meghna Site) Tetuitala Bazar, Meghnaghat, Baliakandi, Gazaria, Munshiganj	(Gumti Site) Chittagong end, Under abutment, Daudkandi, Comilla
How accessible the venue was to the stakeholders	Meetings were held in the center of most probable settlements to be displaced by the project		
Method of notification	Invitation letters, advertisement on newspaper, mosque announcement and personal contact		
Method of consultation	Verbal explanation first in general by the host and individual question/ answer by the participants		
Language spoken	Bengali		
Contents/agenda of the presentation	In the consultation meeting the RAP and EIA policy (mitigation measures of the project impacts) were disclosed to the affected people using flip chart. The affected people were informed about the meeting through publishing in the newspaper, personal contact from Union leaders verbally, announcement in the mosque, etc. The issues disclosed in the meeting were project components and revised alignment by which some people who were registered by previous census as affected people, become as not affected, cut off-date declared during the survey (informed as finally revised to 16 th March from 08 th March 2012), Methodologies adopted during survey, findings of the survey, entitlement matrix as prescribed in the RAP, Grievance redress mechanism, compensation payment procedure, relocation requirements & options, timeline of relocation after payment of compensation, etc. The findings of the environmental survey and proposed mitigation measures of any adverse impacts were also disclosed in the meeting.		
Used documents/materials for the explanation	Flip-chart		

Table 9.5(2) Numbers of the Participants at the 2nd Stakeholder's Meeting

Place	Kanchpur	Meghna	Gumti
Governmental Institutions	3(1)	3 (1)	3(1)
Local People	71(25)	18 (0)	30 (0)
NGOs	0	0	0
Media	0	0	0
Consultant/Study Team	2(0)	2 (0)	2(0)
Total	76 (26)	23 (1)	35 (1)

* (Number of females)

In 2st stakeholder's meeting, the comments from participants are almost about resettlement except the below comments. The details of other discussions are described in RAP.

Table 9.5(3) The 2nd Stakeholders' meeting at Gumti Bridge Site

Position	Sex	Comments/Question	Answer and Policy of Countermeasure
Shop keeper	Male	How many months will require to start civil construction of the project? How many times we may continue business at present location? How is the size and outlook of the proposed bridge?	The project is scheduled to be started in early 2014 and you have at least 18 months time in hand to vacate the project site. Before construction is started every one will have to leave the place and encumbrance free land will be handed over to the contractor. The length of the proposed bridge is 1410 meter and width is 17.45 meter. This will be constructed a very closed to the existing one and distance between these two bridges will be less than one meter.
Shop keeper	Male	The local people especially the affected people should get opportunity to work in civil construction. Is there any provision in the project to engage affected people in civil construction?	According to the policy of the Resettlement Action Plan, the affected people will be preferentially employed in civil construction where possible. During implementation of the project labor contracting society will be formed to bargain collectively for seeking job and getting salary while they are in job.

Table 9.6(1) Brief Overview of the 3rd Stakeholder's Meeting

Dates	1 September, 2012		
Time	2:30 pm	12:00 am	10:00 am
Venue	(Kanchpur Site) Shenpara, Kanchpur, Sonargaon, Narayangonj	(Meghna Site) Chittagong end, Baliakandi, Gazaria, Munshiganj	(Gumti Site) Chittagong end, Daudkandi, Comilla
How accessible the venue was to the	Meetings were held in the center of most probable settlements to be		

stakeholders	displaced by the project
Method of notification	Invitation letters, advertisement on newspaper, mosque announcement and personal contact
Method of consultation	Verbal explanation first in general by the host and individual question/ answer by the participants
Language spoken	Bengali
Contents/agenda of the presentation	<p>In the consultation meeting, policies of the RAP and EIA (mitigation measures of the project impacts) were disclosed to the affected people using flip chart. On August 01, 2012, these policies were disclosed, but due to JICA requirements and some changes in the policy, disclosure of the policy requires again.</p> <p>The affected people were informed about the meeting through publishing in the national daily newspaper (Both Bengali and English daily), personal contact, announcement in the mosque, etc. The disclosed issues in the meeting were project components and alignment, cut off-date declared during the survey (16 March 2012), methodologies adopted during survey, findings of the survey, entitlement matrix as prescribed in the RAP, grievance redress mechanism, compensation payment procedure, relocation requirements & options, timeline of relocation after payment of compensation, etc.</p> <p>The findings of the environmental survey and proposed mitigation measures of any adverse impacts were also disclosed in the meeting.</p>
Used documents/materials for the explanation	Flip-chart

Table 9.6(2) Number of the Participants at the 3rd Stakeholder's Meeting

Place	Kanchpur	Meghna	Gumti
Governmental Institutions	1(0)	1 (0)	1(0)
Local People	72(40)	79 (61)	56 (28)
NGOs	0	0	0
Media	0	0	0
Consultant/Study Team	5(0)	5 (0)	5(0)
Total	78 (40)	85 (61)	62 (28)

(Number of females)

In 3rd stakeholder's meeting, the comments from participants are about resettlement. Hence, the details of discussions are described in RAP.

In view of gender, since woman seldom discloses her mind in public, women were gathered and expressed their opinions each venue at the last half of the 3rd stakeholder's meetings. The minutes are shown in Annex-7.

Government of the People's Republic of Bangladesh
Department of Environment
www.doe-bd.org
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207

Memo No: DoE/Clearance/5150/2012/131

Date: 23 May, 2012

Subject: Approval of Terms of Reference for Environmental Impact Assessment (EIA) in favour of 2nd Kanchpur, 2nd Meghna and 2nd Meghna-Gumti Bridge Project at Dhaka-Chittagong National Highway.

Ref: Your application on 17 April 2012.

With reference to your letter dated 17.04.2012 for the subject mentioned above, the Department of Environment hereby gives approval of TOR for Environmental Impact Assessment (EIA) in favour of 2nd Kanchpur, 2nd Meghna and 2nd Meghna-Gumti Bridge Project at Dhaka-Chittagong National Highway subject to fulfilling the following terms and conditions.

1. Bridge Management Wing of Roads and Highways Department (RHD) shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said three Projects in accordance with the TOR submitted to the DOE and additional suggestions provided herein.
2. The EIA report should be prepared in accordance with following indicative outlines:
 1. Executive summary
 2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
 3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)
 - 4a. Project activities: A list of the main project activities to be undertaken during site clearing, construction as well as operation.
 - 4b. Project schedule: The phase and timing for development of the PMBP
 - 4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.
 - 4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Geological map showing geological units, fault zone, and other natural features.
5. Baseline Environmental Condition should include, inter alia, following:
 - Physical Environment : Geology, Topology, Geomorphology, Soils, Meteorology, and Hydrology.
 - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
 - Environment Quality : Air, Water, Soil and Sediment Quality.
6. Soio-economic environment should include, inter alia, following:
 - Population: Demographic profile and ethnic composition
 - Settlement and housing
 - Traffic and transport
 - Public utilities: water supply, sanitation and solid waste
 - Economy and employment: employment structure and cultural issues in employment
 - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.

7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).

In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man made or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:

For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not capable of mitigation, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures..

An outline of the Environmental Management Plan shall be developed for the project.

In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).

9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)

Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)

10. Conclusion and Recommendations

3. Without approval of EIA report by the Department of Environment, Bridge Management Wing of Roads and Highways Department (RHD) shall not be able to open L/C in favor of importable machineries.
4. Without obtaining Environmental Clearance, Bridge Management Wing of Roads and Highways Department (RHD) shall not start operation of the projects.
5. Bridge Management Wing of Roads and Highways Department (RHD) shall submit the EIA along with a filled-in application for Environmental Clearance in prescribed form, the applicable fee in a treasury chalan, the no objection certificates (NOCs) from the local authority, NOC from forest department (if it is required in case of cutting any forested plant/trees-private or public), NOC in favor of Cutting/Dressing (if it is required) of Hill/Hillock from the concerned authority and NOC from other relevant agencies for operational activity etc. for each project to the Head office of DOE in Dhaka with a copy to divisional office of DOE in Dhaka and Chittagong.


22.05.2012
(Syed Nazmul Ahsan)

Deputy Director (Environmental Clearance)
and
Member Secretary
Environmental Clearance Committee

Mr. Md. Saidul Haque
Additional Chief Engineer
Bridge Management Wing, RHD
Sarak Bhaban, Ramna, Dhaka.

Copy Forwarded to :

- 1) The Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
- 2) Director, Department of Environment, Dhaka Region/Chittagong Division, Dhaka/Chittagong.
- 3) Staff Officer to the Director General, Department of Environment, Head Office, Dhaka.

Terms of Reference (TOR)

Environmental Impact Assessment (EIA) For

Dhaka-Chittagong National Highway No. 1 – Bridge Construction and Rehabilitation Project

1 Project Background

1.1 Deterioration of Existing Bridges

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 Meghna-Gumti bridges are major structures, which are the only way to cross Sitalakhya, Meghna and Meghna-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.

1.2 Substantial Shortage of Capacity for present and future traffic demand

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 Meghna-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 Meghna-Gumti bridges are becoming an essential issue.

1.3 Project Objectives

The overall objective of the Project is to mitigate the increasing traffic demand of National Highway No.1, which can be possible by

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

In consideration with the above Project objectives, the Feasibility study will be carried out in order to appraise ODA loan that will cover Project total cost, Project implementation framework, operation and maintenance system and environmental and social considerations.

2. Project Location

The study area covers Kanchpur, Meghna and Meghna-Gumti bridges on National Highway No. 1. The details of the study area are shown in Table and schematically in the project location map attached.

SINo.	Side	Zilla	Upazilla	Union/Pourashava
Kanchpur E	Dhaka	Narayanganj	Narayanganj Sadar	Siddhirganj
	Chittagong	Narayanganj	Sonargaon	Kanchpur
Meghna	Dhaka	Narayanganj	Sonargaon	Pirojpur
	Chittagong	Munshiganj	Gazaria	Bhaluakandi
Gumti	Dhaka	Munshiganj	Gazaria	Bausia
	Chittagong	Comilla	Daudkandi	Daudkandi

3 Environmental Consideration

In the study, the draft final Environmental and Social Impacts Assessment (EIA) Report is prepared based on the JICA Guidelines for Environmental and Social Considerations 2010 (JICA Guidelines). The report shall cover the contents that are described in the JICA Guidelines and World Bank Safeguard Policy OP4.01. At the stages of draft scoping and draft final EIA report preparations, stakeholders meetings shall be held for public disclosure and results of the meetings are incorporated into scoping and EIA respectively. In the due course, for the purpose to obtain advices from JICA Environmental Advisory Committee, it also is required to provide support by preparing necessary data to reply for inquiries made. In addition, check list for environmental and social considerations shall be prepared as per attached in reference of JICA Guidelines after discussion with recipient government.

The following items shall be studied:

1. Air pollution
2. Water pollution
3. Soil pollution
4. Waste
5. Noise
6. Ground subsidence
7. Offensive odors
8. Geographical features
9. Hydrology
10. Bottom sediment
11. Biota and ecosystems
12. Water usage
13. Accidents
14. Global warming
15. Involuntary resettlement (for hereafter items data are provided)
16. Local economies, such as employment, livelihood, etc.
17. Land use and utilization of local resources
18. Social institutions such as social infrastructure and local decision-making institutions
19. Existing social infrastructures and services
20. Poor, indigenous, or ethnic people
21. Misdistribution of benefits and damages
22. Local conflicts of interest
23. Gender
24. Children's rights
25. Cultural heritage
26. Infectious diseases such as HIV/AIDS
27. Inland water transportation

According to the regulations concerned such as "The Environmental Conservation Act, 1995", this project is classified as RED Category. Therefore, relevant regulations shall be fully

understood and completely covered for the preparation of EIA Report.

For the preparation of EIA Report for three bridges, a supplementary report shall be prepared to fully fill gaps between JICA Guidelines and Bangladesh Regulations. Contents of the supplementary report shall be made for the gap items between the Bangladesh Regulations and JICA Guidelines, and the Consultants and JICA shall confirm the gap items beforehand.

Main items to study as indicated in JICA Guidelines are:

- ① Baseline information for environmental and social conditions including land use, natural environment, indigenous people and their milieu, social and economic conditions in general etc as are specified as 27 items to study in Section 4)
- ② Information about institutional and legal frameworks for environmental and social consideration Bangladesh
 - a. Acts, standards etc for environmental and social considerations including the environmental impact assessment system and information dissemination system.
 - b. Gaps between above regulations and JICA Guidelines
 - c. Concerned agencies: Such as Department of Environment (DOE), Social and Environmental Circle (SEC) of RHD, Bangladesh Water Development Board (BWDB), Dhaka Water and Sewage Authority, Department of Public Health Engineering (DPHE), Bangladesh Inland Water Transport Authority (BIWTA),
- ③ Scoping is implemented, listing items to be considered and methodologies for environmental and social considerations
- ④ Predictions of impacts as are specified as 27 items to study in Section 4)
- ⑤ Evaluation of the impacts and study of options including Zero Option
- ⑥ Mitigation studies for avoiding, minimizing or compensating for the impacts to those as are specified as 27 items to study in Section 4)
- ⑦ Preparation of Environmental Management Plan (EMP) and Monitoring Plan for implementing organization, processes, cost etc
- ⑧ Clarification of total cost, budget source and responsible agencies
- ⑨ Support to stakeholders meetings by advising what is the purpose, who shall participate, what are to be discussed etc

To prepare EIA Report, Information collection (water quality, bottom sediment quality, noise, air quality etc, including field survey) and site investigation are required

- ① Survey of Temperature, pH, Suspended Solid (SS) , Dissolved Oxygen (DO), Bio-Chemical Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD), Coliform as are specified in water quality standard shall be implemented.
- ② Survey of Suspended Particulate Matter (PM10 and PM2.5), Nitrogen Oxides (NO₂), Sulfate Oxides (SO₂) and Lead as specified in air quality standard shall be implemented for the estimation of total amounts of exhausted gases respectively.
- ③ Noise level shall be measured at the site
- ④ Ecological survey shall be implemented by collection of existing data, site reconnaissance, and interview to locals for the confirmation of presences of endangered species.

Local consultant/contractor shall be employed for the flowing measurement:

- Natural environmental survey
 - Surface water quality : 6 locations (up stream and down stream of each bridge site)
Temperature, pH, Turbidity, Total Suspended Solid (TSS) , Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Coliform, Turbidity, BOD₅, TDS, NH₃-N, by sampling river water at the middle of 3 rivers in dry and wet seasons respectively.
 - Groundwater quality : 3 locations

Temperature, pH, DO, Turbidity, Mn, Fe, As, Electrical Conductivity, Chloride as Cl⁻ by sampling tube wells at three bridges.

- Air quality : 3 locations

Particulate Matter (SPM, PM₁₀, PM_{2.5}), Nitrogen oxide (NO_x), Sulfur Dioxide (SO₂), and Lead for wet and dry season near three bridges respectively for 8 hours

- Soil pollution : 6 samples
(Lead, Cadmium, Arsenic, Organic content, Mercury, Chromium⁺⁶ in leached water from 3 samples on land and 3 samples on riverbed)

- Noise : 12 locations (4 locations in each bridge site)

Day time continuous Noise Quality (Equivalent noise level, hourly average) shall be measured near three bridges and at school, mosque, industry etc.

- Ecological survey

The survey will be conducted within 2 km radius for each bridge alignment.

As for social issues, Resettlement Action Plan is to be prepared as per attachment and the results will be incorporated into EIA Report.

4 Content of EIA Report

Table of Contents for EIA report as per World Bank OP4.01

- Executive Summary

Concise discusses significant findings and recommended actions.

Main text as:

- Policy, Legal and Administrative Framework

This section discusses the national and local legal and institutional framework within which the environmental assessment is carried out.

- Project Description

This section describes drawings and maps showing the bridge's layout and major components, the location and the project's area of influence. Materials used for construction, schedule of implementation and project cost will be provided.

- Baseline Data

This Section describes relevant physical, biological and socioeconomic conditions within the study area.

- Environmental Impacts

This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic including occupational health and safety, community health and safety and impacts on livelihood and physical cultural resources in the project's area of influence, in quantitative terms to the extent possible, identifies mitigation measures and any residual negative impacts that cannot be mitigated.

- Analysis of Alternatives

This section examines alternatives to the selected site, technology, preliminary design and operation- including the no project alternative- in terms of their potential environmental impacts.

- Environmental Management Plan

This section includes the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates etc.

- Public Consultation and Disclosure

This section describes the process undertaken during bridge design, preparation for engaging stakeholders including information disclosure and consultation with affected people and other stakeholders.

- Conclusion and Recommendation

This section provides the conclusions drawn from the assessment and provides recommendations

5 Study Schedule

- The first stakeholders Meeting for TOR held mid March 2012
- Field survey works (air, water, soil, noise quality etc.) will be conducted from March to June covering seasonal variation (premonsoon and monsoon)
- The second stakeholders meeting for final draft EIA/RAP reports held on the end of August 2012 and, after revision based on the opinion raised, final reports be submitted to DOE
- Obtaining environmental clearance from DOE within October and formally submitted to Japanese Government

Year	2012											
Month	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sept.	Oct.	Nov.	Dec.	
Review of bridge alignment and study documents	■											
Site Reconnaissance and Field Visit	■											
Expert Consultation	■											
Screening and Scoping	■											
Draft Scoping Report		■										
First Stakeholders' meeting			☆									
JICA advisory committee				☆								
Final scoping report				☆								
Submission of Draft TOR to DoE and JICA			■									
Approval by DOE				☆								
Field Studies and baseline monitoring			■	■	■	■						
Draft reports making			■	■	■	■	■					
Second Stakeholders' meeting							☆					
JICA Advisory Committee							☆					
Submittal of final reports							☆					
Environmental license issuance									☆			

ATTACHMENT : TOR for SOCIAL CONSIDERATION

This is attached as TOR for RAP Preparation for the study team and is only reference for DOE.

Although all the land for project area has been already acquired by RHD and no compensation for land is required, there many occupants residing within the project area and large scale of involuntary resettlement is predicted. Therefore based on JICA Guidelines, preparation of Resettlement Action Plan (RAP) is required. RAP shall include contents as are mentioned in Annex A Resettlement Plan of World Bank Safeguard Policy OP4.12 and they are as sections as below. In the preparation of RAP, also referred is “Involuntary Resettlement Sourcebook Planning and Implementation in Developing Projects”. To get advises from JICA Advisory Committee on each time at preparation of Resettlement Policy and RAP respectively, support is required. Results shall be submitted of socioeconomic survey (census, assent inventory, livelihood and life levels interviews), replacement cost survey, survey for the needs of livelihood restoration program , etc All these results shall be submitted to JICA.

Section 1. Analysis of legal framework for resettlement

- To analyze gaps between Bangladesh Laws about resettlement and JICA Guidelines, and propose the necessary measures to fulfill these gaps if any. Among all, gaps about entitlements for compensation and assistance for livelihood restoration, estimation process of compensation amount, time for that payment, livelihood restoration program, and grievance redressing mechanism are always compared.

Section 2. Description of the necessity of resettlement

- To describe project outline, project area and components which involve involuntary resettlement activity. Also to describe several alternatives, at initial design stage, for the purpose to avoid/minimize the land acquisition and involuntary resettlement

Section 3. Socioeconomic survey (census, assets inventory, livelihood and life level survey, etc)

- Census is implemented to all the project land occupants (Directly Affected Households: DAHs) to count numbers to entitled (land owner, tenant, business person, shop employee, illegal occupants included). It is noted encroachers after Cut-Off-Day are not entitled for any compensation or livelihood assistances at all. When relocation site is provided, the host community shall be consulted as well.
- Assets inventory shall be made for all of the physical and economical properties of DAHs. They shall be itemizes and quantified. Asset inventory shall be made together with census as much possible.
- Survey for livelihood and life level is implemented to 20%, in the minimum, of the total number of DAHs, and clarified are general characteristics of DAHs, baseline data about livelihood and life level, information about socially vulnerable groups such as people below poverty line, landless, aged, female, children, indigenous people, ethnic minorities and those who are not covered by the law.

Section 4. Compensation for lost assets and planning of livelihood restoration

- Establish the policy of entitlement for land owner, tenant, business person, shop employee, illegal occupant
- For the DAHs whose livelihood are land-base, provision of alternative land with equivalent

location and equivalent productivity is preferred to monetary compensation. In case sufficient land is not available, the evidence of lack of adequate land shall be indicated.

- Described are procedure of perfectly replacement cost compensation payment as specified in OP4.12 and its responsible agencies. For the examination of compensation procedure, replacement cost survey shall be properly implemented for the cost estimation of assets of entitled households and presence of legal gaps between Bangladesh Laws and JICA Guidelines shall be confirmed. If gaps are noted, additional compensation procedure shall be required to fulfill the gap and its responsible agency shall be studied. For DAHs who physically move to other location, transportation fee shall be provided.
- Livelihood restoration program shall be proposed for the purpose to restore, in the minimum, or to improve the livelihood compared to the before project. This program includes provision of compensation for lost assets, priority employment, salary compensation, loan, job training etc. This program shall be, of course, technically and feasibly applicable and will be determined after the consultation with entitled households.

Section 5. Preparation of program for relocation site setting up

- Potentially superior relocation site as productivity and feasibility shall be chosen compared to the land to be lost. In the proposed relocation site, planned are program of preparation of housing, infrastructures (tap water and sub-divisional roads, etc) and social services (school, medical care, etc). In addition, EIA/IEE, environmental mitigation measures planning and EMP shall be prepared as required.

Section 6. Examination of grievance redressing procedure

- Study is required for the determination whether to utilize the present system or to propose a new system based on views of easiness, accessibility and reliability. It is required to describe the mandate of responsible agency, members, file application procedure, recommendation preparation process, time limits and information dissemination process, etc.

Section 7. Evaluation of implementation agency

- Identify responsible agencies (Implementing agency, local governments, consultants, NGO, etc) and describe mandate of each agency (organization's responsibility and its detailed chart, each section's role, staff's duty and qualification, cost including personnel expenses).
- Evaluate capacities of implementing agencies responsible and, if found to be necessary, capacity building is proposed

Section 8. Evaluation of implementing schedule

- Time to start relocation shall be after 1) provision of compensate and assistances necessary for relocation including transportation allowance and 2) preparation of infrastructures and social services (medical care, education, etc) have been completed at the relocation site.

Section 9. Cost and resources of budget

- Cost for compensation, preparation of relocation site, livelihood restoration, administrative activities, etc that are necessary for resettlement shall be itemized and estimated and the expenditure schedule shall be prepared. Compensation amount is determined by the assets inventory of respective entitled household, based on the rare obtained from replacement cost

survey of typical land type and properties. To secure the additionally necessary cost as is not covered by Bangladesh Law, budget source shall be studied.

Section 10. Monitoring and post project evaluation

- To study the system of internal monitoring by implementing agency and to prepare monitoring form required. In the monitoring form, indices for input and output are proposed.
- To study the system of external monitoring by the independent agency and propose the form for public disclosure.
- To confirm if the resettlement activities are proceeded as per scheduled and prepare data for public disclosure.

Section 9. To secure involvement of affected people

- The strategy shall be planned to secure the involvement of affected people from the preparation stage of RAP and its implementation stage, especially for the purpose to protect the vulnerable and indigenous people. In the strategy following shall be included:
 - Public discussion for alternatives of earlier design stage
 - Explanation of project outlines to affected households through door to door interview for socioeconomic survey
 - Discussion with key stakeholders
 - Focus group discussion with vulnerable group
 - Discussion about RAP with affected people
 - Delivery of leaflet of RAP
 - To secure the attendance of DAHs at the meeting
 - Monitoring
- It is required to assist the meetings for explanation to affected people and discussion with affected residents. Minutes of meetings shall be prepared, describing opinions raised and their responses, which were incorporated to RAP.

At the survey of study area and affected people, identification of accurate gender profile is required and necessity of special compensation/assistance shall be studied so that females are not treated unfairly.

Table of Content for RAP Report covering World Bank OP 4.12

- Executive Summary
- Main Text
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Numerical analyses were made based on the formula proposed by:

(Ref.1) Road Environment, Sankaido, 1997

(Ref. 2) Technique of the Road Environmental Impact Assessment, Road Environment Institute 2007

(Ref. 3) Technique for Environmental Impact Assessment, Chuou-hoki 1999

Noise

(1) Traffic noise

$L_{Aeq} = L_{AE} + 10 \log N - 35.6$

ASJ CN-Model 2000 (Ref.2)

L_{Aeq} Equivalent noise level, d(B(A))

Noise increment ration in case of concrete pavement

0.1 Experimental(Shoji)

$L_{AE} = 10 \log(1/T) \cdot \sum (10^{L_{A,i}/10} \cdot \Delta T)$

L_{AE} Power level in average from a vehicle, dB(A)

$L_{A,i} = L_w - 8 - 20 \log r_i$

Power level from I'th vehicle, dB(A)

r_i : Distance from I'th source to the location of prediction

$L_{WA} = 46 + 6 \cdot a_2 + 30 \log V$ (high gear driving)

Modified ASJ RTN-Model 2003, Table 2.3(Ref.2)

$L_{WA} = 90 + 10 \log V$ (low gear driving)

"

a_1 : Ratio of smaller vehicle	0.9
a_2 : Ratio of larger vehicle	0.1

l Distance from source to the location of prediction (m)

H Effective emission height 0.3 m

d Average car head spaces, $d = 1000V/N$

V Average driving speed km/h

N Average hourly number of vehicle num/h

α_d Reduction by diffraction [dB(A)]

in case:

$\alpha_d = -9 \log_{10} \delta - 14.3$	$0.5 \leq \delta$
$-2.7(\log_{10} \delta)^2 - 10.5 \log_{10} \delta - 14.5$	$0.07 < \delta \leq 0.5$
$-3 \log_{10} \delta - 9.5$	$0.01 < \delta \leq 0.7$
$-10 \log_{10} \delta (0.2 + 2.5 \delta) - 10$	$-0.001 < \delta \leq 0.01$
$0.24 \delta \log_{10} \delta - 2.2$	$-0.015 < \delta \leq -0.001$
$0.2 \delta \log_{10} \delta + 1$	$-0.3 < \delta \leq -0.015$

δ : difference of transmission distance

(2) Noise level from construction work and lorries

ASJ CN-Model 20003 (Ref.2)

$L_{Aeq, T, Total} = 10 \log(10^{L_{Aeq, T, con}/10} + 10^{L_{Aeq, T, ve}/10})$

$L_{Aeq, T, Total}$ Sum of noise by construction work and lorries

$L_{Aeq, T, con}$ Total noise by construction work

$L_{Aeq, T, ve}$ Total noise by construction lorries

Table: Construction work power level at the reference point

		$L_{WAeff, i}$ dB(A)	ΔL d(BA)
Asphalt paving	Subbase/base	103	5
	Asphalting	113	6
Concrete paving	Subbase/base	116	5
	Concreting	108	5

a. Noise by construction work

$L_{Aeq, T, con} = 10 \cdot \log(1/T) \cdot (\sum T_i \cdot 10^{L_{Aeff, i}/10})$

$L_{Aeq, T, con}$ Total noise by construction work

T Working time

$L_{Aeff, i} = L_{WAeff, i} - 8 - 20 \cdot \log(r/r_0) + \Delta L_{d, i} + \Delta L_{g, i} + \Delta L$

Noise level by i-th construction work unit

$L_{WAeff, i}$ Power level by i-th construction work unit at the reference point

ΔL Correction

r Distance to the location of prediction

r_0 Distance to the reference point

$\Delta L_{d, i}$ Reduction by diffraction, neglected for safety side

$\Delta L_{g, i}$ Reduction by the ground surface condition, neglected for safety side

b. Noise by construction lorries

$L_{Aeq, T, ve} = 10 \log(10^{L_{A1}} \cdot N)$ (Assuming only one type of lorry)

$L_{A, i} = L_{WA} - 8 - 20 \log(r/r_0) + \Delta L_{d, i} + \Delta L_{g, i}$

L_{WA} Power level of 10 tone Lorry =

N Number of lorry/hour 10

r Distance to the location of prediction

r_0 Distance to the reference point

$\Delta L_{d, i}$ Reduction by diffraction, neglected for safety side

$\Delta L_{g, i}$ Reduction by the ground surface condition, neglected for safety side

Air Pollution

(1) Air pollution by traffic during operation (Ref.1)

Assuming infinite line source with wind direction right angle to the traffic

$$c(x,z)=Q/\text{sqrt}(2\pi\sigma zU) \cdot (\exp(-(H-z)^2/2\sigma z^2) + \exp(-(H+z)^2/2\sigma z^2))$$

c(x, z)	Concentration of air pollutant, $\mu\text{g}/\text{m}^3$	
x	Distance m	
Q	Strength of emission of air pollutants ($\text{g}/\text{m}\cdot\text{s}$) $Q=E\cdot N/1,000/3,600$	
E:	NO ₂	$E=-0,902/V-0,00578V+0,0000439V^2+0,026$ for Medium Car ($V<20\text{km}/\text{h}$: $E=0,118\text{g}/\text{km}$) $E=-7,12/V-0,0895V+0,000735V^2+3,93$ for Large Car ($V<20\text{km}/\text{h}$: $E=2,08\text{g}/\text{km}$)
	SPM	$E=-0,0687/V-0,000385V+0,00000287V^2+0,017$ for Medium Car ($V<20\text{km}/\text{h}$: $E=0,007\text{g}/\text{km}$) $E=0,0318/V-0,0031V+0,0000227V^2+0,158$ for large Car ($V<20\text{km}/\text{h}$: $E=0,107\text{g}/\text{km}$)
	CO	$E=-12,5/V-0,0599V+0,000448V^2+2,2$ for Medium Car ($V<20\text{km}/\text{h}$: $E=0,636\text{g}/\text{km}$) $E=10,9/V-0,0168V+0,000115V^2+1,19$ for Large Car ($V<20\text{km}/\text{h}$: $E=1,45\text{g}/\text{km}$)
	SO ₂	$E=0,0783/V-0,000162V+0,00000131V^2+0,0112$ for Medium Car ($V<20\text{km}/\text{h}$: $E=0,012\text{g}/\text{km}$) $E=0,0411/V-0,000699V+0,00000551V^2+0,0424$ for Large Car ($V<20\text{km}/\text{h}$: $E=0,033\text{g}/\text{km}$)
	CO ₂	$E=976V^{(-0,43)}$ $\text{g}/\text{km}/\text{day}$ (By regression analysis, Shoji)
H	Effective height of emission	<input type="text" value="1"/> In case of viaduct, add that height
σz	Vertical dispersion factor m	$\sigma z=1,5+0,31\times 0,83$ Without barrier or less than 3m high $\sigma z=4,0+0,31\times 0,83$ With a barrier equal or higher than 3m
Z	Height of prediction m	Z_0 : Initial height of prediction <input type="text" value="1"/> $Z=Z_0+\Delta z \times N$
	Δz : interval	<input type="text" value="1"/>
U	Wind velocity, right angle to th	<input type="text" value="1"/>
	Width of road lane m	<input type="text" value="4"/>

Table: Correction factor for the emission strength

Year	Correction factor (multiply the emission)
2000	3,4
2001	3,3
2002	3,1
2003	2,8
2004	2,7
2005	2,3
2006	2,1
2007	1,8
2008	1,6
2009	1,4
2010	1,3
2011	1,2
2012	1,1
2013	1,1
2014	1,0
2015	1,0
2016	1,0
2017	1,0
2018	1,0

(2) Air pollution during construction (applicable to NO2 and SPM only)

(Ref. 2)

Total of air pollutions by construction work and by lorries

a. Air pollution by construction work

Assuming wind direction of right angle to the road($y=0$)

- $\Sigma c(x,z)$ Sum of concentration by respective construction activity
 $c(x,z)=Q/2\pi\sigma_z\sigma_yU \times (\exp(-(H-z)^2/2\sigma_z^2) + \exp(-(H+z)^2/2\sigma_z^2))$
 $c(x, z)$ Concentration of air pollutants
 x Distance of prediction m
 Q Emission strength ($\mu g/s$)
 H Emission height m
 In case of viaduct, add that height
 σ_z Vertical dispersion factor m
 $\sigma_z=2,9 + \sigma_{zp}$
 σ_{zp} : Pasquill-Gifford's vertical dispersion factor
 σ_y Horizontal dispersion factor m
 $\sigma_y=W/2+1,82\sigma_{yp}$
 σ_{yp} : Pasquill-Gifford's horizontal dispersion factor
 Z Prediction height m

Table: Emission strength for earth filling work (g/unit/day)

	NO2	SPM
No exhausted gas measure	8,600	260
Primary exhausted gas measure	4,800	190
Secondary exhausted gas measure	3,400	100

b. Air pollution by lorries

See "air pollution by traffic"

Vibration

(Ref. 2)

(1) Vibration by traffic during operation

- L_{10} Upper limit of 80% range (dB)
 $L_{10} = L_{10}^* - \alpha I$
 L_{10}^* Upper limit of 80% range dB at the reference point
 $L_{10}^* = a \log(\log Q) + b \log V + c \log M + d + \alpha \sigma + \alpha f + \alpha s$
 Q Equivalent traffic volume per 500 seconds per lane (number/500s/lane)
 $= 500 / 3,600 / M * (Q1 + KQ2)$
 $Q1$ Number of large vehicles per hour (Number/hour)
 $Q2$ Number of medium vehicles per hour (Number/hour)
 K Conversion factor to medium vehicle from large vehicle=13
 V Driving velocity, km/h
 M Total number of lanes
 $\alpha \sigma$ Correction factor by the evenness of the road surface(dB)
 $= 8,2 * \log_{10} \sigma$ (in case of asphalt pavement)
 σ : Standard deviation of $\square\square$ on the road surface mm
 αf Correction factor by the prevailing frequency of ground (dB)
 $= -20 \log f$: $f \geq 8$ \geq
 $= -18$: $8 > f \geq 4$
 $= -24 + 10 \log f$: $4 > f$
 f Prevailing frequency of the ground
 αs Correction factor by the road structure (dB) : Not considered for this analysis
 αI Damping factor by distance (dB)
 $= \beta \log(r/5 + 1) / \log 2$
 $\beta = 0,068 L_{10}^* - 2,0$ (Clay)
 $\beta = 0,130 L_{10}^* - 3,9$ (Sand)
 r Distance m

(2) Vibration during construction

- L_{total} Total vibrations by construction work and lorries
 $= 10 \log(10 \log L(r) / 10 + 10 \log L_{10,ve} / 10)$
 $L(r)$ Vibration by construction work
 $L_{10,ve}$ Vibration by Lorries

a. Vibration by construction work

- $L(r) = L(r0) - 15 * \log(r/r0) - 8,68 \alpha (r-r0)$
 $L(r)$: Vibration level
 $L(r0)$: Vibration level at the reference point
 r Distance to prediction
 $r0$ Distance to the reference point
 α Internal damping factor =0,01 (given by the work type)

Table: Vibration by construction work at the reference point

		Damping factor	L_{10}^* d(BA)
Asphalt paving	Subbase/base course	0,001	59
	Asphalting	0,001	56
Concrete paving	Subbase/base course	0,001	59
	Concreting	0,001	75

b. Vibration by lorries

- $L_{10,ve}$ Upper limit of 80% range (dB)
 $L_{10,ve} = L_{10}^* + \Delta L$
 ΔL Increment of vibration by lorries
 $= a * \log(\log Q') - a * \log(\log(Q))$
 Q' Equivalent traffic volume per 500 seconds per lane (number/500s/lane)
 $= 500 / 3,600 / M * (Q1 + K(Q2 + Qcon))$
 $Q1$ Number of medium vehicles per hour (Number/hour)
 $Q2$ Number of large vehicles per hour (Number/hour)
 $Qcon$ Number of construction vehicles(=lorries) per hour (Number/hour)
 K Conversion factor of large vehicle to medium vehicle

Annex 2. Formula used for numerical analysis
5/5

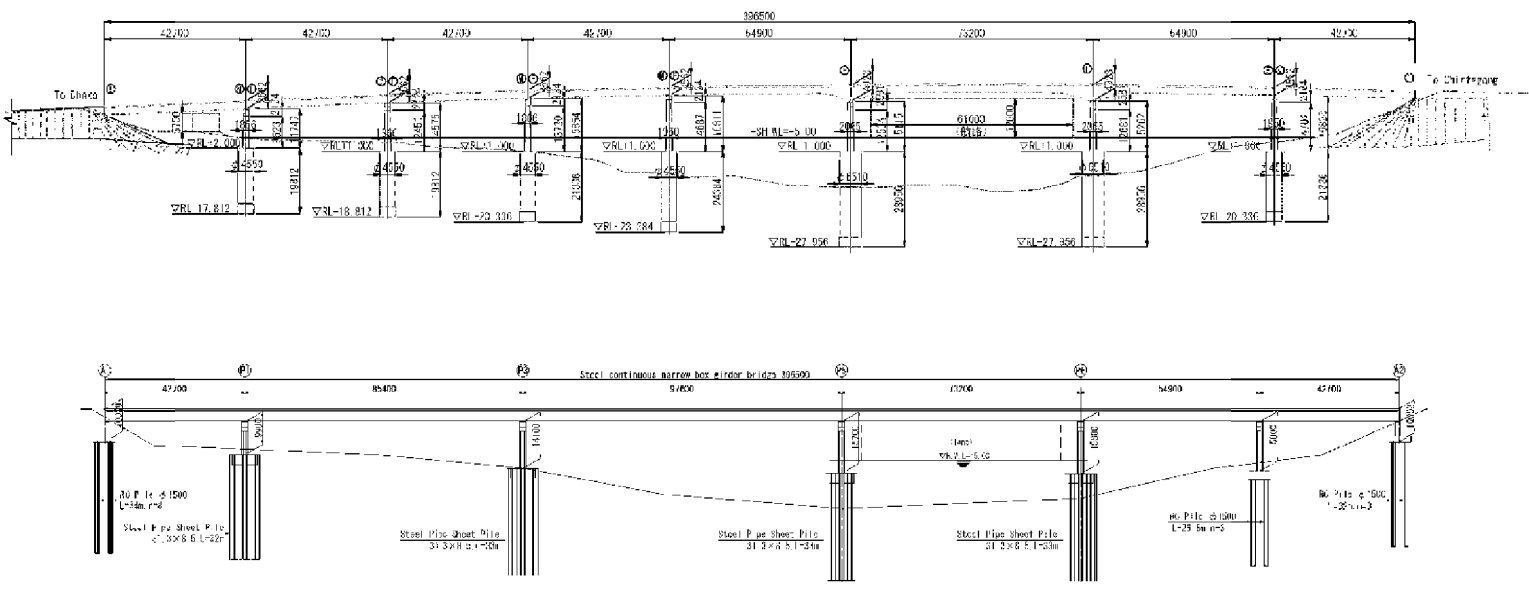
Dust

(Ref. 2)

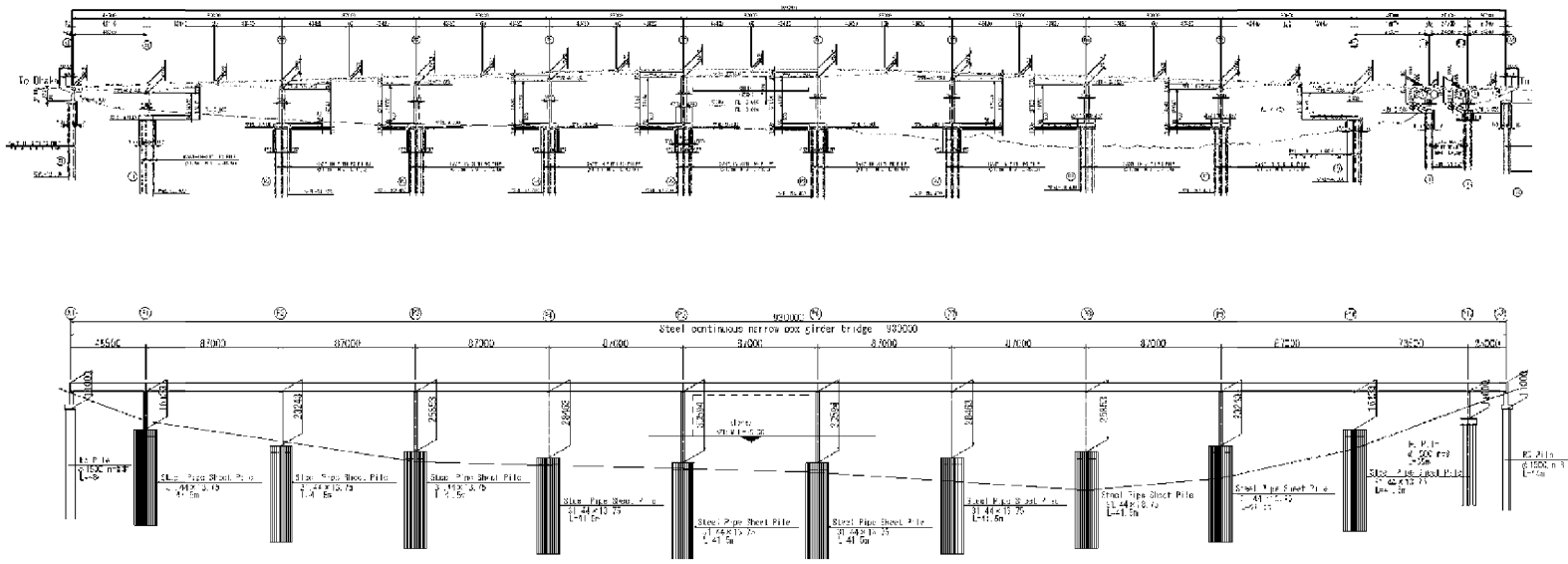
- Rd= Weight of dust fallen ton/km²/day
 $=N \cdot Cd \cdot (3.5 \cdot (0.2 \cdot x + 0.35))$
- N: Daily total traffic volume
- Cd= $a \cdot (u/u_0) - b \cdot (x/x_0) - c$
- Cd: Amount of dust fallen at the location of prediction which was raised by a truck ton/km²/m²/truck
- a: Unit dust fallen at the referent point
 Dust fallen raised from 1m² by a construction vehicle, ton/km²/truck/m²
- u: Wind velocity, right angle to road
- u₀: Reference wind velocity 1m/s
- b: Factor by wind 1
- x: Distance m
- x₀: Reference distance m 1
- C: Coefficient of dispersion of fallen dust 2

Table: Unit dust fallen at the referent point

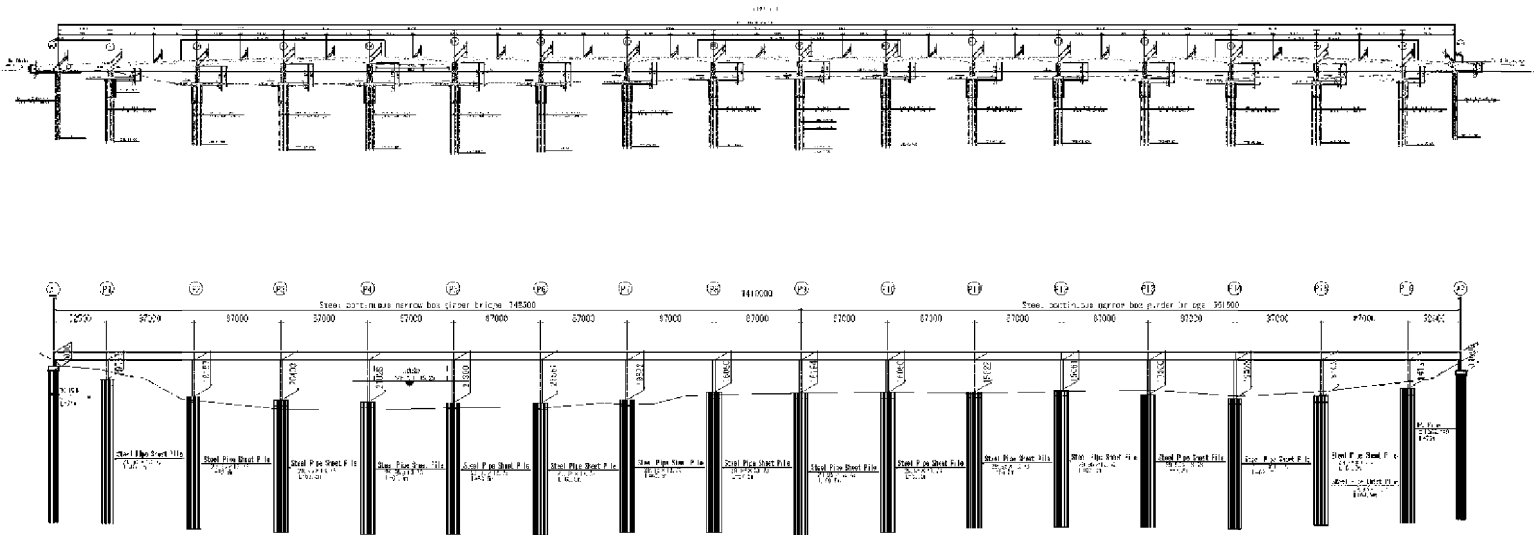
Surface conditions	ton/km ² /truck/m ²
Unpaved	0.23
Unpaved/steel plate	0.03
Unpaved/water sprinkled	0.012
Paved	0.0014
Paved with tire washed	0.0007



Comparison of Existing Bridge(above) and New Bridge(below) at Kanchpur Bridge



Comparison of Existing Bridge(above) and New Bridge(below) at Meghna Bridge



Comparison of Existing Bridge(above) and New Bridge(below)
at Gumti Bridge