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Government of the People`s Republic of Bangladesh

Ministry of Railways, Bangladesh Railway

BANGABANDHU RAILWAY BRIDGE CONSTRUCTION PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

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Executive Summary

The proposed Bangabandhu Railway Bridge is a lifeline connecting the north-western part with the eastern part of Bangladesh. The present project is undertaken by Bangladesh Railway (BR), Ministry of Railways, Government of Bangladesh (GoB). The project envisages the construction of a Railway bridge with provision for a Dual gauge double track which will run 300 meters up stream and parallel to the exiting Bangabandhu Bridge over the river Jamuna. The proposed project is funded by Japan International Cooperation Agency (JICA) and the project comprises of constructing of the 4.8 Km long bridge across the river Jamuna and construction of about 6.5 Km long approach rail track along with the computer based interlocking signalling system. The western alignment passes through the Bangabandhu Eco-Park. No additional land is required for acquisition. As such resettlement and rehabilitation problems will not be required to be addressed in this project. The entire alignment passes through the land owned by the Bangladesh Bridge Authority (BBA) and that of BR. The proposed bridge will address the load restrictions and speed restrictions on the existing Bangabandhu Bridge. The proposed project will generate multi-dimensional benefit for the local population and will improve the inter-regional trade among the South Asian Countries. A feasibility study of this project was conducted during 2013-2014 by ADB and a Supplemental Survey of this project was conducted by JICA in 2015.

The project is classified as Category A by JICA and the Department of Environment (DoE) as Red Category, (Environment Conservation Rules of 1997). Both JICA and DoE requires an Environmental Impact Assessment for this project. Design Consultant for this project is a joint venture of International and National Consulting Firms and at present the design is in progress. The major construction work will include large scale construction of large diameter piles, bridge piers followed by construction of steel truss superstructure as well as the restoration of river training works if any. The workforce is estimated around 2,000 people and the 50% of the work force would be from the local population. The terms of reference issued by DoE, Government of Bangladesh during the feasibility stage was used for conducting the environmental surveys. As there is no change in the location of the proposed bridge, updating of the earlier EIA Study is being done here.

Baseline environmental assessment was conducted for the environmental and ecological features of the project area within 5 km radius of Bangabandhu Bridge at upstream and downstream as shown in the Figure 1. The socio-economic study was carried out for the

local population to assess their livelihood and record the reaction of the local population for the upcoming of the new project.

In addition to these focus group discussions (FGD), public consultations, individual consultations and the stake holder consultations were conducted at the various locations in the project area to gather information and the opinion of the local population regarding the proposed project. As on the day, there were no complications at the project site and the project can be smoothly implemented. The environmental monitoring was carried out during the month of May to July 2017 during the detailed design stage. The environmental monitoring comprised of Air Quality, Water Quality (Surface and Ground Water), Noise and Vibration levels, Soil Quality, River sediment samples, Benthos and Plankton sampling. In the ADB feasibility stage, the parameters like sediments, benthos and plankton sampling, soil sampling and measuring the vibration levels were not considered. Present study was considered all those parameters which were left out during the feasibility stage and also included the fish, birds and dolphin survey. The analytical results showed that the air, noise and water quality baseline conditions of the parameters are very much within the national standards. The following methodology was adopted for measuring various environmental parameters:

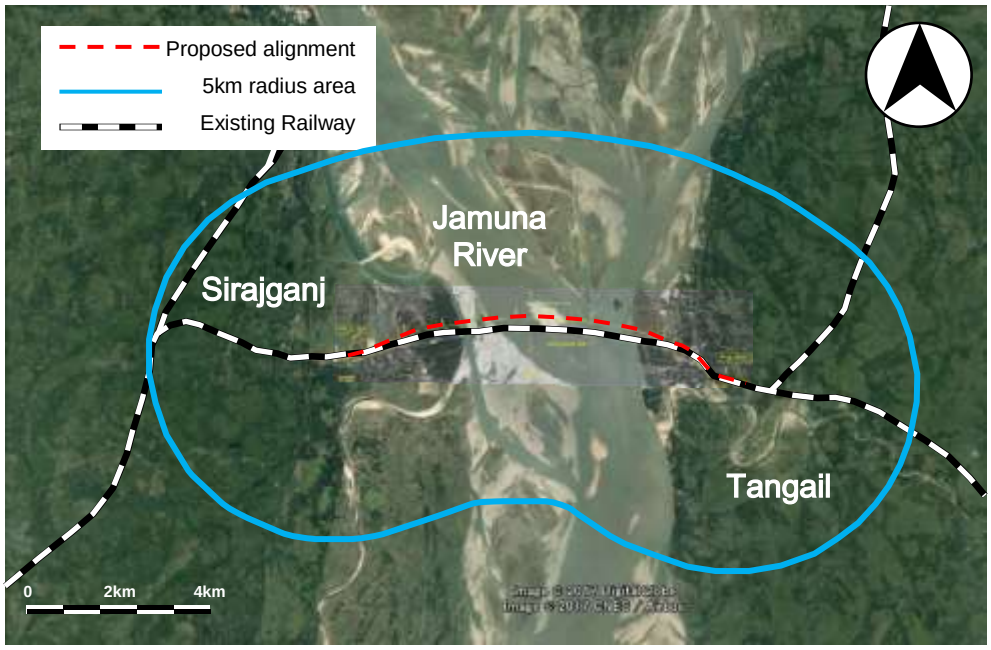

Figure 1: 5 km Radius of the proposed Bangabandhu Railway Bridge

Air Quality: Air Quality monitoring was carried out at 13 locations to assess the background air pollution level within project area including the Bangabandhu Eco-Park. The assessment was carried out to monitor Carbon Monoxide (CO), Oxides of Nitrogen (NOx), Particle Matter within 2.5 micro meters ($PM_{2.5}$), within 10 micro meters (PM_{10}), Tri Oxygen / Ozone (O_3), Sulphur Dioxide (SO_2), and meteorological parameters like temperature, humidity, and the wind speed and direction were measured during the monitoring period. The samples were collected for 8 hours. The particulate monitoring was carried out using a high-volume sampler. The particulates were estimated gravimetrically and the gaseous pollutants by Electro-Chemiluminescence technique. The air quality results showed almost unchanged concentrations when compared to the results obtained during the ADB feasibility stage. On the other hand, the noise levels showed tendency to increase when compared with the result of the Feasibility stage.

Surface Water: Surface Water samples were collected from sixteen (16) locations. For the water samples, a number of physio-chemical parameters were tested on-site. In total Nine (9) Parameters were analysed and those are; pH, Total Organic Carbon (TOC), Total Phosphorus (T-P), Total Suspended Solid (TSS), Oil & Grease, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and the Bacterial Load. All the samples were analysed at Bangladesh University of Engineering and Technology (BUET) for testing and the visual observations were made at the project site for recording for colour and the presence/ absence of detectable odours.

Ground Water: Ground Water samples were collected from six (6) locations. Laboratory Analysis of ground water samples were carried out in BUET. Nine (9) parameters were analysed. Those parameters are; Total Dissolved Solids (TDS), Chlorides (Cl), Heavy Metal, Arsenic (As), Iron (Fe), Manganese (Mn), Sulphur (S), Total Coliform (TC) and Faecal Coliform (FC).

The water quality in both surface and ground water found presence of Arsenic. The bacterial loads were also present in the surface water and ground water samples. Proper drinking water to be supplied to the workers who will be working at the project site during construction stage, as the quality ground/surface water is not very satisfactory.

Noise: Noise measurements were conducted in 13 locations same as the locations for Air Quality Monitoring. The noise was measured one-hour duration during the day time and 15 minutes duration during the night time. The noise monitoring was performed by the

Development Solutions Consultant Ltd. (DSCL). Background sound level has been monitored in time weighted average Leq in dBA both at day and night time at four locations encompassing each of the sample sites. The noise was recorded using a calibrated HTC Sound Level Meter set to A-weighting, slow response and statistical analysis settings. Day and Night Noise has been captured from every location. Vibration was also recorded from two locations using HTC VB-8205 vibration meter.

Soil: Soil samples were taken from seven (7) locations nearby agricultural lands on either side of the Jamuna River including the Bangabandhu Eco-Park and were sent to Department of Soil, Water and Environment of University of Dhaka for laboratory analysis. Observations were also made about the physical characteristics of the soil at the project area such as colour, texture and plasticity. The soil samples were collected for Total nitrogen (T-N), Total phosphorus (T-P), Potassium (K), Sulphur (S), Calcium (Ca), magnesium (Mg), Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn), Boron (B) and Molybdenum (Mo).

Riverbed Sediment: Total 6 numbers of samples were collected at different locations both from the upstream and downstream of the river Jamuna at proposed railway bridge site. Parameters for analyses are; Total Organic Matter, Phosphate, Nitrate, Ammonia, Sulphates, Al, As, Cd, Ca, Co and Cr. The samples were tested in BUET laboratory.

Benthos and Plankton: Total 6 samples of both benthos and plankton were also collected from the same locations of sediment sampling. Samplings have been sent to Department of Zoology, Dhaka University for study of Benthos and Plankton.

In addition to the baseline environmental parameters analysis, the surveys were also conducted in the project area. The survey involves the following:

Fishery Survey: Fishery Survey was conducted to identify the abundant, type and habitat area of different fish species of the river, and fishing gears used around the proposed project area. Fisheries survey was conducted within 5 km radius of Bangabandhu Bridge at upstream and downstream for 7 consecutive days. More than 53 fish species were identified from the river of Jamuna. Identified fishes were categorized according to Red data book of IUCN- Bangladesh. However, the fish population has been greatly reduced due to unsustainable fishing practices.

Wildlife Surveys: Because of many mammalian and reptilian species are cryptic and unlikely to be encountered using standard field sampling methods. As such, experience suggests that interviews with local people are a very useful method for collecting information on local biodiversity. Strongly follow the Red data books on mammals, reptiles, amphibians and birds of IUCN-Bangladesh and categorized the wildlife under endangered, critical endangered, vulnerable, data deficient etc. During the field survey period, extensive interviews with local people were conducted to collect information on animal and plant presence, including occurrences, behaviour, breeding, distribution and seasonal appearance.

Common mammals in and around study area are Mole Rat (*Bandicota bengalensis*), Bandicoot Rat (*Bandicota indica*), House Shrew (*Suncus murinus*), Field Mouse (*Mus booduga*), House Mouse (*Mus musculus*), House Rat (*Rattus rattus*) and Small Indian Mongoose (*Herpestes autopunctatus*) There is an evidence of the Common Otter (*Lutra lutra*) and Jackal (*Canis aureus*), species at risk of extinction and also categorised as endangered by IUCN. The Bengal Monitor and Yellow Monitor have been observed within the study area. These two species were listed as vulnerable (VU) and endangered (EN) in IUCN Red list category. During the survey in total 16 species of mammals, 11 species of reptiles and 6 species of amphibians were identified and recorded.

Avifauna Survey: Avifauna survey was conducted for a period of 6 consecutive days by the team members of Zoology Department under Dhaka University lead by Dr. Sabina Yasmin. The surveys on the migratory birds were conducted at the site by collecting information and interacting with the local population. All the information was collected within the 5 km radius during survey of the proposed bridge location. In total 83 species of birds have been identified and recorded and categorized according to Red data book of IUCN Bangladesh.

Bangabandhu Eco-Park: Bangabandhu Eco-park survey was carried out by different team for making an inventory of plants and wildlife in the eco-park. Two teams were assigned for the survey; one team for plants and the other team for wildlife survey. The works were implemented for 10 consecutive days at the eco-park. Threatened and rare species of wildlife and plants also identified from eco-park.

Gangetic Dolphins Survey: Gangetic Dolphins Survey was conducted to identify the presence, availability and habitat around the project site. The dolphin survey was conducted up to seven consecutive days during day time only to gather the maximum data during survey. Total 4 team (2 teams for both Upstream and Downstream) consisting 2 members

were survey at a time. The survey area was up to 5 km towards both upstream and downstream from the location of existing bridge.

Char land Survey: Char land survey was conducted based on the existing Char Lands up to 5 km both towards upstream and downstream from the existing bridge. To collect further samples regarding Char livelihood, the survey included 4 Char Lands formed at the upstream: Char Kalipur, Char Katnga, Char Bihari and Char Gabsara, and 2 Char Lands at the downstream: Char Singuliar and Char Jalbali. The survey activities were to collect information regarding environmental impacts likely to cause for the local population who are living at Char Lands. 4 teams worked for char land survey where every team consists of 2 members.

Tree Inventory: Tree inventory and classification was a part of baseline environmental survey, trees have been inventoried on Bangabandhu Eco-Park for removal of trees in the proposed alignment and the diversity of trees to be identified and recorded. An inventory of trees with local name, girth, dbh, bole height, height, amount of fuel and numbers has been prepared. In total 3683 trees of 27 species were inventoried which will remove during construction period.

Other Projects around the Project site: The power plant expansion projects, industrial parks and special economic zone proposed at the western bank would increase significant impacts on the water pollution and may affect air quality in and around the project area. When compared to the impacts caused by the proposed developmental activity it may be negligible impacts caused by the proposed bridge construction activity. The baseline chapter discusses about the environmental quality.

Topography: The Project area is located in the flood plain of the Jamuna River, which is part of an active delta system consisting of flat alluvial plains. The topography in the study area is almost flat with elevation differences between three to nine meters on both sides of the Jamuna River. The larger portion of the alluvial deposits in the study area predominantly consists of fine to medium grained sand with greater density at deeper layers. The basal layers are alluvium gravel layers.

Land Use: Land use within 100 m either side of the approach track of the proposed railway bridge comprises of commercial structures, planted forest, water bodies, and open lands.

The surface water along the proposed alignment is dominated by the Jamuna River. The river exhibits flooding during monsoon.

Agriculture: Agricultural crops are the major type of vegetation in the study area. All flood plains in the study area are extensively used for agriculture. The majority of these agricultural fields are regularly inundated during the monsoon season. Paddy is the major crop with the major species being “Irri-Boro”. Among other crops Peanut (*Arachis hypogaea*), Wheat (*Triticum aestivum*), Black Gram (*Vigna mungo*), Sesame (*Sesamum indicum*), Millet (*Pennisetum glaucum*) and Jute (*Corchorus olitorius*) are also commonly grown. The variety of vegetation on the Char land is comparatively poorer than other mainland ecological resources. Most of the plant varieties on the Char land are grasses. The char land is also well known for vegetable cultivation such as Sweet gourd (*Cucurbita maxima*) and Okra (*Abelmoschus esculentus)*. In addition, crops in the Boro (Christmas) season are also cultivated widely on the Char land of the Bangabandhu Railway Bridge area. Vegetation on the Char land is mainly seasonal and agricultural activities are dependent on the length of the dry season. The seasonal wetlands of the river abound in various types of aquatic flora such as free floating, rooted floating, submerged sedges and meadows, and marginal plants. Huge quantity of the pesticides and herbicides are used for protection of standing crops, at the project area. The chemical fertiliser use is also really huge by the local farmers.

Pesticide: Most of the farmers apply pesticides in an unbalanced way. The use of pesticides depends on the degree of pest infestation. Application of pesticides has been noticed for 1-3 times to control pest and diseases for the rice crops grown in the areas. The major insects as reported by the farmers were Stem borer, Green leaf hopper, Grass hopper, Rice bug, Brinjal shoot and Fruit borer, Red Pumpkin beetle and Mosaic. Local farmer reported that they were using different types of pesticides such as D-ten 10G, Krishan5G, Krishan10G, Hi power, Heron, Morter, Foker, Raison-60 EC, Brifer-5G, Siperin-10EC, Regent-3G, Sifanon-57EC and Cumulus etc. to prevent pest infestation in rice, vegetables and others crop cultivation.

Gangetic Dolphin (*Platanista gangetica*) is one of the most important endangered aquatic mammals observed within the project site. The population of this species is considered to be decreasing day-by-day. The Ganges River dolphin is listed in CITES-Appendix I and IUCN as Endangered. The species has been adversely affected by human use of the river system.

Entanglement in fishing nets is also causing significant damage to the local population numbers.

Migratory Birds: No terrestrial or aquatic birds were found endangered within the study area. Although no migratory birds have been observed during site visit, it was evident from the local population as well as from secondary data sources that few migratory bird species nested every year in the study area including: the Grey Headed Lapwing, Black Headed Ibis, Common Tern, Indian River Tern, Long Legged-Buzzard, Short-eared Owl, and Comb Duck. However, the number of migratory birds and their types were decreasing over time due to urban and industrial encroachment.

Environmental Impact

The activities have the potential impact on the environment, society and economy in both positive and negative ways, and these were identified and assessed through environmental impacts chapter of this report. The physical, biological, socio-economic and health aspects have been categorized into pre-construction, construction and operational periods. The proposed Project will have noticeable impacts during the construction period, but will be easily prevented or mitigated.

All impacts, mitigation measures and monitoring requirements have been defined in an EMP, included in the EIA and organized into three components, pre-construction, construction and operations. Most of the pre-construction and operating period measures will be implemented by the Client (BR), while the construction period measures will be the contractor's responsibility, enforced by the Engineer and overseen by BR. The construction period section of the EMP has been integrated into the construction contract as a set of environment issues allowing for easy calculation of financial penalties.

Grievance Redress Committees

Grievance Redress Committees (GRCs) will be organized in two Upazila within the Tangail and Sirajganj administrative areas. The Project will likely trigger both environmental (as defined in the EIA) and social impacts and therefore the GRC will need to be able to address both. Prior to the start of construction, BR will meet with Upazila heads to request each to nominate committee members who could form part of the GRC, and meet when complaints are received. Once the complains reaches the GRC, the GRC has two weeks to render a decision, based on discussion with all parties involved and following the four steps described

in Chapter on EMP. Besides grievances for the affected person, construction workers grievances will also be ensured through individual contractual agreements.

Mitigation and monitoring actions

Mitigation and monitoring actions were defined. The works on construction phase will concentrate around issues arising due to the noise and vibration, char land activities include barge movements, river dredging, material transportation, soil and river channel erosion, topography changes, loss of habitat for aquatic, terrestrial and avian fauna, water pollution and other project induced impacts. The contractor will be required to conduct a regular air, water and noise quality monitoring programme, as specified in the EMP, and submit reports, on a monthly, quarterly, and on annual basis. The contractor's environmental safeguard personnel will have to attend a mandatory training workshop on EMP implementation, prior to the start of work.

Mitigation and monitoring measures

Mitigation and monitoring measures were defined that mainly focus on inspection of contractor work areas, their waste disposal sites, rehabilitation/revegetation, proper landscaping, re-establishment of local access, debris clearance from reconstructed culverts, etc. BR will implement an air and noise quality monitoring programme during three operating years to establish the noise and air quality degradation (if any) at sensitive sites, identified during the EIA and to implement proper noise and air quality attenuation measures.

Environmental and Social Safeguard Unit (ESSU)

The Project will have provision for the creation of an environmental and social safeguard unit (ESSU) within BR to manage the safeguard issues arising from the proposed project. BR will create at least one environmental safeguards staff position and two if its mitigation and monitoring duties are not given to a Consultant. In addition to staff, the ESSU will also need basic equipment to undertaken monitoring as well as staff training. It will be the staff’s duty to monitor the contractor’s environmental compliance, complete all the operating period EMP requirements and ensure that reporting is technically robust and meets JICA and GoB standards. Therefore, the unit must be trained and ready to take on varied tasks and be able to report to International Donors.

Conclusion

To conclude, the Project could generate a number of environmental impacts, such as those associated with the embankment construction, the river crossings or poor housekeeping by the contractor.

The air quality results showed almost unchanged concentrations when compared to the previous results obtained at ADB feasibility stage. On the other hand, the noise levels showed the tendency to increase compared with the result on the Feasibility stage. The water quality in both surface and ground water found the presence of Arsenic.

The air quality will also be affected due to the use of generators, increase in transportation vehicles and construction of residential accommodation would adversely impact the air quality.

No significant environmental safeguard issues were identified and all likely minor impacts can be mitigated to an acceptable level following the recommendation of this study. Impact from Earthwork, Embankment, Signalling and interlocking system are low and manageable by proper implementation of EMP.

The ElA's EMP provides the specific guidelines which BR has put in place to prevent or mitigate these effects. BR is committed to implement these measures and has fully endorsed the EIA which is the basis for the EMP. BR will ensure that the work is carried out in an environmentally acceptable manner and the monitoring and reporting are completed in a compliant and timely fashion acceptable to both DoE and JICA.

ABBREVIATION

ADB	Asian Development Bank
As	Arsenic
BADC	Bangladesh Agricultural Development Corporation
BBA	Bangladesh Bridge Authority
BBS	Bangladesh Bureau of Statistics
BD	Bangladesh
BIWTA	Bangladesh Inland Water Transport Authority
BOD	Biochemical Oxygen Demand
BR	Bangladesh Railways
BRBCP	Bangabandhu Railway Bridge Construction Project
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPRs	Community Property Resources
DG	Director General
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Forest
DSC	Design and Supervision Consultants
DSCL	Development Solutions Consultant Ltd.
DWASA	Dhaka Water Supply and Sewerage Authority
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
EQS	Environmental Quality Standards
ESSU	Environmental and Social Safeguards Unit
Fe	Iron
FGD	Focus Group Discussion
GHG	Greenhouse Gases

GoB	Government of Bangladesh
GRM	Grievance Redress Mechanism
GTCL	Gas Transmission Company Limited
GW	Ground Water
ICTPs	International Conventions, Treaties and Protocols
IDM	Information Disclosure Meeting
IEE	Initial Environmental Examination
IESR	Initial Environmental Scoping Report
IUCN	International Union for Conservation and Nature
JICA	Japan International Cooperation Agency
km	Kilometre
km/h	Kilometre per Hour
Lden	Day-Evening-Night Average Sound Level
LGD	Local Government Division
LGED	Local Government Engineering Department
M	Metre
Mn	Manganese
MOEF	Ministry of Environment and Forest
NEMAP	National Environmental Management Action Plan
NGO	Non-Government Organization
NM	Noise Measurement
NO	Nitric Oxide
NO_2	Nitrogen di-oxide
O_3	Ozone
PC	Public Consultation
PD	Project Director
PM_{10}	Particulate Matter (less than or equal to 10 microns)
$PM_{2.5}$	Particulate Matter (less than or equal to 2.5 microns)
RH	Relative Humidity
RoW	Right of Way
PSIG	Pound per Square Inch Gauge
RTW	River Training Works
SASEC	South Asian Sub - regional Economic Cooperation
SCC	Site Clearance Certificate
SO_2	Sulphur di-oxide
SPS	Safeguards Policy Statement

SW	Surface Water
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
ToR	Terms of References
TSS	Total Suspended Solid
UNO	Upazila Nirbahi Officer
UP	Union Parishad
USD	US Dollars
USEPA	US Environmental Protection Agency
VOC	Volatile Organic Compound

Weights and Measures

1 ha	2.47 acre
1 ha –	10,000 sq
1 acre	100 decimales
ha –	hectare
km –	kilometre
m –	Meter
mm –	millimetre
km/h –	kilometre per hour

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1. CHAPTER -INTRODUCTION

1.1 Background

Bangladesh Railway (BR) is a Government Department under the Ministry of Railways and it is responsible for operation and maintenance of the entire railway network of the country. BR is headed by the Director General.

The proposed Bangabandhu Railway Bridge establishes a strategic linkage between the eastern and north-western parts of country. The proposed project will generate multi-dimensional benefits for the local population and promotes inter-regional trade in the country. The proposed railway bridge will facilitate quick movement of goods and passenger traffic. The major reason for the construction of new rail bridge over the Jamuna River has become inevitable due to load restriction and speed restrictions and single-track facility on the existing bridge.

The construction of the proposed bridge will be funded by Japan International Cooperation Agency (JICA). Detailed designing, construction and supervision will be carried out by joint venture of International and National consulting firms. The Ministry of Railways, Government of Bangladesh conducted a feasibility study for the same project in 2013-2014. The feasibility study was funded by Asian Development Bank (ADB). The proposed Trans Asian Railway through India, Bangladesh and Myanmar, will be benefited by the proposed railway bridge across the River Jamuna. The total length of the proposed bridge will be 4.8 km and will be constructed about 300 meters upstream of existing Bangabandhu Bridge. The railway bridge will contribute to further consolidating regional connectivity and improve livelihood of the local population especially in the northern western region of the country.

The present Environmental Impact Assessment (EIA) Report would give the existing details at the project location with additional surveys carried out at the site. The information from the EIA Report prepared during the ADB feasibility stage was also used in the preparation of the present report and was further updated with the additional environmental surveys.

1.1.1 Purpose of the Study

The purpose of the project is to improve and increase the capacity and safety of railway transportation by constructing a dedicated railway bridge over the Jamuna River in parallel to the existing Bangabandhu Multipurpose Bridge, there by contributing to a more efficient railway network with in the country and with the neighbouring countries. There is increasing

demand from passenger and freight movement, but the existing capacity of Bangabandhu Bridge is only 26 trains in 24 hours, which is absolutely inadequate considering the growing population.

The present study would focus on the environmental impacts due to the implementation of the project. The EIA would quantify the beneficial and adverse environmental impacts due to the project implementation. The adverse impacts caused during the construction period are of short term and there will be long term beneficial impacts to the local population. The BR have to implement the project by safeguarding the environment by following the exiting environmental legislation of the Department of Environment (DoE), Government of Bangladesh and the JICA guidelines for environmental and social considerations (JICA guidelines).

1.1.2 Need of the Project

The Jamuna is one of the three major rivers flowing in Bangladesh and it separates the north-western part of the country from the eastern part of Bangladesh. Thus there was a very poor communication facility before the construction of the Bangabandhu Multipurpose Bridge and the bridge added a new dimension to the national economy. The proposed railway bridge, will reduce the travel time for transportation of the goods and passenger to Chittagong Port, Dhaka and other parts in Bangladesh from north western part of the country

1.1.3 Objectives

EIA is, in its simplest form, a planning tool that is now generally regarded as an integral component of sound decision making process. As a planning tool, it has both information gathering and decision making component which provides the decision maker with an objective basis for granting or denying approval for a proposed development. EIA may be defined as a formal process used to evaluate the environmental consequences of any development project. EIA thus ensures that the potential problems are foreseen and addressed at an early stage in the projects planning and design. EIA is a planning tool main purpose of which is; “to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of a proposed activity before action is taken. The concept has ramifications in the long run for almost all development activities because sustainable development depends on protecting the natural resources which is the foundation for further development. The Project is developed in an environmentally sound and sustainable manner ensuring that all negative effects are mitigated as best as practical and positive impacts are enhanced. More specifically the EIA aims to identify the likely potential impacts to be generated by the project and to quantify those where possible. BR

will be provided with set of actions it requires to implement in order to meet national and international safeguards standards.

The main objective of this study is highlighted below:

- Updating of the EIA Report along with the Environmental Management Plan (EMP) and the updating of the Environmental Monitoring Plan (EMoP). The EIA Report was prepared during the feasibility stage in the year 2013-2014. The report prepared was suiting the requirements of ADB and Department of Environment (DoE), Government of Bangladesh. The same report to be updated following the JICA guidelines.
- Assist the BR to submit the necessary documents to the DoE to obtain necessary environmental clearance certificate from the DoE.
- Assist the BR in information disclosure of EIA Report and related documents.
- Assist the BR in conducting the Stake Holders Consultation and Public Consultation for the information disclosure from the Draft EIA Report and finalization
- Preparation of bid documents along with the clauses for proper implementation of the EMP and the EMoT
- Monitor the effectiveness of EMP in implementation of the mitigation measures.
- Providing technical advice to the BR.
- Provide all possible help for BR stick to the compliance under the JICA guidelines
- Provision of necessary on job training to BR/ Project Implementation Unit regarding the implementation of EMP and EMoT.
- Provision of all possible help to BR/ Project Implementation Unit stakeholder's participation during construction and operation of the Project.

1.1.4 Analysis of Alternatives

Alternative alignments assessment has been carried out for a number of options based on their technical, economical social and environmental feasibility, during the feasibility stage to determine the preferred alignment for the railway corridor and select the preferred bridge type.

The Consultant identified two possible sites for the bridge construction and its rail alignment: the northern alignment which is 300 meters upstream of the existing Bangabandhu Bridge and the southern alignment which is 400 meters downstream of the Bangabandhu Bridge. A comparative study was conducted for both options based on selected environmental and social indicators. The study indicated the northern alignment option as the most preferred option. BR and its Consultant also investigated

bridge and tunnel options for the river crossing and preferred to investigate the bridge option further due to its lower costs for construction and maintenance.

The project envisages the construction of a railway bridge with a provision for a dual-gauge double track parallel to the existing Bangabandhu Bridge over the Jamuna River. The proposed Project is 11.3 km long and which include 4.8 km Rail Bridge. The entire stretch passes through the Bangladesh Bridge Authority (BBA) land indicating that there is no further requirement of land and the land is without any considerable issues like the structures and settlements. The proposed alignment does not have any issues of resettlement and rehabilitation. Mostly passes through the barren lands and partly passes through the Bangabandhu Eco-Park. The implementation of the project may lead to tree cutting at the Bangabandhu Eco-Park. The project would come under the category A of the JICA due to the potential adverse impacts and it comes under Red Category according to the Environmental Conservation Rules (1997) of DoE, Ministry of Environment and Forest, Government of Bangladesh. According to the JICA guidelines and the Government of Bangladesh require an Environmental Impact Assessment for the proposed project. The location map is given down in the Figure 1-1.

Figure 1-1 Location Map of the Bangabandhu Bridge Project

1.2 Scope of Environmental Study

The objective of environmental Study is to identify significant environmental impacts for the construction of proposed Bangabandhu Railway Bridge. In this process of the environmental parameters were collected from the existing data from all possible sources were carried out. The environmental reconnaissance was conducted with a checklist to identify and delineate the significant impacts of the project and to eliminate the other impacts for further considerations. The mitigation measures were proposed for identified environmental impact items. It is noteworthy that the checklist including general environmental impact items was prepared in accordance with the JICA guidelines attached at the end of this chapter. Major positive impacts were found in local economy, employment and landscape improvement.

1.2.1 Anticipated Environmental Impacts

The present report assesses the impacts of the proposed activities on various environmental attributes of the project site. A particular methodology is followed to identify the potential impacts. The issues for consideration have been taken by the following factors:

1. Inputs from the interested and affected parties,
2. Available research information relevant to the proposed project,
3. Site visit and professional assessment by environmental specialist engaged by the implementing agency
4. Evaluation of proposed design scope and project potential impacts based on the environmental specialist past experience.

Categorization of the project and formulation of mitigation measures have been guided by Checklist for development following JICA Environmental Guidelines. The Checklists Railways and Bridges are attached in the Appendix -1

Possible Environmental impacts during the construction phase are noise, air pollution, surface and ground water pollution, soil contamination, and trees removal, impact on avifauna, solid waste generation, occupational health and safety.

The load restrictions and the speed restrictions will overcome when the new bridge will be in operation with double track dual gauge facility and this will enhance more passenger and freight carrying capability of this route as such substantial amount of passenger and freight traffic will be diverted to environment friendly railway route from the road sector and will also reduce cost of transportation.

1.2.2 Assessment of impacts

Based on the impacts assessment, the issue such as infrastructure, transportation and communication, health and education facilities, and tourism have major positive impacts. The industry and agriculture have positive impact from this proposed construction activity. There will be minimal impact on the topography and demography. The proposed railway bridge would bring beneficial impacts to the to the project area as well as for the nation. The air quality, surface water and noise have negative impacts on the environment. The soil, and occupational health and safety have the moderate negative impacts because of the project activities. The climate, solid waste and the wetland habitats will have negative impacts by construction the proposed bridge project. These issues might be problematic, concerned with environmental issues for the studied area if necessary mitigation measures would be taken consideration. The remaining parameters studied like the topography, land use, areas of

cultural values have no impacts from the activities of construction of the proposed Railway Bridge.

1.3 Scope of Services

The present study would focus on updating the existing EIA Report which was prepared during feasibility stage of the project by ADB fund. The Report was moulded as per the Environmental Conservation Rules, 1997 (ECR 1997) of DoE, Government of Bangladesh and the JICA guideline. The focus would be on consultation meeting for Women Groups, which referred to as Focus Group Discussion to note their suggestions and comments regarding the implementation of the proposed project. The Focus Group Discussions was conducted based on the JICA guidelines.

As the primary data on air quality, water quality and noise levels were generated during the feasibility stage (2013-2014). In this particular, Water quality monitoring in JICA survey was carried out during the monsoon months and the following parameters were monitored pH, Total Organic Carbon (TOC), Total Phosphorous (T-P), Total Suspended Solid (TSS), Oil and Grease, Dissolved Oxygen (DO) at sixteen locations. The ground water samples also were monitored at six locations and following parameters were analysed, which were Total Dissolved Solid (TDS), Chlorides (Cl), Heavy metal, As, Fe, Mn, and S. Air quality.

An ecological survey for the migratory birds/resident birds were carried out and were wetted by a proper ornithologist. The changes in the migration pattern were also being recorded from the available secondary information and an expert opinion was considered. As a part of the ecological study a nest study was also be conducted. The nest study was an important aspect which indicated the nesting pattern of the migratory birds. Secondary information on the migratory birds was collected from the studies conducted by the IUCN, World Bank and the Research Papers. The migratory birds never visit during the monsoon season. Information on gangetic dolphins were also collected and wetted with the expert opinion.

The requests and the complaints of the local residents were also being listed out in the report. The preparation of present EIA Report reflected all of the recent EIA studies conducted by various multilateral and bilateral funding agencies and it was used in building up and strengthening of the EIA Report.

1.4 Methodology used for the Baseline Data Collection

In order to conduct the required impact assessment for the component of this project, it was necessary to collect relevant data from appropriate primary and secondary sources to fully

establish existing baseline conditions for the relevant environmental (biophysical and socio-economic) aspects. Secondary data were collected from different concerned government departments, books, reports and published materials to establish baseline profile for physical, ecological and socioeconomic environmental conditions. Primary data were collected through baseline environmental survey and public consultation. The details of baseline environmental monitoring were incorporated in the baseline chapter of the EIA Report. The methodology was adopted for the collection of the primary data.

1.5 EIA Report

The EIA Report was comprised by the following details represented in various chapters of the Report:

Chpater-1: Emphasized on the project activities and the brief scope and methodology, structure of the EIA Report.

Chapter-2: Focus on the present environmental legislation applicable for the proposed project and the necessary clearance to be obtained by the executing agencies.

Chapter-3: Project description gave an overview of the proposed project. Methodology adopted for conducting the environmental surveys.

Chapter-4: Discussion for the existing environmental status and the results obtained during baseline monitoring surveys

Chapter-5: Description of the caused impacts and the suggested mitigation measures due to the construction activity of the proposed project.

Chapter-6: Noise and Vibration Prediction,

Chapter-7: Social Consideration

Chapter-8: Formulation of the EMP with a focus on the implementation of mitigation measures for various stages of the project to curtail the adverse impacts.

Chapter-9: Details of the Stakeholder Consultation, Public Consultation and the focus group discussion with the women groups, agricultural labour and the fisher man community and the feedback received from the local population. A summary on the information disclosure meeting was also enclosed.

Chapter-10: Preparation of the detailed monitoring plan worked out for safeguarding the environment. In addition, the frequency for the environmental monitoring activities also was listed out for the project.

Chapter-11: Drawing of the conclusion from the EIA study and Provision of suggestion and recommendations

1.6 Project Proponent

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1.7 EIA Team

The following team members are actively participated in the preparation of the EIA Report for the proposed Bangabandhu Bridge Project. The team members are as follows in the given Table 1-1.

Table 1-1 Team Involved in the Study

Expert Name	Specialization	Organization
Dr. Ravi Shankar Vantaram	Environmental Expert (International)	SMEC
Dr. Tajul Islam	Environmental Expert (Local)	Development Design Consultants Limited
Mr. Ando Keigo	Environmental Expert	Oriental Consultants Global Co., Ltd.
Dr. Kushal Roy	Fisheries Expert	ACE Consultants Limited
Dr. Sabina Yasmin	Ornithologist	ACE Consultants Limited
Mr. Shafiq Rahman	Environmental Expert	ACE Consultants Limited
Mr. Feroze Raisin	Environmental Survey Expert	ACE Consultants Limited

A comparative statement was drawn between the ADB feasibility and the JICA detailed design study. The table compares only the environmental surveys conducted during the 2013-2014. What are the additional surveys required were added to the present study. A thorough review of the feasibility study was carried out before formulating Table 1-2.

Table 1-2 Comparative Statement between ADB and JICA Study

Sl. No	ADB-Feasibility Study	JICA Study –Detailed Design study
1	ADB Study was divided into 2 packages: 1. Construction of Railway Bridge parallel to the existing Bangabandhu Bridge with provision for Dual gauge Double Track over the Jamuna River 2. Construction of four (4) intermediate crossing Stations between Joydebpur and Bangabandhu Setu East.	JICA Study include the following aspects: 1. Construction of Railway bridge 2. Civil works & signalling and tele communication works at Bangabandhu Setu West/ East 3. Construction of training center West Bank of the Jamuna River. 4. Construction of temporary Museum building
2	There is land acquisition in the case of the ADB Proposal and there is Projected Affected Population (PAP). There are CPR, Households and structures are affected by the ADB Proposal	1. There is no land acquisition or PAPs as there will not be any extra land required for the project. 2. There is no requirement for a resettlement and rehabilitation study in the JICA funded projects. 3. The proposed alignment will pass mainly on the BBA and BR Land.
3	The number of tree cutting will be much higher as there are more activities involved in the project.	The tree cutting is restricted to the Bangabandhu Eco-Park Only
4	Air quality monitoring conducted during the pre-monsoon and post monsoon period	Air quality monitoring was conducted during the rainy season
5	Surface and ground water quality was conducted during the Pre-and Post-monsoon season	We have monitored during the monsoon period.
6	Soil Sampling not carried out during EIA Study	Soil quality sampling was carried out during survey.
7	No sediment survey was conducted during study	Sediment quality study was carried out in the project site.
8	No Benthic Study was conducted	Benthic study was carried out in the project site.
9	No Planktonic study was conducted	Planktonic study was carried out in the project site.
10	No vibration study was conducted	A vibration study was conducted at the site at the same location where the noise was monitored.
11	Ecological study carried out during the study period	Ecological study extensively done during the present study period.
12	It was not done during ADB Study	Market survey was carried out during the survey work.
13	Char land study was done during ADB stage	Char land study was conducted for gathering more information, and was incorporated into the Report
14	Usage of pesticides details are not available in the ADB Report	The pesticide list was gathered from the Department of Agriculture and it was incorporated in the Report

Source: JICA Team

2 CHAPTER-POLICY, LEGAL, ADMINISTRATIVE FRAME WORK

2.1 Introduction

Bangladesh is a developing country that is particularly vulnerable to environmental change. Poverty, growth and environmental sustainability are bound together in Bangladesh. Half of the population depends on an over exploited and degrading natural resource base. Industrial urban growths are contributing economic livelihoods, but already there are serious threats to environmental and human health because of inadequate attention to the environment and sustainable development. Bangladesh has been experiencing degradation of the natural environment for decades in terms of deforestation, river erosion, soil quality depletion, water and air pollution, poor solid waste disposal practices, pollution from chemical fertilizers and pesticides, biodiversity loss and urban congestion. On the top of all these, more recently climate change impacts devastating by global warming and unseasonal flooding are playing havoc to the environment and human beings. Considering the above conditions, there should be a stronger environmental legislation to curb the environmental pollution.

Bangladesh constitution is the supreme law of the country. Article 18 A of the constitution ensures environmental protection and pursuit of sustainable development. The Article 18 A envisages about Protection and Improvement of Environment and Biodiversity; in the Constitution of the People's Republic of Bangladesh states that, "The state shall endeavour to protect and improve the environment and to preserve and safe-guard the natural resources, biodiversity, wetlands, forest and wildlife for the present and future citizens". The pursuit of sustainable development is, therefore, a Constitutional obligation in Bangladesh.

Increasing industrialization and lack of wastewater treatment is leading to a major water pollution problem in many parts of Bangladesh, impacting on aquatic ecosystems and the population who depend on them for their livelihood activities. However, Bangladesh has a well-developed set of environmental policies, Acts, and Rules that deal with industrial pollution of water, soil and air.

The Country's Environmental Legislation dates back to the East Pakistan Water Pollution Control Ordinance, 1970, which established by the East Pakistan Water Pollution Control Board, defined their remit, and outlined responsibilities for implementation of policies formulated by the Board. This ordinance provided several definitions. The fundamentals of which have meet retained in the Environmental Pollution Control Ordinance, 1977. The 1977

Ordinance also reconstituted the environmental pollution control boards with a similar mandate like the 1970 Ordinance, but extending more areas in environment pollution control and imparting more powers. In late 1980s, the Government started to attach increased importance to environmental issues. Creation of a separate Ministry of Environment and Forests in 1989 and restructuring and expansion of the DoE are the major Government initiates.

The Ministry of Environment and Forest was responsible for control and abetment of water pollution comes under the jurisdiction of DoE with in the Ministry of Environment and Forest (MoEF). The MoEF is the principal Government institution to deal with the environmental activities in Bangladesh. It is the final body for all the matters relating to National Environmental Policy and regulatory issues. It was created with stated goal to play a key role in planning, reviewing, monitoring and environmental initiates and ensuring that environmental concerns were properly integrated into national development process. The MoEF has a jurisdiction over the activities of the following technical/implementing agencies under it: DoE, Department of Forests, Bangladesh Forest industries Development Corporation, Bangladesh Forest Research Institute,

The DoE is the technical arm under the MoEF and is the agency responsible for environmental planning, management and monitoring. Under the provision of the Environmental Conservation Act, 1995 (ECA 1995), the DoE is authorized to issue environmental clearance for all types of the projects and mandated to formulate environmental guidelines. The DoE is also too mandated to coordinate the activities of any authority or agency. The DoE is also responsible for the environmental quality standards air, water, and soil, usage of water and wastewater discharge. The department is also responsible for defining EIA procedures, issuing the environmental clearance certificate, and declaring and protecting degraded eco systems. The following Policy, Acts and Rules facilitate the activities of the Department:

- Environmental Policy 1992
- Environmental Conservation Act, 1995 and subsequent amendments in 2000, 2002 and 2010
- Environmental Conservation Rules 1997 and subsequent amendments in 2002 and 2003
- Environmental Court Act 2000 and subsequent amendments

The principal activities of the DoE are:

- Defining EIA procedures and issuing the environmental clearance certificate-the latter being legal requirements before proposed projects can proceed to implementation.
- Providing advice or taking direct action to prevent degradation of environment
- Pollution control, including the monitoring of effluent sources and ensuring the mitigation of environmental pollution.
- Siting the Water Quality Standards (WQS) for particular uses of water and for discharges to waterbodies.
- Declaring Ecologically Critical Areas where the ecosystem has been degraded to a critical state.
- There are several polices and laws were brought out by the Government of Bangladesh, they are the National Water Policy; National Environmental policy and Rules and the ECA 1995. There are over two hundred laws aimed at addressing environmental issues in the country.

2.2 Environmental Clearance Procedures

The ECR provides a basic framework for environmental evaluation of proposed projects in all sectors and establishes procedures. Accordingly, the project proponent should first obtain a location clearance and conduct the appropriate study to obtain environmental clearance of the project. Any project constructed in Bangladesh must obtain an Environmental Clearance Certificate (ECC) before its operation.

Similar to Environmental Screening process of the projects, Rule 7 of ECR has classified the projects into following four categories based on the site conditions and the impacts on the environment. The projects are categorized under four categories they are: Green, Orange A, Orange B and Red. Various industries/projects falling under each category have been listed in schedule-1 of the ECR. According to the Rules of the ECC to all existing and proposed industrial units and projects, which are falling in the green category without undergoing EIA. However for category Orange A and B and for Red projects require location clearance certificate and followed by issuing of ECC upon the satisfactory submission of the required documents.

For getting location and environmental clearances, the project proponent of concerned project should apply to the concerned Divisional Officer of DoE by filling Form-3 as per the rules given in the ECR. They should accompany with the following documents:

1. Application through prescribed form-3 under ECR 1997
2. Prescribed fee under the schedule of ECR 1997 (Amended in 2002)

3. Report on Feasibility of the industrial unit or project
4. Initial Environmental Examination (IEE) Report or EIA as per the Terms of Reference Provided by the DoE
5. EMP for the proposed project
6. No Objection Certificates (NOC) from the Local Authorities.
7. Emergency plan relating adverse environmental impact and plan for mitigation of the effect of pollution
8. Outline of Relocation and rehabilitation plan
9. Other necessary information (based on the type of the project)

The environmental clearance is One-year validity for the Projects which come under the Red Category. The environmental clearance process as per the DoE, Ministry of Environment and Forests, Government of Bangladesh is shown in Figure 2-1.

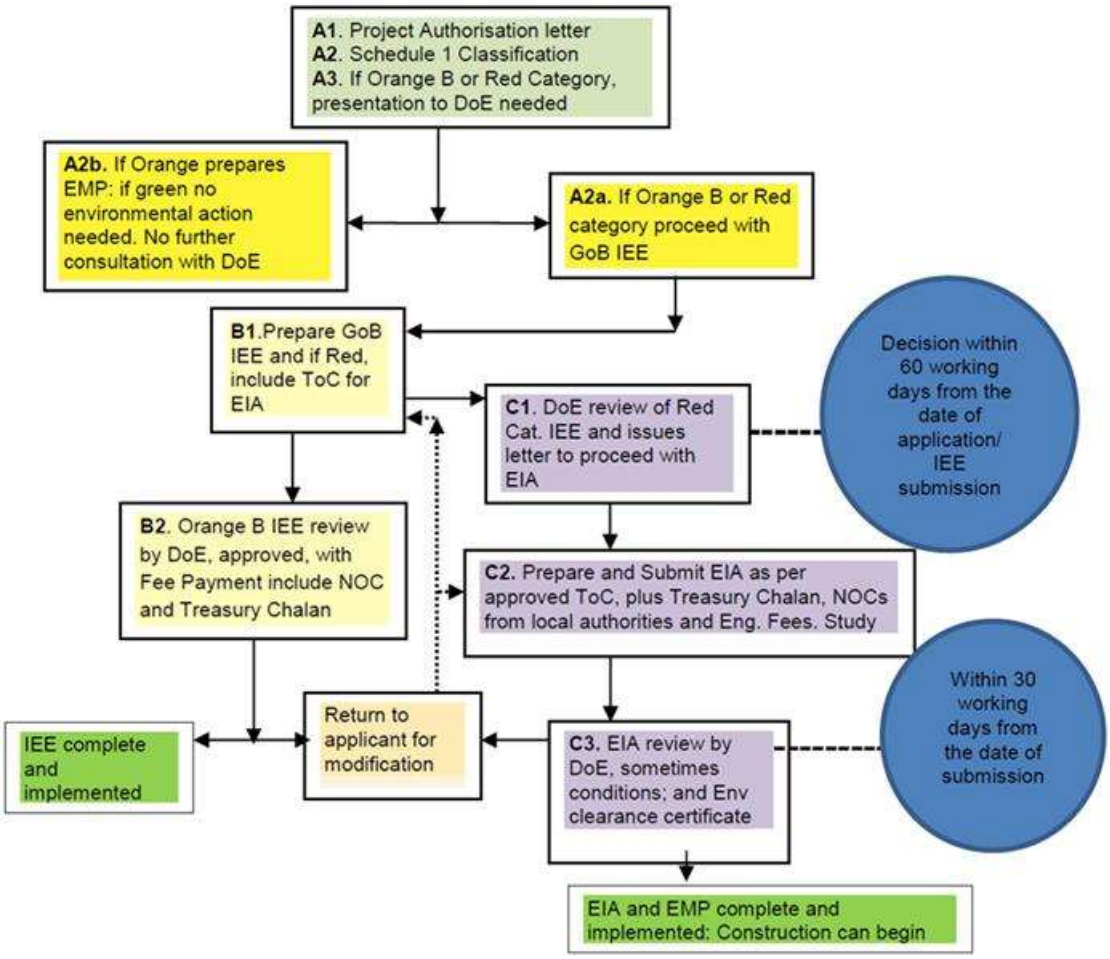


Figure 2-1 Government of Bangladesh Environmental Assessment Process

As part of the ECC application, a detailed IEE/ EIA with EMP satisfactory to the DoE must be prepared.

The project is considered to have some negative environmental impacts. Therefore the project requires having an EIA Report along with EMP which has to be accepted by DoE as part of the LCC & ECC Issuance. Under the ECR'97, DoE has 60 days to respond after reviewing documents from the receipt of the ECC application for a Red category project. Submission of any further materials would be carried out, as per requirement of DoE toward obtaining the LCC and ECC. Steps to be followed for obtaining the ECC for this Railway bridge project are shown in Figure 2-1. Additionally, Detailed Flow Diagram for ECC for Red Category Projects is shown as below Figure 2-2.

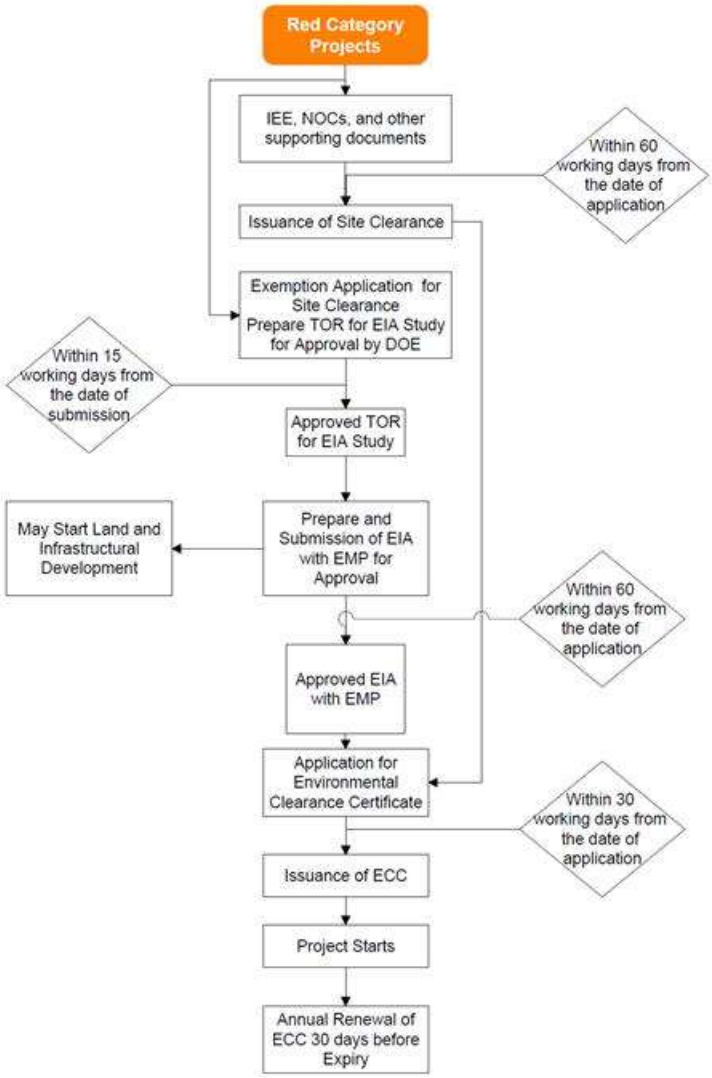


Figure 2-2 Flow Diagrams for Environmental Clearance Certificate for Red Category Projects

In addition to ECA 1995 and ECR 1997, there are a number of other policies, plans, and strategies which need to be considered in the project. The detailed description of all these relevant legislations is provided afterward in the Section II of this report.

2.3 Policies and Legislations

2.3.1 National Environmental Policy 1992

In 1992 the National Environmental Policy was drawn up with the aim of providing protection and sustainable management of the environment. The National Environment Policy 1992 embraces a number of related sectors including agriculture, industry, health, energy, water, land, forest, fisheries, marine, transport, housing, population, education and science. The central theme of the Environment Policy of 1992 is to ensure the protection and improvement of the environment. It requires the Government of Bangladesh to ratify international convention and protocols in view of its suitability. The National environment policy has introduced a number of salient environment principles like precautionary approach and EIA. It also assigned the Ministry of Environment and Forests (MoEF) with the responsibility of coordinating the implementation of the policy.

The National Environmental Policy (NEP) was drawn in 1992 to aim of providing protection and sustainable management of the environment. The objective of the Policy includes:

2.3.2 National Environmental Management Action Plan, 1995

The National Environmental Management Plan (NEMP) was developed as the framework of programmes and interventions aimed at implementing NEP. This was developed in the year of 1995. Its activities attempt to lead to better management of scarce resources, reducing the rate of environmental degradation, improving the natural and manmade environment, conserving habitats and biodiversity promoting sustainable development and improving quality indicators of human life. NEMP proposed actions and interventions are for government agencies, NGO and wider civil society and include activities relating to fisheries and agriculture.

- Identification of key environmental issues affecting Bangladesh
- Identification of actions necessary to halt or reduce the rate of environmental degradation
- Improvement of the natural and built environment
- Conservation of habitats and biodiversity
- Promotion of sustainable development
- Improvement in the quality of life of the people.

2.3.3 Sustainable Environmental Management Plan (SEMP)

A segment of NEMAP, cantered on green initiates, was launched in 1998 by Ministry of Environment and Forests. The SEMP was unique in the sense that it was the largest single

initiative under the environmental sector aimed at larger national objectives in the area of environment with the participation of host of Government Departments, agencies, and Ministries, NGOs, CSOs and international bodies like the IUCN. They implemented number of projects in 5 thematic areas, they are:

- Environmental Policy & Legislation
- Participatory Eco-System Management
- Community Based Environmental Sanitation
- Advocacy and awareness Campaign
- Training and Education.

A strategic plan was prepared with the experience gained from various projects. The main elements of the Strategic Plan are:

- Development of a comprehensive enforcement and compliance policy and related strategies
- Development of improved EIA Procedures and guidelines.
- Standards and guidelines related to EC, inspection and legal enforcement
- Development of associated enforcement and compliance information system
- Bolstering the environmental monitoring capacity of DoE
- Innovative approaches to promote compliance
- Ensuring Bangladesh commitments to international instruments.
- Enhancing DoE's role in designation and management of ECA
- Improving coordination and reporting function of DoE
- Improving DoE's outreach activities

2.3.4 National Biodiversity Strategy and Action Plan for Bangladesh

The National Biodiversity Strategy and Action Plan for Bangladesh (NBSAP) provide a framework for conservation, sustainable use and sharing the benefits of the biodiversity of the country. A major focus of the plan is to ensure cross-sectoral linkages, reflecting the fact that in Bangladesh, more so than most other countries, biodiversity conservation is closely inter-woven with social and economic development. Thus, the NBSAP also provides a framework for securing the necessary environmental setting to reduce poverty, ensure sustainable development and implementation of Poverty Reduction.

Ministry of Environment and Forests is to coordinate the implementation of the NBSAP. All relevant Ministries/Divisions, Government agencies, institutions, academic institutions, non – governmental organisations and communities would be responsible for activities that fall within their mandate. A communication strategy was also incorporated in the plan for effective awareness raising and information dissemination.

2.3.5 Environmental Conservation ACT and Rules, 1995 & 1997

The Bangladesh ECA passed in 1995 and the Rules in 1997. It is the most important legislative document for pollution aspects. The Act is dedicated to the conservation, improvement of quality standards and control through mitigation of pollution of environment (ECA 1995). The ECR 1997 made in accordance with 1995 Act provides additional guidance for specific components of the Act. The Act is in theory enforced by the DoE, which has responsibility for:

- Coordinating with other authorities or agencies that have relevance to the objectives of the Act
- Adopting safety measures and determining abatement measures to prevent accidents that may cause environmental degradation.
- Advising persons on environmentally sound use, storage, transportation, import and export of hazardous material or its components.
- Conducting research and assisting other authorities and agencies in conservation and the improvement of the environment.
- Investigating locations, equipment, manufacture or other processes, ingredients or materials, to ensure improvement of the environment, and control and mitigation of pollution.
- Collecting, publishing and disseminating information regarding environmental pollution
- Advising the Government on manufacturing processes and materials that may cause pollution.
- Ensuring the potable water quality.

Since the gazetting of the 1995 Act, all projects must obtain environmental clearance from the DoE. The projects are divided into four categories based on the environmental impacts. In order to obtain environmental clearance, one has to submit several application forms, documents and remit the requisite fees. Once the environmental clearance is obtained, its validity is for three years in case of green category projects and one year for rest of all Categories (Orange and Red). Application for renewal must be made 30days before expiry.

The Act has been amended in 2000, 2002, 2007, 2010 and 2012 Bangladesh constitution was amended to specify that the state shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests, and wildlife for the present and future citizens.

2.3.6 Environmental Conservation Act (Amendment 2000)

The Bangladesh Environmental Conservation Act (Amendment, 2000) focuses on ascertaining responsibility for compensation in case of damage to ecosystems. It allows for increased provision of punitive measures both for fines and imprisonment, and the authority for nominated officials to record the details of alleged offences and to prosecute the offenders. The major focus is on:

- Ascertaining responsibility for compensation in cases of damage to ecosystem.
- Increased provision of punitive measures both for fines and imprisonment.
- Fixing authority on cognizance of offence.

2.3.7 Environmental Conservation Act (Amendment 2002)

The 2002 Amendment of the Environmental Conservation Act elaborates on the following aspects of the ACT:

- Restrictions on automobile emissions
- Restrictions on the sale and production of environmentally harmful items like polythene bags.
- Assistance from law enforcement agencies for environmental actions, and
- Authority to try environmental cases in court (also supported Environmental Court Act 2000)
- Authority to try environmental cases

2.3.8 Environmental Conservation Act (Amendment 2010)

The Bangladesh Environment Conservation Act (Amendment 2010) elaborates on the following aspects, they are:

- Demarcation of wetlands and waterbodies
- Hazardous waste import, transportation, storage etc.
- Cutting of hills, mountains
- Ecologically critical areas

2.3.9 Environmental Conservation Rules (ECR) 1997 (Amended 2002, 2003)

The Environment Conservation Rules are the first set of rules promulgated under the Environment Conservation Act, 1995. There have been three amendments to this set of rules - February and August 2002 and April 2003. These rules provide categorization of industries and projects, and identify types of environmental assessment required against respective categories of industries or projects. These Rules provide:

- National Environmental Quality Standards (NEQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise, and vehicular exhaust etc.;
- Listing out industries, development projects, and other activities to group into four environmental assessment categories on the basis of actual (for existing industries/ development projects/ activities) and anticipated (for proposed industries/ development projects/ activities) pollutant loading;
- Procedure for planning and completion of IEE and EIA, including the preparation of EMP, document format and content,
- The requirement for and procedures to obtain environmental clearance; and,
- Procedure for damage-claiming by persons affected or likely to be affected due to activities causing pollution or activities causing hindrance to normal civic life.

The Environment Conservation Rules, 1997 were issued by the GOB to exercise the power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered:

- Declaration of ecologically critical areas;
- Classification of industries and projects into 4 categories;
- Procedures for issuing the ECC; and
- Determination of environmental standards.

Rule 3 defines the factors to be considered in declaring an 'ecologically critical area' as per Section 5 of the ECA (1995). It empowers the Government to declare the area as the Ecologically Critical Areas (ECA), if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which operations or processes may be carried out or may not be initiated in the ecologically critical area. Under this mandate, the Ministry of Environment and Forest (MOEF) has declared Sundarban, Cox's Bazar-Tekhnaf Sea Shore, Saint Martin Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marzat Baor and

Gulshan-Baridhara Lake as ecologically critical areas and prohibited certain activities in those areas.

According to Rule 7 of the ECR 1997, depending on the industry, activity, development project location, type of work, size, and severity of pollution loads and impacts, DoE classified 186 activities into four environmental assessment categories. These categories are:

I. Green;
II. Orange A;
III. Orange B; and
IV. Red.

“Green category” does not require any environmental assessment; “Orange A & B category” requires IEE and “Red category” requires full environmental assessment or EIA. The categorization of a project determines the procedure for issuance of an ECC. All proposed industrial units and projects that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed industrial units and projects falling in the “Orange-A”, “Orange-B” and “Red” Categories, firstly a site clearance certificate (SCC) and thereafter an ECC will be required. A detailed description of those four categories of industry/ project is in Schedule-1 of ECR 1997. Apart from general requirement, for every Red category proposed industrial unit or project, the application must be accompanied with Feasibility Report, IEE, EIA based on approved Terms of References (TOR) by DoE, and EMP, etc.

2.3.10 Environmental Court Act 2000

The 2000 Environmental Court Act supports the ECA 1995 and the ECR 1997 by providing for the establishment of Environmental courts for the trial of offences relating to environmental pollution. It includes protocols for establishment of the court, and defies the court’s jurisdiction, appropriate penalties, powers of search and entry and procedures for investigation, trial and appeal. The ECA 2000 was amended in 2002 and ECR 1997 were extended to incorporate ambient air quality and exhaust fan vehicles. The following rules comes under this Act, they are:

- Impose penalties for violating court orders
- Confiscate any article, equipment and transport used for the commission of the offence 2
- Pass any order or decree for compensation
- Issue directions to the offender or any person (a) not to repeat or continue the offence, (b) to take preventive or remedial measures with relation to any injury, specifying the

time limit and reporting to the DoE regarding the implementation of the directions.

The Environmental Court Act, 2000 allowed the Government to form court only at divisional headquarters. According to the law, a person might be jailed for a maximum three years or fined Tk 3 Lakhs for polluting environment. But the new legislation increased jail term to five years and the fine up to Tk 5 Lakhs. Both the special magistrate court and the environmental court will enjoy authority to realize fines from the offenders. Besides, the courts may order to meet the expenditures for conducting cases and give the money in compensation to the affected individuals or organizations.

2.3.11 Ecologically Critical Areas

Although the ECA 1995 deals mainly with processes and activities that result s in pollution, aspects of the Act also make provision for protection of ecosystems. Under the Act the Government can declare ecologically critical areas in any area likely to reach environmentally critical conditions, and can specify operations and processes that cannot be initiated or continued in those areas. The Act also confers power to the DoE to order corrective measures to be taken by any person believed to be responsible directly or indirectly, for causing damage to the ecosystem.

There are number of laws and regulations applicable which are relevant for the projects. These ae as following: The list of Acts is provided in Table 2-1.

Table 2-1 Characteristics of Each Environmental Zoning Area

Acts/Law/ Ordinance	Brief Description	Responsible Agency
Ground Water Management Ordinance, 1985	Describe the management of ground water resources licensing of tube well	Upazila Parishad
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Regulation and Protection of forests reserves, protected forests and village forests.	Ministry of Environment and Forests
Water Supply and Sanitation Act 1996	Regulate the management and control of water supply and sanitation in urban areas	Ministry of Local Government, Rural Development and Cooperatives.
The Vehicle Act, 1927, The Motor Vehicles Ordinance 1983	Provides rules for exhaust Emission, air and noise pollution and road traffic safety	Bangladesh Road Transport Authority
The Private Forest Ordinance Act, 1959	Deals with the conservation of private forests and afforestation of wasteland	Ministry of environment and Forests
Bangladesh Wildlife (Preservation) Act, 1974	Describes the preservation of wildlife sanctuaries, parks reserve	Ministry of Environment and Forest
The Protection and Conservation of Fish Act 1950 subsequent amendment 1982	Deals with the Protection/Conservation of fishes in Government owned water bodies	Department of Fisheries
The Embankment and Drainage Act 1952	Describes the protection of Embankments and drainage facilities	Ministry of Water Resources
The Antiques Act 1968	Describe the preservation of cultural heritage, historic monuments and protected sites	Department of Archaeology

2.3.12 National Environmental Management Action Plan (NEMAP) 1995-2005

The National Environmental Management Action Plan (NEMAP) is a wide-ranging and multi-faceted plan which builds on and extends the statements set out in the National Environmental Policy (NEP), 1992. NEMAP was developed during the period 1995 to 2005 to address specific issues and management requirements, and set out the framework within which various decisions, plans, legislative measures, rules, and regulations toward safeguarding the environment and natural resources including those of biological diversities are to be implemented that have been recommended in the National Conservation Strategy (NCS). It has been developed based on the following broad objectives which remains highly relevant today:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Sustainable resource use and improve management of the natural environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and,
- Improvement of the quality of life of the people.

To this end, it has grouped all the relevant necessary actions under four heads: institutional, sectoral, location-specific and long-term issues. The institutional aspects reflect the need of inter-sectoral cooperation to tackle environmental problems those need new and appropriate institutional mechanisms at national and local levels. The sectoral aspects reflect the way the Ministries and agencies are organized and make it easier to identify the agency to carry out the recommended actions. The location-specific aspect focuses on particularly acute environmental problems at local levels that need to be addressed on a priority basis. The long-term issues include environmental degradation of such degree that it might become more serious and threatening than they seem to be if their cognizance is not immediately taken.

2.3.13 National Water Policy 1999

The National Water Policy has some 50 clauses of relevance to the environment and it is intended that compliance with the Policy will ensure protection, restoration and preservation of natural habitats, particularly wet lands, mangroves, other forests and endangered species that depend on them. Specific provision made under the policy include are:

- Protection, restoration and enhancement of water resources
- Protection of water quality, including strengthening regulations concerning agro-

chemicals and industrial effluent.

- Sanitation and potable water
- Fish and fisheries and
- Participation of local communities in all water sector development

2.3.14 Water Act 2013

Salient Features of the Water Act have been mentioned below:

- Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh.
- The new law has provided the right framework for better management of water resources in the country.
- The formation of the high-powered National Water Resources Council (henceforth termed as the Council) with the prime minister as the head implies the importance the government is paying to the management of this precious resource. An Executive Committee under the Ministry of Water Resources will implement the decisions taken by the Council.
- http://www.bangladeshchronicle.net/index.php/2013/07/review-of-the-water-act-2013/
- Control on water resources development and management has been described including approval of national water resources plan and issuance of clearance certificate on water resource development.
- Control on water use and protection and conservation of water resources including declaration of water stress area and management, preferential use of water in the water stress area and exemption, fixing the lowest safe yield of aquifer and restriction on abstracting groundwater, ensuring normal flow of water course, protection of flood control embankment, water zone demarcation and management, restriction on water storing, declaration of flood control zone and management, restriction on abstraction of total water from any water source, water pollution control. Offence, punishment and trial for violence of this act have been included in the act.

2.3.15 Environmental Protection Bill 2010

Bangladeshi Parliament passed the Environment Protection Bill 2010, to amend the Bangladesh Environment Protection Act 1995. The amended law “empowers the government to control the production, processing, stockpiling, supplying, transporting, importing, exporting, dumping and disposal” of hazardous waste.

The law increases punishment for offenses causing environment pollution, to up to 10 years' imprisonment and a substantial monetary fine. The stiffer penalty also applies to particular offenses, such as causing a health hazard, by anyone involved in the ship-breaking business. By the same token, the law therefore newly requires owners of ship-breaking yards, and ship owners and importers, to ensure that no environmental risks or health hazards are caused by ship-breaking.

The amended law empowers individuals or communities affected by environmental pollution to file cases with the environment court seeking compensation. The Director General of the Directorate of Environment may also file a case on behalf of affected persons or communities.

The law requires that an environmental clearance certificate be obtained from the Directorate of Environment before the setting up of any industrial site. Industries established before the enactment of the new provision will also have to obtain environmental clearance certificates. The amended law states in addition that the government will be allowed to declare any place an ecologically critical area subject to heightened environmental protection.

2.3.16 National Conservation Strategy

National Conservation Strategy was drafted in late 1991 and submitted to the Government in early 1992. For sustainable development the strategy document offered various recommendations but none was there concerning the present specific project execution program or related matters.

- The relevant recommendations are:
- The use minimum possible area of land in exploration sites
- Rehabilitate site when abandoned
- To take precautionary measures against the environmental pollution from the liquid effluent, condensate recovery and dehydration plants,
- Technology assessment for appropriate technology.

2.3.17 National Agricultural Policy 1999

This policy aims to make the nation self-sufficient in food through increasing production of all crops including the cereals and ensure a dependable and secure food system for all. The policy particularly stresses on research and development of improved varieties and technologies for cultivation in water logged and salinity affected areas. The policy also

recognizes that adequate measures should be taken to reduce water logging and salinity and provide irrigation facilities for crop production.

2.3.18 National Land Use Policy 2001

Optimum use of land and water depends on planned use of land, water resources and natural environment which are important sources for growth. It is possible to ensure optimum use of scarce land resources by way of integrating the uses of three natural resources. With this end in view, the government has approved National Land Use Policy, Bangladesh. Government has adopted various other national policies and measures to prevent land depletion. These include The National Environmental Policy, National Environment Act and Rules; National Forest policy and national Plan

2.3.19 National Forest Policy 1994 (Amended 2010)

The National Forestry Policy has been revised in 1994 based on the National Forest Policy of 1977 in the light of the National Forestry Master Plan. An amendment of this policy has been conducted in 2010.

In general, the major targets of the Policy are to conserve the existing forest areas; bring about 20% of the country's land area under the forestation program, and increase the reserve forestland by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

The important specific objectives of the Policy include private initiatives to be encouraged to implement programs of tree plantation and forestation on fallow and hinter land, the banks of the ponds and homestead land, technical and other support services to be extended by the Forest Department for introducing agro-forestry on privately owned fallow and hinter land. Massive forestation on either side of land surrounding roads, railways, dams, khals, tanks, lakes, and ponds through the partnership of the local people and the NGOs may be commenced. Encouragement may be extended to grow fruit trees for producing more fruits along with the production of timber, fuel wood and non-wood forest products under the forestation program. Women may be encouraged to participate in homestead and farm forestry, and participatory forestation programs. There may be massive campaign through the government and non-government medias for raising consciousness among the people regarding forestation and conservation, and use of forest resources.

The amendments of the existing forestry sector related laws and adoption of new laws have been recognized very important factor for achieving goals and objectives of the policy. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

2.3.20 National Fisheries Policy 1996

The policy focusses on aquaculture and marine fisheries development and includes the following mandates:

- Maintaining biodiversity in all-natural water bodies and in marine environment
- Ensuring that chemicals harmful to the environment will not be used in fish shrimp farms.
- Using environment friendly fish shrimp culture technology
- Expanding fisheries areas and integrating rice, fish and shrimp cultivation.
- Undertaking control measures against the activities that have a negative impact on fisheries resources and vice-versa.
- Formulating laws to ban the disposal of any untreated industrial effluents into the water bodies.

2.3.21 Dredged and Dredged Material Policy 2013

Salient features of the Policy with respect to dredging are: Project has to be formulated after identifying location of dredging and location for projecting/dumping of dredged materials in dry season, in no way dredged material shall be projected into flowing water. In rainy season, material might be disposed into river flow based upon the recommendation with proper study with hydro-morphological considerations. With respect to the dredged material management policy says no agricultural land is hampered or damaged, might be dumped plan-wise in shallow places in river upon technical considerations, connection channels are not disconnected etc. And best way of management to fill in up low land (following Conservation act 2000) or pile in government owned khas (waste land).

2.3.22 National Conservation Strategy 1992 (updated 2013)

The National Conservation Strategy (NCS) was prepared in recognition of Bangladesh's natural resource conservation commitments under several international treaties, conventions and its own constitution. It provides specific strategies and actions for conservation and sustainable development in 18 areas including human resources, land resources, water resources, forests, biodiversity, fisheries resources, livestock, crop agriculture, urbanization, health and sanitation, industry, energy and minerals, rural development, transport and communications, disasters and disaster management, environmental awareness and

education, gender issues, and environment and international obligations. By adopting the NCS, the government hopes not only to reinforce its national and international commitments for conservation of resources and sustainable development but also to strengthen the economy for today and the future. While the NCS provides for coordinated conservation of natural resources, it does not explicitly address issues of biodiversity conservation. National Biodiversity Strategy and Action Plan aims to address these gaps whilst being fully consistent with the measures identified in the NCS.

2.3.23 National Biodiversity Strategy & Action Plan (NBSAP) 2007

As a Contracting Party to the Convention on Biological Diversity (CBD), Bangladesh is committed to initiating and implementing conservation and sustainable management of its national biological diversity according to the CBD principles for the sustenance of her present as well as future generations. The NBSAP document embodies Bangladesh's strategic approach to conserving the nation's biological diversity as well as the action plan for fulfilling our obligations as a signatory to the CBD. The NBSAP is a national framework for initiating and executing activities leading to the conservation and sustainable use of biodiversity, and establishing mechanisms to ensure equitable sharing of the benefits derived from such activities. A major focus of the plan is to ensure cross-sectoral linkages, reflecting the fact that in Bangladesh, more so than most other countries, biodiversity conservation is closely inter-woven with social and economic development. The implementation of the strategy is based on partnerships and coalitions between specialized government organizations, NGOs, conservation partners, the private sector, academia and other exponents of the civil society.

The major objectives of the NBSAP are to:

- Conserve, and restore the biodiversity of the country for well-being of the present and future generations;
- Ensure that long-term food, water, health and nutritional securities of the people are met through conservation of biological diversity;
- Maintain and to improve environmental stability for ecosystems;
- Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations;
- Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country; and
- Stop introduction of invasive alien species, genetically modified organisms and living modified organisms.

2.3.24 Bangladesh Wildlife (Conservation & Security) Act 2012

This act was known as Bangladesh Wildlife [Preservation] Order, 1973; Amended as Bangladesh Wildlife [Preservation] Act 1974

The Bangladesh Wildlife (Preservation) Order, 1973 & Wildlife (Preservation) (Amendment) Act, 1974 have been revamped to Wildlife (Conservation & Safety) Act of 2012. The Act is an improved version taking into consideration of current development issues and management tools. The Act has adopted 10 (ten) new types of protected areas for conservation and protection of wildlife resources, created avenue for community conserved areas and also community based management of protected areas. The Act has included revised schedule of protected wildlife and has included many species that were previously not listed as protected wildlife such as Gangetic dolphins and smooth-coated otters in the rivers.

This Act proposed 1 (one) year imprisonment and Taka 50,000 fine for violation of law. The law also proposed at least 2 (two) years and highest 7 (seven) years imprisonment and minimum Taka 1 (one) Lakh and maximum Taka 10 (ten) Lakh fine for killing a tiger or elephant.

2.3.25 Bangladesh National Building Code 2006

The basic purpose of this code is to establish minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of all buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property and public welfare. The installation and use of certain equipment, services and appurtenances related, connected or attached to such buildings are also regulated herein to achieve the same purpose.

Part-7, Chapter-3 of the Code has clarified the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical check-ups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

Section 1.4.1 of chapter-1, part-7 of the BNBC, states the general duties of the employer to the public as well as workers. According to this section, “All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift etc. shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them”.

Part-7, Chapter -1 of the Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7; “in a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing”. These however will not absolve the owner from any of his responsibilities under the various provisions of this Code and other applicable regulations and bye-laws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923”. (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed).

To prevent workers falling from heights, the Code in section 3.7.1 to 3.7.6 of chapter 3 of part 7 sets out the detailed requirements on the formation and use of scaffolding. According to section 3.9.2 of the same chapter, “every temporary floor openings shall either have railing of at least 900 mm height or shall be constantly attended. Every floor hole shall be guarded by either a railing with toe board or a hinged cover. Alternatively, the hole may be constantly attended or protected by a removable railing. Every stairway floor opening shall be guarded by railing at least 900 mm high on the exposed sides except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board except at entrance to opening. Every open sided floor or platform 1.2 meters or more above adjacent ground level shall be guarded by a railing on all open sides except where there is entrance to ramp, stairway or fixed ladder. The precautions shall also be taken near the open edges of the floors and the roofs”.

2.3.26 Labour Laws 2006

The labour law system is more than a century old in Bangladesh. The Bangladesh Labour act was enacted in the year 2006. The law is a consolidation and updating of the 25 separate acts. The comprehensive nature of the law can immediately be gleaned from its coverage ~ conditions of service and employment, youth employment, maternity benefit, health and hygiene, safety, welfare, working hours and leave, wages and payment, workers' compensation for injury, trade unions and industrial relations, disputes, labour court, workers' participation in companies' profits, regulation of employment and safety of dock workers, provident funds, apprenticeship, penalty and procedure, administration, inspection, etc.

Large number of amendments taken place in the 2006 Labour Act. In particular the Act amends the 2006 Labour Act with respect to: adding a new section concerning the status of workers (section 4); compensation due to death (section 19); termination of employment (section 23, 24 and 27); adding a new section 28A entitled 'Employers-Workers relations due to any disaster beyond control or damage thereby'; resolving dispute over a child's age (section 36); dangerous work for children (section 39); emergency exits (section 62); access to gangways, stairs etc. for workers (section 72); adding a new section 78a concerning mandatory use of personal safety equipment; notification of competent authority in case of incident (section 80); establishment of a health centre in companies employing more than 5000 workers (section 89); adding a new section on formation of a safety committee (section 90a); adding a new section 94a entitled 'Residential Facility for Physically Challenged Workers'; compulsory group insurance (section 99); adding a new section 124a entitled 'Payment of dues including wages through conciliation'; adding a new section 140a entitled 'Special Power of the Government'; prohibition on deducting money to survivors of a worker who has died (section 155); provisions on social dialogue, trade unions and dispute resolution (sections 168, 176, 177, 178, 179, 180, 183, 187, 200, 202, 202a, 205, 211, 213, 214, and 215); employers and companies responsibilities (sections 232, 233, 234, 235, 236). The labour market of Bangladesh is one of the major attractions for foreign investors due to cheap wage rate and availability of skilled labour. In order to safeguard the interest of the labourers, the Government has implemented several laws and regulations recently. The labour laws are governed by the Bangladesh Labour Act 2006 as amended in 2010 and 2013 and Labour rules 2015.

Some of the laws pertaining to the occupational health and safety are given down in the Table 2-2.

Table 2-2 Some of the laws pertaining to the occupational health and safety

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

2.4 International Policy

The most of the development projects have been implemented in Bangladesh by the financial help and technical guidance of some international donor agencies. These international agencies have their own environmental and social safeguard policies. Bangladesh Government has also agreed and signed some international treaties, conventions, protocols and agreements for environmental assessment, protection, and pollution Control. International Design Codes, Standards and Guidelines have also been implemented to conduct any development project here in Bangladesh.

Bangladesh is a party to a large number of international conventions, treaties, and protocols (ICTPs) related to the Project and is committed to ensure that these protocols are complied with during all development works. The applicable ICTPs are Rio declaration (environment and development) 1992, Convention on Biological Diversity (Rio de Janeiro) 1992, UNESCO World Heritage Convention 2011, International Plant Protection Convention (IPPC) 1951, Plant Protection Agreement for the South East Asia and Pacific Region 1956, Convention on Biological Diversity (CBD) 1992, UN Framework Convention on Climate Change (UNFCCC) 1992, Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) 1971, Convention on Persistent Organic Pollutants (Stockholm) 2001.

2.4.1 Convention of Biological Diversity

The Convention on Biological Diversity was adopted at Rio de Janeiro on 5 June 1992and entered into force on 29 December, 1993. This convention sets out commitments for maintaining the world's ecological underpinnings during any development activities. Under the Convention, all the participating governments undertake actions to conserve biodiversity and sustainably use natural resources. In addition, governments require to develop national biodiversity strategies and action plans, and to integrate these into broader national plans for environment and development. It established an advance informed agreement procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory. Bangladesh has signed and ratified the Convention on 05 June 1992 and 20March1994 respectively. As a Contracting Parties of the Convention Bangladesh has committed to the following issues:

- EIA must be introduced to any proposed development projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where applicable allow for public participation in such procedures; and
- Appropriate arrangements must be introducing to ensure that environmental consequences of its programs and policies, that are likely to have significant adverse impacts on biodiversity, are duly taken into account,
- It is obligatory to Bangladesh as a contracting party to provide EIA of projects that are likely to have significant adverse effects on biological diversity (art. 4).

2.4.2 UNESCO World Heritage Convention

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) Convention Concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention) was entered into force in 1975. Total 187 countries, including the United States, are party to the Convention. Bangladesh is also a member of the Convention. This convention identifies and helps protect international sites of such exceptional ecological, scientific, or cultural importance that their preservation is considered a global responsibility.

Under the Convention, participating countries nominate sites to be included on the World Heritage List and the List of World Heritage in Danger (Danger List). Countries that are party to the Convention agree to protect listed sites within their borders and refrain from actions that might harm such sites in other countries. Currently, the World Heritage List is composed of 936 natural and cultural sites in 153 countries, and the Danger List includes35 sites from 28 countries. These are the 'Jewels in the Crown' of conservation.

The World Heritage Site in Bangladesh includes the Sundarbans. The proposed project should be carried out in such a manner that the multilateral cultural &environmental agreements may not be violated and may not cause adverse impact on the natural resources. In fact, there is minor chance to cause adverse impact on Cultural and Natural Heritage from the proposed project.

2.4.3 Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris 1972)

Convention concerning the Protection of the World Cultural and Natural Heritage was held at Paris in 1972. This convection has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties). These are the 'Jewels in the Crown' of conservation. Bangladesh has accepted and ratified the convention on 03.08.1983 and 03.11.83 respectively. As per provision of the convention it is obligatory for Bangladesh to prevent of damage or destruction of culturally and/or historically significant sites, monuments, etc.

2.4.4 International Plant Protection Convention (IPPC) 1951

This convention was arranged at Rome in 1951. Bangladesh has ratified this convention. Under the convention, Bangladesh has to secure actions to prevent the introduction of plants pests from Project work or construction materials and to promote appropriate measures for their control. It is governed by the Commission on Phyto-sanitary measures which adopts international standards of this measure.

2.4.5 Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) 1973

Bangladesh has also ratified this Convention. It provides guidance for international cooperation for the protection of certain species of wild fauna and flora against over-exploitation through international trade.

2.4.6 Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) 1971

The Convention on Wetlands of International Importance especially as Waterfowl Habitat was adopted at Ramsar in Iran on 2 February 1971 which is known as Ramsar Convention. Bangladesh has ratified the Convention on 20 April, 2002. There are 127 Parties with 1085

wetland sites designated as Wetlands of International Importance. This is an intergovernmental treaty which provides direction for the conservation and wise use of all wetlands and wetland habitats through local, regional, and national actions and international cooperation. The Convention includes marine wetlands (wetlands up to a depth of six meters at low tide), islands, lakes and rivers.

The signatory states made a commitment to reverse the loss and degradation of wetland habitats and to prevent filling of wetland and its drainage during construction. It is obligatory for Contracting Parties is that the designation of wetlands to the "List of Wetlands of International Importance", the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves must be conducted. Parts of the Sundarbans Reserved Forest (Southwest of Bangladesh) are one of the Ramsar Sites.

2.4.7 London Convention on the Prevention of Marine Pollution by dumping of waste and other Matters, 1972

The main objective of the convention is to take all practical steps to prevent pollution of the sea by dumping of waste and other matter (oil, noxious liquid, harmful substances, sewage, garbage, air) that is liable to create hazards to human health, to harm living resources and marine life's, to damage amenities to intervene with other legitimate users of sea.

2.4.8 International Convention for Prevention of Pollution from Ships (MARPOL) 1973/1978

The main objective of the convention is to prevent the pollution of the marine environment by operational discharges of oil and other harmful substances and the minimization of accidental discharges of such substances.

2.4.9 UN Convention to Combat Desertification (UNCCD 1992):

The UNCCD is the centrepiece in the international community's efforts to combat desertification and land degradation in the drylands (DLDD). The UNCCD recognizes the physical, biological and socio-economic aspects of desertification, the importance of redirecting technology transfer to be demand driven, and the importance of involving local communities in combating DLDD. The core of the UNCCD is the development of national, subregional and regional action programmes by national governments, in cooperation with UN agencies, donors, local communities and non-governmental organizations (NGOs).

2.4.10 Convention on the Conservation of Migratory Species of Wild Animals 1979:

The Convention was designed to allow for expansion and revision of commitments and to provide a framework through which parties may act to conserve migratory species and their habitat by: adopting strict protection measures for migratory species that have been characterized as being in danger of extinction throughout all or a significant portion of their ranges.

2.4.11 UN Framework Convention on Climate Change (UNFCCC) 1992:

UNFCCC sets out a legal framework for stabilizing atmospheric concentrations of greenhouse gases (GHGs) to avoid "dangerous anthropogenic interference with the climate system". Together with mitigation, adaptation and loss & damage as well have been adopted as policy planks to address climate change and its impacts. Because of her disadvantaged geographical location Bangladesh is regarded as one of the most vulnerable countries in the world.

2.4.12 Kyoto Proto col (1997) and Copenhagen Accord (2009):

To achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To achieve such a level within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. The international conventions are given in the following Table 2-3 given below:

Table 2-3 International conventions singed by Bangladesh

Treaty or Convention	Year	Brief Description	Responsible Agency
On protection of Birds, Paris	1950	Protection of Birds in Wild State	DoE/ Department of Fisheries
Convention of Oil Pollution damage (Brussels)	1969	Civil Liability on oil pollution damage from ships	DoE / Ministry of Shipping
Ramsar Convention	1971	Protection of Wetlands	DoE/ Department of Fisheries
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	Department of Archaeology
CITES Convention (Washington)	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/ Department of Fisheries
Bonn Convention	1979	Conservation of migratory species of wild animals	DoE/ Department of Fisheries
Prevention and Control of Occupational Hazards (Geneva)	1974	Protect workers against occupational exposure to carcinogenic substances and agents	Ministry of Health and Family Welfare
Occupational hazards due to air pollution,	1977	Protect workers against Occupational hazards in the working environment	Ministry of Health and Family Welfare

Treaty or Convention	Year	Brief Description	Responsible Agency
Noise Vibration (Geneva)			
Occupational Safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment.	Ministry of Health and Family Welfare
Occupational Health Services (Geneva)	1985	To promote a safe and healthy working environment	Ministry of Health and Family Welfare
Vienna Convention	1985	Protection of Ozone layer	DoE/ MoEF
Civil Liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railways and inland vessels	Ministry of Communications
Convention on Oil Pollution (London)	1990	Legal framework and preparedness for control of oil pollution	DoE/ MoEF
London Protocol	1990	Control of Global Emissions that deplete ozone layer	DoE/ MoEF
Un framework convention on climate change (Rio de Janeiro)	1992	Regulation of Greenhouse gases emission	DoE/ MoEF
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity sustainable use of its components and access to genetic resources	DoE/ MoEF
International Convention on Climate Change (Kyoto Protocol)	1997	International treaty on Climate change and emission of greenhouse gases	DoE/ MoEF
Protocol on biological Safety (Cartagena protocol)	2000	Biological safety in transport and use of genetically modified organisms	DoE/ MoEF

2.5 Policy of Japan International Cooperation Agency

The environmental social consideration which is applied to this project is taken from the JICA guidelines entitled as “JICA Guidelines for Environmental and Social Considerations 2010”. The guideline encourages the project proponent to have appropriate consideration for environmental and social impacts and bear the ultimate responsibility for the environment and social consideration of project. JICA supports and examines appropriate environmental and social considerations undertaken to avoid or minimize the impacts on the environment and local communities and to prevent the occurrence of unacceptable adverse impacts. JICA places importance on dialogue involved partners (e.g. the host country, local governments, borrowers and project proponents) regarding environmental and social consideration. Transparent and accountable process, as well as active participation of key stakeholders (e, g local residents and local NGOs affected by the project) in all stages of the project are highly considered. The JICA guidelines are formulated in accordance to the World Bank Operational Policy.

JICA classifies projects into four categories according to the extent of environmental and social impacts, taking into account an outline of project, scale, site conditions.

Category A: if the project is likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts are also come under the same category. Category A comprise of projects in sensitive sectors. Projects that have characteristics those are liable to cause adverse environmental impacts.

Category B: The Projects having potential adverse impacts on the environment and society are less adverse than those of Category A, projects. Generally, they are site specific, few are irreversible and in most cases normal mitigation measures can be designed more readily.

Category C: The Projects have minimal or little adverse impact on the environment and society.

Category F1: Projects which come under F1 Category satisfy the following requirements:

- JICA's funding of the project is provided to a financial intermediary.
- The selection and assessment of the actual sub project is substantially undertaken by such an institution only after JICA's approval of the funding and therefore the sub projects cannot be specified prior to JICA approval of funding (or assessment of the project) and
- Those sub-projects are expected to have potential impact on the environment.

The Project, as per the above categorization, falls under category A for the purpose of environmental investigations. Final EIA approved by DOE needs to be laid operator for public inspection at JICA headquarters 120 days before a loan agreement for category A projects.

2.6 Major Institutions involved in Environmental Planning and implementation

In the country, there are more than 200 laws and by-laws exist to tackle these challenges related to environmental issues. Strategies and policies are in place. The Government of Bangladesh (GoB) realizes that good public policy needs to be matched by investments to ensure implementation. Some key investments have been made, by the government on its own, or supported by development partners. The following government Departments are involved in the implementation of Environmental Planning in Bangladesh: This is shown in the Table 2-4.

Table 2-4 List of major Institutions involved in Environmental Planning and Implementation

Item	Government Department
Environmental Planning and Implementation	• Department of Forest (DoF) • Department of Environment (DoE) • Department of Fishery (DoF) • Department of Inspection for Factories Establishments (DIFE) • Institutional Framework of Environmental management in Bangladesh • Planning Commission • Department of Agriculture • Department of Livestock • Bangladesh Water Development Board • Local Government Engineering Department • Department of Public Health Engineering • Water Supply and Sewerage Authority • Bangladesh Inland Water Transport Authority(BIWTA) • Barind Multipurpose Development Authority • Bangladesh Bureau of Statistics.

3 CHAPTER -PROJECT DESCRIPTION

3.1 Introduction

Rail transport plays a major role in regional development and economic growth in the present world. Rail communication is considered as a social obligatory, cheapest, environmental friendly, comfortable and efficient mode of transport in both in developed and developing countries. The history of Railways dates back about 150 years. BR network connects 44 districts out of 65 districts in the country. Rail transport is very much attractive for long distance uninterrupted route network. Bangladesh being a riverine country there are about 546 major railway bridges having a length more than 40 meters and 3,104 numbers of minor bridges. Most of the rail bridges are old and during the monsoon period the rail links are disrupted in many points. Speed restrictions also create a drawback in the rail communication. The vision of BR is to play an important and dominant role integrated transport system.

The Jamuna River is one of the largest rivers in Bangladesh. The river is a naturally physical barrier between the north western and eastern part of Bangladesh. This Bangabandhu Multipurpose Bridge acts as a permanent link between the east and north-west. The Bridge was constructed about 8 Km downstream of the existing ferry ghat near Bhaupur. The bridge catered for the movement of road, rail traffic power and energy transfer. The Bangabandhu Multi-Purpose Bridge created an important infrastructure link in Bangladesh. The EIA studies were carried out way back in 1989 for the existing Bangabandhu Bridge. The Existing Bridge was opened in 1998 for the traffic. The Bridge was not planned as Road-Rail Bridge. It was originally designed for a four lane road bridge, but fitting of Railway track created inadequacy in the carrying capacity of the road traffic causing the width of the corridor got reduced considerably. The present arrangement is not good for rail traffic.

Considering the above technical issues in the Bangabandhu Bridge, Ministry of Railways, Government of Bangladesh, decided for a new dedicated rail bridge across the Jamuna River. The rail bridge will benefit the rail users to a great extent. The bridge will not have any speed limitation or weight restrictions. It is considered to be the one of the busiest rail routes of Bangladesh. The feasibility study was conducted during 2014 with funding provided by the ADB. Construction of an exclusive rail bridge over the Jamuna has become very crucial as the Bangabandhu Multipurpose Bridge is now handicapped by various limitations and restrictions. The detailed designing is being carried out by the JV of International and National Consulting Firms.

3.2 Location

The Jamuna River, the Meghna and the Padma River constitute major river system which divides Bangladesh into east, south west, and North-West regions. The east is relatively more developed because it includes Dhaka (Capital), Chittagong and the most important port of the country, Chittagong. The western region includes Rajshahi (north west) and Khulna (South West) Divisions. The North-West region has a large population and has highly fertile land bounded by Ganges on the South and the Jamuna on the east and remains relatively isolated from the rest of the country. The services provided at these river crossings is of poor quality, subject to many interruptions owing to the adverse geographical and meteorological conditions and involving waiting time up to many hours or days for freight traffic.

The major transportation services are ferries across these major rivers. The passenger and freight transport was carried out by Bangladesh Inland Water Corporation (BIWTC) and by BR, and by privately owned launches and country boats. The ferry ports have to be moved because changing levels of silt deposition by the Jamuna River. In addition, erosion swallows up the access roads and the navigational channels became very narrow.

The proposed new double track Bangabandhu Railway Bridge will be the second crossing over the Jamuna River and dedicated to the rail traffic. The project comprises the railway bridge and the linking tracks falls within the administrative boundaries of Sirajganj and Tangail District. The bridge will be located about 300 meters upstream from the existing bridge. The proposed project starting chainage on the West Side is Km.284+300 and the ending at Km. 287+300 (West Guide Bund) and out of this 3 Km about 800 meters pass through the Bangabandhu Eco Park. The bridge across the Jamuna River is about 4+800 Km. on the Eastern side starts from the chainage Km. 292+200 (eastern Guide Bund) and extends up to 295+ 600. The land portion on eastern and western side putting together is about Km. 6+400 and the bridge portion is about Km 4+800. The rail track passes through Saidabad and Nikrail Unions. As such there are no land acquisition or resettlement and rehabilitation issues at the site. Figure 3-1 shows the location of the proposed railway bridge project,

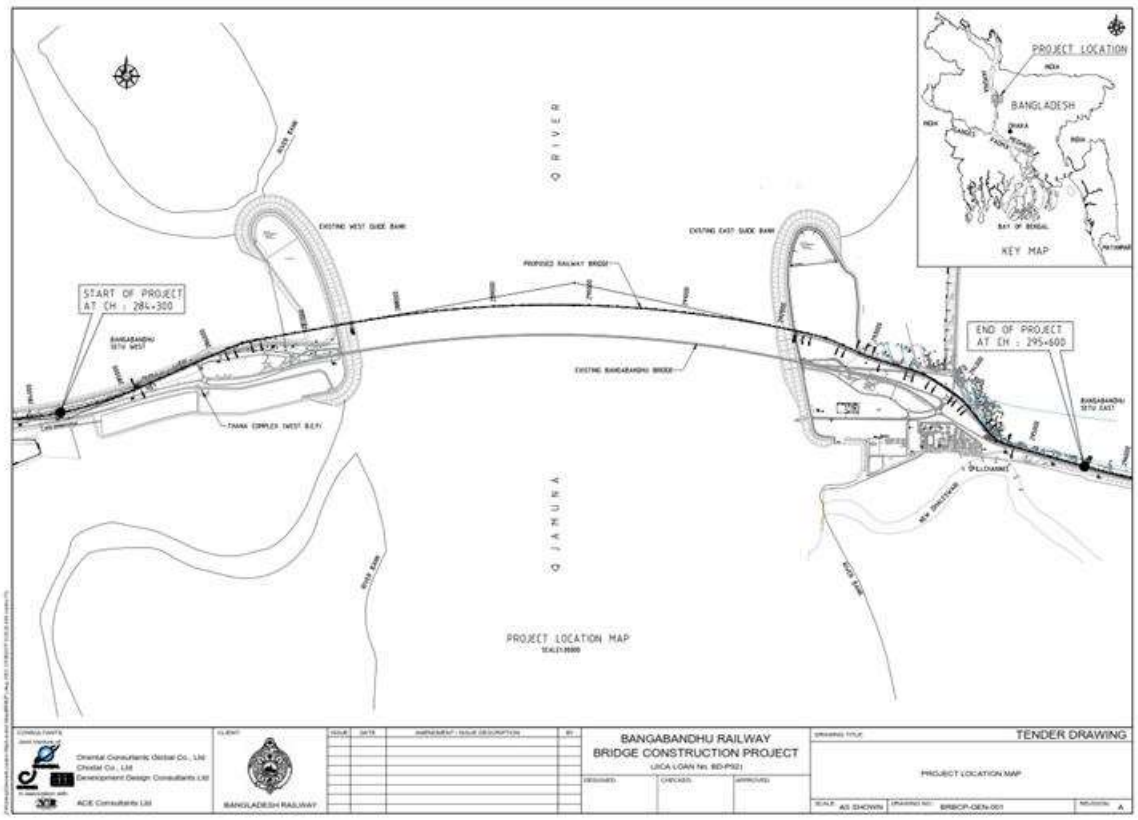


Figure 3-1 Location Map of the Proposed Bangabandhu Railway Bridge (JICA Study Team, 2017)

Both the Tangail and Sirajganj district are predominantly with rural with small towns and urban centres. The population of District Tangail is about 3,749,085 and the population comprise 93% of Muslims, 6.5% of Hindus and about 0.4% of Christians. The literacy rate in the district is about 46.8% out of which 50% males are literate and 43.8% females are literates in the district. Agriculture is the main occupation of the district and the major crops grown there are paddy, potato, jute, sugar cane, sesame, linseed, wheat, mustard and pulses. The fruits which are grown in the district are Jack fruits, mango, litchis, bananas, pineapples. In addition, the local population is actively engaged in fishing, dairying, and poultry. Tangail Sarees are quite famous and the local population are living on weaving, there are about 60,000 looms for weaving the sarees. There are medical colleges, engineering college and three universities in the Tangail District.

Sirajganj District is in the Rajshahi Division and there are six municipalities. The total population of the district is about 30, 97, 489 and the male population comprise of 15, 51, 368(50.09%) and the female population comprise of 15, 46,121(49.91%). The Hindu population is about 141406, Buddhists are about 371, Christians are about 70 and other

religions are 259. There are medical colleges, engineering colleges and university. Most of the population lives on agriculture and fisheries. The major agriculture crops are paddy, sugar cane, jute, onion, garlic, potato, yam, peanuts, chilly and mustard. The district has agricultural economy. The local population produce varieties of crops, namely, local and HYV rice, wheat, jute, sugarcane, pulses, spices, vegetables and other minor crops. Various fruits like mango, jackfruit, litchi, jam, palm, and betelnut. The most common fishes are ruhi, katla, mrigel, magur, sing, koi, puti, shoil, gozar, boal etc. All these fishes are economically valuable. Besides these common varieties some other well-known varieties of fish are pangas, airh, kholisha and chingri. Besides crops and fruits, livestock and poultry are the other sources of household income of the district. Weaving is prominent in the district.

Some of the main activities involved in the steel bridge construction include the SPSP piling work, fabrication of steel bridge components, installation of bridge elements and dredging and disposal of the dredged material. The construction will involve large scale boring and complex deck placement. Construction sites and staging areas on both sides require 800-1000 workers. This would be requiring housing facilities for the workers even though 50% will be recruited from the local areas. The location of the worker camp and construction yard is already identified on the eastern side of the project area.

The proposed Bangabandhu Railway Bridge will be located upstream of Jamuna River at about 300 meters away from the existing Bridge. On the west side of the Jamuna River, the Project areas run through Ponchoshona and Mohonpur villages of the Saidabad Union, and on the eastern side of the Jamuna River run through bollovbari village (Nikrail Union) and Pathailkandi village (Nikrail Union). The activities of the Project comprise construction of a 4.80 kilometer main rail bridge, 11.3 track kilometer long new rail alignment

The alignment takes off from Bangabandhu East Railway Station and runs parallel to the existing railway track on the northern side gently traversing on the land belonging to the BBA. It then crosses the Jamuna River at about 300 m upstream from the existing bridge and lands on the right bank and passes through the Bangabandhu Eco Park and finally connects with the existing track of the Bangabandhu Setu West Railway Station. There is no additional land acquisition for this project.

The proposed bridge comprises of main bridge with a length of 4.8 Km. the total overall length is about 11.3 Kilometers. Figure 3-2 shows the General Arrangement for Proposed Alignment

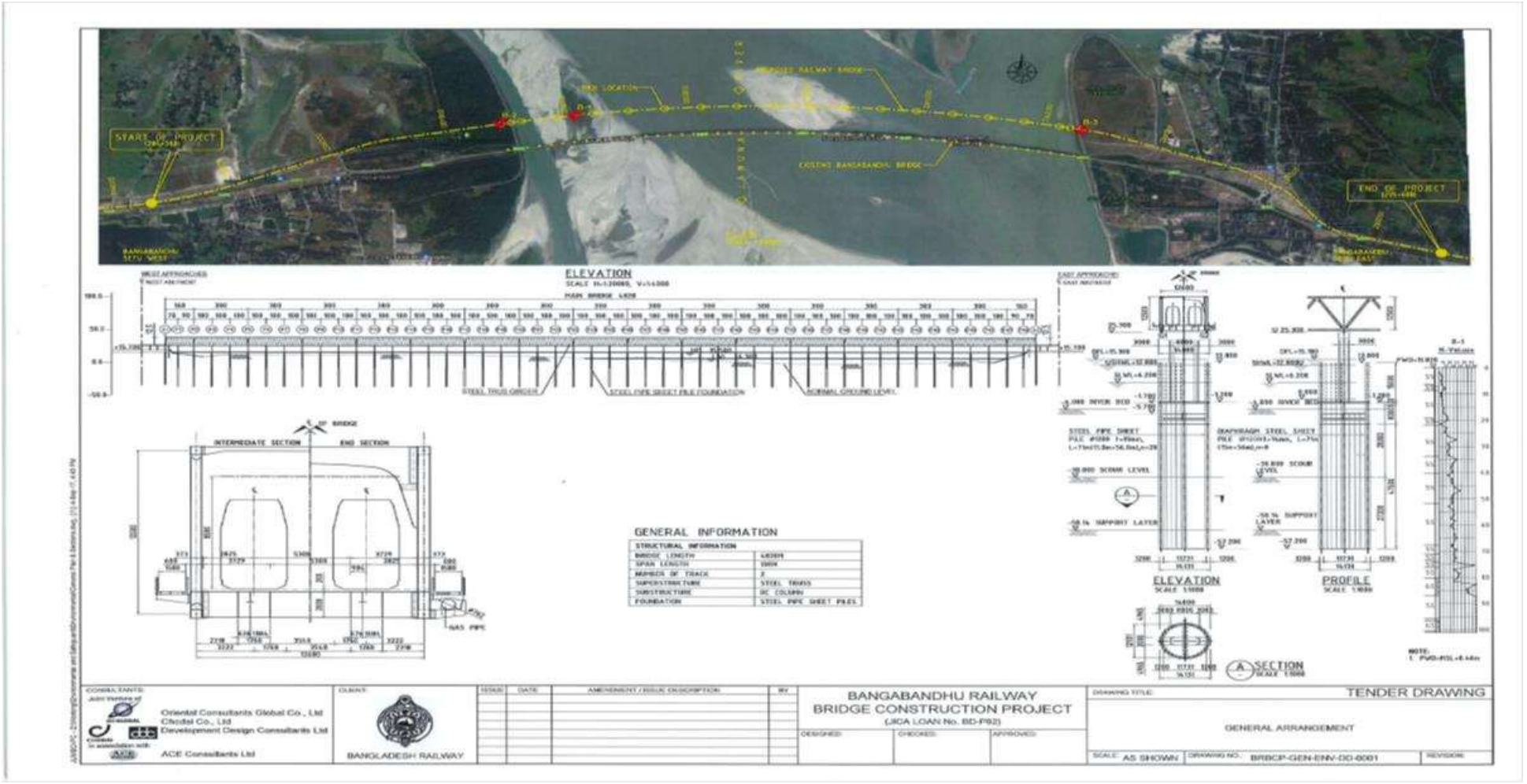


Figure 3-2 General Arrangement for Proposed Alignment

3.3 Environmental Impact Assessment Study

An EIA was conducted in the May to July 2017 along the proposed alignment and the project area. The baseline environmental condition was assessed and was compared to the data generated during the feasibility stage study. The study was conducted about 2 km on either side of the project area. The IEE was conducted as per the requirements of the DoE, Government of Bangladesh. Table 3-1 gives the EIA boundaries.

Table 3-1 EIA Boundaries

Component	Parameters	Locations and Number of Samples
Air Quality	Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Nitrogen Dioxide (NO_2), $PM_{2.5}$, PM_{10}, O_3, SO_2, temperature, humidity, Wind speed and Wind direction	• Bangabandhu Bridge East Station -1 • 50m far from Bangabandhu Bridge -East Station (North & South side)-2 • Bangabandhu Bridge West Station-1 • 50m far from Bangabandhu Bridge West Station (North & South side)-2 • Proposed Rail Bridge East Side-1 • 50m far from Proposed Rail Bridge East Side (North & South side) 2 • Proposed Rail Bridge West Side-1 • 50m far from Proposed Rail Bridge West Side (North & South side)-2 • Bangabandhu Eco Park-1
Surface Water Quality	pH, Total Organic Carbon (TOC), Total Phosphorus, Total Suspended Solid (TSS), Oil & Grease, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Bacterial Load	• Bangabandhu Railway Bridge West & Existing Side Near Shore-1 • Bangabandhu Railway Bridge West & Existing Side Far Shore-1 • Bangabandhu Railway Bridge West & Proposed Side Far Shore-1 • Bangabandhu Railway Bridge West & Proposed Side Near Shore-1 • Bangabandhu Railway Bridge East & Existing Side Near Shore-1 • Bangabandhu Railway Bridge East & Existing Side Far Shore-1 • Bangabandhu Railway Bridge East & Proposed Side Far Shore-1 • Bangabandhu Railway Bridge East & Proposed Side Near Shore-1 • Samples from 500m distance both in upstream and downstream of the above far shore locations-8
Noise Levels	Noise level recorded at the same locations	• Bangabandhu Bridge East Station -1 • 50m far from Bangabandhu Bridge -East Station (North & South side)-2 • Bangabandhu Bridge West Station-1 • 50m far from Bangabandhu Bridge West Station (North & South side)-2 • Proposed Rail Bridge East Side-1 • 50m far from Proposed Rail Bridge East Side (North & South side) 2 • Proposed Rail Bridge West Side-1 • 50m far from Proposed Rail Bridge West Side (North & South side)-2 • Bangabandhu Eco Park-1
Ground Water Quality	Total Dissolved Solids (TDS), Chlorides, Heavy Metal, Arsenic (As), Iron (Fe), Manganese (Mn), Sulphur (S), Total Coliform (TC) and Faecal Coliform (FC)	• Bangabandhu Railway Bridge West Side Station -1 • 100m distance from Bangabandhu Railway Bridge West Side Station (North & South side)-2 • Jamuna East side station-1 • 100m distance from Bangabandhu Railway Bridge East Side Station (North & South side)-2

Component	Parameters	Locations and Number of Samples
Sediment Sampling	Total Organic Matter, Phosphate, Nitrate, Ammonia, Sulphate, Al, As, Cd, Ca, Co, Cr	• East side of the proposed bridge location-1 • 1km far shore from the east side of the proposed bridge-1 • West side of the proposed bridge location-1 • 1km far shore from the west side of the proposed bridge-1 • 1 km upstream from the middle of the proposed bridge-1 • 1 km downstream from the middle of the proposed bridge-1
Soil Quality Sampling	Nitrogen, Phosphorus, Potassium, Sulphur, Calcium, Magnesium, Iron, Manganese, Copper, Zinc, Boron and Molybdenum	• From the nearest agricultural land within 1km towards North between East side of the bridge and East Station-1 • From the nearest agricultural land within 1km towards South between East side of the bridge and East Station-1 • From the nearest agricultural land within 1km towards North between West side of the bridge and West Station-1 • From the nearest agricultural land within 1km towards North between West side of the bridge and West Station-1 • From the nearest agricultural field within 1 km of the Char Land both to the upstream and downstream-1 • Bangabandhu Eco Park-1

Source: Designed by the Environmental Team of the Bangabandhu Railway Bridge Project.

In addition to the above baseline parameters ecological, (fish, Birds, gangetic dolphin), char land survey, Bangabandhu Eco Park Survey and consultation were also conducted to record the local population's opinion about the proposed project. Nearby industrial areas are also visited for collection of the data.

3.4 Need of the Project

To overcome the above difficulties of transportation and connectivity of these areas to the rest of the country the Bangabandhu Railway Bridge project is designed to provide a permanent solution and would sustain all weather conditions. The bridge included a railway connection in addition it allows transmission of electricity and transfer of natural gas between the east and west regions. Existing Bangabandhu Bridge appears to be unable to cater the smooth and speed rail communication, the Bangladesh Government has planned to construct a railway bridge parallel to the existing Bangabandhu multipurpose bridge across the Jamuna River. The proposed railway bridge will improve the railway communications with the neighbouring countries. The BR, Ministry of Railways, Government of Bangladesh, has already conducted a feasibility study in 2014 for the proposed railway bridge project under the technical assistance aid provided by the ADB. The proposed bridge will ensure smooth railway communication. The railway bridge will give a positive impact by providing better connectivity to the Northern Part of the Bangladesh. The project will be designed and constructed with the assistance of JICA loan and also give the technical inputs for the proposed project.

3.5 Project Conditions

Bangladesh has a tropical monsoon type climate with hot and rainy summer and a dry winter season. January is the coolest month and April is the warmest. The climate is wet when compared to the other parts of the world. Most of the areas in Bangladesh receive high rainfall during the monsoon . The project area does not fall under flooding area. The proposed Bangabandhu Railway Bridge project falls under the seismic zone, the map depicting the seismic zones along with the intensity are shown in Figure 3-3.

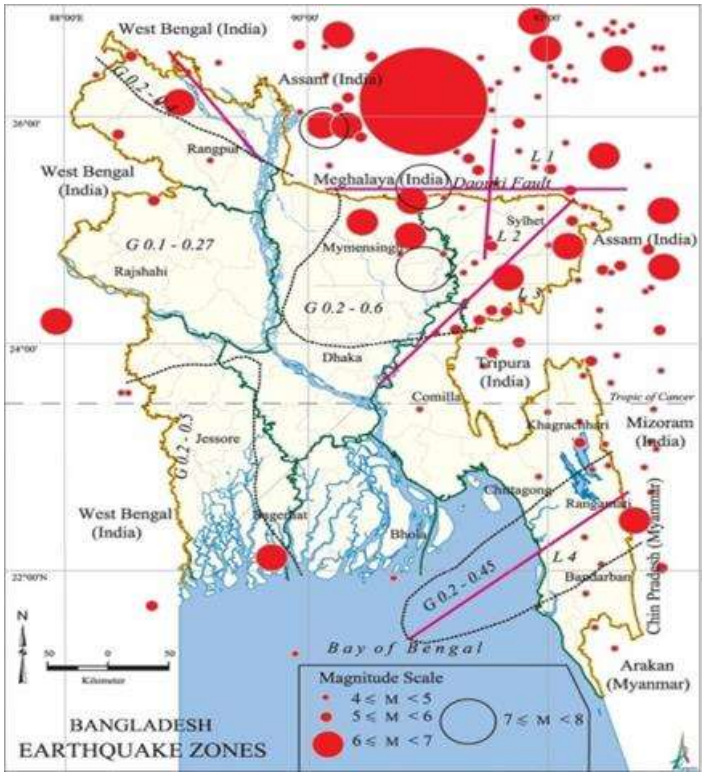


Figure 3-3 Seismic Zone showing the magnitude scale

The Project area falls in a seismic zone of the north and east regions of Bangladesh, which are seismically the most active area. During the last 150 years, seven major earthquakes with Magnitude >7 have struck Bangladesh. Two of them had their epicentres within Bangladesh. Thus seismic considerations are an important aspect during the design of the bridge.

3.6 Design

The Bangladesh Railway Standard will be applied for alignment design. The track spacing (centre to centre) is 5.3 m at all the section between Bangabandhu West & East station. The design speed is 120 km/h, however on the curved (R = 500 m) section of Bangabandhu Setu East Station, then the operation speed will be limited to 80 km/h. The train will increase or

decrease the speed at around the station due to railway alignment. The New Bridge alignment location will be - at 300 m upstream of existing bridge which is laid on curve radius of 12,000 m. The vertical gradient is less than 0.4%.

3.6.1 Main Bridge

From the initial survey and JICA recommendation, the proposed bridge will likely be constructed with steel truss girder super structure, with the entire 4.8 km bridge assumed to be composed of multiple units of three-span continuous truss Girder Bridge. If the steel truss girder bridge is confirmed to be the best alternative, the D/D will determine the optimal number of continuous spans, between 3-span and 10-span continuous bridge, taking into consideration the thermal expansion, necessary number of expansion joints, constructability, and seismic resistance.

The possible construction methods for a steel truss girder include piece-by-piece construction, panel construction (erection of pre-fabricated panels composed of several members and block construction. The greater the degree of pre-fabrication, the faster the construction can proceed, but the larger the lifting equipment is required.

It will be important to incorporate future maintenance requirements including access facility for inspection and maintenance. This issue will be addressed at the detail design stage.

3.6.2 Horizontal Track Alignment

Bangabandhu Setu West Station

There are 5 no of tracks in station yard. The track spacing on the station yard is 5.3 m from line No. 1 to line No. 4. The spacing between No. 4 and No. 5 line is 15.0 m. On the west side of the station, there is a power station and the clearance from power station was kept 2.8 m from the track. The effective length of station yard is 750 m. The track layout was investigated and it was decided that location of No. 1 line and platform will not be changed. The curved turnout was adopted on F/S study. The alignment of station yard was improved to use the standard turnout. The track arrangement is shown in Figure 3-4. It can be possible to pass through on train speed 120 km/h.

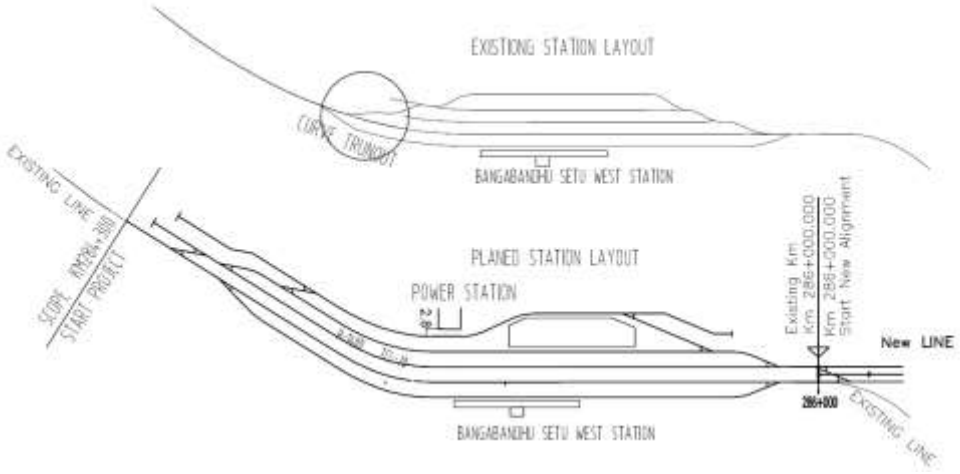


Figure 3-4 Track Alignment

Bangabandhu Railway Bridge and Approach

The kilo post of both east and west station will not be changed. The starting point of new bridge alignment is km 286 + 000. The new alignment will join to original alignment at kilo post km 293 +674.042. However, existing bridge ends at 293+674.042 so there is a difference of 74.042m. The difference of kilo post between new and existing aliment will be treated as brake system. The change will be done in the curve of front and backward of the bridge. The alignment is shown in Figure 3-5.

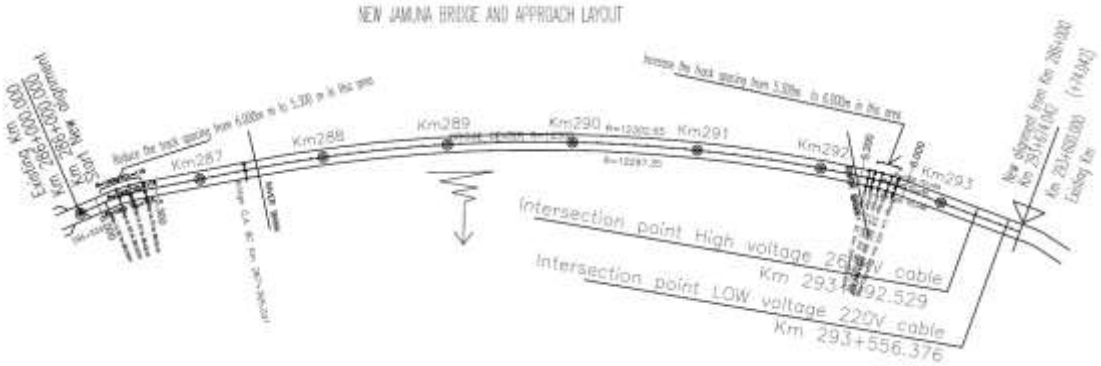


Figure 3-5 Alignment of Bridge Section and Approach

Bangabandhu Setu East Station

The stabling line is connected to the main line in existing track alignment; the stabling line will be connected to siding track in this project. There will be 4 lines in station yard and the track spacing will be 5.3 m. The effective length of station yard will be kept 700 m. The track layout was investigated that location of No. 1 line and platform will not be changed. The track arrangement is shown in Figure 3-6.

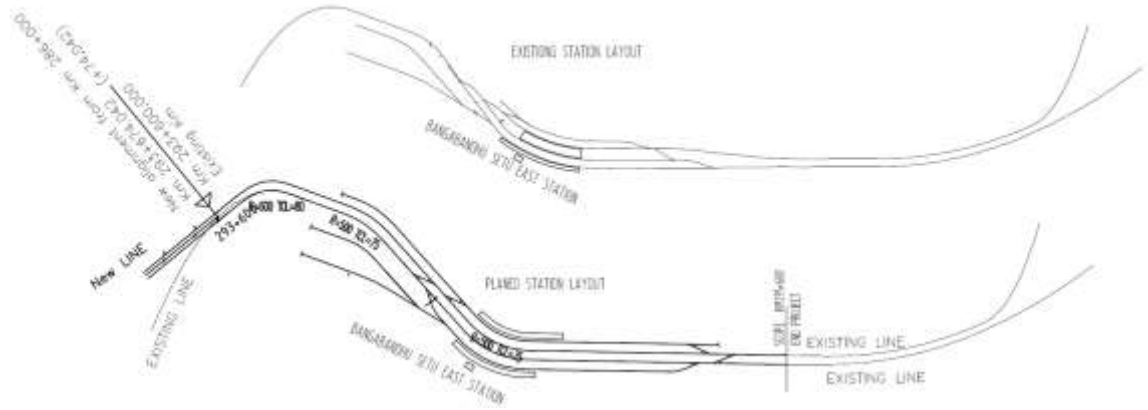


Figure 3-6 Track Arrangement in Station Yard

3.6.3 Vertical Track Alignment

There is a difference of topographic survey result between F/S study and this project. The rail level of the west station and east station was specified as 16.5 m and 11.5 m respectively based on topographic data in this project. The level section on the bridge will be kept more than 1,800 m and the vertical gradient will be less than 0.4 %. The railway alignment will intersect with 230 kv high-voltage electric power line at km 293 + 292.529 and 220 v electric power line at km 293 + 556.376. There is not enough clearance between proposed track and high-voltage electric power line, so the power line needs to be relocated. The vertical alignment diagonal is shown in Figure 3-7 below.

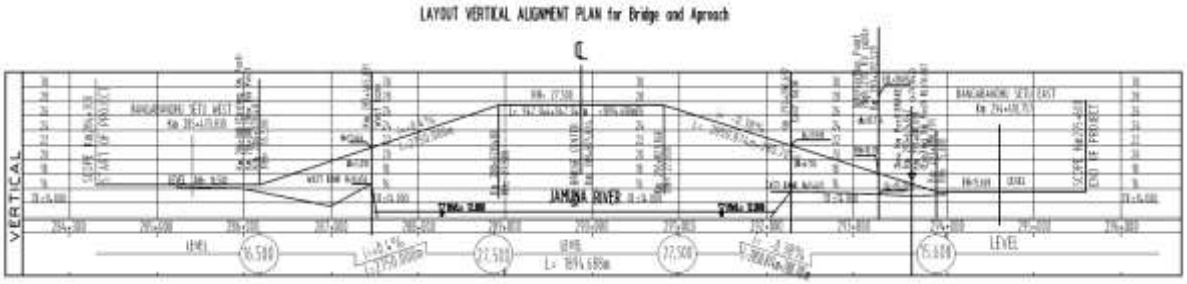


Figure 3-7 Vertical Alignment (diagonal)

The track structure is dual gauge except for a part of east station yard (1,000 mm gauge). So, the alignment drawing will be specified as centre of 1,676 mm gauge. The results of the geological investigation linked to the existing datum shall be studied to determine the ground coefficients for the foundation design. A bearing stratum applicable to the bridge foundation will be examined so that the foundation depth for each substructure can be optimized.

The design loads, such as the dead load of superstructure, live load, wind load, seismic load, stream flow pressure, ship collision force, etc., shall be estimated in detail complying with the

selected design standards and standard code of practice. Those loads shall be applied to the substructure and foundation design in combination including the expected scouring effects as well as liquefaction effects.

3.6.4 Construction Clearance of Bangabandhu Railway Bridge

According to DFC (Dedicated Freight Corridor) Standard (Standard Schedule of Dimensions, Eastern and Western Dedicated Freight Corridors of Indian Railways), the dimensions for the through girder bridges are defined as shown in Figure 3-8. Based on this dimension and the Indian Railways Schedule of Dimensions (1676mm (BG) Revised, 2004 (Updated with CS No.1 to 15-as on 12.11.2014), the 6.0m distance between centers of tracks by DFC was reduced to 5.3m following the provisions of Indian Railways Schedule of Dimensions. The result is shown in Figure 3-9.

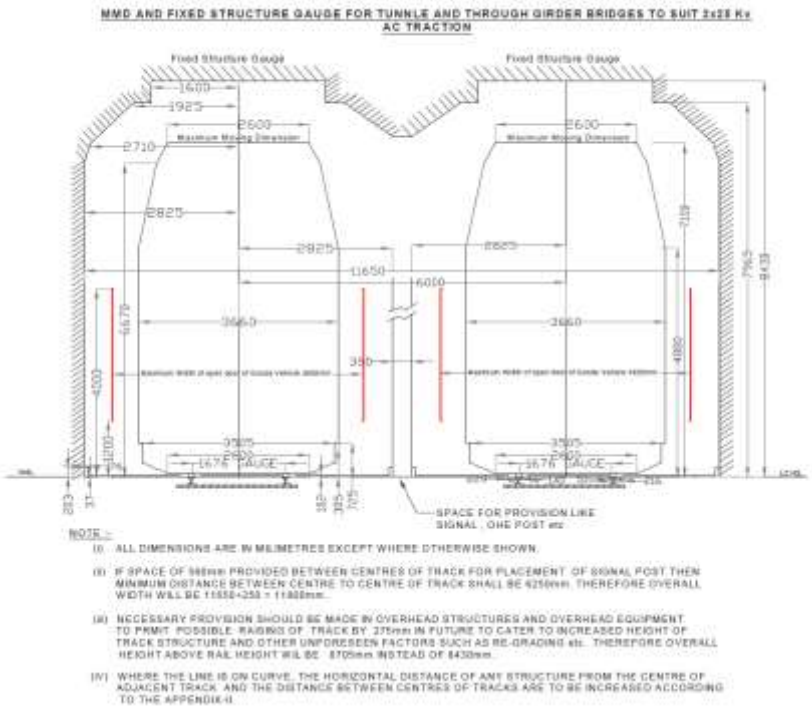


Figure 3-8 Dimensions of DFC

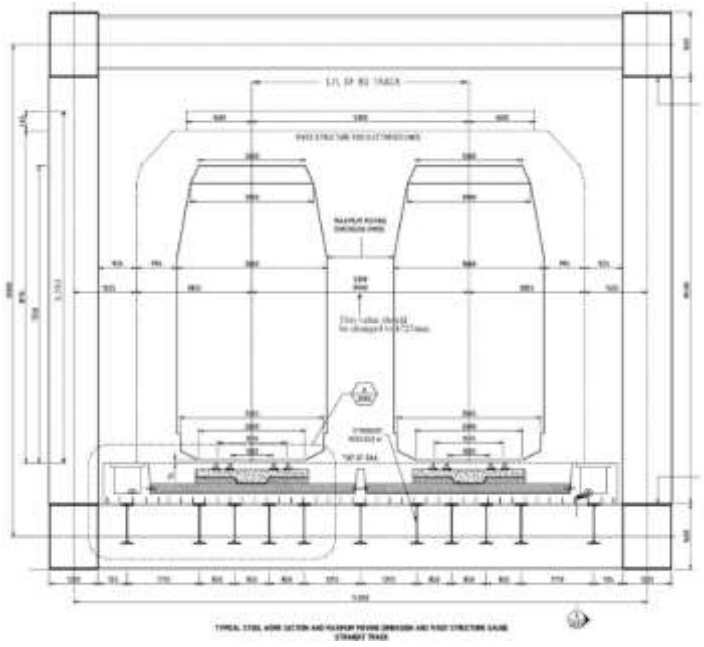


Figure 3-9 Proposed Railway Clearance by ADB-F/S

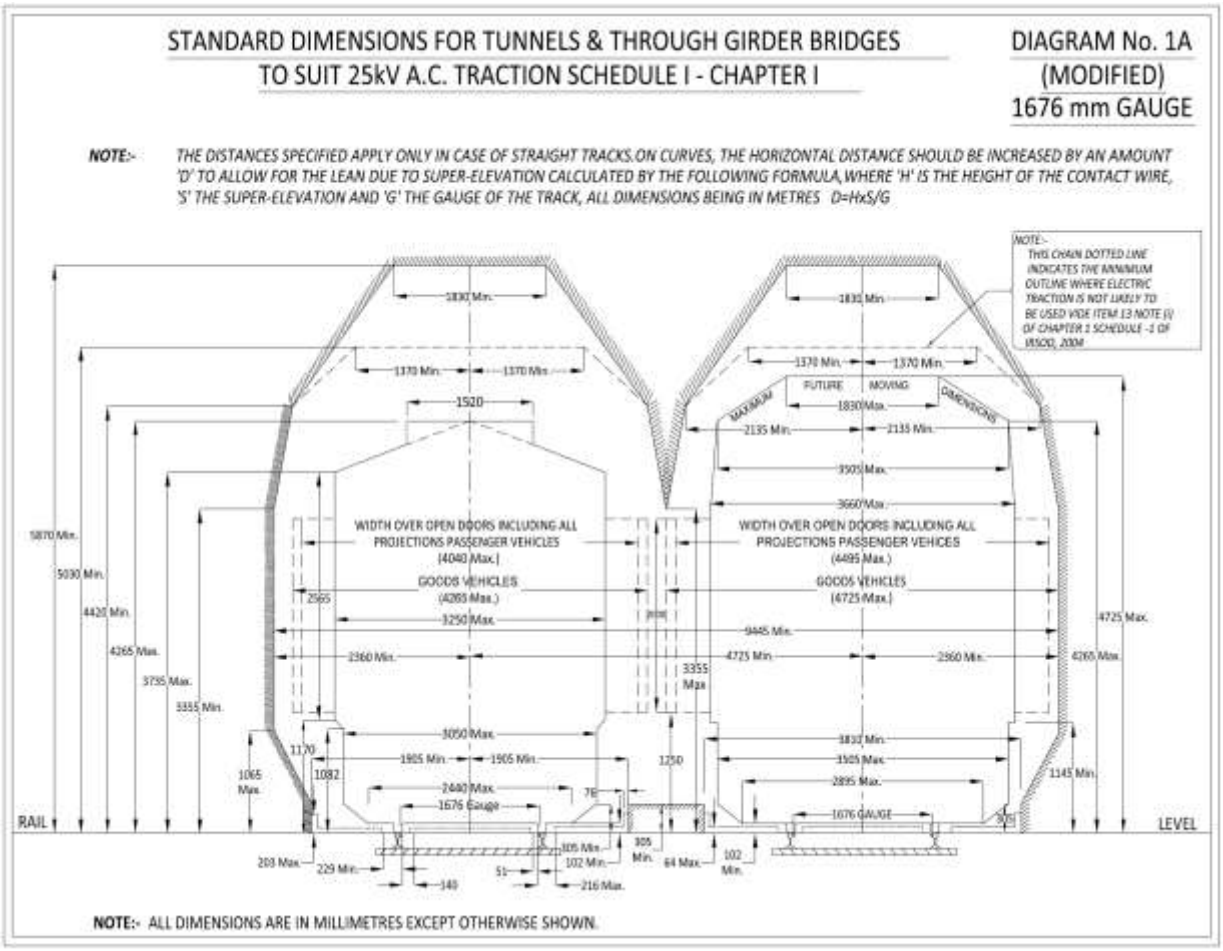


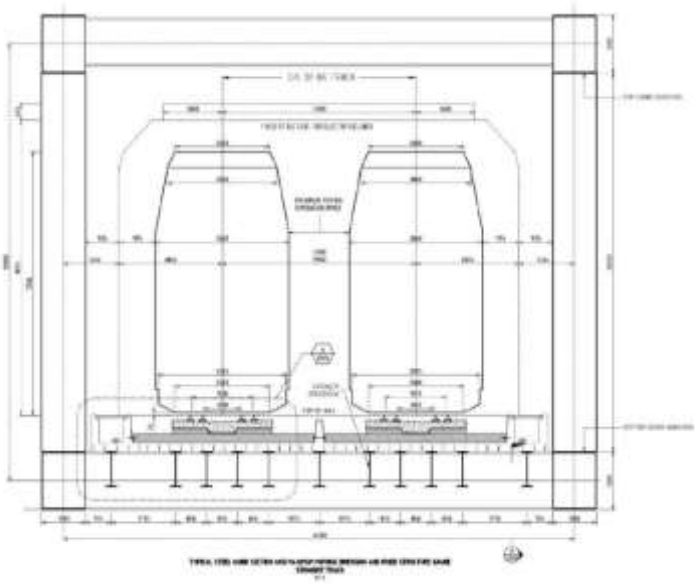
Figure 3-10 Dimensions by Technical Aid

According to Indian Railways Schedule of Dimensions, this value can be reduced to 4.725m for the though girder bridges. The clearance height of 3-9 is 8430mm whereas that of Figure 3-10 is 8580mm. 150mm higher. This was proposed by ADB-F/S to accommodate the deeper sleepers, rail, ballast, etc. As the height will not influence on the steel weight of the truss girder bridge because the height is decided by the 100m span, this height difference is at present, negligible.

Another dimensions specified by the technical aid (Technical Aid to Indian Railways Schedule of Dimensions 1676mm Gauge (BG)) is shown in Figure 3-10. In this dimensions, the side clearance, distance between two centres of tracks and the side clearance is 2.360m, 4.725m and 2.360m respectively.

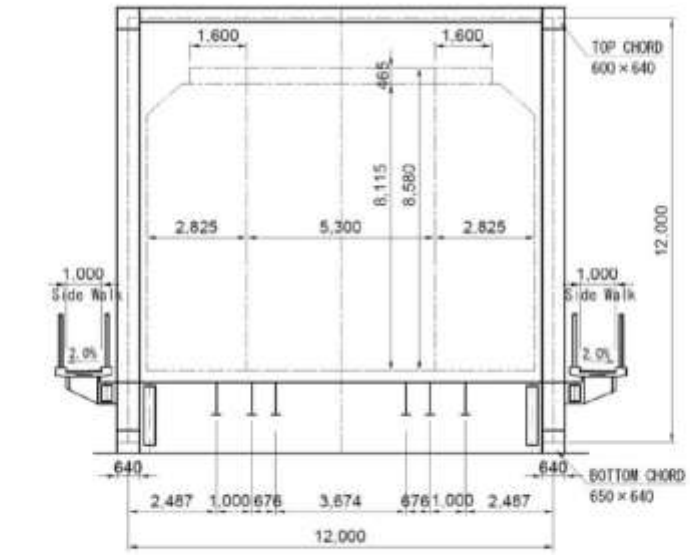
For the width of clearance, there are three alternatives. One is the original ADB-F/S proposal which is 2.825+5.30+2.825=10.95m. Another is 2.825+4.725+2.825=10.375m. This is based on the suggestion of DG at the meeting to reduce the centre distance of 5.3m. The other is 2.36+4.725+2.36=9.445mThese three alternatives are compared.

In the Review of ADB-F/S the following truss girder cross section shown in Figure 3-11 was proposed. The steel weight of truss girder bridges with three different widths, 10.95m, 10.375m and 9.445m, is calculated. The result is shown in Figure 3-12.



Source: ADB-F/S

Figure 3-11 Truss Girder cross section of ADB-F/S



Note : Construction gauge is exactly the same as ADB-F/S

Source: Survey Team

Figure 3-12 Truss Girder cross section proposed in review of ADB-F/S survey

3.6.5 Superstructure Configuration

In this project, the construction gauge indicated in Figure 3-13 will be applied to design the double track railway bridge. The spacing of double track is 5,300 mm and the distance between main chords is 12,600 mm.

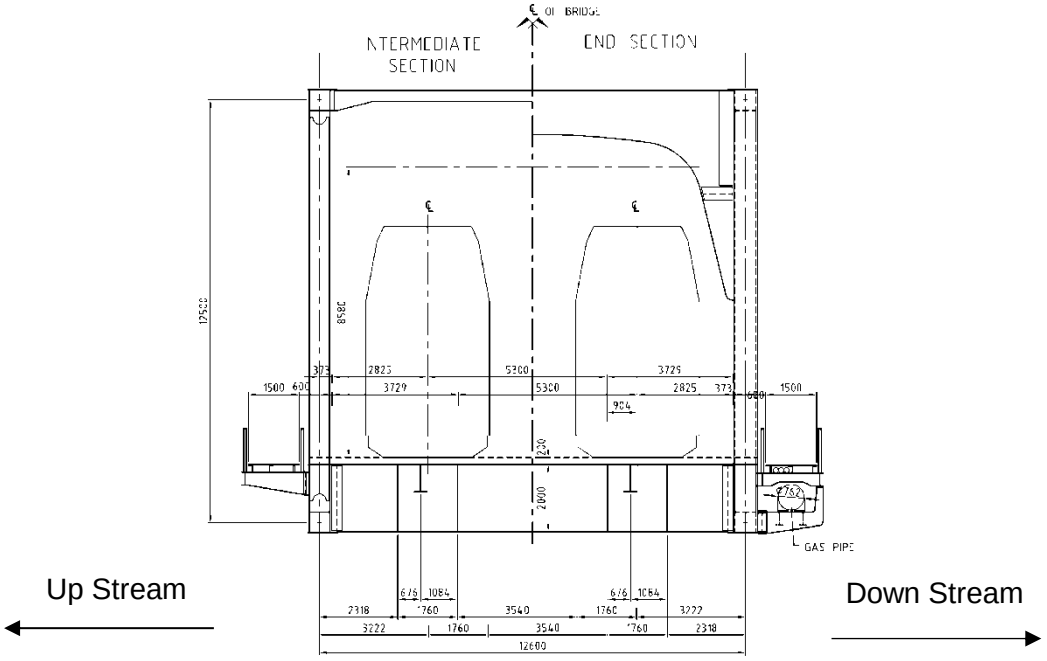


Figure 3-13 Construction Gauge

The foot way will be installed on both side of the bridge, and the Gus Pipe Line will be attached under the foot way on the downstream side.

Open Deck Type Direct Rail Fastener on Steel Girder

The direct rail fastener will be applied for the track structure as shown in Figure 3-14. The advantage of open deck type direct rail fastener is that the dead load is lower than that of ballasted track, and the distance between rail level and girder bottom can be minimized. Therefore, it is effective to lower the rail level and to reduce the structure height. The rail replacement work is easier and less maintenance works are needed. The Continuous Welded Rail (CWR) will be used to improve the riding quality. The expansion joints for CWR will be installed on bridge section to adapt the rail expansion and shrinkage due to temperature change.

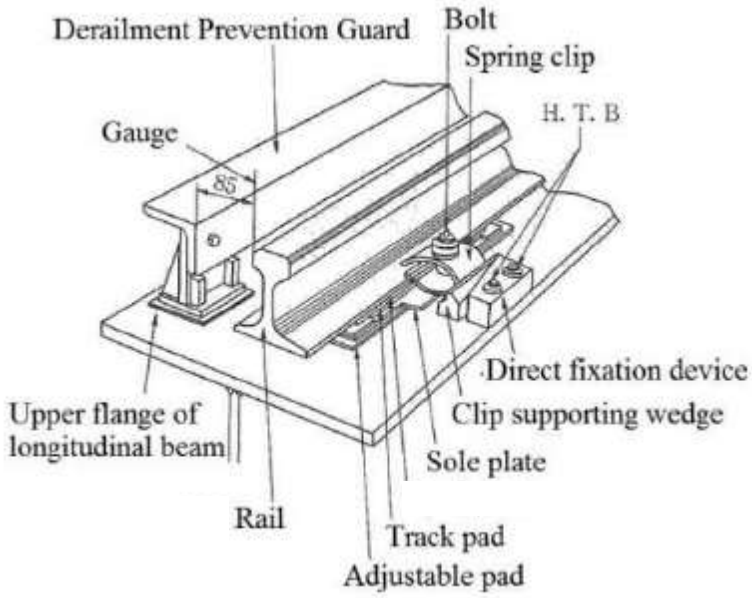


Figure 3-14 Direct Rail Fastener

3.6.6 General View of Truss Bridge

The general view of 3-span continuous truss girder bridge is shown at following Figures. The center span of the bridge is 100.0 m and the side span is 99.1 m. The stringer will be arranged along with the railway alignment. The point at the intersection of stringer with cross beam will be shifted according to the location of the panel point. The method of erection will be the cantilever method of construction using the traveler crane.

3.6.7 Landscape Design (Iconic Design)

The landscape design was carried out by using 3-D view computational device to consider the aesthetic appearance of bridge. The 3-D view of 3-span continuous truss bridge is shown on the following Figure 3-15 and Figure 3-16.

Figure 3-15 3-D View of Truss Bridge-1

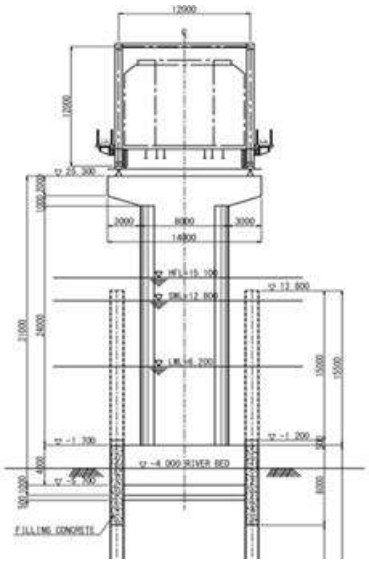
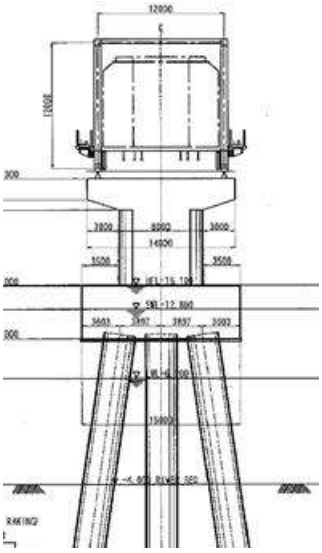
Figure 3-16 3D View of Truss Bridge-2

3.6.8 Substructure

From the result of the comparison table shown in Table 3-2, steel pipe sheet pile foundation (SPSP) combined with temporary coffer-daming method was comprehensively superior not only economically but also in workability and technical know-how transfer including shorter period of construction and procurement. Based on this result, we will recommend steel pipe sheet pile foundation combined with temporary coffer-daming method at the stage of D/D as

well as additional survey by JICA. Two types of piles were studied prior to conclude the preferred type that is provided as below.

Table 3-2 Comparison of proposed structures between ADB-F/S and this Survey

Alternative	Alternative 1, Steel Truss + SPSP	Alternative 2, Steel Truss + Battered Piles
Illustration		
Stability Check	● Foundation Top Horizontal Displacement : 93.8mm≦100.0mm ● Rotation of Foundation Top : 2.451mrad ≦6.0mrad ● Pile Bearing Capacity : 2466kN ≦ 4939kN ● Stress : 192.9N/mm2≦210.0N/mm2	● Foundation Top Horizontal Displacement : 47.4mm≦88.0mm ● Rotation of Foundation Top : 0.5mrad≦ 6.0mrad ● Pile Bearing Capacity : 26178kN ≦ 26612kN ● Stress : 81.2N/mm2≦175.0N/mm2
Const. Period	52 Months (10/10)	54 Months (9/10)
Ship Collision	● The sectional area above the river bed is smaller than the battered multi-pile foundation. Consequently the probability of collision becomes smaller. (9/10)	● The sectional area above the river bed is larger and the probability of ship collision is larger than the SPSP-Foundation. (7/10)
Scour	● The periphery of the foundation is smaller than the battered multi-pile foundation and the possibility of scour may be smaller. (8/10)	● The periphery of this foundation is larger than the SPS-Foundation and the influence of the scour may be larger. But the mechanism of scour is different from SPSP-Foundation to Multi-pile Foundation and the appropriate evaluation is difficult. (8/10)
Constructability of Substructure	● Popular pile driving machines are utilized and there are no problems of availability and the constructability. ● The foundation size and the depth are within the scale of many precedent examples. As this is a new bridge construction project, there are no specific constraints for the construction method and no special machines are needed. ● Inside of the river section, the foundation can be constructed from the barges. Over the char section, the foundation	● Large diameter battered piles need to be driven to the large depth. Large driving machines are needed. ● Quality control such as the site welding, accuracy control, pile driving depth control, etc. is very difficult. ● Large diameter Steel piles are very difficult to fabricate and they need to be fabricated at the site. To handle these piles, larger machines are needed. ● Pile caps are constructed above the water and the construction is comparatively easy without the heavy

Alternative	Alternative 1, Steel Truss + SPSP	Alternative 2, Steel Truss + Battered Piles
	can be constructed with the machines on the char. A large scale dredging may not be necessary. (10/10)	temporary scaffoldings. (6/10)
Constructability of Superstructure	● Members of steel truss bridges are fabricated at a shop and the members are assembled at s site. Thus the construction period can be minimized. ● As the construction method, there are the single member erection method, the panel member erection method and the launching erection method. (10/10)	● Members of steel truss bridges are fabricated at a shop and the members are assembled at s site. Thus the construction period can be minimized. ● As the construction method, there are the single member erection method, the panel member erection method and the launching erection method. (10/10)
Cost Ratio	1.000 10/10)	1.007 (9/10)
Technology Transfer	● Weathering steel, direct fastened railway on steel girders, SPS-foundations are new technologies and suitable for the technology transfer. (10/10)	● Weathering steel, direct fastened railway on steel girders are new technologies and suitable for the technology transfer. (5/10)
Evaluation	Best (67/70)	Acceptable 54/70)

3.6.9 Viaduct section

The viaduct section in the F/S Report was illustrated on both Guide Banks with a length of 128 m. In the D/D, since the vertical alignment RL height is designed to be lowered by 5 m or more than that of estimated in F/S, it is found that 128m length viaduct section is not required at all (Figure 3-17).

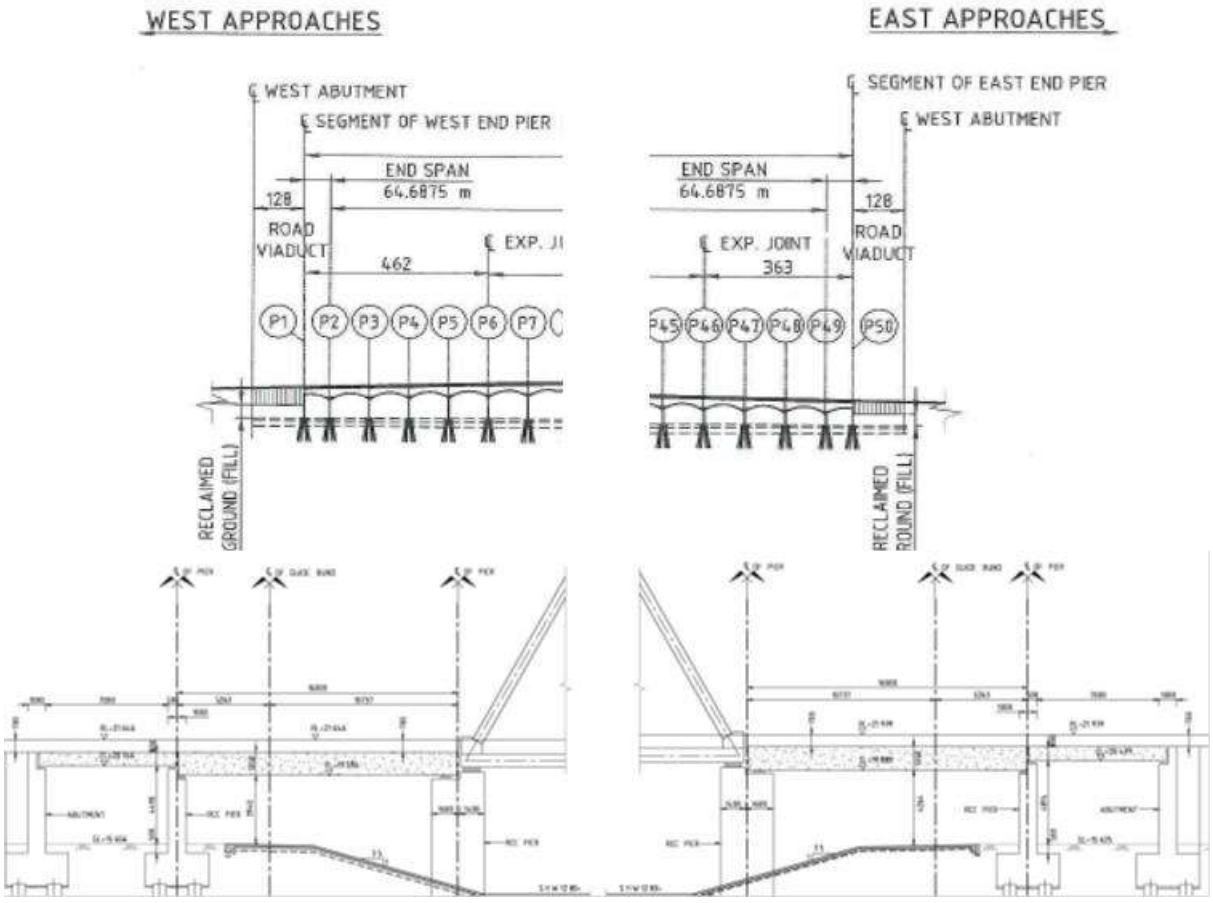


Figure 3-17 Viaduct Section

3.6.10 elocation of existing road in Cantonment area

In the approach section in the cantonment area, the proposed railway track will overlap the existing service road, thus relocation of the road is required. As shown on the attached plan view, road will be sifted around 30m to the north, since if the road is shifted to the south, road will cross the proposed new railway. In order to minimize encroachment to the Cantonment area, as shown on the attached cross-section drawing, the railway truck will be built inside Retaining wall, which can avoid slope in cantonment side, as shown on the next page.

3.6.11 Gas Pipe Line

A gas transmission line will be installed on the proposed Railway Bridge, as per the specifications of Gas Transmission Company., Ltd. (GTCL). GTCL and will prepare the necessary work plan deciding right of way based on the alignment for the proposed Bangabandhu Railway Bridge.

3.6.12 Hydrology and River Training

The Brahmaputra-Jamuna is a generally branched, wandering braided river. The large braided river is characterised by wide channel, rapid shifting of bed material and continuous shifting of the channel course. The average width of the river within Bangladesh is 11.8 km. the active channels between the left and the right bank of the river near the bridge site is 12 - 15 km wide. The proposed rail bridge crossing the Jamuna River is to be located up stream of the existing Bangabandhu Bridge. During the design of the guide bund it was recognised that the dynamic nature of a braided river like Jamuna could cause serious scour and attack to occur during the floods with magnitude less than the designed for flood, as resulted in adverse platform conditions. The existing river training works consists of guide bunds at each abutment, approximately 3 km long and two hard points upstream- at Bhuapur on the left bank and at Sirajganj on the right bank.

Most of the perennial rivers in Bangladesh are classified as navigable channels by the Bangladesh Inland Water Transport Authority (BIWTA). The river Jamuna at Bangabandhu Bridge Site is class II category of BIWTA Classification.

3.6.13 Earthworks

The approach embankment of the proposed Bangabandhu Railway Bridge will be approximately 3.2 km and 3.3 km from the western and eastern side respectively. The embankment will ramp up from 4 m to 18 m to approach the deck level. The transition zones are among the most demanding locations of the railway embankment. The proposed

embankment will be constructed with suitable fill material from outside the proposed RoW. The estimated earthwork volume for construction of embankment is approximately 300,000 cubic metres. The construction of the embankments, with proper slope design and ensuring that the subgrade has adequate bearing capacity, will be carried out with suitable soil available from the nearby vicinity of the embankments.

3.6.14 Other Bridges and Culverts

The selected alignment option will require construction of ten other bridges and culverts as shown in Table 3-3.

Table 3-3 List of Proposed other Bridges and Culverts

No.	Chainage (m)	Span	Type	Structure
1	284+942	1.0 x 1.0 m	RCC	Culvert
2	285+342	1.0 x 1.0 m	RCC	Culvert
3	285+693	1.0 x 1.0 m	RCC	Culvert
4	286+450	1.0 x 1.0 m	RCC	Culvert
5	286+996	1.0 x 30.0 m	RCC	RUB
6	287+382	1.0 x 1.0 m	RCC	Culvert
7	293+762	1.0 x 1.0 m	RCC	Culvert
8	294+370	1.0 x 1.0 m	RCC	Culvert
9	294+936	1.0 x 1.0 m	RCC	Culvert
10	295+435	1.0 x 1.0 m	RCC	Culvert

3.6.15 Level Crossings

There will be only one traffic level crossing in Bangabandhu Setu East which needs to be upgraded during construction of the proposed Bangabandhu railway bridge to accommodate the additional tracks. Appropriate level crossing protection equipment for the level crossing within station limits will be designed.

3.6.16 Construction Yards

Two construction yards on the Tangail side and the other construction yard to be located on the Sirajganj. The construction yards are required to carry out construction works and storage of construction materials. The access for the water should be given due importance. The environmental and social aspects are given due importance while selecting the construction yards. There is no land acquisition for the construction yards as the entire project will be on the BBA and BR lands. The design team is looking at the several options for the construction yard. On the west side it can be planned also near the Bangabandhu Setu West Station as there is adequate vacant land available for setting up the construction yards.

3.6.17 Tree cutting

The proposed alignment of Bangabandhu Railway Bridge will pass through the Bangabandhu Eco Park area on the western Bank of the Jamuna River. There will be tree cutting on the western bank. There is more number of trees in the western bank when compared to the eastern bank. In total 3683 trees of 27 species will be uprooted for the construction. The access roads which will be planned at a later stage will also invite tree cutting. The alignment pictures of Bangabandhu Eco-Park are given in the following Figure 3-18 and Figure 3-19.

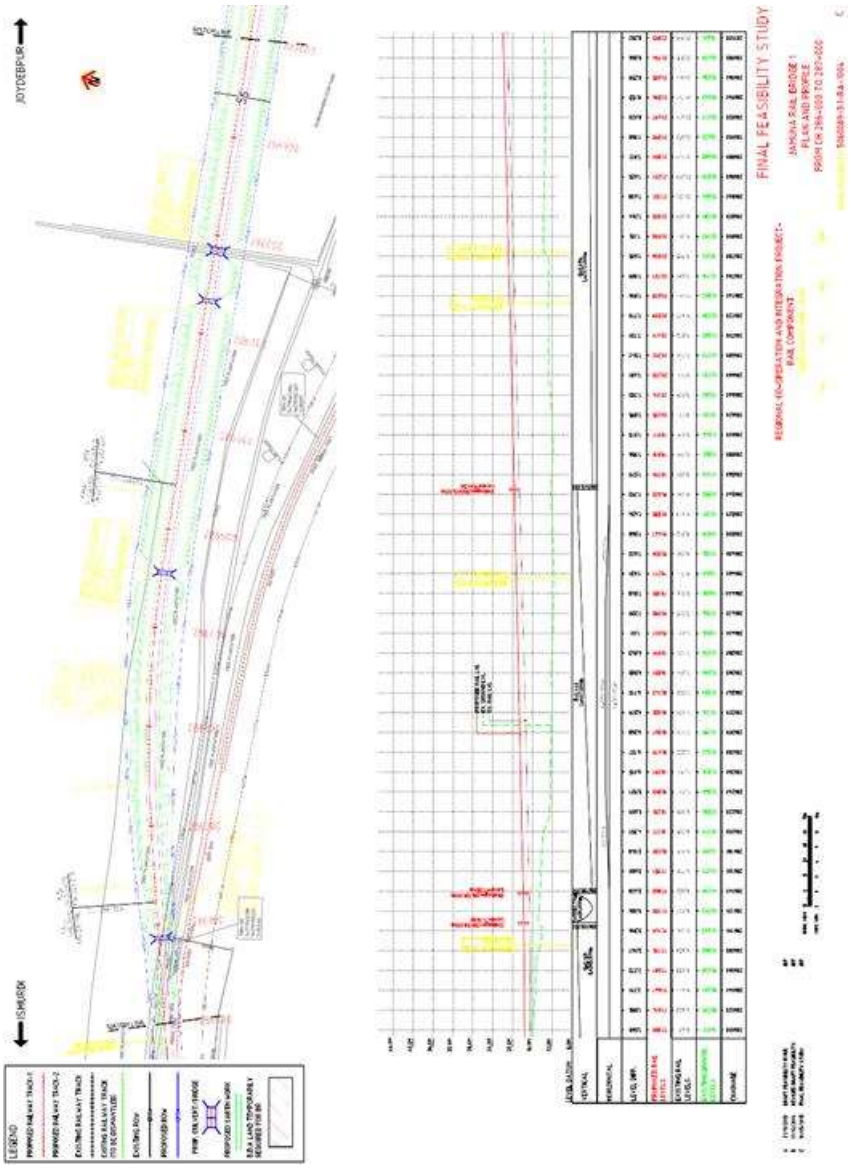


Figure 3-18 Proposed Alignment on the Bangabandhu Eco-Park (1)

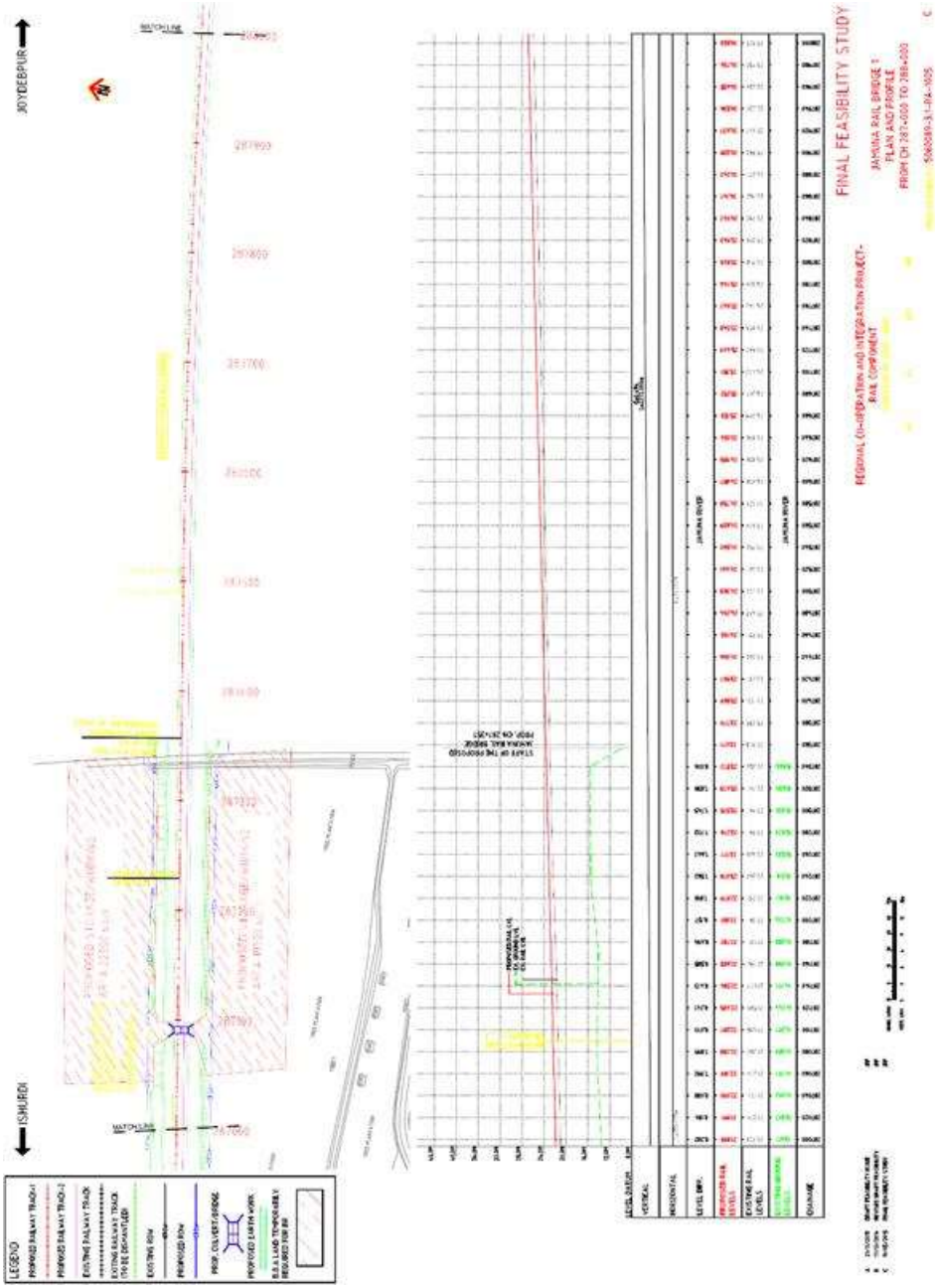


Figure 3-19 Proposed Alignment on the Bangabandhu Eco-Park (2)

The above two drawings show the major tree cutting areas in the project location. The tree cutting requires an inventory and species identification before uprooting them. It is a requirement for the DoE to know how many trees will be uprooted. The Department of Forests (DOF) already issues requisite No-Objection Certificate (NOC) after they verify the things from the project location.

Two field inventory groups were made and each group comprised of (one enumerator for remove bark, and painting one for measuring/recording and supervised by one

environmental specialist. Each group was assigned with a paint, brush, tap, slick, 20 feet plastic pipe, recording form, pencil, eraser, sharper, PPE, etc. the tree inventoried 1.3-meter height and above 6 inches girth/ circumference and below 6 inches girth of trees only counts the number of species. The environmental specialist has worked mostly as supervise and review the data. Following form was used for three inventories

- Local name
- Girth/dbh (diameter at breast height)/ circumference(feet)
- Circumference (feet)
- Height (feet)
- Bole Height (feet)
- CFT
- Amount of Fuel (kg)

The following formula was used for calculating the CFT

CFT= Bole height x $(dbh)^2$ /16

This formula will be used for the timber calculation

4 CHAPTER-BASELINE

4.1 Introduction

A baseline study is nothing but an inventory of environmental, social and historical features in and around of the proposed project area. The baseline environmental parameters are monitored to assess the prevailing site conditions. The concentration of the environmental parameters would focus on how the natural resources are getting impacted due to the rapid urbanisation and industrialisation of the surrounding areas. Generally, the ground conditions are assessed by monitoring the environmental parameters and are further strengthened by gathering the secondary information's from the environmental studies conducted in the adjacent area for different projects. There was expansion taking place for the existing power plant at Sirajganj. The power plant is on the west bank of the Jamuna River. Department of Industries proposed couple of industrial parks on the west bank of the Jamuna River. The industrial park belongs to the Bangladesh State Industrial Department. The two parks developed alongside the western bank of Jamuna River will give employment opportunities to the local population. The projects would give an economic boost to the local economy as number of people would be employed. There is also a corridor widening project is also coming up to ever increasing traffic on the Tangail Road. The project is funded by the ADB and it is known as the South Asian Subregional Economic Cooperation (SASEC) Road. The road widening work is going on a fast track.

Baseline environmental monitoring forms backbone for any EIA and it gives scope for the impact prediction and for designing and formulating the management plan to be adopted at the site during the implementation stage. The baseline parameters would indicate present environmental status of the project area. The primary data like the existing air quality, ground and surface water quality, sediment and soil quality and the noise levels forms the primary parameters, which should be generated at the site by monitoring and collecting samples and analysing the same at well recognised laboratory. The questionnaire surveys require the collection of data through the observations, discussions and personal interviews and last but not the least secondary data should be gathered from the published information.

This present chapter throws light on the primary data obtained during the monitoring and the secondary information gathered from the site. The present pollution loads existing at the project site also discussed in the various sections of the chapter. The primary survey and the secondary information gathering were done during the months of May and July 2017.

4.2 Air Quality

The air quality assessment was made during the pre-monsoon and post monsoon months during the feasibility stage of the proposed project. The same locations were considered for air quality monitoring and the same parameters are considered. The season was conducted during the month of June 2017.

The air quality monitoring were carried out in and around the project site for the various parameters like Carbon Monoxide (CO), Oxides of Nitrogen (NOx), Respirable particulate matter ($PM_{2.5)}$ and Suspended particulate matter (PM_{10}), Ozone (O_3) and Sulphur dioxide (SO_2). Meteorological data was also collected simultaneously for the respective monitoring sites, so that the meteorological conditions can be correlated with the concentration of pollutants. The meteorological parameters considered are the temperature, humidity and wind speed and wind direction. The Bangabandhu Eco Park also considered for air quality monitoring as some portion of the railway track alignment will pass through the Eco Park. A lot of activities are taking place near to the Eco Park at present juncture and there is heavy traffic conjunction. It can be attributed to the massive construction activities taking place on the West Bank of the Jamuna River. The power plant expansion project is also going in a rapid pace. However, the results are given in the below Table 4-3. The appendix 1 gives the raw date of the air quality.

4.2.1 Conversion of Hourly to 24 hour Averages

Agencies, including the GoB's DoE, use the 24-hour collection period as the standard for establishing ambient air quality levels. However, with over 30 stations and hundreds of hours of sampling to complete, 24-hour sampling was not technically or financially feasible for the RCIP. Many agencies (e.g. New York State Dept. of Environmental Conservation, California Office of Environmental Health Hazards Assessment, USEPA, Ontario Ministry of Environment) face the same problems and have had to adapt by applying a conversion process using Pasqual's (1961) air mass dispersion tables defining six air mass stability classes (Table 4-1) and a set of meteorological conditions (Table 4-2). Using the simple power law principle Schroeder and Jugloff (2012) described the steps for converting one-hour readings to 24-hour values. (Schroeder & Jugloff, 2012).

The stability classes (Table 4-1) are related to average wind speed, daytime solar radiation and night-time cloud cover and a second table (Table 4-2), refining these relationships, was also developed by Pasquill.

Table 4-1 Pasquill-Gifford Air Dispersion Stability Classes and Associated Dispersion Exponents

Stability Class	P	Definition
A	0.5	Very unstable
B	0.5	Unstable
C	0.333	Slightly unstable
D	0.2	Neutral
E	0.167	Slightly stable
F	0.167	Stable

Source: Table 1, pg 15 of Schroeder & Jugloff, 2012

Table 4-2 Meteorological Conditions Used to Define the Stability Classes

Surface wind speed		Daytime Incoming Solar Radiation		Night Time Cloud Cover	
m/s	Strong	Moderate	Slight	>50%	<50%
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

Source: Table 2, pg 15 of Schroeder & Jugloff, 2012
Note: Grey highlight indicates condition selected for Bangladesh

Therefore, taking the simple average of these three values from Table 4-2, the Project stability class was calculated as 0.39 (see below).

$$\mathrm{P} = \frac{0.5 + 0.5 + 0.167}{3} = 0.389 \approx 0.39$$

This suggests a somewhat unstable air mass, resulting in considerable dilution of an 8 hour sample when spread out over a 24 hour period. In order to provide 24 hour averages for the five parameters: NO_X, NO_2, PM_{10}, $PM_{2.5}$ and SO_2, the following power-law equation, as defined in Schroeder and Jugloff was applied:

$$C_{24h} = C_{8h}\left(t_{short}/t_{long}\right)^{0.39}$$

Where C_{8h} is the measured 8 hour concentration and C_{24h} is the estimated average using the exponent 0.39., and "t" is time. Therefore:

$$C_{24h} = C_{8h}(8/24)^{0.39} \approx 0.652$$

So for example for the 8 hour measurement of PM_{10} of 190 μg/m^3 the 24 hour average would be:

$$24hr\ Avg.PM_{10} = 190 \times 0.652 = 123.9\mu g/m^3$$

Table 4-3 Ambient Air Quality Monitoring Results after the conversion

Sampling Location	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	CO ($\mu g/m^3$)
Bangabandhu Setu East Station	123.9	29.3	40.4	18.4	16.2	93.43	285
50m far away from Bangabandhu Bridge East Station (South side)	71.7	30.0	40.9	18.6	15.8	16.32	272
50m far away from Bangabandhu Bridge East Station (North side)	50.9	36.5	39.6	18.0	14.7	8.38	279
50m far away from Proposed Rail Bridge East Side (South side)	93.9	31.3	49.2	22.4	7.9	12.24	289
Proposed Railway Bridge East Side	46.3	28.0	28.2	14.0	12.7	113.36	241
50m far away from Proposed Rail Bridge East Side (North side)	29.3	18.9	10.3	4.7	3.6	50.23	287
Bangabandhu Bridge West Station	58.7	14.9	11.3	5.2	9.2	31.74	301
50m far away from Bangabandhu Bridge West Station (South side)	42.8	22.3	16.5	7.5	19.3	10.47	287
50m far away from Bangabandhu Bridge West Station (North side)	41.8	44.7	15.1	6.9	16.9	399.55	268
Proposed Rail Bridge West Side	47.7	81.9	29.8	13.5	30.7	29.05	279
50m far away from Proposed Rail Bridge West Side (North side)	22.0	44.2	10.4	4.7	17.7	48.92	312
50m far away from Proposed Rail Bridge West Side (South side)	15.9	22.8	17.4	7.9	14.5	37.72	259
Bangabandhu Eco Park	52.6	35.0	35.2	16.0	30.6	26.84	304
DOE standard for Ambient Air	**150**	**65**	**100**	**-**	**365**	**157**	**10000**
EHS Standards of IFC	**150**	**75**	**-**	**200**	**125**	**160**	**10000 (WHO)**

Source: JICA Survey Team, 2017

PM_{10}: From the above test results, All PM_{10} values found are below DoE standard as well as IFC standard for all the locations.

$PM_{2.5}$: The test results show that all the values of $PM_{2.5}$ were below both DoE and IFC standards except for on Proposed Rail Bridge West Side (North).

NO_x: The table shows that, the values of NO_x for all the locations were within both the DoE and IFC standards.

NO_2: The table shows that, the values of NO_2 for all the locations were within both the DoE and IFC standards.

SO_2: The table shows that, the values of SO_2 for all the locations were within both the DoE and IFC standards.

O_3: The table shows that, the values of O_3 for all the locations were within both the DoE and IFC standards except for 50m far from Bangabandhu Bridge West Station (North Side). The value of O_3 exceeds both DOE and IFC standards in this location.

CO: The table shows that, the values of CO for all the locations were within both the DoE and IFC standards.

The Sulphur dioxides are very much in the prescribed standards. The ozone results mostly in the prescribed limits except at one location it is exceeding the limit laid down by the DoE. The limit exceeds at Bangabandhu West Station. The carbon monoxide limits are very much in the prescribed limits of the DoE.

The air quality data shows there is increase in the particulate and gaseous pollutant concentrations when compared to the air quality results of July 2013 and February 2014, which was generated during the period of feasibility stage. The increase in the particulate concentration can be attributed to the construction works taking place at the west bank of Jamuna and the increased traffic volume on the road corridor both on the west and eastern side of Jamuna River. The particulate concentration has not increased at any of the sampling locations, but respirable particulate matter concentration has increased at one location this clearly indicates that the pollution levels are gradually increasing up at the project site due to anthropogenic activities. If there is same level of activities continues at the project site, than there will be considerable increase in the particulates and gaseous pollutants. When the humidity levels are ranging at 66%- 99%, high the particulate and gaseous concentration is not expected. This becomes detrimental for the existing environment. The trucks should not idle for longer duration, which give rise to pollutants irrespective of the climatic conditions. There should be stringent regulation for the emission controls should be implemented by DoE otherwise the concentration of the particulate matter and for the gaseous pollutants will be increasing in the next few years. There should be strict emission control and should be monitored at regular intervals. The Oxides of nitrogen and nitrogen dioxide levels are very much in the prescribed limits of the DoE, Government of Bangladesh. The Monitoring locations are given in the below Figure 4-1.

Table 4-4 Ambient Air Quality Monitoring Results in July 2013

Sampling Location	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	CO ($\mu g/m^3$)
Bangabandhu Bridge East Station	2.36	4.56	10.56	1.22	1.71	38.63	26.8
50m far away from Bangabandhu Bridge East Station	2.55	0.03	0	0	4.76	55.14	0
Proposed Rail Bridge East Side	1.21	0.7	0.06	0	0	50.05	41.4
50m far away from Proposed Rail Bridge East Side	0.55	0.1	1.05	0	4.54	47.38	6.25
Proposed Rail Bridge West Side	2.43	1.71	6.6	0.21	13.6	44.26	23.44
50m far away from Proposed Rail Bridge West Side	3.156	0.13	0.39	0	18.96	50.19	3.33
DOE standard for Ambient Air	**150**	**65**	**100**	**-**	**365**	**157**	**10000**
EHS Standards of IFC	**150**	**75**	**-**	**200**	**125**	**160**	**10000 (WHO)**

Source: F/S for Construction of Railway Bridge parallel to the Existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the River Jamuna

Table 4-5 Ambient Air Quality Monitoring Results in February 2014

Sampling Location	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	CO ($\mu g/m^3$)
Bangabandhu Bridge East Station	79.46	37.36	10.41	8.74	54.82	76.37	922.15
50m far away from Bangabandhu Bridge East Station	65.05	32.94	9.44	8.08	53.15	56.4	623.11
Proposed Rail Bridge East Side	57.03	31.09	8.82	8.03	33.54	108.33	611.13
50m far away from Proposed Rail Bridge East Side	48.54	28.57	7.78	6.17	32.84	98.15	519.91
Proposed Rail Bridge West Side	59.63	34.36	8.59	7.92	42.6	130.14	736.97
50m far away from Proposed Rail Bridge West Side	53.3	32.22	7.85	6.58	39.26	114.79	649.02
DOE standard for Ambient Air	**150**	**65**	**100**	**-**	**365**	**157**	**10000**
EHS Standards of IFC	**150**	**75**	**-**	**200**	**125**	**160**	**10000 (WHO)**

Source: F/S for Construction of Railway Bridge parallel to the Existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the River Jamuna

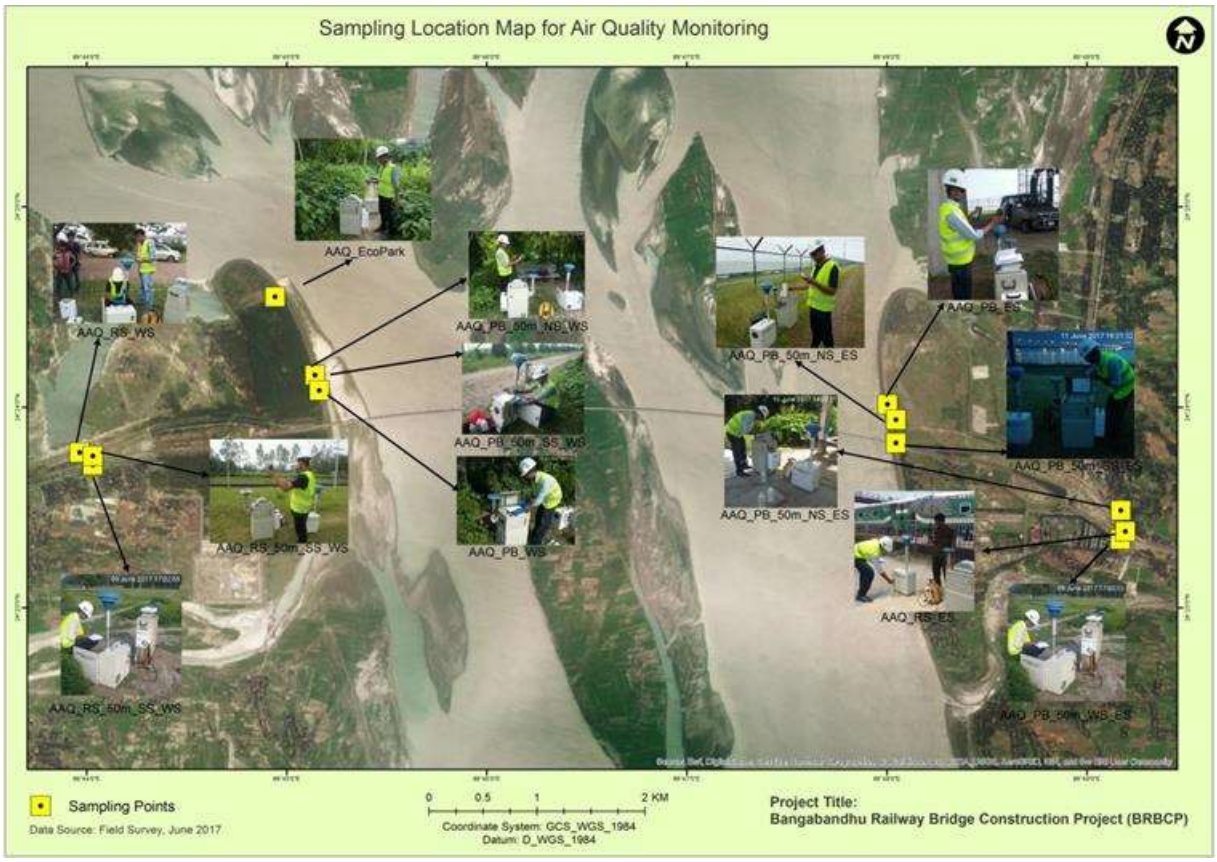


Figure 4-1 Air quality Sampling Locations

The high-volume samplers are used for air quality monitoring for collection of particulate matter. The high-volume samplers used are capable enough to represent the air quality in the 5 kilometres radius where they are placed. The air quality obtained by the monitoring will give an idea of the air quality on the eastern bank and western bank of the Jamuna River. The Eco Park is being sensitive the air quality monitoring was carried out. The air quality data generated will give an assessment of the project area. The data can be graphically represented below graphical representation inFigure 4-2 and Figure 4-3.

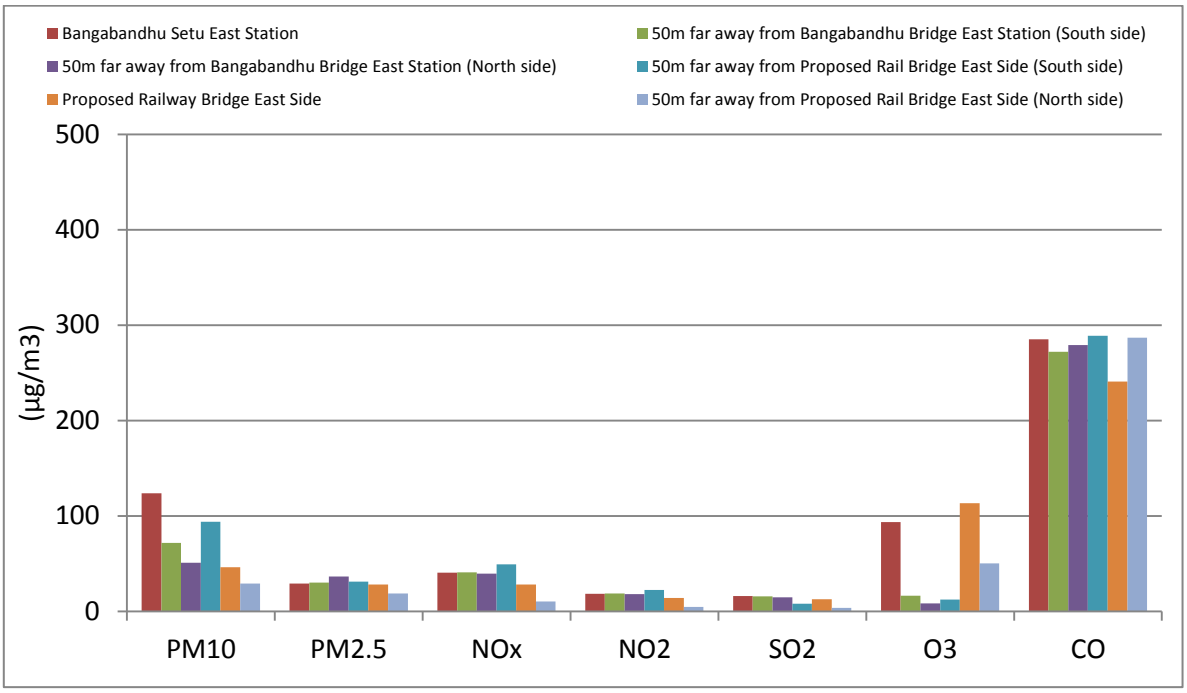


Figure 4-2 Air Quality Data on Eastern Side of Bangabandhu Railway Bridge

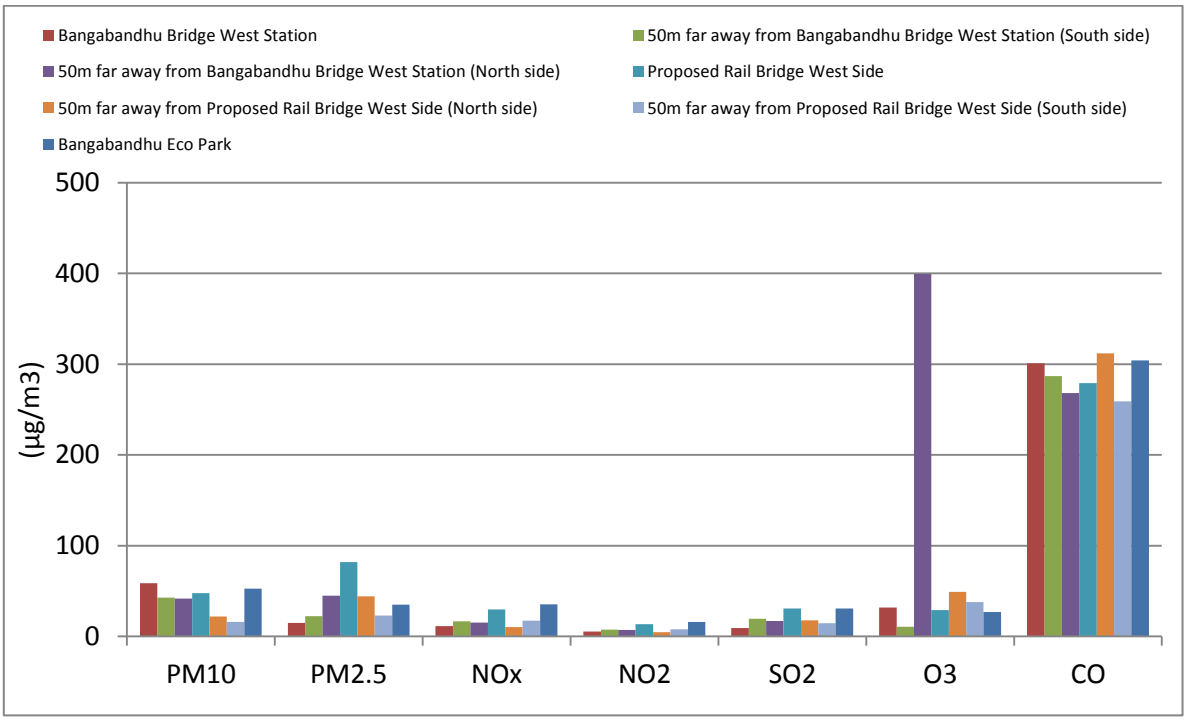


Figure 4-3 Air Quality Data on Western Side of Bangabandhu Railway Bridge

The air quality monitoring was carried out in around the project location during the month of June, 2017. Filter and each chemical were measured before testing. Electro-Chemical Sensor device were calibrated before testing some other parameters. The particulate are

higher when compared to the particulate concentration during the ADB Feasibility Stage study.

The increased levels of air pollutants prompt the project authorities to implement the strict mitigation measures during the project execution stage. The mitigation measures to be monitored at regular intervals. The increased traffic and the rapid industrialisation taking place in the area. These can be considered for the raise in particulate concentration.

4.2.2 Difference between Feasibility and Detailed Design

The air quality assessment was made during the pre-monsoon and post monsoon month (2013- 2014) during the feasibility stage for the proposed project. The same locations were considered for air quality monitoring and the same parameters are considered even at the detail designed stage. The monitoring was conducted during the month of June 2017 which represents the onset of monsoon in Bangladesh.

The air quality parameters were measured in the field using the Environmental Perimeter Air Sampler (haz-Scanner) make of the Environmental Devices Corporation USA. This sampler was used for measuring the various air pollutants. The sampling was carried out by using an Environmental Perimeter Air Sampler and it is a portable air quality analyser using an automated air sampler system during the feasibility stage. In case of detailed design stage the air quality monitoring was carried out using a high volume air sampler. The high volume air sampler has a suction rate of 1.5 cubic meters per minute. Higher volumes of air are drawn in this case.

The difference between the concentrations of air particulate matter can be attributed to the high suction rates of high volume sampler and low suction rates in personal monitors. In most of the South Asian Countries High volume samplers are used for measuring the ambient air quality status. The portable monitors are used measuring the indoor air quality and for assessing industrial environment. The contributing factor is the ever increasing traffic at the road corridor opposite to the Bangabandhu Setu East and the Bangabandhu Setu West Station. The traffic (the automobile numbers) is increasing at the rate of 10% per year. At present there are about 16,000 vehicles ply on that road daily..

4.3 Noise Monitoring

Noise Level Monitoring conducted at the project site during the month of June 2017. The same locations where the air quality monitoring was carried out were chosen for the noise

level monitoring. Noise monitored at regular intervals of 15 minutes and was measured during the day and night times. The results are given in Table 4-6 Noise Monitoring Results.

Table 4-6 Result of Noise level Measurement

Location	Land Use Category	Noise Level dB(A) (LAeq)		Bangladesh Standard dB (A)** (Leq)	
		Day	Night	Day	Night
Bangabandhu Eco Park	Silent	44.98	48.23	45	30
50m far away from Proposed Rail Bridge East Side (North)	Silent	51.04	51.74	45	30
50m far from Bangabandhu Bridge West Station (North Side)	Silent	51.61	56.53	45	30
50m far away from Proposed Rail Bridge East Side (South)	Silent	60.04	57.25	45	30
50m far away from Proposed Rail Bridge West Side (South)	Silent	61.59	56.32	45	30
Proposed Rail Bridge West Side	Silent	63.34	50.73	45	30
Proposed Railway Bridge East Side	Silent	56.34	53.69	45	30
50m far from Bangabandhu Bridge East Station (North Side)	Residential	54.12	60.81	50	40
50m far away from Proposed Rail Bridge West Side (North)	Residential	44.67	53.69	50	40
50m far from Bangabandhu Bridge East Station (South Side)	Commercial	51.36	53.51	70	60
50m far from Bangabandhu Bridge West Station (South Side)	Residential	65.54	65.98	50	40
Bangabandhu Bridge East Station	Commercial	65.34	63.56	70	60
Bangabandhu Bridge West Station	Commercial	66.74	60.43	70	60

Source: JICA Survey Team, 2017

Notes:

- Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)
- Shaded cells indicate noise levels in excess of Noise Pollution Control Rules ambient noise limits for a given land use area
- The sound level standards for residential area at day and night are 50dB and 40 dB respectively.
- The sound level standards for silent zone at day and night are 45 dB and 30 dB respectively.
- The sound level standards for commercial area at day and night are 70 dB and 60 dB respectively.
- Noise Level is the average noise recorded over the duration of the monitoring period.

The result shows that time weighted average value of the sound monitored inside the project exceeded the standard set for silent zones except Eco-Park at day time. The sound monitored inside the project exceeded the standard set for residential areas except few locations far away from Proposed Rail Bridge West Side (North) at the day time. And the sound monitored inside the project did not exceed the standard set for commercial areas except Bangabandhu Bridge East Station and Bangabandhu Bridge West Station at night time. The noise monitoring stations are showed in the Figure 4-4 down below. The raw data collected given in the appendix.2

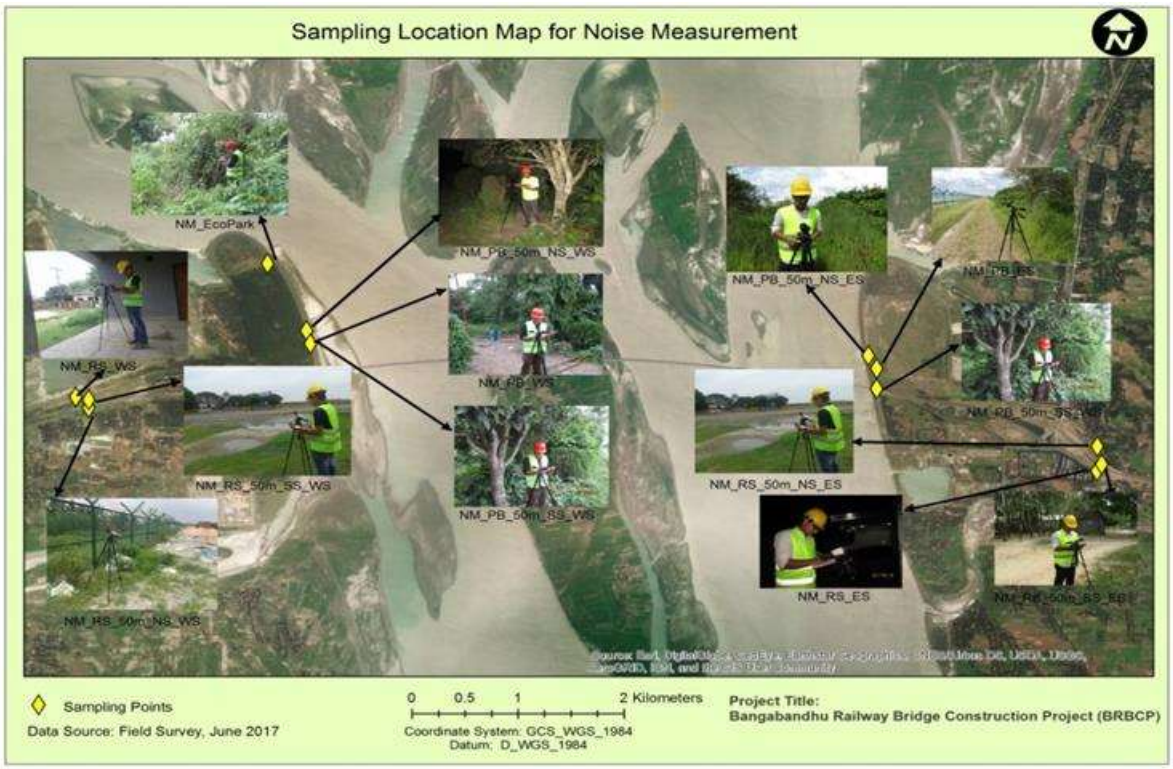


Figure 4-4 Sampling Location for Noise Monitoring

The existing vehicle and train movements along the Bangabandhu Bridge and the vehicle movements are the major source of noise along the project area. The existing noise levels can be attributed high volume audio playing using loud speakers; the air horns used by the trucks are contributing for the higher levels of the Noise. When compared to the feasibility study higher noise levels were recorded this time.

There is not much difference between the noise level recorded during 2013 and 2014. The magnitude of noise levels may increase marginally, but the traffic volume will attribute to the noise levels. This will go up over the period of time those are shown in Figure 4-6 and Figure 4-7

Table 4-7 Result of Noise level Measurement in July 2013

Location	Land Use Category	Noise Level dB(A) (LAeq)		Bangladesh Standard dB (A)** (Leq)	
		Day	Night	Day	Night
Bangabandhu Bridge East Station	Commercial	56	51.2	70	60
50m far from Bangabandhu Bridge East Station (North Side)	Residential	58.6	44.5	50	40
Proposed Railway Bridge East Side	Silent	52.2	48	45	30
50m far away from Proposed Rail Bridge East Side (North)	Silent	46.2	43.3	45	30
Proposed Railway Bridge West Side	Silent	44.5	40	45	30
50m far away from Proposed Rail Bridge West Side (North)	Silent	43.5	41.1	45	30

Source: F/S for Construction of Railway Bridge parallel to the Existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the River Jamuna

Table 4-8 Result of Noise level Measurement in February 2014

Location	Land Use Category	Noise Level dB(A) (LAeq)		Bangladesh Standard dB (A)** (Leq)	
		Day	Night	Day	Night
Bangabandhu Bridge East Station	Commercial	52.4	58.7	70	60
50m far from Bangabandhu Bridge East Station (North Side)	Residential	49.1	47.3	50	40
Proposed Railway Bridge East Side	Silent	50.2	46.5	45	30
50m far away from Proposed Rail Bridge East Side (North)	Silent	50.6	49.1	45	30
Proposed Railway Bridge West Side	Silent	48.6	49.5	45	30
50m far away from Proposed Rail Bridge West Side (North)	Silent	52.8	47.1	45	30

Source: F/S for Construction of Railway Bridge parallel to the Existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the River Jamuna

4.4 Vibration

This result showed that the maximum velocity was 29.15m/s in Bangabandhu Bridge West Station and minimum velocity remained same in all the locations. The standard deviation of velocity maxed in WS which is 4.677m/s and was minimum in 50m far away from Proposed Rail Bridge East Side North and the value was 0.116m/s. Maximum acceleration occurred in Bangabandhu Bridge West Station and which was 0.9m/s^2. Minimum acceleration was mostly 0. Maximum displacement occurred in 50m far from Bangabandhu Bridge East Station South Side and the value was 0.115 mm. Minimum displacement was mostly 0. The monitoring/sampling locations are given in Table 4-9 and Figure 4-5 showing locations attached. The appendix-3 gives the raw data of the vibration.

Table 4-9 Vibration Result of Velocity, Acceleration and Displacement

Location	Velocity (mm/s)				Acceleration (m/s^2)				Displacement (mm)			
	Max.	Min.	Standard Deviation	Mean Value	Max.	Min.	Standard Deviation	Mean Value	Max.	Min.	Standard Deviation	Mean Value
Bangabandhu Eco Park	0.5	0.05	0.127	0.158	0.2	0	0.100	0.100	0.059	0	0.009	0.012
Bangabandhu Bridge East Station	16.51	0.05	3.048	0.847	0.2	0	0.100	0.100	0.036	0	0.006	0.010
50m far from Bangabandhu Bridge East Station	1.21	0.05	0.190	0.305	0.1	0	0.029	0.009	0.11	0	0.019	0.031
50m far from Bangabandhu Bridge East Station	1.05	0.05	0.199	0.293	0.2	0	0.058	0.023	0.152	0	0.018	0.028
50m far away from Proposed Rail Bridge East Side (North)	0.67	0.05	0.116	0.175	0.1	0.1	0	0.100	0.086	0	0.014	0.025
50m far from Bangabandhu Bridge West Station	1.29	0.05	0.240	0.310	0.1	0	0.050	0.050	0.095	0	0.020	0.027
50m far away from Proposed Rail Bridge East Side	0.29	0.05	0.043	0.084	0.2	0	0.027	0.004	0.035	0.001	0.005	0.011
50m far from Bangabandhu Bridge West Station	0.73	0.05	0.139	0.185	0.5	0	0.147	0.192	0.115	0	0.017	0.019
Proposed Railway Bridge East Side	1.33	0.05	0.199	0.349	0	0	0	0	0.109	0.001	0.020	0.042
Proposed Rail Bridge West Side	0.65	0.05	0.127	0.180	0.1	0.1	0	0.100	0.094	0	0.015	0.018
Bangabandhu Bridge West Station	29.15	0.05	4.677	1.348	0.9	0	0.175	0.115	0.024	0	0.004	0.006
50m far from Bangabandhu Bridge West Station	1.89	0.05	0.312	0.166	0.2	0	0.100	0.100	0.075	0	0.007	0.008
50m far from Bangabandhu Bridge West Station	0.8	0.05	0.121	0.172	0.3	0	0.092	0.062	0.062	0	0.010	0.018

Source: JICA Survey Team, 2017

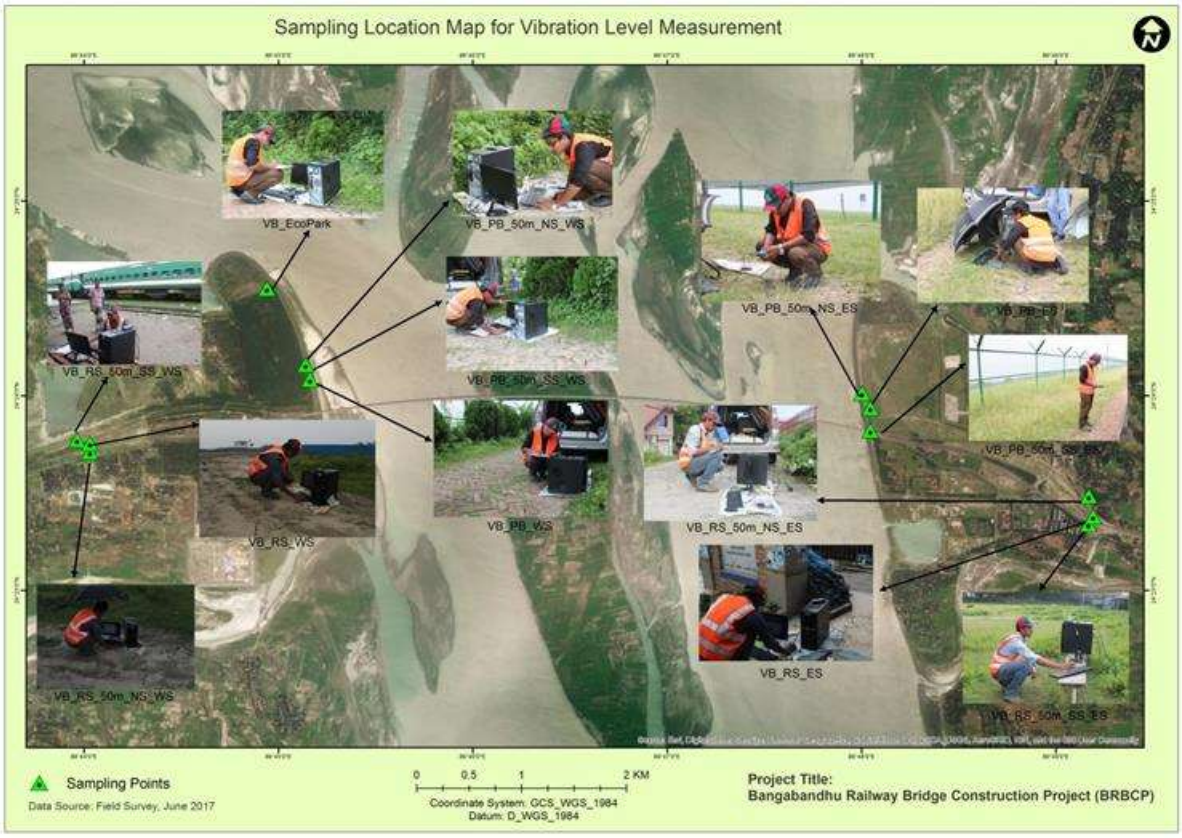


Figure 4-5 Vibration Level Monitoring Location Map

Vibration study was not conducted during the feasibility stage.

4.5 Surface Water Quality

Surface Water samples were collected from sixteen locations in the month of May 2017. The parameters measured were pH, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Total Phosphorus (TP), Total Organic Carbon (TOC), Total Coliform (TC), Faecal Coliform (FC), and Oil & Grease. All samples were collected in plastic sampling bottles, kept in an ice cooler, after necessary stabilization/fixing, and analysed within 72 hours of being collected. Tests are done from Laboratory of BUET and University of Dhaka. Test Result of surface water sampling analysis of project influenced area is given at Table and monitoring location are given. The pH of surface water is quite alkaline in the entire river. The discussion on the results is as follows: Table 4-10 gives the results. And the location map in the Figure 4-6.

4.5.1 Results & Discussions

pH: The accepted range of pH prescribed by the DoE is between 6.5 and 8.5. This is the range, which provides adequate protection to the life of fresh water fish and bottom dwelling

invertebrates. In most of the water bodies of the area, the pH range is found above the DoE prescribed standards. The pH value is governed largely by the carbon dioxide, carbonate, and bicarbonate equilibrium. Organic substances may affect it, by change in the carbonate equilibrium due to the bioactivity of plants and in some cases by hydrolysable salts. The presence of calcareous grey soils in Jamuna basin might have affected the pH level to be little high.

Total Dissolved Solids (TDS): The standard for inland surface water for Total Dissolved Solids is 1000mg/L. the test results show that, for all the locations, the values of TDS were below national standard.

Dissolved Oxygen (DO): The dissolved oxygen is necessary for organisms living in water including fish, invertebrate, bacteria and plant. Decrease in DO values below the critical level of 3 mg/L causes death of most fishes and other aerobic aquatic organisms. The dissolved oxygen values were within the national standards for all the locations.

Chemical Oxygen Demand (COD): The standard for inland surface water for COD is 200mg/L. the test results show that, for all the locations, the values of COD were below national standard.

Biochemical Oxygen Demand (BOD_5): The standard for inland surface water for BOD_5 is 50mg/L. the test results show that, for all the locations, the values of BOD_5 were below national standard.

Total Suspended Solids (TSS): The standard for inland surface water for TSS is 150mg/L. the test results show that, for all the locations, the values of TSS were below national standard.

Total Phosphorus (TP): The value of TP varied within the range 0.17 mg/L to 0.25 mg/L. Among the locations possesses the lowest value and 500m South of Proposed Bridge, Far Shore East, Tangail possesses the highest value. The phosphorus can be attributed to the anthropogenic activities of the local population living on char lands.

Total Organic Carbon (TOC): The value of TOC varied within the range 0.407 mg/L to 0.855 mg/L. Among the locations 500m North of Bangabandhu Bridge, Far Shore East,

Tangail possesses the lowest value and 500m South of Proposed Bridge, Far Shore East, Tangail possesses the highest value.

Total Coliform (TC): The value of TC varied within the range 10 CFU/100ml to 60 CFU/100ml. Among the locations 300m North of Bangabandhu Bridge, Far Shore West, Tangail) possesses the lowest value and 500m South of Bangabandhu Bridge, Far Shore West, Tangail possesses the highest value.

Faecal Coliform (FC): The value of FC was nil in 6 locations. On the other locations, the values varied within the range 10 CFU/100ml to 40 CFU/100ml.
Raw data attached in the appendix-4.

The result of Feasibility Study is also shown in Table 4-11 as below. Numerical values are larger or smaller than this study's ones depend on the item. Therefore the respective results cannot be compared each other as a rule because the respective survey periods are also different.

Table 4-10 Result of Surface Water Quality in June 2017

Parameters	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Standards for Inland Surface Water*
pH	-	8.6	8.7	8.8	8.5	8.7	8.9	8.8	9.3	8.9	8.7	8.5	8.6	8.9	8.1	9.2	8.7	6.5-8.5
Total Dissolved Solids (TDS)	mg/L	0.05	0.05	0.04	0.05	0.02	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	1000
Dissolved Oxygen (DO)	mg/L	6.38	6.32	6.35	6.36	6.42	6.35	6.44	6.75	6.87	6.5	6.73	6.38	6.93	6.44	6.9	6.36	4.5-8
Chemical Oxygen Demand (COD)	mg/L	2	1	4	3	2	2	2	2.2	3	2	2.2	3	2.2	1.6	3.1	1.8	200
Biochemical Oxygen Demand (BOD_5)	mg/L	0.2	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	50
Total Suspended Solids (TSS)	mg/L	70	2	55	50	97	95	74	63	73	78	71	65	77	82	56	79	150
Total Phosphorus (TP)	mg/L	0.17	0.22	0.23	0.2	0.23	0.21	0.23	0.23	0.22	0.23	0.22	0.22	0.19	0.25	0.23	0.21	-
Total Organic Carbon (TOC)	mg/L	0.777	0.621	0.57	0.458	0.417	0.443	0.486	0.535	0.456	0.554	0.467	0.583	0.568	0.855	0.472	0.407	-
Total Coliform (TC)	CFU/100ml	20	30	40	20	20	10	30	20	50	20	50	60	50	40	30	20	-
Faecal Coliform (FC)	CFU/100mL	Nil	20	Nil	10	Nil	Nil	10	Nil	20	10	20	40	30	10	Nil	10	-
Oil & Grease	mg/L	<5.0	<5.0	<5.0	<5.0	5.80	<5.0	<5.0	24.60	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.40	-

Source: JICA Survey Team, 2017

Note:
- A SW_EB_NS_ES = Under the Bangabandhu Bridge, Near Shore East, Tangail
- B SW_PB_NS_ES = 300m North of Bangabandhu Bridge, Near Shore East, Tangail
- C SW_PB_FS_ES = 300m North of Bangabandhu Bridge, Far Shore East, Tangail
- D SW_PB_FS_500m_US_ES = 500m North of Proposed Bridge, Far Shore East, Tangail
- E SW_PB_FS_500m_US_WS = 500m North of Proposed Bridge, Far Shore West, Tangail
- F SW_PB_FS_WS = 300m North of Bangabandhu Bridge, Far Shore West, Tangail
- G SW_PB_NS_WS = 300m North of Bangabandhu Bridge, Near Shore West, Sirajganj
- H SW_EB_NS_WS = Under the Bangabandhu Bridge, Near Shore West, Sirajganj
- I SW_EB_FS_WS = Under the Bangabandhu Bridge, Far Shore West, Tangail
- J SW_EB_FS_500m_US_WS = 500m North of Bangabandhu Bridge, Far Shore West, Tangail
- K SW_PB_FS_500m_DS_WS = 500m South of Proposed Bridge, Far Shore West, Tangail
- L SW_EB_FS_500m_DS_WS = 500m South of Bangabandhu Bridge, Far Shore West, Tangail
- M SW_EB_FS_500m_DS_ES = 500m South of Bangabandhu Bridge, Far Shore East, Tangail
- N SW_PB_FS_500m_DS_ES = 500m South of Proposed Bridge, Far Shore East, Tangail
- O SW_EB_FS_ES = Under the Bangabandhu Bridge, Far Shore East, Tangail
- P SW_EB_FS_500m_US_ES = 500m North of Bangabandhu Bridge, Far Shore East, Tangail

Table 4-11 Result of Surface Water Quality in March 2013 and in February 2014

Parameters	Unit	March 2013								February 2014								Standards for Inland Surface Water*
		Q	R	S	T	U	V	W	X	Q	R	S	T	U	V	W	X	
pH	-	7.89	8.17	8.21	8.21	7.99	7.85	7.91	7.95	7.61	7.86	8.37	7.99	8.58	8.53	8.46	8.38	6.5-8.5
Dissolved Oxygen (DO)	mg/L	7.54	6.81	6.94	7.37	7.21	6.94	7.01	6.97	7.11	6.22	7.28	7.68	6.27	6.30	7.62	7.41	4.5-8
Total Suspended Solids (TSS)	mg/L	22	30	23	36	22	25	23	30	12	1	2	2	2	1	2	2	150
Total Phosphorus (TP)	mg/L	<0.01	0.02	0.02	<0.01	<0.01	0.01	1.44	<0.01	0.04	0.05	0.07	0.04	0.06	0.08	0.07	0.11	-
Total Organic Carbon (TOC)	mg/L	5.9	4.9	3.7	3.7	3.6	5.2	5.2	4.4	0.9	0.9	0.8	0.8	1.0	0.9	0.8	1.0	-
Oil & Grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-

Source: F/S for Construction of Railway Bridge parallel to the Existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the River Jamuna

Note:
- Q SW_SP3_ExNS_DS_W_001 = Jamuna Bridge West & Existing Side Near Shore
- R SW_SP3_ExFS_DS_W_002 = Jamuna Bridge West & Existing Side Far Shore
- S SW_SP3_PrFS_US_W_003 = Jamuna Bridge West & Proposed Side Far Shore
- T SW_SP3_PrNS_US_W_004 = Jamuna Bridge West & Proposed Side Near Shore
- U SW_SP3_ExNS_DS_E_005 = Jamuna Bridge East & Existing Side Near Shore
- V SW_SP3_ExFS_DS_E_006 = Jamuna Bridge East & Existing Side Far Shore
- W SW_SP3_PrFS_US_E_007 = Jamuna Bridge East & Proposed Side Far Shore
- X SW_SP3_PrNS_US_E_008 = Jamuna Bridge East & Proposed Side Near Shore

Figure 4-6 Surface Water Sample Collection Map

4.6 Ground Water Quality

The results, sampling locations are given in the rest of the paragraphs. Ground Water samples were collected from the project locations in the month of June 2017. The parameters measured were pH, Total dissolved solids (TDS), Chloride (Cl^-), Arsenic (As), Iron (Fe), Manganese (Mn), Sulphate (SO_4), Total Coliform (TC) and Faecal Coliform (FC). All samples were collected in plastic sampling bottles, kept in an ice cooler, after necessary stabilization and analysed within stipulated time period at the Laboratory of BUET. The results are given in the Table 4-12 and the sampling locations were given in the Figure 4-7. The raw data is given in the appendix-5

Table 4-12 Result of Ground Water

Parameters	Unit	A	B	C	D	E	F	Standards for drinking water*	WHO Guideline Value, 2004
		GW	GW	GW	GW	GW	GW		
pH	-	7.6	7.8	8.0	7.3	7.5	7.3	6.5-8.5	6.5-8.5
Total Dissolved Solids (TDS)	mg/L	0.35	0.25	0.02	0.31	0.17	0.30	1000	1000
Chloride (Cl-)	mg/L	83	60	86	47	14	32	150-600	250
Arsenic (As)	mg/L	0.007	<MDL	0.005	0.012	0.018	0.084	0.05	0.01
Iron (Fe)	mg/L	0.02	0.02	0.02	1.8	2	2.72	0.3-1.0	0.3

Parameters	Unit	A	B	C	D	E	F	Standards for drinking water*	WHO Guideline Value, 2004
		GW	GW	GW	GW	GW	GW		
Manganese (Mn)	mg/L	0.667	0.495	0.678	1.42	1.33	2.4	0.1	0.4a, 0.1b
Sulphate (SO_4)	mg/L	40.8	41.3	41.3	15.3	<MDL	<MDL	400	250
Total Coliform (TC)	CFU/100 ml	4	0	2	0	0	0	0	0
Faecal Coliform (FC)	CFU/100 ml	2	0	0	0	0	0	0	0

Source: JICA Survey Team, 2017

Note: A: GW_WS_100m_N: Bangabandhu Bridge West Railway Station, Sirajganj
B: GW_WS: Rehabilitation Jame Mosque, Sirajganj Sadar, Sirajganj
C: GW_WS_100m_S: Saidabad, Sirajganj Sadar, Sirajganj
D: GW_ES_100m_N: Bangabandhu Bridge East Railway Station, Bhuapur, Tangail
E: GW_ES_100m_S: Bollovbari Graveyard Kalihati, Tangail
F: GW_ES: Beyaramarua, Kalihati, Tangail

Figure 4-7 Ground Water Sample Collection Map

4.6.1 Results

pH: From the pH value of the groundwater samples it is observed that the values were within both the DoE and WHO standards.

Total dissolved solids (TDS): TDS values indicate the general nature of water quality and are usually related to conductivity. However, the values of TDS of all the samples collected throughout the project influence area are within both the DE and WHO standards.

Major Irons: The abundance of major irons largely depends upon the nature of rocks, climatic conditions and mobility. The ion distribution is also influenced by the infinite complex surface and subsurface physicochemical environments.

Arsenic (As): The concentrations of Arsenic in the study area WHO standards for two locations including Bangabandhu Bridge East Railway Station, Bhuapur, Tangail and Bollovbari Graveyard Kalihati, Tangail and for ground water the value exceeded the DOE standard

Chloride (Cl^-) concentrations in the study area are within both the standards. On the other hand, Iron (Fe) content of groundwater samples along the project influenced area exceeded both the WHO standard and DOE standard. Manganese (Mn) content of groundwater samples exceeded both the DOE and WHO standards.

Total Coliform (TC): The value of total coliform was within both the standards for all the locations except for Bangabandhu Bridge West Railway Station, Sirajganj Sadar, Sirajganj and Saidabad, Sirajganj Sadar, Sirajganj.

Faecal Coliform (FC): The value of total coliform was within both the standards for all the locations except for Bangabandhu Bridge West Railway Station, Sirajganj Sadar, Sirajganj.

4.6.2 Discussion

Iron

The rural ground water contains iron is a common problem. Iron dissolved in ground water is in reduced form of Iron II. This form of Iron is soluble and normally does not cause any problems by itself. The iron is degraded by bacterial action and gets converted to Iron II. Biological Iron removal is done by using water filters.

Arsenic

Abundance of iron and manganese minerals triggers higher concentration of Arsenic. Arsenic concentration in ground water can be attributed to the presence of calcareous and calc-silicate rocks. Sulphide minerals like arsenopyrite and pyrites which gives higher levels of Arsenic contamination in the ground water. The main anthropogenic activity like the usage of arsenic fungicides usage in the agricultural practices will increase the arsenic in the

ground water. Arsenic rich water occurs mainly in the shallow ground water, deep tube wells more than 150 meters deep would curtail the arsenic levels to some extent.

Health Effects of Arsenic

The presence of Arsenic deposition is prevalent in project area. There is presence of iron, manganese and arsenic is found in the entire Bengal stretch. The health effects of arsenic are discussed in the following paragraphs.

The health effects of arsenic in drinking-water include skin cancer, internal cancers (lung, bladder, and kidney) and peripheral vascular disease. Evidence of chronic arsenic poisoning includes melanosis (abnormal black-brown pigmentation of the skin), hyperkeratosis (thickening of the soles of the feet), gangrene and skin and bladder cancer. Arsenic toxicity may not be apparent for some time but the time to appearance of symptoms and the severity of effects will depend on the concentration in the drinking-water, other sources of exposure, dietary habits that may increase arsenic concentrations in staple dishes and a variety of other possible nutritional factors.

Arsenic accumulates in sedimentary environments by being co-precipitated with hydrous iron oxides or as sulphide minerals in anaerobic environments. It is mobilized in the environment through a combination of natural processes such as weathering reactions, biological activity and igneous activity as well as through a range of anthropogenic activities. Of the various routes of exposure to arsenic in the environment, drinking-water probably poses the greatest threat to human health. High concentrations of arsenic in groundwater also occur in regions where oxidation of sulphide minerals (such as arsenopyrite) has occurred. Best correlations between the concentration of arsenic in sediments and other elements are with iron. Arsenic shows a high sensitivity to mobilization at the pH values typically found in groundwater (pH 6.5-8.5) and under both oxidizing and reducing conditions.

4.6.3 Difference between Feasibility and Detailed Design

The result of Feasibility Study is also shown in the Table 4-13 as below. Numerical values are larger or smaller than this study's ones depend on the item. Therefore the respective results cannot be compared each other as a rule because the respective survey periods are also different.

Table 4-13 Result of Ground Water in March 2013 and February 2014

Parameters	Unit	March 2013		February 2014		Standards for drinking water*	WHO Guideline Value, 2004
		A	B	A	B		
pH	-	6.54	6.62	7.25	6.87	6.5-8.5	6.5-8.5
Total Dissolved Solids (TDS)	mg/L	379	469	392	668	1000	1000
Chloride (Cl-)	mg/L	30	30	29	58	150-600	250
Arsenic (As)	mg/L	<0.001	0.002	<0.001	0.023	0.05	0.01
Iron (Fe)	mg/L	<0.01	0.02	0.15	0.02	0.3-1.0	0.3
Manganese (Mn)	mg/L	0.556	1.83	0.623	2.90	0.1	0.4a, 0.1b

Source: F/S for Construction of Railway Bridge parallel to the Existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the River Jamuna

Note: A: GW_SP3_Brg.W_001: Jamuna Bridge West Side Station
B: GW_SP3_Brg.E_002: Jamuna Bridge East Side Station

4.7 Soil Monitoring

According to the national classification, the proposed site is a part of the Brahmaputra-Jamuna River flood plain. In this region, the soil is predominantly sandy with fine silt. Soil investigation in the proposed site is to be conducted. This region comprises the belt unstable alluvial land along the Brahmaputra-Jamuna Rivers where land is constantly being formed and eroded by shifting river channels. It has an irregular relief of broad and narrow ridges and depressions. The area is occupied by sandy and silty alluvium rich in minerals with slightly alkaline in reaction. Six general soil types occupy the area; of which, only Non-calcareous Alluvium predominates. Organic matter status is low and fertility status low to medium. The samples will be collected and analysed for various parameters.

Soil samples were collected from various project locations during the month of May 2017. The investigation of chemical releases to soil usually requires collection of composite samples to characterise a large area or volume or near surface soil in likely contaminated areas. In this context, a composite soil sampling technique was followed to measure contaminants. The test results of the soil analysis of the project area were given down below. The methodology adopted for the soil sample analysis is discussed in the table given below gives methodology adopted and the results obtained in Table 4-14 and Table 4-15.

Table 4-14 Methodology for Soil Sample Analysis

Sl.No	Parameter	Methodology
1	Total Iron (Fe)	Atomic Absorption Spectrometer(AAS)
2	Total Manganese (Mn)	Atomic Absorption Spectrometer(AAS)
3	Total Copper (Cu)	Atomic Absorption Spectrometer(AAS)
4	Total Zinc (Zn)	Atomic Absorption Spectrometer(AAS)
5	Total Boron (B)	Atomic Absorption Spectrometer(AAS)
6	Total Molybdenum (Mo)	Atomic Absorption Spectrometer(AAS)
7	Total Nitrogen(N)	Kjeldahal Method
8	Total Phosphorus(P)	Acid Digestion and Yellow color Spectrophotometer (AAS)
9	Total Potassium(K)	Acid Digestion and Flame Photometer
10	Total Sulphur(S)	Turbidometric Method
11	Total Calcium(Ca)	Acid Digestion and Atomic Absorption Spectrophotometer
12	Total Magnesium(Mg)	Acid Digestion and AAS

Source: JICA Survey Team, 2017

Table 4-15 Soil Monitoring Results

Parameters	Unit	A	B	C	D	E	F	G
Total Iron (Fe)	%	3.10	3.44	3.22	2.25	2.01	2.86	3.45
Total Manganese (Mn)	ppm	627.7	595.2	540.2	450.2	437.7	495.2	622.7
Total Copper (Cu)	ppm	97.5	152.5	72.5	120.0	30.2	295.8	50.0
Total Zinc (Zn)	ppm	128.7	529.5	47.3	96.5	16.9	210.6	77.4
Total Boron (B)	ppm	0.725	0.556	0.520	0.625	0.338	0.475	0.488
Total Molybdenum (Mo)	ppm	22.9	18.0	17.5	21.9	17.2	14.3	17.0
Total Nitrogen (N)	%	0.061	0.093	0.074	0.017	0.026	0.089	0.057
Total Phosphorus (P)	%	0.059	0.053	0.063	0.069	0.068	0.073	0.067
Total Potassium (K)	%	1.13	1.15	0.89	0.83	0.89	0.79	0.88
Total Sulphur(S)	%	0.12	0.10	0.06	0.07	0.04	0.05	0.06
Total Calcium (Ca)	%	0.04	0.13	0.05	0.24	0.07	0.08	0.06
Total Magnesium (Mg)	%	0.62	0.74	0.65	0.86	0.68	0.90	0.84

Source: JICA Survey Team, 2017

Note:
A: Saidabad, Sirajganj Sadar, Sirajganj
B: Rehabilitation Area, Sirajganj Sadar, Sirajganj
C: Bangabandhu Eco-park, Sirajganj Sadar, Sirajganj
D: Nolchia, Bhuapur, Tangail
E: Jomunabali, Sirajganj Sadar, Sirajganj
F: Bollovbari, Kalihati, Tangail
G: Jokar Char, Kalihati, Tangail

4.7.1 Results

Total Iron (Fe): From the test results, the Iron (Fe) concentration in the project influenced areas ranged from 2.01% to 3.45%. The minimum value was in Jomunabali, Sirajganj Sadar, Sirajganj and maximum value was in Jokar Char, Kalihati, Tangail.

Total Manganese (Mn): From the test results, the Mn concentration in the project influenced areas ranged from 437.7ppm to 627.7ppm. The minimum value was in Jomunabali, Sirajganj Sadar, Sirajganj) and maximum value was in Saidabad, Sirajganj Sadar, Sirajganj.

Total Copper (Cu): From the test results, the Cu concentration in the project influenced areas ranged from 30.2ppm to 295.8ppm. The minimum value was in Jomunabali, Sirajganj Sadar, Sirajganj and maximum value was in Bollovbari, Kalihati, Tangail.

Total Zinc (Zn): From the test results, Lowest Zinc (Zn) concentration was found to be 16.9ppm in Jomunabali, Sirajganj Sadar, Sirajganj and highest Zinc (Zn) concentration was 529.5ppm in SS_WS_SS (Rehabilitation Area, Sirajganj Sadar, Sirajganj).

Total Boron (B): From the test results, Boron (B) concentration ranges from 0.338ppm to 0.725ppm. The minimum value was in Jomunabali, Sirajganj Sadar, Sirajganj and maximum value was in Saidabad, Sirajganj Sadar, Sirajganj.

Total Molybdenum (Mo): From the test results, Molybdenum (Mo) concentration ranges from 14.3ppm to 22.9ppm. The minimum value was in Bollovbari, Kalihati, Tangail and maximum value was in Saidabad, Sirajganj Sadar, Sirajganj.

Total Nitrogen (N): From the test results, Nitrogen concentration ranged from 0.017% to 0.093%. The minimum value was in Nolchia, Bhuapur, Tangail and maximum value was in Rehabilitation Area, Sirajganj Sadar, Sirajganj.

Total Phosphorus (P): From the test results, Phosphorus concentration ranges from 0.053% to 0.073%. The minimum value was in Rehabilitation Area, Sirajganj Sadar, Sirajganj District) and maximum value was in Bollovbari, Kalihati, Tangail.

Total Potassium (K): From the test results, Potassium concentration ranges from 0.79% to 1.15%. The minimum value was in Bollovbari, Kalihati, Tangail and maximum value was in Rehabilitation Area, Sirajganj Sadar, Sirajganj District.

Total Sulphur(S): From the test results, Sulphur concentration ranges from 0.04% to 0.12%. The minimum value was in Jomunabali, Sirajganj Sadar, Sirajganj and maximum value was in Saidabad, Sirajganj Sadar, Sirajganj District.

Total Calcium (Ca): From the test results, Calcium concentration ranges from 0.04% to 0.24%. The minimum value was in Saidabad, Sirajganj Sadar, Sirajganj and maximum value was in Nolchia, Bhuapur, Tangail.

Figure 4-8 Soil Sample Collection Map

During the feasibility stage there was no soil monitoring conducted for the Environmental Monitoring study. See the sampling collection map in Figure 4-8 and the raw data given in appendix.7.

4.8 River Sediments Analysis

The Riverbed sediment samples were collected from all the project influenced locations at June, 2017. Test results and discussion of sediment analysis of project area is given in below tables which depicts the results sediment samples.

Total Organic Matter: From the test results**,** Total Organic Matter concentration in the project area ranged from 0.23% to 0.78%. The minimum value was in 500m far shore from the west side of the proposed bridge and 500m far shore from the east side of the proposed bridge and maximum value was in 500m upstream from the middle of the proposed bridge.

Total Phosphorus as Phosphate: From the test results**,** Total Phosphorus concentration in those areas ranged from 0.052% to 0.086%. The minimum value was in 500m far shore from the west side of the proposed bridge and 500m downstream from the middle of the proposed bridge and maximum value was in West side of the proposed bridge location.

Nitrate (NO_3^-): As per the test analysis lowest Nitrate (NO_3^-) concentration was in 500m far shore from the east side of the proposed bridge which is 2.87ppm and highest Nitrate NO_3^-

concentration was in 500m upstream from the middle of the proposed bridge which is 21.23ppm.

Ammonium (NH_4^+): From the test results**,** Ammonium (NH_4^+) concentration ranges from 18.91ppm to 43.28ppm**.** The minimum value was in 500m downstream from the middle of the proposed bridge and maximum value was in 500m upstream from the middle of the proposed bridge.

Sulphate (SO_4^-): From the test results**,** Sulphate (SO_4^-) concentration ranges from 27.63ppm to 56.88ppm. The minimum value was in 500m far shore from the west side of the proposed bridge and maximum value was in 500m upstream from the middle of the proposed bridge.

Total Aluminium (Al): From the test results**,** Aluminium (Al) concentration ranges from 3.07% to 6.03%. The minimum value was in 500m far shore from the east side of the proposed bridge and maximum value was in West side of the proposed bridge location.

Arsenic (As): From the test results**,** Arsenic (As) concentration ranges from 1.081 to 3.296. The minimum value was in 500m far shore from the east side of the proposed bridge and maximum value was in 500m upstream from the middle of the proposed bridge.

Cadmium (Cd): Cadmium (Cd) concentration is below detection limit in all the locations except for East side of the proposed bridge location which is 0.251.

Calcium (Ca): From the test results, lowest Calcium (Ca) concentration was found to be 816.3 in 500m far shore from the west side of the proposed bridge and highest Calcium (Ca) concentration was 3037.5 in 500m upstream from the middle of the proposed bridge.

Cobalt (Co): Lowest Cobalt (Co) concentration was found to be 2.81 in 500m far shore from the east side of the proposed bridge and highest Cobalt (Co) concentration was 11.83 in 500m upstream from the middle of the proposed bridge.
The results and monitoring locations are given in the Table 4-16 and Table 4-17 and the sampling locations are given in the Figure 4-9.

Table 4-16 Methodology Adopted

Sl.No	Parameter	Methodology Adopted
1	Total Organic Matter	Wet Oxidation Method
2	Total Phosphorus as Phosphate	Acid Digestion and Yellow color Spectrophotometric Method
3	Nitrate (NO_3^-)	Micro Kjeldahal Distillation Method
4	Ammonium (NH_4^+)	Micro Kjeldahal Distillation Method
5	Sulphate (SO_4^-)	Turbidometric Method
6	Total Aluminium(Al)	Na_2CO_3 Fusion and Atomic Absorption Spectrophotometer (AAS) Method
7	Arsenic (As)	Acid Digestion and Yellow color Spectrophotometer (AAS)
8	Cadmium (Cd)	Acid Digestion and Flame Photometer
9	Calcium (Ca)	Acid Digestion and Atomic Absorption Spectrophotometer (AAS) Method
10	Cobalt (Co)	Turbidometric Method

Source: JICA Survey Team, 2017

Table 4-17 River Sediment Analysis

Parameters	Unit	RBM_PB_ ES_NS	RBM_PB_ 500m_US	RBM_PB_ FS_ES	RBM_PB_ WS_NS	RBM_PB_ FS_WS	RBM_PB_ 500m_DS
Total Organic Matter	%	0.41	0.78	0.23	0.45	0.23	0.24
Total Phosphorus as Phosphate	%	0.070	0.072	0.079	0.086	0.052	0.052
Nitrate (NO_3^-)	ppm	13.74	21.23	2.87	18.29	17.51	12.61
Ammonium (NH_4^+)	ppm	30.53	43.28	40.12	41.56	32.09	18.91
Sulphate (SO_4^-)	ppm	41.22	56.88	30.26	34.34	27.63	28.64
Total Aluminium(Al)	%	4.22	4.79	3.07	6.03	4.27	3.37
Arsenic (As)		2.574	3.296	1.081	1.949	1.094	1.221
Cadmium (Cd)		0.251	*BDL	BDL	BDL	BDL	BDL
Calcium (Ca)		2545.1	3037.5	1525.2	1837.5	816.3	910.1
Cobalt (Co)		10.78	11.83	2.81	7.09	3.58	3.04
Chromium (Cr)		21.8	14.5	4.8	9.1	5.5	5.0

Source: JICA Survey Team, 2017

Note: RBM_PB_ES_NS = East side of the proposed bridge location;
RBM_PB_500m_US = 500m upstream from the middle of the proposed bridge;
RBM_PB_FS_ES = 500m far shore from the east side of the proposed bridge;
RBM_PB_WS_NS = West side of the proposed bridge location;
RBM_PB_FS_WS = 500m far shore from the west side of the proposed bridge;
RBM_PB_500m_DS = 500m downstream from the middle of the proposed bridge.

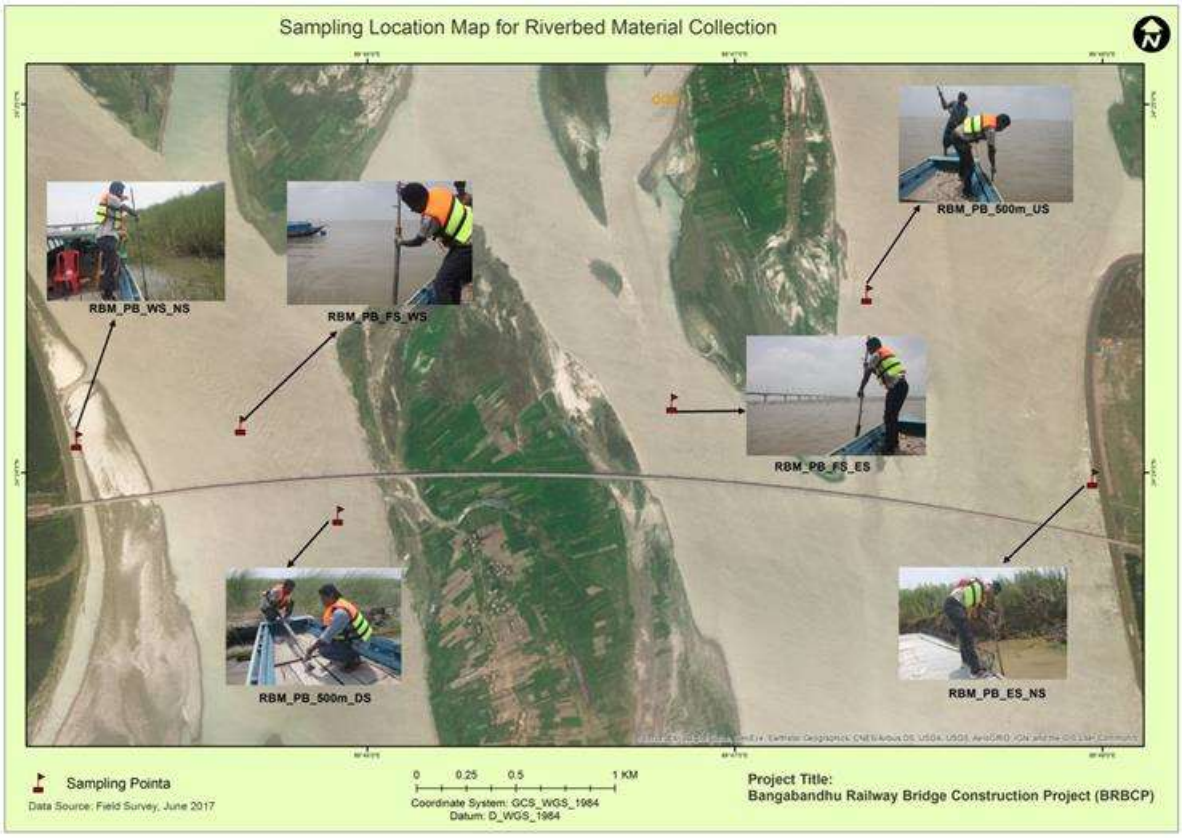


Figure 4-9 Sediment Sample Collection Map

4.8.1 Geology & Topography

The whole country consists of mainly low and flat land, except for the hilly regions in the northeast and southeast. Geology of Bangladesh is generally dominated by poorly consolidated sediments deposit over the past 10,000 to 15,000 years (Holocene age). The geology of the study area consists of Quaternary deltaic sediments, which have been strongly influenced by tectonic movements on deep-seated faults. Bangladesh is a part of the Bengal Basin, one of the largest in the world. Bangladesh occupies a major part of the Bengal delta and it is one of the largest deltas in the World. Bangla Basin consists of quaternary sediments deposited by the Ganges, the Brahmaputra, and the Meghna rivers, and their numerous tributaries and distributaries. The project area falls in the seismic Zone-II. This is major affecting zone. The seismic co-efficient or load factor of this zone is 0.05 g. The texture of soils of the project area is silt loam to sandy loam. The proposed Railway Bridge site is located in the eastern flank of India Platform, in the deep basinal part of the Bengal Basin. The basin is bounded by the Dauki Fault in the North and Tripura folded belt of Himalayas, with continuing tectonic movement causing severe earth quakes in the region.

Bangladesh occupies a major part of the Bengal delta, one of the largest deltas in the world. The geological evolution of Bangladesh is related to the uplift of the Himalayan Mountains and outbuilding of deltaic landmass by major river systems in this delta. Thus, the geology of Bangladesh is largely characterized by the rapid subsidence and filling of the Bengal Basin in which a huge thickness of deltaic sediments were deposited as a mega-delta out built in the past which then progressed towards the south of the country over time. The delta building still continues with material being added to the present Bay of Bengal.

Bangladesh is divided into two major tectonic units, the stable Precambrian Platform in the North West and the geosynclinals Basin in the South East. The project area occurs within a geosynclinals basin which is characterized by a vast thickness of tertiary aged, classical sedimentary rocks, mostly sand stone and shale. The thickness of sediments in the basin is a result of a tectonic mobility or instability of the areas causing rapid subsidence and sedimentation over a relatively short span. Of geological time the geosynclinals basin which underlines Bangladesh is sub divided into two parts, that is fold belt in the east and a fore deep to the west.

The proposed Railway Bridge site is located on the eastern flank of Indian Platform, in the deep basinal part of the Bengal basin. The basin is bounded by the Dauki Fault in the North and Tripura folded belt. Both features are part of the orogenic belt of Himalayas with continuing tectonic movement causing severe earth quakes.

The elevation on the approach of rail embankment ranges from 21.24 m to 21.86 m on the eastern side and 21.24 to 21.85 m on the west side of the existing bridge. The elevation on the both sides of the rail embankment varies from half of a meter to one meter above the mean sea level. However, the elevation of the ground level varies 2 msl (mean sea level) on either side of Jamuna River. The elevation at the nearby settlement 12.34 meters on east side and 10.37 meters on the west side of the bridge. The elevation at the East Railway station is between 15.59 meters and West railway station is between 16.03 and 16.12 meters. The elevation of the entire project area is relatively flat. The topographic surveys are in progress at the proposed site and may be completed by the end of July 2017.

The elevation of the entire project area is relatively flat. However due to the construction of the existing bridge and its abutments the elevation varies from 8,5 m to 9.5 m on the eastern

side of the Bangabandhu Bridge and 11.5 to 12.0 m on the western side of the bridge. At present topographic surveys are being conducted at the site.

4.8.2 Seismicity

Bangladesh is an earthquake prone country. It is one of the largest deltas of the World situated at the confluence with the Bay of Bengal of Padma-Meghna-Jamuna River system. The country, being located closed to the plate margins of India and Eurasian Plates, is susceptible to earth quakes. Bangladesh is sounded by regions of high seismicity with numerous active faults, including the Dauki fault system. The impact of the earth quake in Bangladesh can lead to many hazards, including the ground shaking, liquefaction, fire following earth quake, ground subsidence, tsunamis, seches, and landslides. Primarily due to its low-lying deltaic geography, the main hazard from earthquake in Bangladesh is ground shaking. In general, many parts of Bangladesh, in particular the north and the east, the seismic hazard is considered to be high. However, occurrences of earthquake both inside and outside of the country and around major cities indicate that earthquake hazard exists for the country in general and the cities in particular. The northern and eastern regions in particular are known to be subjected to earthquakes of magnitudes greater than 5 on the Richter scale. Techtronic frame work of Bangladesh and adjoining areas indicate that Bangladesh is situated adjacent to the plate margins of India and Eurasia where devastating earthquake have occurred in the past and still now Bangladesh is seismically active. Various factors contributing to the earth quake risk in the urban and rural areas in Bangladesh have developed in a fast pace to accommodate the increasing population resulting in extensive construction of multistorey buildings without proper earth quake consideration.

As Bangladesh is located in a tectonically active much of the country including Chittagong, Sylhet, Dhaka, Rangpur, Bogra, Mymensingh, Comilla, Rajashahi are very much vulnerable to major earthquake disaster. Considering the geology and tectonics of Bangladesh and neighbourhood five tectonic blocks can be identified which have been active in producing damaging earthquakes. These are depicted in the below Table 4-18.

Table 4-18 Maximum Earthquake Magnitude in Different Tectonic Blocks

Tectonic Block	Earth Quake Magnitude (M)	Distance from the Bridge Site
Assam Fault Zone	8.0	120 km
Tripura Fault Zone	7.0	180 km
Sub-Dauki fault zone	7.3	120 km
Bogra fault zone	7.0	25-50 km

The country is located close to the boundary of two active plates (Indian Plate in the west and Eurasian plate in the east and north) the country has always been under the threat of earthquake that might be catastrophic. Bangladesh can be divided into three main earth quake zones as below Figure 4-10.

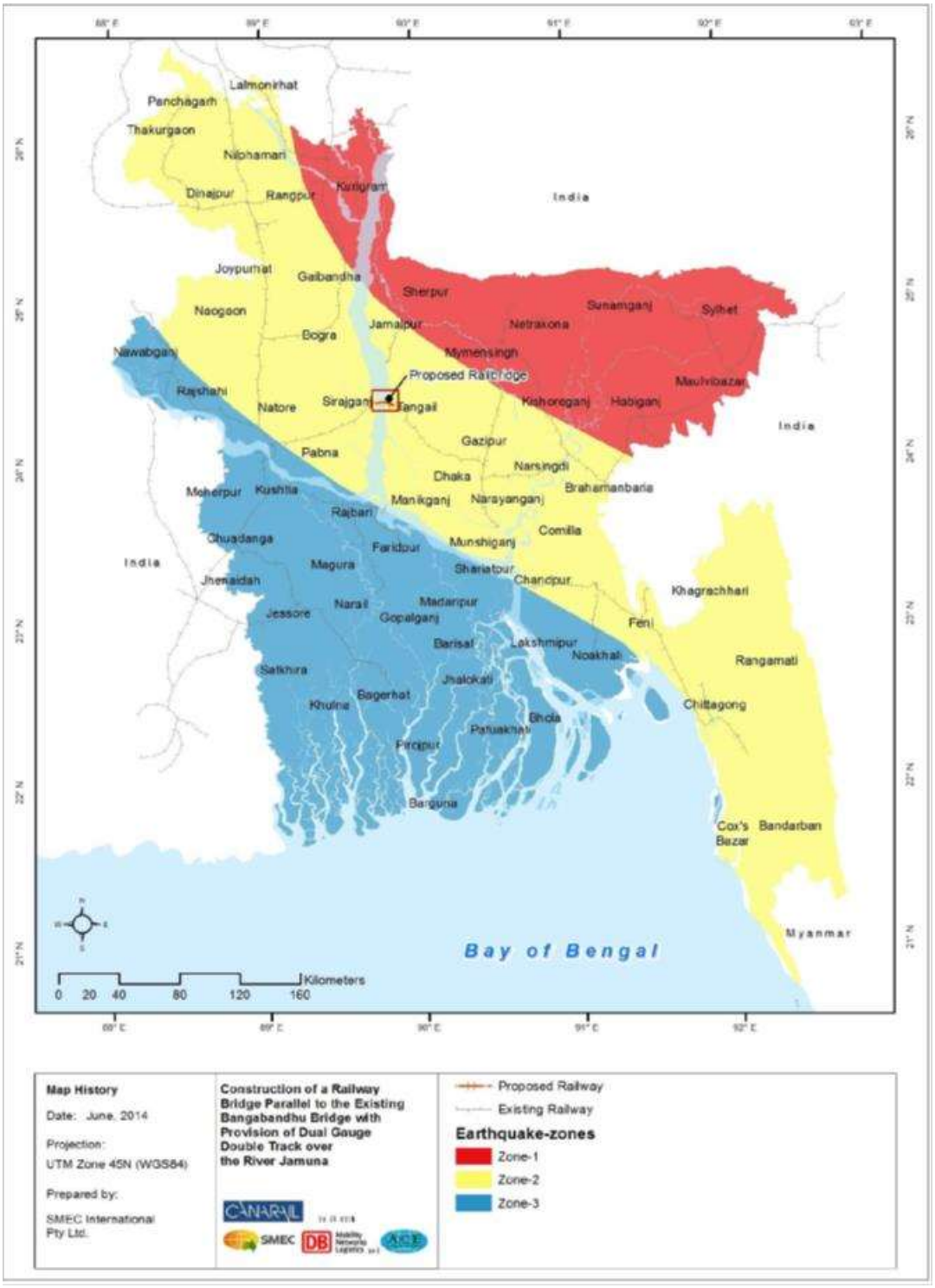


Figure 4-10 Seismic Zones of Bangladesh

1. Zone 1: Sylhet-Mymensingh is with the possible magnitude of 7 on Richter scale.
2. Zone-2: Chittagong-Comilla-Dhaka and Tangail are with the possible magnitude of 6 on Richter scale.
3. Zone-3: Rest of the country is with possible magnitude of 6 on the Richter scale.

The most severe zone is Zone 3, which includes the north and north-eastern parts of Bangladesh. The bridge site is located near the boundary between Zone 2 (Z=0.15) and Zone 3 (Z=0.25), where the zone coefficient Z represents the PGA value for that zone. The bridge design is thus consistent with the seismic zoning map of the country.

4.8.3 Land Use

The land use with 100 meters on either side of the proposed rail bridge area comprise of settlements, worship places, graveyards, commercial areas, construction yards, Eco park. The project passes through the Jamuna River.

4.8.4 Climate

Bangladesh, a small country with generally low-lying area, is located at the central part within the Asiatic monsoon region where the climate is tropical. Bangladesh has a tropical monsoon climate characterized by wide seasonal variations in rainfall, high temperatures and high humidity. The country of Bangladesh is mainly agricultural. The agricultural activities of our country largely depend on climate. Its climate has moderate variation in terms of temperature, rainfall, relative humidity and wind speeds. There are two marked seasons in Bangladesh, the rainy season from May to October, during which more than 85% of the total annual rainfall occurs and the dry season from November to April. The beginning and ending of the rainy season vary from year to year. Heavy rains may commence anywhere between mid-April and early June and may end anywhere between the end of September and mid-November. Climatic conditions of the study area were collected from the environmental studies carried out in this region. Rainfall, temperature, relative humidity and wind speed are described in the following paragraphs.

4.8.5 Temperature

January is the coldest month in Bangladesh. However, the cold winter air that moves into the country from the north-western part of India loses much of its intensity by the time it reaches the north-western corner of the country. Average temperatures in January vary from about 17'C in the north-western and northeaster parts to 20°-21°C in the coastal areas. In late December and early January, minimum temperature in the extreme north-western and north-eastern parts of the country reaches within 4 to 7 degrees of freezing point. As the winter

season progresses into the pre-monsoon hot season, temperature rises, reaching the maximum in April, which is the middle of the pre-monsoon hot season. Average temperatures in April vary from about 27°C in the northeast to 30°C in the extreme west central part of the country. After April, temperature decreases slightly during the summer months, which coincides with the rainy season. Widespread cloud covers causes dampening of temperature during the latter part of the pre-monsoon season. Average temperatures in July vary from about 27°C in the southeast to 29°C in the north-western part of the country.

4.8.6 Relative Humidity

March and April are the least humid months over most of the western part of the country. The lowest average relative humidity (57%) has been recorded in Dinajpur in the month of March. The least humid months in the eastern areas are January to March. Here the lowest monthly average of 58.5% has been recorded. The relative humidity is everywhere over 80% during June through September. The average relative humidity for the whole year ranges from 78.1% to 70.5%. The monitoring period the relative humidity ranged from 66% to 99%.

4.8.7 Rain fall

The single most dominant element of the climate of Bangladesh is the rainfall. Because of the country's location in the tropical monsoon region, the amount of rainfall is very high. However, there is a distinct seasonal pattern in the annual cycle of rainfall, which is much more pronounced than the annual cycle of temperature. The winter season is very dry, and accounts for only 2%-4% of the total annual rainfall. As the winter season progresses into the pre-monsoon hot season, rainfall increases due to intense surface heat and the influx of moisture from the Bay of Bengal. Rainfall during this season accounts for 10%-25% of the total annual rainfall which is caused by the thunderstorms. The amount of rainfall in this season varies from about 20 cm in the west central part to slightly over 80 cm in the northeast. Rainfall during the rainy season is caused by the tropical depressions that enter the country from the Bay of Bengal. These account for 70% of the annual total in the eastern part, 80% in the southwest, and slightly over 85% in the north-western part of Bangladesh. The amount of rainfall in this season varies from 100 cm in the west central part to over 200 cm in the south and northeast. Average rainy days during the season vary from 60 in the west-central part to 95 days in the south eastern and over 100 days in the north-eastern part. Geographic distribution of annual rainfall shows a variation from 150 cm in the west-central part of the country to more than 400 cm in the north-eastern and south-eastern parts.

Rainfall impact (from both the regular monsoon rains and torrential rains), the heaviest rainfall occurs in July and ranges from 350 mm to over 875 mm accordingly (Bangladesh Meteorological Department 2015). The main features of the Rainfall Impact are:

- Surface runoff caused by the rainfall results in sheet erosion
- Flooding (monsoon periodic floods and those created by storms/ cyclones.
- Monsoon rainfall causes flooding which gives rise to serious washing of embankment top soil.
- The high flow rate of water makes the water current turbulent which is accompanied by vortex motion in rivers and estuaries often cause erosion of the banks.

4.8.8 Winds

These are characterised by seasonal reversals between summer and winter in Bangladesh. A stream of cold air flows eastward from this high pressure and enters the country through its northeast corner by changing its course clockwise, almost right-angle. This wind is the part of the winter monsoon circulation of the South Asian subcontinent. The prevailing wind direction in Bangladesh during the summer season has generally a southerly component (flowing from the south, southwest or southeast). However, wind directions during the transition seasons (in spring and autumn) are variable. Generally, winds are stronger in summer (8-16 km/hr) than in winter (3-6 km/hr). The meteorological data is given in the appendix attached

4.8.9 Tangail

Humidity levels are consistently very high during the monsoon season, and drop significantly for a relatively short period at the end of the dry season. Sunshine levels are low during the monsoon, but from November to May are consistently high. The five-yearly average of maximum relative humidity at Tangail is 85% and five-yearly average of minimum relative humidity is 68%. The five-yearly average relative humidity was recorded as 78%.

4.8.10 Sirajganj

The climate is tropical in Sirajganj. In winter, there is much less rainfall in Sirajganj than in summer. This climate is considered to be Aw according to the Köppen-Geiger climate classification. The average temperature in Sirajganj is 25.5 °C. The rainfall here averages 1789 mm. The precipitation varies 351 mm between the driest month and the wettest month. During the year, the average temperatures vary by 10.5 °C.

4.9 Benthos Sampling

Benthos samples were collected from the project area during June, 2017. The sampling location map is enclosed for information. The species identified are:

Bellamya sp.: Bellamya is a genus of freshwater snails with a gill and an operculum, aquatic gastropod molluscs in the family Viviparidae. *Bellamya* sp. as tolerant or accumulate indicator. *Bellamya* sp. can tolerate pollutants of sewage wastewater by their moderate population nos.

Tubifex: The species *Tubifex* belongs to the Family Tubificidae (Naididae). Aquatic oligochaete are known for their use as water quality indicators, especially in areas with urban and sewage effluent. In particular, the oligochaete species *Tubifex* is used as a water quality indicator because of its ability to tolerate low oxygen conditions, the presence of heavy metals, and other environmental conditions.

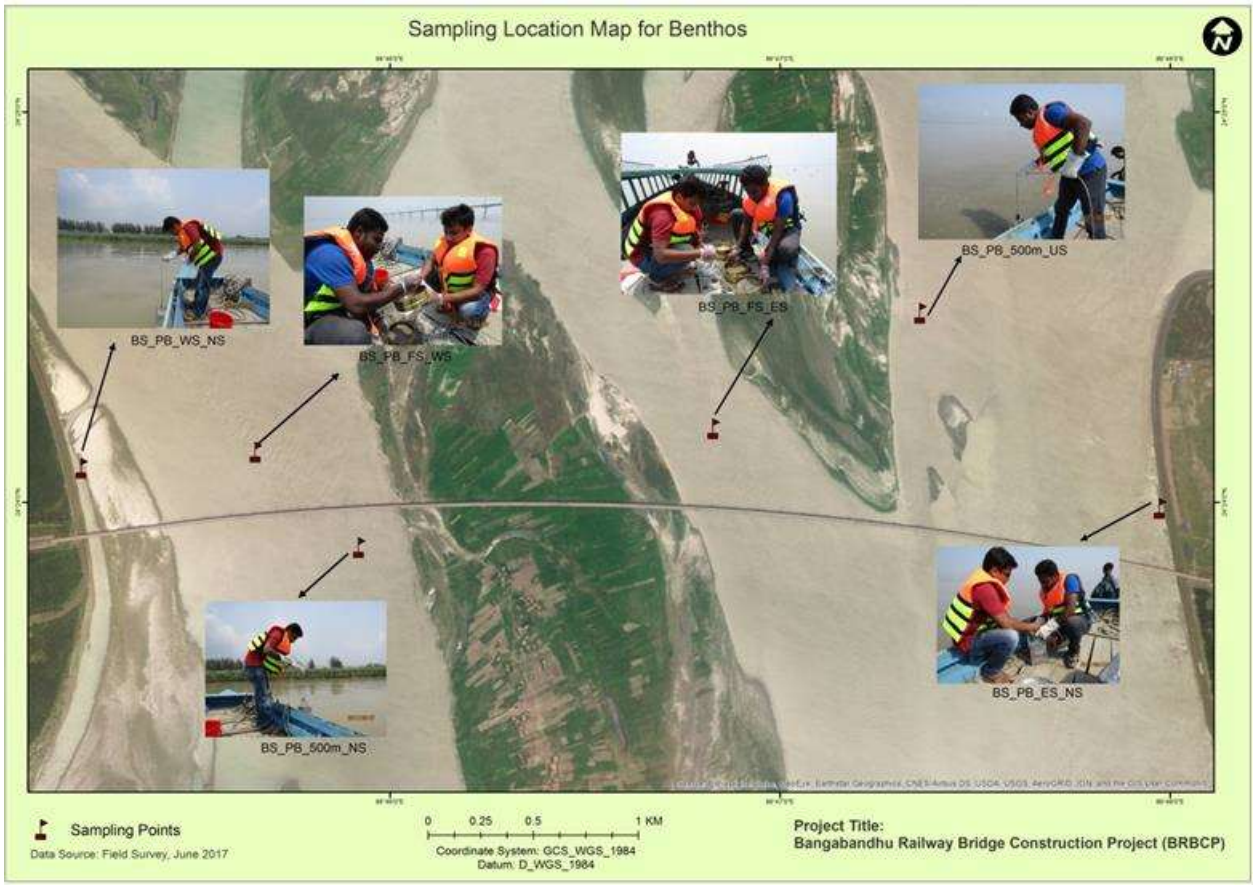
Polychaeta: *Polychaeta* are usually the most abundant taxon in benthic communities and have been most often utilized as indicator species of environmental conditions. *Polychaeta* may be used as sensitive monitors of water quality especially in terms of the effects of pollutants on life history characteristics. They may also be utilized as general indicators of community diversity but those species indicative of lower diversity may differ geographically and temporally. While sewage is often a mixture of high organic material and other pollutants such as heavy metals and pesticides, high organic situations associated with aquaculture facilities indicates that members of the *Capitella capitate* species complex and the dorvilleid genus Ophryotrocha are often dominant. Some species of P*olychaetes* are able to live in sediments very high in trace metal content and body burden of these metals often does not reflect sediment concentrations due to regulation by these species. Many species seem relatively resistant to organic contaminants and pesticides and the effects of these pollutants on life history characteristics of these species may provide a more sensitive assay method.

Brotia: Brotia is a genus of Southeast Asian freshwater snails, gastropod molluscs in the taxonomic family Pachychilidae. Species are found predominantly in fast flowing, well oxygenated rivers, occasionally also in lakes. They are gonochoristic, and viviparous, retaining developing eggs and young in special brood pouch. They depend on oxygen dissolved in the water for respiration; they are intolerant of sites where dissolved oxygen is

scarce, such as sites of organic pollution. The test results are given in the below Table 4-19 along with the Figure 4-11

Table 4-19 Result of Benthos Analysis of Project Influenced Area

No.	Locations	Results
01	East side of the proposed bridge location	*Bellamya* sp. (Mollusca, Gastropod)-04. Polychaeta (Annelida)- 02.
02	500m upstream from the middle of the proposed bridge	*Bellamya* sp. (Mollusca, Gastropod)-05 *Tubifex* (Annelida, Oligochaetes) - 02.
03	500m far shore from the east side of the proposed bridge	No benthic animal observed
04	West side of the proposed bridge location	*Brotia* sp. (Mollusca, Gastropod)- 01.
05	500m far shore from the west side of the proposed bridge	*Bellamya* sp. (Mollusca, Gastropod)-03.
06	500m downstream from the middle of the proposed bridge	*Bellamya* sp. (Mollusca, Gastropod)-03. Polychaeta (Annelida)- 03.



Source: JICA Survey Team, 2017

Figure 4-11 Benthos Sample Collection Map

4.10 Plankton Sampling

Plankton samples were collected from all the project influenced locations during the month of June, 2017. The following observations were recorded. They are:

Difflugia sp.: *Difflugia* are known to be widely unable to adhere to artificial surfaces, that is why they remain absent at sampling campaigns from the wet season, with higher discharge and flow velocities. *Difflugia* is found in PS_PB_500m_US (500m upstream from the middle of the proposed bridge) and PS_PB_FS_ES (500m far shore from the east side of the proposed bridge).

Asplanchna sp.: The genus *Asplanchna* feeds on even larger algae, protozoa, other rotifers (*Katella*) and small cladocera like Bosmina, catching them individually. These are found in PS_PB_WS_NS (West side of the proposed bridge location).

Horaella sp.: According to Sharma (2010) dominance of rotifers communities indicates the water quality deterioration and onset of eutrophication at alarming rate. *Horaella* was found in PS_PB_WS_NS (East side of the proposed bridge location).

Cypris sp.: It is sensitive to discharges, and may be used as an indicator species for good ecosystem health***.*** It is found in PS_PB_500m_US (500m upstream from the middle of the proposed bridge).

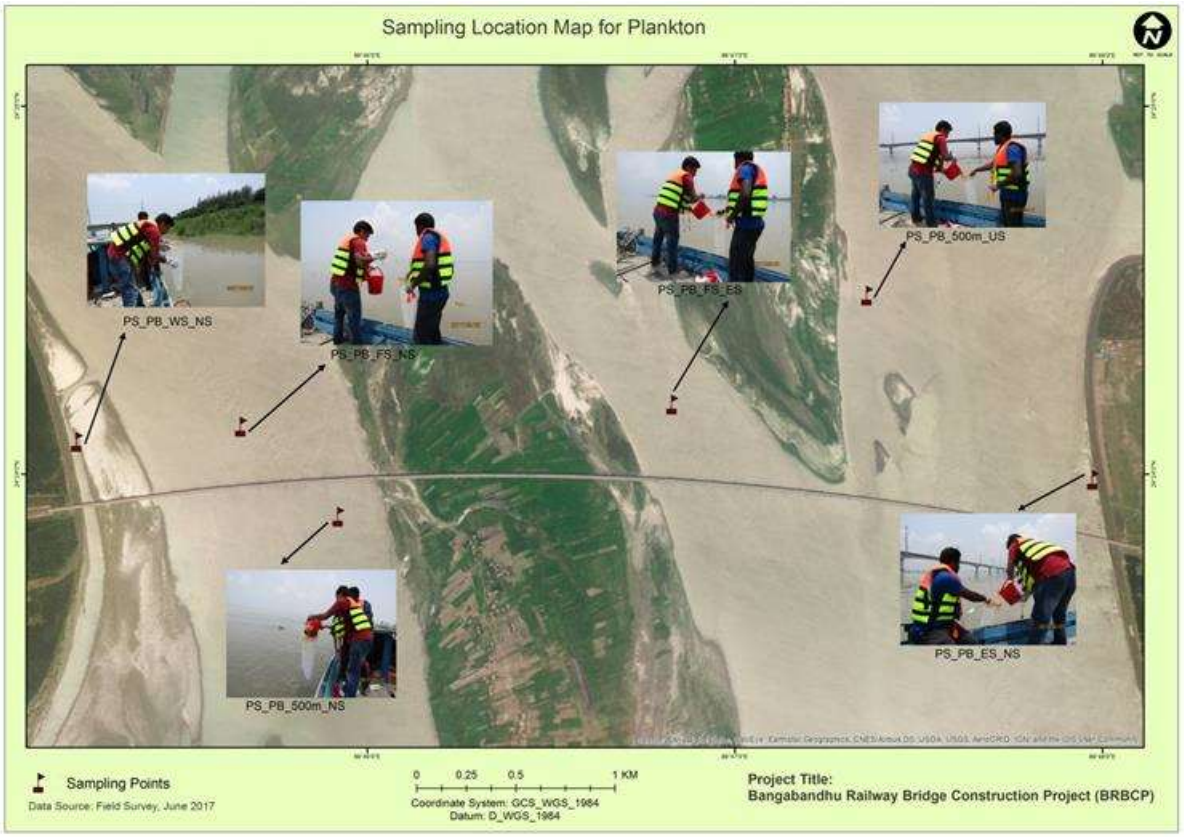
Algae: Planktonic forms are the producers in an aquatic ecosystem and also primary food base for nektons like fishes and other fishable organism. Algae act as a biological indicator of water pollution. Algae act as primary producers in many aquatic system and also important food source for other organism. Algae are important in an environmental impact study is as much they are extremely responsive to change in the environment and fluctuation that may occurs.

Bacillaria sp. is a diatom genus in the Bacillariaceae family. Benthic zone, marine and brackish/freshwater species, but is also commonly found in Plankton. *Bacillaria sp*. Present at Mid – high brackish water situation / alkaline pH, high cation and nutrient levels. In taxonomy, *Closteriopsis* is a genus of green algae, specifically of the *Chlorellacee*. *Coelastrum* is a genus of green algae in the Scenedesmaceae family. *Gyrosigm*a is a genus of diatom (Bacillariophyta) with about 30 species, which occur in fresh and salt water. *Gyrosigm*a mainly occurs in the sea. It is also frequently present in brackish water and in oligo- to eutrophic fresh water.

The results are shown in the table attached along with the plankton site sampling is shown in the Table 4-20 and the sampling location shown in Figure 4-12.

Table 4-20 Result of the Phyto Plankton

Group Name	Species Name	Sample Code					
		PS_PB_ 500m_DS	PS_PB_ 500m_US	PS_PB_ WS_NS	PS_PB_ FS_WS	PS_PB_ ES_NS	PS_PB_ FS_ES
Protozoa	*Difflugia sp.*		0.75				1.5
Rotifera	*Asplanchna sp.*			0.75			
	Horaella sp.			0.75			
Ostracoda	*Cypris sp.*		0.75				
Algae	*Bacillaria sp.*						0.75
	Closteriopsislongissima	0.75		0.75	0.75		
	Coelastrum sp.		0.75				
	Gyrosigma sp.			0.75			
	Unidentified			1.5			
TOTAL (Plankton/L)		**0.75**	**2.25**	**4.5**	**0.75**	**0.75**	**2.25**



Source: JICA Survey Team, 2017

Figure 4-12 Plankton Sample Collection Map

4.11 Archaeological and Historical Treasures

There are no archaeological and historical monuments surrounding proposed Bangabandhu Railway Bridge Project. Fresh excavations are required at Tangail and Sirajganj Districts. The projects will not come across any hindrance from the Archaeological and historical monuments. It is safe to construct the proposed railway bridge project.

4.12 Bangabandhu Eco Park

The Eco Park is a part of the North Bengal and located in the Bangabandhu Railway Bridge of Saydabad Upazila in the Sirajganj Sadar District. The park is controlled by Pabna Forest Range. The main objectives of setting this eco-park is preserving and development of almost extinct and rare species of flora, protection and development of existing flora and fauna, breeding and development of local species of floral species through intestine management, environment protection and socio-economic development of the local people, expansion of planned eco-tourism industry and creation of opportunity for study and research.

The park was established through a gazette notification 1998-1999. The Eco Park covers an area of 600 ha (coordinates). The park is transacted by a highway, a railway, a bridge, a power transmission corridor, rest house, forest beat office and other institute in the middle of the park. The dominant plant species are Shisu (*Dalbergia sisoo)* jam (*Eugenia jambolana*) mehoginy (*Switenia mahogoni*) babla (*Acacia arabica*) debadaru (*Polyalthia longifolia*) bandarlathy (*Cassia fistula*) kadam (*Anthocephalus chinensis*) wood apple (*Aegle marmelos*) coconut (*Cocos nucifera*) tetul (*Tamarindus indica*) amloki (*Emblica officinalis*) Neem tree (*Azadirachnta indica*) muktajuhri (*Acalypha indica*) arohor (*Cajanus cajan*) horitiki (*Terminalia chebula*) krishnachura (*Delonix regia*), nalkhagra (*Phragmites karka*). A total 125 species of timber, fruit bearing and medicinal plants are identified during the survey. Table 4-21 given below gives the list of species identified during the survey.

Table 4-21 List of floral species found in the Bangabandhu Eco Park.

Sl no.	Local Name	*Sc. Name*	Type
1	Kadam	*Anthocephalus chinensis*	Tree
2	Jhapi	*Abutilon sandwicense*	Herb
3	Babla	*Acacia arabica*	Tree
4	Akashmoni	*Acacia auriculiformis*	Tree
5	Muktajuhri	*Acalypha indica*	Tree
6	Kotbel	*Aegle marmelos*	Tree
7	Mushroom	*Agaricus bisporus*	Herb
8	Helencha	*Alternanthera philoxeroides*	Herb
9	Lal shak	*Amaranthus cruentus*	Herb
10	Kata note	*Amaranthus spinosus*	Herb
11	Broomsedge	*Andropogon virginicus*	Herb
12	Ata	*Annona reticulata*	Tree
13	Pithraj	*Aphanamixis polystachya*	Trees
14	Shupari	*Areca catechu*	Tree
15	Jackfruit	*Artocarpus heterophyllus*	Tree
16	Giant reed	*Arundo donax*	Herb
17	Kamrangga	*Averrhoa carambola*	Tree
18	Carpet grass	*Axonopus scoparius*	Herb
19	Nim	*Azadirachta indica*	Tree
20	Bash	*Bambusa nutans*	Tree
21	Pui shak	*Basella alba*	Herb

Sl no.	Local Name	Sc. Name	Type
22	Moss	*Bryophyte sp*	Herb
23	Arohor	*Cajanus cajan*	Herb
24	Gada Ful	*Calendula officinalis*	Herb
25	Akonddo (white)	*Calotropis gigantean*	Shrub
26	Jhal marich	*Capsicum sp.*	Shrub
27	Papaya	*Carica papaya*	Shrub
28	Bandarlathy	*Cassia fistula*	Climber
29	Morog ful	*Celosia argentea var. cristata*	Herb
30	Bet	*Chamaedorea elegans*	Shrub
31	Bathuwa shaak	*Chenopodium helenense*	Herb
32	Assam lata	*Chromolaena odorata*	Herb
33	Chora Kata	*Chrysopogon aciculatus*	Herb
34	Son	*Chrysopogon zizanioides*	Herb
35	Jambura	*Citrus maxima*	Tree
36	Lebu	*Citrus sp.*	Tree
37	Telakucha	*Coccinia grandis*	Herb
38	Pata Bahar	*Codiaeum variegatum*	Shrub
39	Kocu	*Colocasia esculenta*	Herb
40	Narikel	*Cocos nucifera*	Tree
41	Kanchira	*Commelina diffusa*	Herb
42	Pat (Jute)	*Corchorus capsularis*	Woody Herb
43	Bon morich	*Croton bonplandianu*	Shrub
44	Durva	*Cynodon dactylon*	Herb
45	Mutha ghas	*Cyprus rotundus*	Herb
46	Shisu	*Dalbergia sisoo*	Tree
47	Datura	*Datura metel*	Herb
48	Krishnachura	*Delonix regia*	Tree
49	Mete alu	*Dioscorea alata*	Herb
50	Jolpai	*Elaeocarpus floribundus*	Tree
51	Goosegrass	*Eleusine indica*	Herb
52	Jam	*Eugenia jambolana*	Tree
53	Eucalyptus	*Eucalyptus sp.*	Tree
54	Amloki	*Emblica officinalis*	Shrub
55	Dumur	*Ficus racemosa*	Tree
56	Asbattha	*Ficus religiosa*	Tree
57	Gamari	*Gmelina arborea*	Tree
58	Clock Vine	*Gnaphalium pensylvanicum*	Herb
59	Hatishur	*Heliotropium indicum*	Herb
60	Joba	*Hibiscus rosa-sinensis*	Tree
61	Kolmi shak	*Ipomoea aquatica*	Herb
62	Dhol kolmi	*Ipomoea carnea*	Shrubs
63	Belly ful	*Jasminum azoricum*	Shrub
64	Kocha	*Jatropha gossypifolia*	Tree
65	Jarul	*Lagerstroemia speciosa*	Tree
66	Kotbel	*Lannea coromandelica*	Tree
67	Raktodrone	*Leonurus sibiricus*	Herb
68	Shetrodon	*Leucas aspera*	Herb
69	Lichu	*Litchi chinensis*	Tree
70	Dhundul	*Luffa cylindrical*	Tree
71	Mango	*Mangifera indica*	Tree
72	Natal Grass	*Melinis repens*	Herb
73	Chinese Creeper	*Mikania micrantha*	Herb
74	Lazzabati	*Mimosa pudica*	Herb
75	Mnesithea	*Mnesithea annua*	
76	Sojina	*Moringa oleifera*	Tree
77	Kundali	*Murdannia nudiflora*	Herb
78	Nimbhut	*Murraya koenigii*	Tree
79	Kamini	*Murraya paniculata*	Shrub
80	Shuli ful	*Nyctanthes arbor-tristis*	Tree

Sl no.	Local Name	Sc. Name	Type
81	Amrul Shak	*Oxalis corniculata*	Herb
82	Amrul	*Oxalis corniculata*	Herb
83	Carrot Grass	*Parthenium hysterophorus*	Herb
84	Virginia creeper	*Parthenocissus quinquefolia*	Herb
85	Jhumkalata	*Passiflora incarnate*	Herb
86	Nalkhagra	*Phragmites karka*	Herb
87	Napier grass	*Pennisetum purpureum*	Herb
88	Bishkatali	*Persicaria lapathifolia*	Herb
89	Khajur	*Phoenix rupicola*	Tree
90	Debadaru	*Polyalthia longifolia*	Tree
91	Palms	*Phoenix rupicola*	Tree
92	Kar ghas	*Phyla nodiflora*	Herb
93	Amloki	*Phyllanthus indofischeri*	Tree
94	Nak ful	*Poaceae sp.*	Herb
95	Piyara	*Psidium guajava*	Tree
96	Pteris	*Pteris sp*	Herb
97	Bherenda	*Ricinus communis*	Herb
98	Curly Dock	*Rumex crispus*	Herb
99	Kash Ful	*Saccharum spontaneum*	Herb
100	Rain tree	*Samanea saman*	Tree
101	Lizard's tail	*Saururus cernuus*	Herb
102	Kasturi	*Saussurea costus*	Herb
103	Chakunda	*Senna obtusifolia*	Herbs
104	Dhaincha	*Sesbania bispinosa*	Herb
105	Svetbarela	*Sida rhombifolia*	Shrub
106	Phuti Begun	*Solanum americanum*	Herb
107	Tomato	*Solanum lycopersicum*	Herb
108	Begoon	*Solanum torvum*	Shrub
109	White-head Broom	*Spermacoce verticillata*	Herb
110	Bon palong	*Spinacia sp.*	Herb
111	Amra	*Spondias mombin*	Tree
112	Florida Betony	*Stachys floridana*	Herb
113	Mahogany	*Swietenia mahagoni*	Tree
114	Jam	*Syzygium cumini*	Tree
115	Jamrul	*Syzygium samarangense*	Tree
116	Golap Jam	*Syzygium travancoricum*	Tree
117	Tetul	*Tamarindus indica*	Tree
118	Arjun	*Terminalia arjuna*	Tree
119	Bahera	*Terminalia bellirica*	Tree
120	Indian almond/kath badam	*Terminalia catappa*	Tree
121	Haritaki	*Terminalia chebula*	Tree
122	White clover	*Trifolium repens*	Herb
123	Bon okra	*Urena lobata*	Shrub
124	Vitis	*Vitis sp.*	Herb
125	Elephant Ear	*Xanthosoma sagittifolium*	Herb

Source: JICA Survey Team, 2017

Bangabandhu Eco-park is not a critical habitat because of it is manmade or artificial habitat. It was established in 2004. There are no threatened plants species identified during biodiversity survey on this Eco-park. A few wildlife identified and recorded in the report are threatened. This recorded wildlife`s came from adjacent habitats. Wildlife's are movable or shifting in another habitat if they get disturb. So, there is no possibility to loss of any wildlife by project during construction.

Most of the faunal species recorded in Eco Park are actually introduced. Later a few birds and reptiles migrated to the region. A total of 6 species of amphibians, 52 species of birds, 11 species of reptiles and 16 species of mammals have been recorded. Species wise, bird were most common fauna found in the Eco Park. Table 4-22 depicts the wild life species found in Eco Park

Table 4-22 List of wildlife found in Bangabandhu Eco Park

Sc. Name	English name	Local name	Sighting status	Total Sightings (7 days)	IUCN BD status	Habitat
Class: Amphibia						
Hoplobatrachus tigerinus	Bull Frog	Shonabangl /Kolabang	VC	5	LR	OP, P, Dt
Euplyctis cyanophlyctis	Skipper Frog	Kotkoti Bang	C	-	LR	R, P, We
Rana alticola	Boulenger's Frog	Pana Bang	F	8	vu	Bh, P
Bufo melanostictus	Common Toad	Kuna Bang	VC	17	LR	Bh, Op, Hh, H, Dt
Microhyla ornate	Ornate Microhylid	China Bang	F	-	vu	Bh, H
M. rubra	Red Microhylid	Red china Bang	F	-	vu	Bh
Class: Reptilia						
Hemidactylus flaviviridis	House Gecko	Tiktiki	C	10	LR	Bh, Op, Hh, Tt
H. brookii	Spotted House Lizard	Tiktiki	C	20	LR	Bh, Op
H. bowringii	Bowring's House Lizard	Tiktiki	C	8	vu	Bh
Gekko gecko	Wall Gecko	Takkhak	C	10	vu	Bh, Op
Calotis versicolor	Common Garden Lizard	Rokto-chosa	VC	9	LR	Bh, Op
Mabuya carinata	Common Skink	Anjoni	VC	8	LR	Bh, Op
M. dissimilis	Stripped Skink	Anjoni	C	5	Vu	Bh, Op
Varanus bengalensis	Bengal Monitor	Gui Shap	FC	-	Vu	Bh, P
V. flavescens	Yellow Monitor	Holdy-gui	F	-	EN	Bh, Cl
Xenochorphis piscator	Cheekered Keel back snake	Dhora-shap	C	-	LR	P, C, Dt
Amphiesma stolatum	Stripped Keel back Snake	Dhora-shap	C	-	LR	Bh, Op
Class: Aves						
Ardeola grayii	Pond Heron	Kana Bok	C	8	LR	Op, Cl, R, P, Dt, We
Bubulcus ibis	Cattle Egret	Go Bok	FC	-	LR	R, P, C
Egretta intermedia	Intermediate Egret	Maijala Bok	FC	-	Vu	Op, R, P
E. garzetta	Little Egret	Jotti Bok	C	16	LR	R, C
Nycticorax nycticorax	Night Heron	Nishi Bok / Ratchora	F	-	EN	P, C, We
Milvus migrans	Pariah Kite	Bhuban-cheel	VC	-	Vu	Op, Hh, Tt
M. lineatus	Large Pariah Kite	Cheel	FC	-	LR	Op
Gyps bengalensis	White-backed Vulture	Shakun	FC	3	Vu	Op, Cl, Tt
Haliastur indus	Brahminy Kite	Lal-cheel	C	-	DD	Op, Cl
Gallicrex cinerea	Water-cock	Kora	FC	-	CR	R
Amaurornis phoenicurus	White-breasted Water Hen	Dahuk	C	-	Vu	R
Sterna aurantia	River Tern	Gang-cheet	FC	-	LR	R
S. albifrons	Little Tern	Khudey-gangcheel	F	-	LR	R
Streptopelia decaocto	Ring Dove	Raj-ghugu	C	17	EN	Bh, Tt
S. tranquebarica	Red Turtle Dove	Lal-ghugu	FC	-	EN	Tt
S. chinensis	Spotted Dove	Tila-ghugu	VC	-	LR	Op, Tt
Columba livia	Rock Pigeon	Jalali Kabutar	C	33	LR	Bh, Op, Hh, Cl, Tt
Psittacula krameri	Rose-ringed Parakeet	Tia	VC	6	EN	Op

Sc. Name	English name	Local name	Sighting status	Total Sightings (7 days)	IUCN BD status	Habitat
Clamator jacobinus	Pied Crested Cuckoo	Jhuti Kokil	C	-	EN	Op
Cuculus varius	Common Hawk-cuckoo	Choggelo	C	-	LR	Bh, Tt
Eudynamys scolopaceus	Koel	Kokil	C	-	LR	Tt
Centropus sinensis	Crow-pheasant	Kanakuwa	FC	-	LR	Op
Tyto alba	Barn Owl	Laxmi-pencha	FC	3	EN	Op
Athene brama	Spotted Owlet	Phuti-pencha	C	-	LR	Op, Tt
Apus affinis	House Swift	Ghorani-nakkati	C	20	DD	Bh, Op, Tt
Ceryle rudis	Lesser Pied Kingfisher	Pakra Mach Rangha	FC	-	LR	R, Dt
Alcedo atthis	Common Kingfisher	Choto Machranga	FC	-	LR	H, R, P
A. meninting	Blue-eard Kingfisher	Mach-rangha	FC	4	LR	P, C
Halcyon smyrnensis	White-breasted Kingfisher	Shet buk Machrangha	C	-	LR	R, P
Merops philippnus	Blue-tailed Bee -eater	Nilez suichora	FC	-	DD	Cl, Bh, Op,
M. orientalis	Green Bee-eater	Suichora	C	12	DD	Bh, Cl,
Upupa epops	Hoopoe	Hudhud-pakhi	C	-	DD	Op
Megalaima	Crimson breasted	Choto basanta	C	-	LR	Bh, Op
Haemacephala	Barbet	Bauri		-		
M. asiatica	Blue-throated Barbet	Nilgri-basanta Bauri	FC	-	LR	Op
Dendrocopos macei	Fulvous breasted pied wood pecker	Badami buk Kaththokra	C	-	LR	Tt
Dinopium benghalense	Lesser-golden back wood pecker	Sonali pit Kaththokra	FC	-	LR	Bh, Tt, H
Lanius schach	Black-headed Shrike	Kalashir-koshi	C	-	LR	Bh
Hirundo rustica	Common Swallow	Ababil Pakhi	C	-	LR	We
Oriolus oriolus	Golden Oriole	Sonali-halud Pakhi	C	-	DD	Bh, Tt
O. xanthornus	Black headed Oriole	Holdey pakhi	C	-	LR	Tt
Dicrurus macrocerus	Black Drongo	Fingey	VC	-	DD	Op, Cl
D. leucophaeus	Ashy Drongo	Dhusar- Fingey	F	-	LR	Op, Tt
D. aeneus	Bronzed Drongo	Choto-fingey	C	-	LR	Bh, Op
Sturnus malabaricus	Grey-headed Myna	Kath-shalik	C	-	LR	Bh, Op, Hh, Cl, Tt, H
S. contra	Pied Myna	Gobrey-shalik	VC	-	LR	Bh, Op, Hh, Cl, Tt, H
Acridotheres tristis	Common Myna	Bhat-shalik	VC	-	LR	Bh, Op, Cl
A. ginginianus	Bank Myna	Gang-shalik	C	-	DD	R, We
A. fuscus	Jungle Myna	Jhuti-shalik	C	-	LR	Bh, Tt
Cuculus varius	Common Hawk-cuckoo	Choggelo	C	-	LR	Bh, Tt
Eudynamys scolopaceus	Koel	Kokil	C	-	LR	Tt
Centropus sinensis	Crow-pheasant	Kanakuwa	FC	-	LR	Op
Class-Mammals						
Suncus murinus	Whit- tailed Shrew	Chika	C	-	LR	Op, Tt, H
Pteropus giganteus	Flying-fox	Badur	C	-	LR	Tt
Pipistrellus coromandra	Pipistrelle	Chamchika	FC	-	LR	B, Tt
Tylonycteris pachypus	Club-footed Bat	Chamchika	FC	-	LR	Bh
Canis aureus	Asiatic Jackal	Shial	FC	-	Vu	Bh, Op, H
Vulpes bengalensis	Bengal Fox	Khek-shial	FC	-	EN	H
Herpestes auropunctatus	Small Mongoose	Choto-beji	F	-	EN	Tt
Felis chaus	Jungle Cat	Ban-biral	FC	-	Vu	Bh, Dt
Lepus nigricollis	Black-naped Here	Khargosh	O	-	Vu	H
Rattus rattus	Black Rat	Indur	C	-	LR	Bh, Cl
R. norvegicus	Brown Rat	Dhamshi Indur	FC	-	DD	Bh, Cl
R. fulvescens	Short Tail Rat	Ghashua Indur	FC	-	DD	Cl
Mus musculus	House Rat	Nengti indur	FC	-	LR	Hh, H
M. booduga	Little Field Mouse	Metho-indur	FC	-	LR	Hh, H, p
Bandicota indica	Larges Bandicoot Rat	Indur	FC	-	LR	Op, Hh
Calloscirus pygerythrus	Irrawaddy Squirrel	Badami-katbirali	FC	-	Vu	Bh

Source: JICA Survey Team, 2017

RA = Relative Abundance, PD = Population Density, HU = Habitat Utilization, VC = Very Common, C = Common, F = Few, O = Occasional, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LR = Lower Risk, DD = Data Deficient, M = Migratory, R = Resident, Bh = Bush, Op = Open place, Hh = Human habitation, Cl = Cultivated land, Tt = Tall tree, H = Hole, R = River, P = Pond, C = Canal, Dt = Ditch, We = Water edge.

Every year, cyclones destroy the nesting and feeding grounds of wild animals. The requirement for firewood and timber for the large number of inhabitants in the study area is a big threat for reducing the park areas. Most of the local population are depending on thr forest resources. As a result, nesting trees are being destroyed day by day.

Regular patrolling by trained persons should control unwise and illegal exploitation of forest resources. Plantation of indigenous fruit trees with the help of the local population. Wild life Protection Law 1974 should be strictly implemented through the local enforcement agencies. There is presence of monoclonal plantation (casuarina) is quite common feature in the Bangabandhu Eco Park.

4.12.1 Hydrology

The Brahmaputra-Jamuna is the second largest river in Bangladesh and one of the largest rivers in the World, flowing through Tibet, India, China, and Bangladesh. Actually, Jamuna is the downstream course of the Brahmaputra. Presently the Brahmaputra continues southeast from Bahadurabad (Dewanganj Upazila of Jamalpur district) as the OLD BRAHMAPUTRA and the river between Bahadurabad and Aricha is the Jamuna, not Brahmaputra. From August to October due to the combined flows of those rivers and the Ganges. As a rule, the flow of the Brahmaputra-Jamuna is more erratic than that of the Ganges. The gradient of the Jamuna averages 1:11,850 which is slightly more than that of the Ganges. The Jamuna discharges a large volume of water and at the same time brings in huge amounts of SEDIMENTs. During the rainy season it brings down something like 1.2 million tons of sediment daily, and the annual silt runoff at Bahadurabad is estimated at 735 million tons. A considerable volume of river training work was done to keep the river within the bridge instead of a flood-width of 14 km at the bridge site. During the dry season, water levels can be as low as 0.52 m above sea level, while during the monsoon season water levels can be much higher causing the Jamuna to overflow onto the low-lying floodplains.

4.12.2 Drainage

The most obvious feature of the braided Brahmaputra/Jamuna River channel are the braid bars exposed during periods of low flow which are responsible for the multi-channel cross-section. Studies of the river have shown two distinct braid bar levels, those with elevations which are very close to bank top level and lower bars which are submerged during the

majority of high in-bank flows. The upper sand bars, known as either islands or attached chars, are relatively stable and vegetated and are often inhabited. They can be considered as parts of the flood plain contained within the braid belt, only submerged during over bank flows. The lower braid bars are unstable and are being continually re-worked by the river.

The Jamuna River stretches 240km along what is generally a North-South transect through the centre of Bangladesh. It is a braided river system complete with unstable sandbars and meta-stable islands (chars), the latter of which having surfaces almost at the floodplain level. In keeping with other braided rivers, the outer banks of the active braid corridor (herein referred to as the bank line), are generally not parallel, but may be divided into either narrow 'nodal' or wide 'island' segments, seemingly governed by the underlying geology. To enable meaningful description of the Jamuna River and its tributaries form the natural drainage system for the site. The recorded highest peak flow of Brahmaputra-Jamuna is 98,000 cusecs in 1988; the maximum velocity ranges from 3-4 m/sec with a depth of 21-22m. The average discharge of the river is about 20,000 cusecs with average annual silt load of 1,370-tons/sq. km. The average slope of the Jamuna is about 1:11,400; however, the local gradient differs quite considerably from the average picture. Jamuna River provides the major drainage outlet.

Data related to hydrology and drainage was collected to identify the elements of the hydrological cycle that are likely to have impacts on the project and the possible impacts that the project could have on the hydrological regime. Field assessments included a determination and verification of all the existing inflows into the drain, assessment of drainage issues, interviews with local community members, and discussions with stakeholders.

4.13 Fishes and Fishing Survey

There are about 55 species under 44 genera and 28 families were identified in Jamuna River. Among the families Cyprinidae contributes highest number (10 Species) of species and genus (7 genera) which was followed by Schilbeidae has 4 species under 4 different genera, Osphronemidae responsible for 3 species under 2 genera and maximum family has single species with single genus. Among the fish species found in Jamuna 10 species made the IUCN (Bangladesh) threatened list. These species are Labeo bata (English name: Bata, Local Name: Bata), Labeo calbasu (English name: Orange-fin labeo, Local Name: Calbaus), Botia Dario (English name: Bengal loach, Local Name: Rani/bou), Botia lohachata (English name: Y-loach, Local Name: Rani/bou), Channa marulius (English name: Great snakehead,

Local Name: Gozar), Mystus seenghala (English name: Giant river catfish, Local Name: Guizza ayre), Ompok bimaculatus (English name: Butter catfish, Local Name: Boili pabda), Ompok pabda (English name: Pabdah catfish, Local Name: Pabda), Mastacembelus armatus (English name: Zig-zag eel, Local Name: Sal baim), Notopterus chitala (English name: Clown knifefish, Local Name: Chital). The fish species identified during the fisheries survey in Jamuna River is presented in below Table 4-23.

Table 4-23 Fish species found in Jamuna River

Family	*Scientific Name*	English Name	Local Name
Ambassidae	1) *Parambassis ranga*	Indian glassy fish	Ranga chanda
	2) *Chanda nama*	Elongate glass-	Lomba chanda
	3) *Chanda lala*	Highfin glassy perchlet	Choto chanda
Aplocheilidae	4) *Aplocheilus panchax*	Blue panchax	Bechi
Badidae	5) *Badis badis*	Badis	Napte koi
Bagridae	6) *Rita rita*	Rita	Rita
	7) *Sperata seenghala*	Giant river-catfish	Ayre
	8) *Mystus vittatus*	Stripedd warf catfish	Tengra
	9) *Mystus aor*	Long whiskered catfish	Bagha Ayre
	10) *Mystus tengana*	Tengara catfish	Choto tengra
Belonidae	11) *Xenentodon cancila*	Freshwater garfish	Kakila
Channidae	12) *Channa marulius*	Great snakehead	Gozar
	13) *Channa punctate*	Spotted snakehead	Taki
	14) *Channa striata*	Snakehead murrel	Shol
	15) *Channa orientalis*	Walking snakehead	Cheng
Clariidae	16) *Clarias batrachus*	Walking catfish	Magur
Clupeidae	17) *Gudusia chapra*	Indian river shad	Chapila
	18) *Tenualosa ilisha*	Hilsa shad	Hilsa
Cobitidae	19) *Botia Dario*	Bengal loach	Bou mach
Cyprinidae	20) *Devario devario*	Sind danio	Banspata
	21) *Labeo bata*	Bata	Bata
	22) *Labeo calbasu*	Orange-fin labeo	Kalibaus
	23) *Amblypharyngodon mola*	Mola carplet	Mola
	24) *Puntius sarana*	Olive barb	Shorpunti
	25) *Barbonymus gonionotus*	Java barb	Rajputi
	26) *Rasbora daniconius*	Slender rasbora	Darkina
	27) *Salmostoma acinaces*	Silver razorbelly	Chela punti
	28) *Labeo dyocheilus*	-	Ghora mach
	29) *Cyprinus carpio*	Indian major carp	Catla
Dasyatidae	30) *Dasyatis zugei*	Pale-edged stingray	Sapla pata
Gobiidae	31) *Glossogobius giuris*	Tank goby	Bele
	32) *Pseudapocryptes elongates*	-	Chewa
Hemiramphidae	33) *Dermogenys pusilla*	Wrestling halfbeak	Ek thota
Heteropneustidae	34) *Heteropneustes fossilis*	Stinging catfish	Shing
Mastacembelidae	35) *Mastacembelus armatus*	Zig-zag eel	Baim
	36) *Macrognathus aculeatus*	Lesser spiny eel	Tara baim
Mugilidae	37) *Sicamugil cascasia*	Yellowtail mullet	Kachki
Nandidae	38) *Nandus nandus*	Gangetic leaffish	Nandil
Notopteridae	39) *Chitala chitala*	Clown knifefish	Chital
Osphronemidae	40) *Colisa fasciata*	Banded gourami	Khailsha
	41) *Pseudosphromenus cupanus*	Spiketail paradisefish	Koi
	42) *Colisa lalia*	Dwarf gourami	Lal kholisha

Family	Scientific Name	English Name	Local Name
Pangasiidae	43) *Pangasius pangasius*	Yellowtail catfish	Pangas
Schilbeidae	44) *Ailiichthys punctate*	Jamuna ailia	Kajuli
	45) *Pseudeutropius atherinoides*	Potasi	Batashi
	46) *Ailia coila*	Gangetic alia	Baspata
	47) *Clupisoma garua*	Garua bacha	Gang gaira
Sciaenidae	48) *Otolithoides pama*	Pama croaker	Poa
Siluridae	49) *Wallago attu*	Wallago	Boal
	50) *Ompok pabda*	Pabdah Catfish	Pabda
Sisoridae	51) *Bagarius bagarius*	Dwarf goonch	Baghair
Soleidae	52) *Brachirus pan*	Pan sole	Kathal pata
Synbranchidae	53) *Monopterus cuchia*	Cuchia	Kuchia
Syngnathidae	54) *Ichthyocampus carce*	Crocodile-tooth pipefish	Kumirer khil
Tetraodontidae	55) *Tetraodon fluviatilis*	Green puffer fish	Potka

Source: JICA Survey Team, 2017

4.13.1 Fishing Gears

Generally fishing gear is one kind of equipment which is used for harvesting of aquatic resources especially fish. The fisher man catch fish in the Jamuna River by using different types of gears like gill nets (Current jal, Nagini jal, and Chandi jal) Push net (Thela and Moiya jal), cast net, Hook and line etc. Species specificity of fishing net identified that current jal under the group of gill net was found to catch fish indiscriminately. Fisheries sector of Bangladesh is considered the most profitable business and socio-economic improvement sector, but there is lack of awareness. As per the survey the following fishing gears are used for fishing. Table 4-24 gives about details of fishing gears.

Table 4-24 Overview of the fishing gears found in Jamuna

Gear types	English name	Local name
Net	Cast net	Khepa jal
	Gill net	Koi jal
		Pungus jal
		Chapilla jal
	Entangling net	Current jal
	Lift net	Khora jal
		Dharma jal
	Drag net	Moiya jal
	Push net	Thela jal
	Purse net	Fansh jal/sunti jal
	Seine net	Ber jal
	Falling net	Doir jal
Traps		Kholson
		Charo
		Hancha
		Vair
		Doair
		Polo
		Chunga
		Chaloon
Wounding gears		Teta
		Ek-Kata

Gear types	English name	Local name
		Konch
		Shat phala
		Aro
Hooks and lines		Danti Borsi
		Down Borsi
		Wheel Borsi
		Basha Borsi
		Chhip Borsi
		Pata Boriss
Others		Dewatering
		Hand fishing
		Cloth fishing

Source: JICA Survey Team, 2017

4.13.2 Seasonal of Fishing

A fisherman cannot get enough fish around the year. It is almost evidence that rainy season (June-September) is most suitable time to get the fish species. In this the river fulfils of water and its breeding season of fishes, but in the dry season (November to March) it is relatively inverse conditions. In this season, the river is almost drying out. Fishermen identifies peak season as August – February when water stays deep and river current is present. April – June was identified as off-season. However, fishermen commented that there are variations of fish availability and fish catch over the year. In post monsoon, deep water fish are more available while in dry season smaller fish are common. On average, the amount of fish caught in peak season was at least 4 times higher than that of off season. For example, with *current jal* the average fish catch per day is around 5-7 kg during peak season, while during off season the catch comes down to 0.5 – 1.5 kg per day. With *barshi* the stats are 10-12 kg day^{-1} and 2-2.5 kg day^{-1} for peak season and off season, respectively.

The diversity of fish fauna is higher in the winter months (mainly November to February) than other months. The maximum numbers of fish species are also caught during this time. This is because, water depth reduced to minimum due to lack of sufficient rainfall this time allowing fishermen to employ their fishing gears more effectively. The lowest numbers of species are caught in the month of June; this is due to heavy rain during this time which makes fishing very difficult as water level reached its maximum. However, it is also found that, during post monsoon, although number of species caught becomes lower, but the amount of catch of bigger fishes becomes higher. There is decline in the fish catch over the period of 30 years.

4.13.3 Impacts on Fishery

- The fishing activities have increased several folds during the last two decades.
- Using of current jals is one of the reasons for the decline of the fisheries.

- Jamuna is getting braided pretty fast. Deeper waters are now only very localized, so as the larger or more commercial fish species.
- There is no proper management policy in fisheries that is visible in the area. Bans are not enforced properly. Fishermen also needed to be properly rehabilitated during fishing bans.
- The fisher folk feel that the Jamuna River is already braided in nature; the construction of bridge may accelerate the pace of sand bar formation and thus obstructing the fish migration route.
- Bangabandhu Rail Bridge might have adverse impacted the fish breeding here which has a deep impact on fish decline.

4.14 Gangetic Dolphins

The Ganges River dolphin, or Susu, inhabits the Ganges-Brahmaputra-Meghna and Karnaphuli-Sangu river systems of Nepal, India, and Bangladesh. This species is categorised as endangered by the International Union for Conservation of Nature. The Ganges River dolphin lives in one of the world's most densely populated areas, and is threatened by removal of river water and siltation arising from deforestation, pollution and entanglement in fisheries nets. In addition, alterations to the river due to barrages are also separating populations. The species is found exclusively in freshwater habitat. In Nepal, it inhabits clear water and rapids. In Bangladesh and India, individuals live in rivers that flow slowly through the plains. The Ganges River dolphin favours deep pools, eddy counter-currents located downstream of the convergence of rivers and of sharp meanders, and upstream and downstream of mid-Channel Islands.

The decrease river depths and appearance of sand bars during the winter season cause danger to the dolphins as river is divided into small segments, causing segregation of populations in deeper pools. Narrowing of gene pool, increased intensity of fishing, river traffic, pollution due to untreated effluents from industries, incidental or intentional capturing for oil extraction for use as fish attractant, liniment and aphrodisiac etc. have become major threat for its survival.

The survival of the Ganges River dolphin is threatened by unintentional killing through entanglement in fishing gear; directed harvest for dolphin oil, which is used as a fish attractant and for medicinal purposes; water development projects (e.g. water extraction and the construction of barrages, high dams, and embankments); industrial waste and pesticides; municipal sewage discharge and noise from vessel traffic; and overexploitation of

prey, mainly due to the widespread use of non-selective fishing gear. Irrigation-related projects have had an adverse impact on the habitat of this species. These projects result in major changes in the flow, sediment load, and water quality of rivers, which affects the quality of waters downstream. Pollution levels are a problem, and are expected to increase with the development of intensive modern industrial practices in the region. Compounds such as organochlorine and butyltin found in the tissues of Ganges River dolphins are a cause for concern about their potential effects on the subspecies.

According to the information gathered from the locals, seasonality, food availability and environmental conditions of the water are the main factors of the river dolphin for its habitat use/preference. Depth of water and also water turbidity in Jamuna Rivers varies greatly due to changes of seasons, physical characteristics and other anthropogenic reasons. Water depth increases during the monsoon months and decreases during the winter and summer months in the river where dolphin survey was conducted. During the winter and summer months, dolphins are found to remain concentrated in the deeper sections (*kola or khari*) in the river. This was reflected in the higher number of sightings during our survey in pre-monsoon in the lower portions of the river. So, optimum water depth preferred by the Ganges River dolphin throughout the year is mostly available in sections where scours in the river exist. Secondly, most river fishes occur or should have occurred in the scours of the river during the winter and summer months, as the local fishermen said. The dolphins feed on fishes, hence distribution, composition and abundance of their prey may also play an important role in the distribution and abundance of dolphins and consequently habitat utilization. Interview with the local population has thrown light on intentionally trapping and killing of dolphins in the rivers for commercial reasons and it is gradually gaining momentum for oil extraction. Agricultural activities along the river banks and chars were observed to rise and agro-chemical runoffs from these cultivated river banks and spilled oil pollution from the oil tankers and cargo ships plying the Jamuna River are the major concerns for water pollution of the rivers. Solid wastes, particularly the plastics, discarded fishing nets do pose a problem for the dolphins.

Dolphin survey conducted in the five-km radius area of proposed project. During construction may affect on dolphin during movement but will not affect physically. IUCN (International Union for Conservation of nature and natural resources) Bangladesh have been selected some sites for dolphin conservation in the river Jamuna and also develop some strategies

for dolphin conservation. In the radius 5 km area there is no dolphin conservation site of IUCN Bangladesh.

4.15 Bird survey

A survey for the birds was conducted at the Eco Park., Bridge area and Char lands comprising of a team. The details were obtained by discussing to the locals. Identify the species of birds with the help of an expert ornithologist. About 83 species are identified over a period of seven days. Migratory birds visit during winter period. The team could identify about 83 species in the project area.

All recorded species are belonged to fourteen orders. The maximum species are included under the order Passeriformes (49 species) and the Anseriformes, Apodiformes Strigiformes, Ciconiiformes and Psittaciformes included minimum species. Twenty-six species are found in the ground, 21 species in air, 15 species are found in char land, 11 species wire, 12 species are found in fence and 7 species in river bank continued

Many birds have at least a partially insectivorous diet, and insects are a critical source of protein for many growing nestlings. While young birds are still dependent on their parents for food, they may be fed mostly insects, even if their mature diet will be much different. To be considered insectivorous, a bird does not necessarily need a diet of exclusively insects, but the insect proportion is quite significant. Many additional birds eat a great variety of insects, including small birds of prey such as screech-owls and kestrels.

An Ecosystem consists of all of the flora and fauna living within area and the interactions between them. Birds are obviously important member of the Ecosystem; they are integral parts of food chains and food webs. Birds have a natural way to control pests in gardens, farmlands and other places. Bird's excreta are fertile manure to plants. Nectar-feeding birds are important pollinators, many fruit- eating birds help disperse seeds. Birds are the some of the creatures which add beauty to environment. Also, birds are very important in time telling during the morning (night) especially in rural areas, and become tourist attraction for leisure as pets. Birds like eagle, carry away rodents for consumption, thus they keep the rodent growth under control which in turns help the farmers economic growth.

Birds are generally specific about their food and nest to the selective trees and niches. If char destroyed or habitat loss or char gone under water, Zitting cestocola, graceful prinia, paddy field perit, tricolor munia, striaed grass birds, bristled grass birds, baya weaver, red

wattled lapwings, and insectivore birds and many other water birds and all types of grainivore birds will lost their habitat. In this survey time, bon biral, gui shap, monkey, shial and another wild animal were also seen.

4.16 Critical Habitats

According to the World Bank Operational Manual 4.04, the proposed project influence area does not fall under critical habitat conditions. The project influence area has no legal or officially Protected Area as to Government Gazette notification and also no conservation area has been declared by Non-Government Organization and local communities.

Dolphin Habitat in Jamuna

However, IUCN (International Union for Conservation of nature and natural resources) Bangladesh have been selected some sites for dolphin conservation in the river Padma - Jamuna and also develop some strategies for dolphin conservation, but in the radius 5 km area there is no dolphin conservation site of IUCN Bangladesh. However, recently a wildlife (dolphin) sanctuary near Nogorbari-Mohanganj area has been declared by the Government of Bangladesh, which is located at least 40 km downstream from the proposed railway bridge site. A survey was conducted by Carinam in 2011 in the Padma-Jamuna river section in the including project area and identified 4 hotspots for river dolphin which are not located at least 45-50 km from the project area. These hotspots are

1. Najirganj Ferry Ghat Kum in the Padma river
2. Nagarbari Ghat Kum
3. Char Nakalia and Machhkhali Kum and
4. Mohanganj Kum in the Jamuna river

A critical habitat map is shown in Figure 4-13.

Gharials Habitat in the Jamuna

Several studies have been conducted to identify the gharials hotspot in Padma-Jamuna River. None of these studies indicates any hotspot near to the proposed railway bridge locations. The nearest hotspot has been identified near Sariakandi that is approximately 60km north from the project site.

Important Bird Area (IBA)

Jamuna River and its floodplain areas are designated as Important Bird Area (IBA) by Birdlife International which is outstanding experts NGO, and the Project area is included in this IBA. During the bird survey, a trigger species Black-bellied Tern *Sterna acuticauda,*

designated by IBA has been identified. However, the bird survey was unable to identify their habitat near to 5km radius from the proposed site. Therefore, it was concluded that this species use the proposed bridge location as flying route. However, there are some areas with high conservation value such as char land where migratory bird inhabit each year. Among the available habitats, however, the most notable are parts of the uninhabited chars that are the shelters of thousands of migratory winter birds and many resident birds like wild ducks and terns.

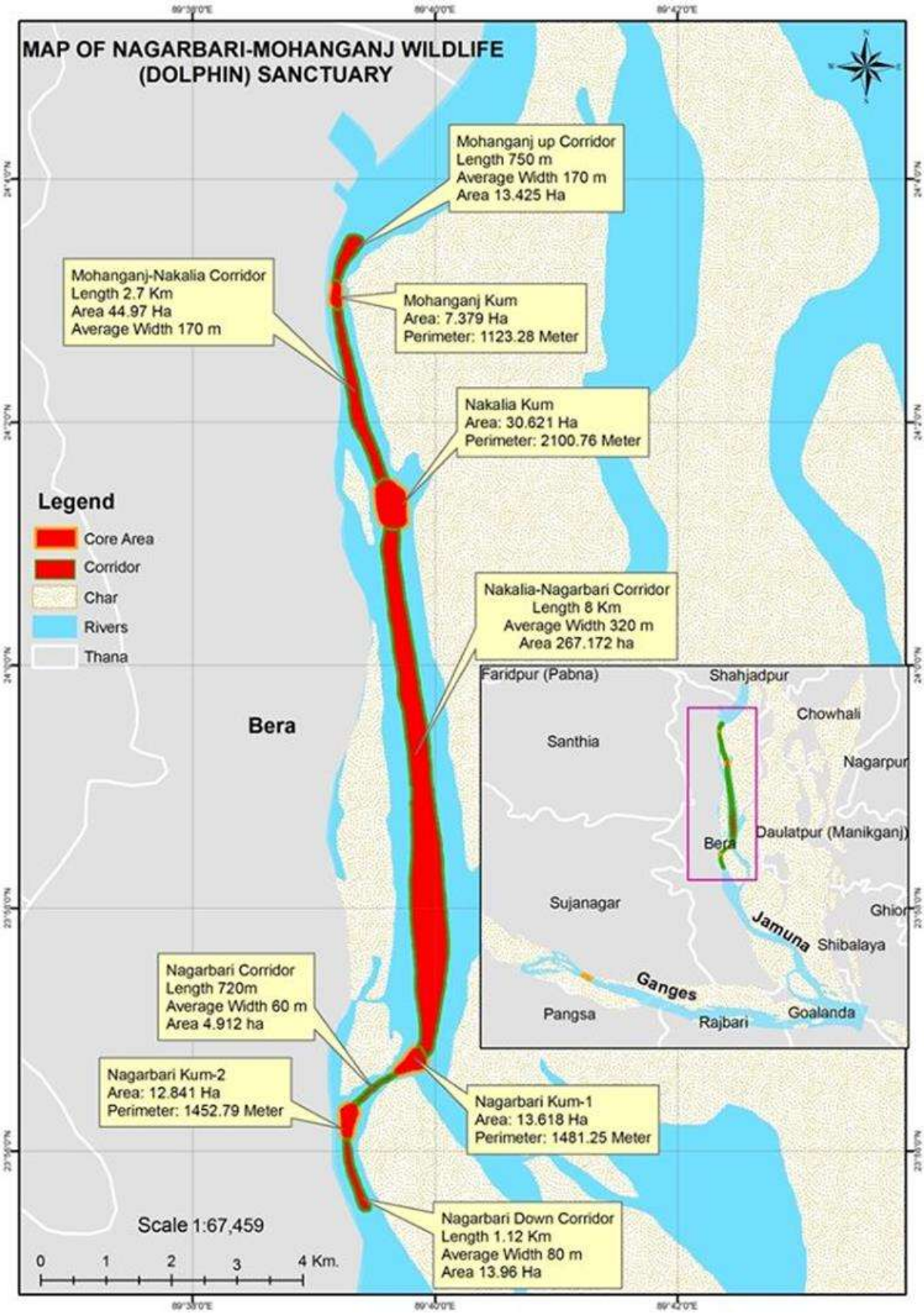


Figure 4-13 Dolphin Habitats

4.17 Char Lands Status

The project falls under Sirajganj and Tangail districts within the active Brahmaputra-Jamuna Floodplain. At the point where the Brahmaputra meets the Tista River in Bangladesh, it becomes known as the Jamuna. The Jamuna is notorious for its shifting sub channels and for the formation of fertile silt islands (chars). No permanent settlements can exist along its banks. This region comprises of unstable alluvial land where land is constantly being formed and eroded by shifting river channels both the rivers Brahmaputra and Jamuna.

Consultations were made at the Char Lands and at the nearby human settlements on either side of the Jamuna River. Most of people were looking for a Government's interference and help was expected from the various Department of Government of Bangladesh. The local population feels that there will not be much impact due to the construction activities of the proposed project. They are more interested for employment opportunities with the project implementation. The char lands are abused to the maximum extent on the Eastern bank there is heavy sand mining going all over the area. The Char Lands are used for cultivation purpose and they mostly grow jute on these lands. The usage of pesticides, herbicides are of huge quantities. The chemical fertiliser use is also really huge by the local farmers. There is no proper sanitation in this char land. During the floods the char lands are flooded and the flood water is contaminated with heavy chemicals and contains large amounts of the pollutants.

A questionnaire survey is conducted in the project area to record the socio-economic status of the local population. This survey was conducted both in Tangail and Sirajganj Districts. The primary occupation of the local population is agriculture, fishing and business. The agriculture crops grown in this area are the rice, mustard, jute and ground nut. There is electrical connection to most of the households and they still depend on the leaves, straw and cow dung cakes are popularly used for energy purpose. There is no medical facility among the villages and local doctor gives first aid to the patients. The most common dieses found in this area are dysentery, diarrheal disease, cough and cold and common fever. The transportation is the bus for the nearest place. Most of the local population depends on the ground water and the sanitation facilities are very poor. Homestead land used for growing trees like lemon, jack fruit, litchi, coconut and mango. There are also timbers trees are mahogany and eucalyptus are grown by the local population. The other activities include poultry, duck rearing, and keeping goats. Cow rearing is not very common in this area. The literacy rate is quite low in these areas.

Most of the farmer applied fertilizer unbalanced way. The use of pesticides depends on the degree of pest infestation. Application of pesticides has been noticed for 1-3 times to control pest and diseases for the rice crops grown in the areas. The major insects as reported by the farmers are Stem borer, Green leaf hopper, Grass hopper, Rice bug, Birinjal shoot and Fruit borer, Red Pumpkin beetle and Mosaic. Local farmer reported that they are using different types of pesticides such as D-ten 10G, Krishan5G, Krishan10G, Hi power, Heron, Morter, Foker, Raison-60 EC, Brifer-5G, Siperin-10EC, Regent-3G, Sifanon-57EC and Cumulus etc. to prevent pest infestation in rice, vegetables and others crop cultivation.

The Western Bank falls under Sirajganj and the adjacent char lands are being used for the development of special economic zone and for development of industrial parks. The land acquired is about 400 acres of land is for the industrial park and around 1000 acres land is allocated for the special economic zone. Both the projects fall under the Bangladesh Small Scale Industries Corporation, Government of Bangladesh. The department is expecting few chemical, agricultural related and textile units would come there. The proposed set up will generate employment for more than a lakh population. The garment industry forms the backbone for the economy, so the preference is given to them first and other companies which were planned at the special economic zone are the camera lenses, shoes, mobile phone components, car parts manufacturing unit.

4.17.1 Agrochemicals use in Char Lands

Farmer in the project is adopting agricultural and fishing practices for their livelihood. In the char land, mainly Jute, Vegetables, Sesame, Wheat are grown extensively. The local population use all kinds of fertilizers for their crops land but at the same time they use more than 30 types use agrochemicals for pest control. These agrochemicals deteriorate the water and soil quality and thus polluting the water of Jamuna River. After the rains and flooding the agrochemicals are washed into the Jamuna River thus increasing the bio-magnification of the chemicals. The list of agro chemicals are listed below in the Table 4-25.

Table 4-25 Utilized agro chemicals on Char Land

S/N	Name of Agrochemicals	S/N	Name of Agrochemicals
1	Virtaco 40 DG	16	JUJ 80 WP
2	Sobicron 425 EC	17	Rivas 250 SC
3	Karate 2.5 EC	18	Thiovit 80 WG
4	Procrem 5 SG	19	Silica 80 WG
5	Pegasus 50 SC	20	Rifit 500EC
6	VoliamFlexi 300 SC	21	Logran 75 WG
7	Aktara 25 WG	22	Leger 10 WP
8	Plenum 50 WG	23	Glamaxon 20 SS
9	Crusar 70 WS	24	Bingo
10	Vartimack 018 EC	25	Magma

S/N	Name of Agrochemicals	S/N	Name of Agrochemicals
11	Tilt 250 EC	26	Gloxin
12	Score 250 EC	27	Lanirat
13	Emister Top 325 EC	28	PG-16 spayer
14	Filia 525 SI	29	SP-16
15	Remodil Gold M Z 68 WG	30	XP-16

Source: JICA Survey Team, 2017

4.18 Involuntary Resettlement and Land Acquisition

From the socio-economic survey and further study of this project revealed that no land acquisition and involuntary resettlement is required for Bangabandhu Railway Bridge Construction (main Bridge as well as other subsidiary works). Further, proposed Bangabandhu Railway Bridge alignment will cross through a newly emerged low-lying Charland (sand bar) in the middle of Jamuna River where no human settlement observed, thus no socio-economic impacts will occur.

The construction areas are quite protected and belong to Bangladesh Army which will be transferred to Bangladesh Railway prior to commencement of the construction. In 2014, ADB through RCIP Consultant Team, has conducted a Social Safeguard study for the same project to identify project affected persons which recorded no Social Impact of any significant nature had taken place in the Project Influence Areas (PIA). No land acquisition and no case of Involuntary Resettlement will occur due to implementation of the project.

However, BR will identify actual project affected persons (PAPs) through cross checking with the local administrations and provide compensation to affected people who will loses land, resources and structures in accordance with the applicable laws of Bangladesh. BR will eventually prepare a Resettlement Plan for land acquisition and compensation, if required in future. In 1998, when first land acquisition has been taken place due to construction of the existing bridge, GOB and World Bank agreed to compensate all adversely affected persons despite their reasons, and developed Erosion and Flood Policy to be used for that project. It is not possible to determine whether or not BR will follow that same procedure as the proposed railway bridge has neither socio-economic impacts nor land acquisition.

4.19 Conclusion

Bangabandhu Railway Bridge will provide better connectivity between the east and the west. The better quality will help carrying more freight and passenger. The traffic can be reduced to certain extent. The baseline environmental parameters showed that there is not much of pollution. Things can be improved over the period of time. The environmental parameters require to be monitored on a regular basis to maintain the environmental quality. Proper implementation measures to be adopted during stage of the construction of the project.

5 CHAPTER -ANALYSIS OF ALTERNATIVES

Based on their technical, economical social and environmental feasibility several alternatives, including “Do nothing” River-crossing options, Superstructure and Substructure options as well as alignment options are described below.

5.1 Alternative 0 – ‘Do Nothing’

Without the Project, the train will continue operating through the existing Bangabandhu Bridge that was not built to accommodate any rail traffic. It was designed as a four-lane road bridge, for which its width of 18.5 m was adequate but not generous (the Bangladesh standard is 20.8 m). Fitting the rail track within 18.5 m compromised the bridge’s capacity to carry road vehicles. Rail traffic arrangement was considered on the Bangabandhu Bridge when road traffic was limited during its initial operational period and the one-and-a-half lanes each way was sufficient for road traffic. However, it is projected that the present configuration will reach its theoretical capacity to carry road traffic by 2016 and the present arrangement is not adequate for both road and rail traffic.

It is understood that the present arrangement of road rail traffic over the Bangabandhu Bridge will not serve its purpose after a few years due to increase of road traffic. Moreover, railway bridges are usually level but Bangabandhu Bridge has a slight gradient. Since BR’s freight rolling stock is largely unbraked, a descending locomotive that applies its brakes might cause a trailing wagon to lift a bogie off the rails, derail, and perhaps topple into the river. Another factor is that the Bangladesh Bridge Authority needs to protect and maintain the Bridge intensively because there are major cracks - not necessarily, or only, because of railway trains. The point to be made is that, for a mix of reasons, train speeds across the bridge are limited to 20 km/h (currently 10 km/h, which may or may not be temporary) and axle loads are limited to 16 tonnes (25 tonnes elsewhere). Most importantly, the Project corridor is has potential to be considered for as Trans-Asian railway corridor which means Indian Railways (IR) will use this route. Indian Railways have rolling stock that uses higher axle loads on its broad gauge (BG) wagons than BR. Therefore, it would be most likely that the Bangladesh Bridge Authority (BBA) would prohibit all IR wagons from crossing the Bangabandhu Bridge, irrespective of their actual weight.

Without the Project, the continual traffic congestion on the Bangabandhu Bridge will continue to worsen which will have adverse impact on the socio-economic development of the country, the north-western region in particular, as well as hinder sub regional connectivity. Current

risky traffic management of both road and rail will remain in service, often resulting accidents, and long waiting times in toll areas will continue.

A dedicated rail bridge with a dual gauge (DG) railway line, as proposed under the Project, will, therefore, benefit BR and all rail users as there will be no need for weight and speed restrictions. Other rail bridge benefits will accrue to BBA and road users. This is because BBA can restore Bangabandhu Bridge to its intended full width, thereby greatly increasing the capacity of the bridge to take road vehicles. Diversion of some bus passengers to rail would also assist in the management of traffic volumes.

5.2 Alternatives Analysis

Bangladesh Railway and the previous ADB Consultant considered both alignment and river crossing alternatives for selecting preferred option. The process is for selecting the preferred option. The ADB Consultant identified two railway alignment alternatives and two alternatives for the river crossing investigations that are briefly described below in Figure 5-1.

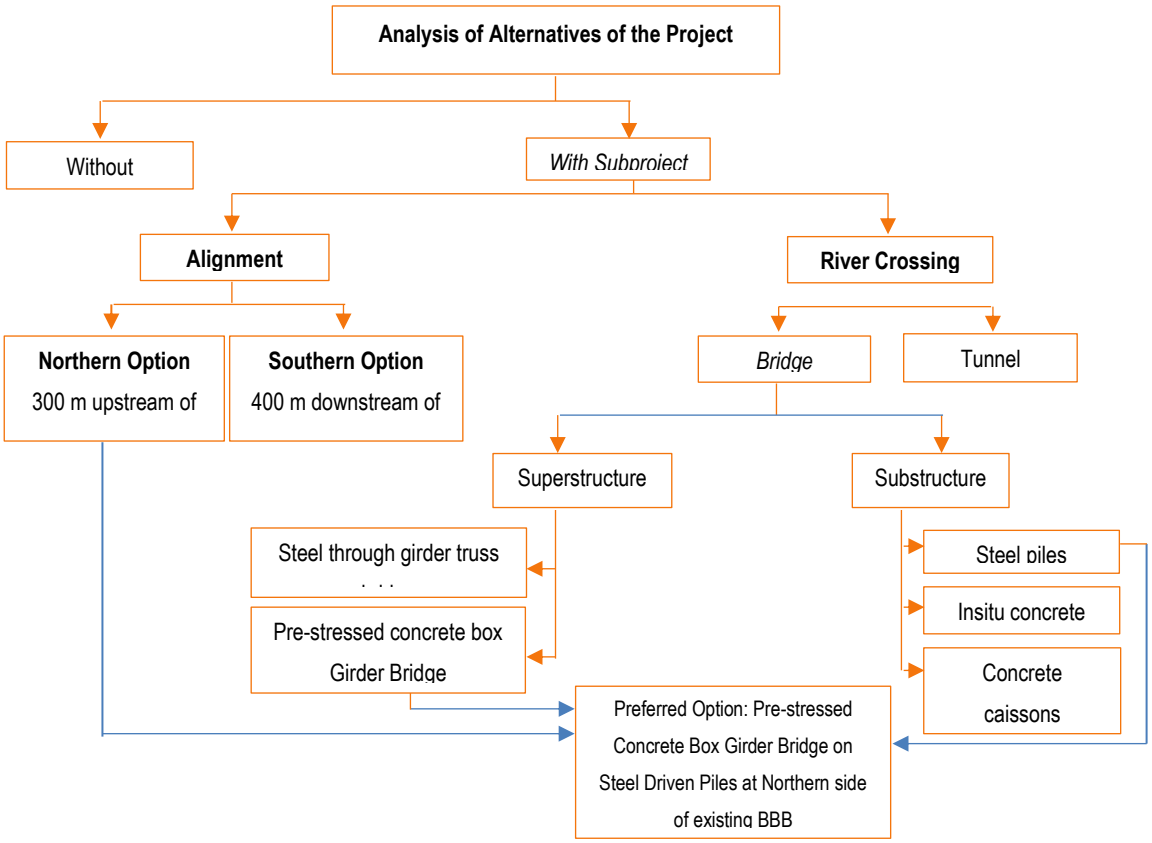


Figure 5-1 Outline of Analysis of Alternatives (RCIP report)

5.3 Alignment

During the previous ADB feasibility study, the Consultant team identified two possible alignments (sites) for construction of the bridge. These alignments are given below. The environmental parameters were assessed for both the alignments. These are:

- *Option 1:* Northern Option: 300 m upstream of the existing Bangabandhu Bridge
- *Option 2:* Southern Option: 400 m downstream of the existing Bangabandhu Bridge.

The alignment for Option 1 starts from Km 284+300 at an offset of 6 m to the north of the existing track with center line of the existing Bangabandhu Setu West Railway Station at Km 285+283. The existing station is partly on curve radius of 4000 m and partly on straight. The alignment continues to be on curve radius of 4000 m up to 285+176 and thereafter on straight up to Km 286+140. For installation of the transition switch (which will facilitate transition of the dual gauge track from the standard 3-rail configuration to the 4-rail configuration on the bridge), a straight length of 125 m has been provided between the last stock rail joint (at Km 285+984) to vertical grade point (end of vertical curve) at Km 286+124 after the Bangabandhu Setu West station. Thereafter the alignment turns right with a 1,250-m radius curve, starting from Km 286+140 up to Km 286+533. There is a straight length of 957 m following the curve. Thereafter, the alignment turns right with a 12,000-m radius curve and crosses the Jamuna River between Km 287+357 to Km 292+157 (length of Jamuna main bridge is 4.80 km). The alignment lies at an offset of 300 m to the north side of the existing bridge.

The transition switch has been proposed in grade of 0.25% (1 in 400) between the end of transition curve (at Km 293+775) to last stock rail joint (at Km 293+853). The alignment is parallel to the existing track from Km 293+750 onwards. After a straight length of 208 m, the alignment takes a sharp right hand turn with a curve of 500 m radius. Thereafter, the proposed alignment is on straight from Km 294+195 to Km 294+441 for a length of 245 m and remains parallel to existing track. After the left hand curve of radius 500 m from Km 294+441 to Km 294+834, the alignment remains straight up to the project limit at Km 295+600. The speed potential on this 500-m radius curve is 85 km/h. The Bangabandhu Setu East Station is at Km 294+560 on a left-hand curve of radius 500 m.

In case of Alignment Option 2, this option starts from center of Bangabandhu Setu West station (Km 285+458) and follows Alignment Option 1 up to Km 285+831. Thereafter

alignment follows a right-hand curve of radius 500 m from Km 286+908 to Km 287+375. The alignment crosses the Highway at Km 286+650. After a straight section of 203 m, the alignment turns left with curve of radius 1000 m up to Km 288+166 and crosses the Jamuna River from Km 287+400 to Km 292+400.

After a straight section of 4,539 m over Jamuna River, the proposed alignment turns right with curve radius of 3,500 m up to Km 293+703. After a straight section of 127 m, the proposed alignment turns left on a curve of radius 875 m from Km 293+830 to Km 294+206. Thereafter, the alignment is straight up to Km 294+635. The proposed alignment follows two sharp curves of radius 500 m having a straight section of 454 m between these curves up to Km 295+808. The alignment again crosses the National Highway at Km 293+510. The alignment joins the Option 1 alignment at Km 294+200 and follows it completely afterwards.

In this option, the proposed rail bridge lies to the south (downstream) of the existing Bangabandhu Bridge. The proposed rail alignment, which lies to the north of the existing highway at the Bangabandhu Setu West Station will cross the highway to move on to south side, where the new rail bridge is proposed to be located. This road will be at grade as there will not be sufficient length to ramp up/down for provision to fly over the existing road. After crossing the Jamuna River, the proposed alignment will again cross the existing road and here too, length is insufficient for provision of fly over. For a main road with current traffic the provision of a level crossing will not be a desirable option. Given the large traffic volumes already passing on this road, the provision of two at-grade crossings will cause severe impediment to road and rail traffic, significantly increase the risks of accidents and reduce overall safety.

Thus, the alignment on the downstream side (south side) will require crossing of the existing road twice at grade as the flyover option is not feasible due to space constraints. This option will also have 3 curves of 500 m radius and 1 curve of 875 m radius, which would further restrict the design speed and hinder rail operations.

Therefore, Option 1 - Northern Option: 300 m upstream of the existing Bangabandhu Bridge has been selected for construction of the railway bridge. An Environmental Screening Matrix for Comparative Environmental Assessment of Alternatives Alignments developed and provided in 5.2.1 below.

5.3.1 Environmental Screening Matrix for Comparative Environmental Assessment of Alternatives

Environmental Social Indicators	Alignment Option-1			Alignment Option-2		
	Impact	Likelihood	Total Weighted Score	Impact	Likelihood	Total Weighted Score
Land use	**5**	**3**	**15**	**5**	**4**	**20**
Air Quality	**2**	**2**	**4**	**2**	**2**	**4**
Biodiversity	**4**	**3**	**12**	**4**	**4**	**16**
Natural Hazards	**3**	**3**	**9**	**3**	**3**	**9**
Hazardous Materials	**3**	**3**	**9**	**3**	**3**	**9**
Waste Management	**3**	**2**	**6**	**3**	**2**	**6**
Water Quality and Hydrology	**3**	**3**	**9**	**4**	**4**	**16**
Safety and reliability of Existing Bridge	**3**	**3**	**12**	**3**	**3**	**9**
Scouring on Existing Bridge	**3**	2	**6**	**4**	**3**	**12**
Natural Resources	**4**	2	**8**	**4**	**3**	**12**
Noise	**3**	3	**9**	**3**	**3**	**9**
Social Aspects	**0**	0	0	**2**	**4**	**8**
Resettlement	0	0	0	**2**	**4**	**8**
Population, Housing and Employment	**2**	2	**4**	**3**	**3**	**9**
Transportation and Traffic	**2**	2	**4**	**3**	**4**	**12**
Risks of accidents and overall safety	**2**	2	**4**	**3**	**4**	**12**
Total Score	**107**			**163**		
	Impact 1 = very minor impact 2 = Minor impact 3 = Moderate impact 4 = Major, but reversible impact 5 = Major irreversible impact			Likelihood 1 = very low likelihood of the E. Aspect causing the E. impact 2 = low likelihood of the E. Aspect causing the E. impact 3 = Moderate likelihood of the E. Aspect causing the E. impact 4 = Above average likelihood of the E. Aspect causing the E. impact 5 = High likelihood of the E. Aspect causing the E. impact		

Source: Environment Team of RCIP-Rail & JICA Team

5.4 River Crossing Alternatives

BR and its Consultant considered two river crossing options, namely.

- Bridge Option; and
- Tunnel Options.

A comparison between the bridge and tunnel options, as summarised in Table 5-1, was conducted and the bridge option was found to be the most preferred option due to the following constraints associated with the construction and maintenance of a rail tunnel:

- The costs of construction, safety and reliability of a tunnel option will be less than optimal compared to a bridge solution;
- Length of tunnel required to maintain portals above the flood line;
- Construction difficulties, economic cost and technical challenges in designing and construction of a tunnel of this magnitude;

- The potential reliability of power supplies, the mixture of locomotive types that are likely to be used on the line; and
- The limitations due to train schedules and the cost of overcoming the problems related to capacity.

Given the above, the tunnel option is not considered to be as cost effective as a bridge option and is therefore was not considered further.

Table 5-1 Comparative Assessment between the Alternatives of River Crossing

Parameter	Bridge Option (Preferred)	Tunnel Options
Cost	Lower Cost than Tunnel Option and Cheaper	Higher Cost than Bridge Option and Expensive
Constructability	Locally understood and there is local skill, expertise and experience available.	Difficult and has no local experience
Maintenance	Well known	No local experience
Proven Previous Use	Yes	No local experience
Effects on Environment	Less environmental effects	Significant environmental effects

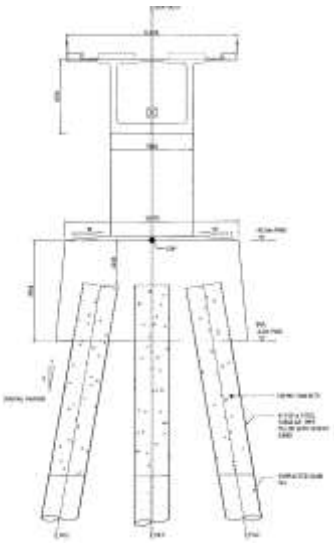
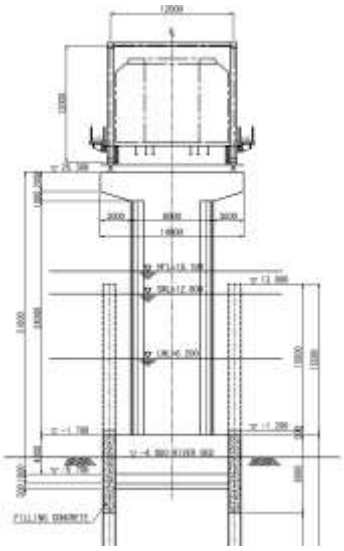
Selection of Bridge Options: In selecting an appropriate superstructure under specific conditions, span length and major materials are essential factors affecting construction cost. Whether the supporting system is continuous or simply supported affects not only the cost, but the constructability, drivability and maintainability. There are various superstructure and substructure foundation types, but each type has its own characteristics to apply in terms of technical and economic feasibility.

5.5 Comparison of Bridge Type Alternatives

Superstructure: After through revision of several superstructure types, BR and its Consultant have shortlisted two types of superstructure:

- Concrete box girder bridge plus battered piles; and
- Steel through girder truss bridge plus SPSP-F.

Both types of superstructure were analysed in terms of material and fabrication costs, erection speed, ongoing maintenance costs and durability. Although both of the bridge types are common in Bangladesh and technology and skills required for the design, construction and maintenance of these bridges are available within the country, the capital cost for the pre-stressed concrete box girder bridge is significantly less than the steel through girder truss bridge.

Alternative	Alternative 1, F/S Alternative (PC Box Girder Bridge+LargeDiameter Battered Piles)	Alternative 2, Steel Truss Bridge+Steel Pipe Sheet Pile Foundation
Illustration		
Const. Period	55 Months (8/10)	48 Months (10/10)
Against Ship Collision	・Cross sectional area above river bed is larger and probability of ship collision is higher than Alternative 2. (7/10)	・Cross sectional area above river bed is smaller and probability of ship collision is smaller. Also number of piers is less and ship collision probability becomes less. (9/10)
Scouring	・As cross sectional area is larger, scouring effect may be larger, too. But the multi pile effect and the single column effect may be different and it is difficult to estimate. (7/10)	・As cross sectional area is smaller, the scouring effect may be smaller. (8/10)
Substructure Constructability	・Pile-Caps can be constructed above the water level so that the temporary works are simple. ・Battered piles are difficult to position correctly. ・Large diameter piles need to be fabricated at site and largest machines are needed to handle piles. Quality control of large diameter steel pipes, such as welding control, manufacturing error control, etc. is difficult. ・Hammering down large diameter battered piles is very difficult. Confirmation of bearing capacity is important but difficult. Closure effect of pile end is difficult to confirm and reduction of bearing capacity of pile end may be needed. ・Large Diameter Steel Battered Piles are adopted agaist the larger superstructure weight. This adoption can reduce the number of piles. (6/10)	・Steel Pipe Sheet Piles form a temporary cofferdam. Lower part of these sheet piles is utilized as a permanent foundation, which is a rational structure. ・There are no problems for the substructure construction compared to large diameter battered piles. ・There are many examples of these diameter piles and depth of foundations. As this bridge is newly constructed, there are no special construction constraints. No special machines are needed. (10/10)
Superstructure Constructability	・Balanced Cantilever Method of Construction is stable and well-established. But careful quality control of concrete is needed. ・Superstructure is similar to Existing Jamuna Bridge but rails are placed just above webs which is a better improvement from the existing bridge. ・Earthquake Resistance is improved because of adoption of rigid frame structure of piers and girders.	・As the rail level is lower, the approch section becomes shorter. ・Piece by piece erection of steel truss bridge is stable and well-established. ・A Steel Truss Bridge with Direct Rail Fastening Devices, which is about 1/3 of weight of PC Box Girder Bridge. ・Shop fabricated steel members are assembled at the site and the construction period can be shortened more easily than Alternative 1. ・As members of bridge are prefabricated in shops, quality control of construction is comparatively easier.
Cost Ratio	1.04 (9/10)	1.00 (10/10)
Technical Transfer	・As battered large diameter piles are difficult to fabricate and to construct. This may not be recommended for a technical transfer. (2/10)	・As this is a new technology, a technical transfer can be achieved. (10/10)
Evaluation	Better (48/70)	Best (67/70)

6 CHAPTER-PREDICTIONS ON NOISE AND VIBRATION

6.1 Construction stage

6.1.1 Noise

The Noise during construction stage of the project is coming from the activities such as pile driver, or machines and materials transportation. Noise level from each type of machines is shown as in Table 6-1. The Noise level is measured at 50 feet (approximately 15 meter) far from the machines, the loudest noise as stated in the table is at 101 decibel (dB). The noise level assessment during construction will consider sound level in different distances from origins. Decay Formula Equation will be used in this assessment, which will be done on spare basis, as the Equation (1).

$$Lp2 = Lp1 - 20 \log (r2/r1) \quad \ldots\ldots (1)$$

When

Lp1 = Sound level at distance r1 from the origin

Lp2 = Sound level at distance r2 from the origin

r1, r2 = Distance from the origin at sound level Lp1 and Lp2

Table 6-1 Noise Levels from the various Equipment while operating

Sl.No	Equipment	Noise Level (dBA) with 50 feet from the source
1	Air Compressor	81
2	Backhoe	80
3	Ballast Equalizer	82
4	Ballast Tamper	83
5	Compactor	82
6	Concreate Mixer	85
7	Concrete Pump	82
8	Concrete Vibrator	76
9	Crane Derrick	88
10	Crane Mobile	83
11	Dozer	85
12	Generator	81
13	Impact Wrench	85
14	Jack Hammer	88
15	Loader	85
16	Pile Driver (impact)	101
17	Pile Driver (Sonic)	96
18	Pump	76
19	Rail Saw	90
20	Shovel	82
21	Truck	88

Source: the EPA Report Measured data from railroad construction equipment taken during the northeast corridor Improvement project and other measured data.

From Table 6-1, the assessment shows that the maximum noise level, without any noise proof such as trees in the Eco-Park, any buildings etc., is coming from the pile driver. Noise prediction result on the west riverbank shows as Figure 6-1 and Figure 6-2 with Noise contour in case of pile driving activity. According to the result, a part of the residential area may be included in 60dB zone. However, since sound walls effect by the tree-covered Eco Park is expected, it is considered that the zone will be reduced.

Figure 6-1 Result of Noise prediction by Pile driving on the west riverbank of Jamuna River

Figure 6-2 Result of Noise prediction by Pile driving on the east riverbank of Jamuna River

On the east embankment, part areas for resident, relaxation and refreshment including Jamuna Ananda Park, Jamuna Resort Wild Life Museum and residential towers in the cantonment might be covered by zones of not only 60dB but also 65dB. Therefore, noise proof sheet should be installed during the pile driving work in order to reduce the noise level.

6.1.2 Vibration

On the construction stage of the project, the machines and tools that cause vibration will be used. The main activities that cause vibration are such as pile driver, digging, drilling, or demolition. The vibration effect assessment process during construction is as follows;

1. Vibration source level of the equipment at the reference distance 25 feet or 7.62 meters as shown in the Table 6-2.
2. Assess the vibration propagation on single source base by the equation

$$PPV_{equip} = PPV_{ref} \times (D/25)^{1.5}$$

When

PPV_{equip} = Particle velocity in in/sec of the equipment at specific distance

PPV_{ref} = Reference vibration level in in/sec at 25 feet

D = Distance from the source to receptor (feet)

3. Vibration level at different distances during construction stage

From Table 6-2, the machine that causes the maximum vibration level in case of having construction activities is pile driver. The vibration level at 25 feet, or 7.62 meters, from the source has particle velocity 1.518 in/sec. Then, next step is to assess the vibration level from construction activities at different distances, as shown in Table 6-3. The vibration level from construction activities will decrease when the distance increases, in other words, at distances; 15, 30, 50, 100, 200, 500, 1,000 and 1,500 meters, the peak particle velocity (PPV) is 13.63, 4.97, 2.29, 0.81, 0.29, 0.073, 0.026 and 0.014 millimetres/sec accordingly.

Table 6-2 Vibration level caused by construction equipment

Equipment		PPV (at 25 feet)		
		in/sec	mm/sec	Approximate L_v at 25ft
Pile Driver (Impact)	Upper Range	1.518	38.557	112
	Typical	0.644	16.358	104
Pile Driver (Vibratory)	Upper Range	0.734	18.644	105
	Typical	0.170	4.318	93
Clam Shovel Drop (Slurry Wall)		0.202	5.131	94
Hydro mill (Slurry Wall)	In Soil	0.008	0.203	66
	In Rock	0.017	0.432	75
Vibratory Roller		0.210	5.334	94
Hoe Ram		0.089	2.261	87

Equipment	PPV (at 25 feet)		
	in/sec	mm/sec	Approximate L_v at 25ft
Large Bulldozer	0.089	2.261	87
Caisson Drilling	0.089	2.261	87
Loaded Trucks	0.076	1.930	86
Jack Hammer	0.035	0.889	79
Small Bulldozer	0.003	0.076	58
RMS velocity in decibels (VdB) re 1 micro-inch/second			

Source: TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT/ Federal Transit Administration 2006

Table 6-3 Vibration Level of Construction machines by distance

Machine	Distance		Peak Particle Velocity (PPV)	
	feet	meter	in/sec	mm/sec
Pile Driver (as max vibration level machine)	50	15	0.537	13.63
	98	30	0.196	4.97
	164	50	0.090	2.29
	328	100	0.032	0.81
	656	200	0.011	0.29
	1,640	500	0.003	0.073
	3,281	1,000	0.001	0.026
	4,921	1,500	0.0005	0.014

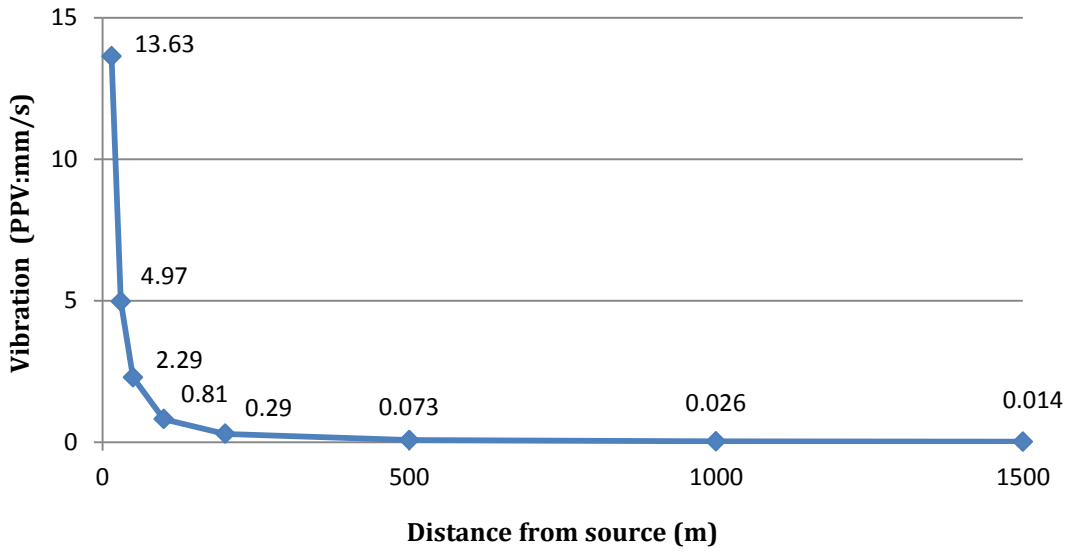


Figure 6-3 Vibration Distance-Decay (Pile driver)

4. Vibration level in vulnerable area during construction stage

From Table 6-2 that shows the vibration level caused by construction equipment at reference distance 25 feet (7.62meters), the pile driver has maximus vibration level at 1.518 in/sec. That information will be used to assess the vibration level from station construction activities in 6 nearby vulnerable areas at both riverbanks of Jamuna River as below.

Table 6-4 Vulnerable areas on the both riverbanks

Riverbank	Vulnerable areas
East	Residential towers at the cantonment, Jamuna Ananda Park, Jamuna Resort Wild Life Museum
West	Combined Cycle Power Plant, Power Grid Company of Bangladesh (PGCB), Ponchoshona Resort

Those areas would receive vibration from construction in the range between 0.048 and 0.235 millimetres/sec, which is within the standard by Department of Industry, innovation and Science, Australian government, Issue BS-6472-2:2008, as shown in Table 6-5. Therefore, no mitigation measure is required.

Table 6-5 Forecasted Construction Vibration Level in Vulnerable Areas

Vulnerable Area		Approx. Distance (meter)	Vibration Level in PPV		
			PPV (in/sec)	PPV (mm/sec)	Standard Value in Australia (mm/sec)
1	Residential towers at the cantonment	750	0.00924	0.235	0.3
2	Jamuna Ananda Park	950	0.00648	0.165	2.5
3	Jamuna Resort Wild Life Museum	1,900	0.00229	0.058	2.5
4	Combined Cycle Power Plant	1,650	0.00283	0.072	2.5
5	Power Grid Company of Bangladesh (PGCB)	1,580	0.00302	0.077	2.5
6	Ponchoshona Resort	2,170	0.00188	0.048	2.5

Source: Standard value for Ground vibration limits for human comfort by Department of Industry, innovation and Science, Australian government, Issue BS-6472-2:2008

Peak component particle velocity at Daytime

Residential : 0.3 mm/s

Offices : 0.6 mm/s

Occupied non-sensitive sites, such as factories and commercial premises : 2.5 mm/s

Figure 6-4 Pile driving points and Location of Vulnerable Areas

6.2 Operation stage

6.2.1 Noise

i) **Prediction procedure**

Noise level assessment on the operation stage will be following these steps;

1. To calculate Maximum Noise level (L_{Amax}) based on the cross-section structure and Train speed.
2. To calculate Single event noise exposure level (L_{AE}) based on L_{Amax} and train passage time.
3. To calculate equivalent noise level (L_{Aeq}) based on the number of train per hour.

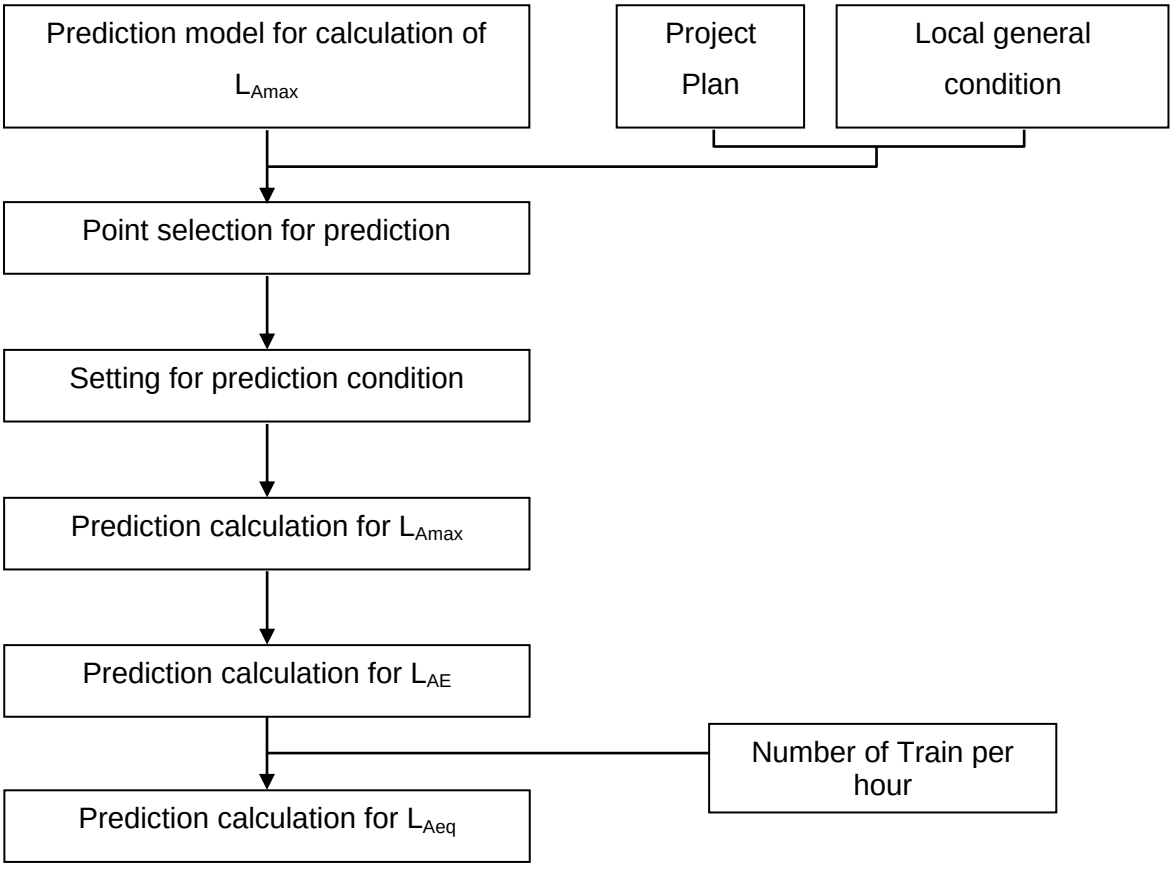


Figure 6-5 Prediction procedure for Railway Noise

ii) **Prediction model**

An appropriate prediction model for Railway noise[1] suggested by Mr. Yoshio Moritoh (Railway Technical Research Institute, Japan) et al. can be utilized in the project because of applying to several railway structural requirements such as Viaduct, Embankment and Flat. Since there are these requirements in this project, the model should be adopted. Since Railway travel noise is compound of various noise types; Rolling noise, Structure noise and Rolling stock device noise, these noises should be calculated and synthesized in order to composite noise level.

iii) **Calculation of Maximum Noise level**

The important information on the operation stage that will be utilized in this assessment is including; number of train trip, length of train, train speed, distance from noise source etc. Maximum Noise level (L_{Amax}) is calculated by the three calculation formulas; (1), (2) and (3) as follows.

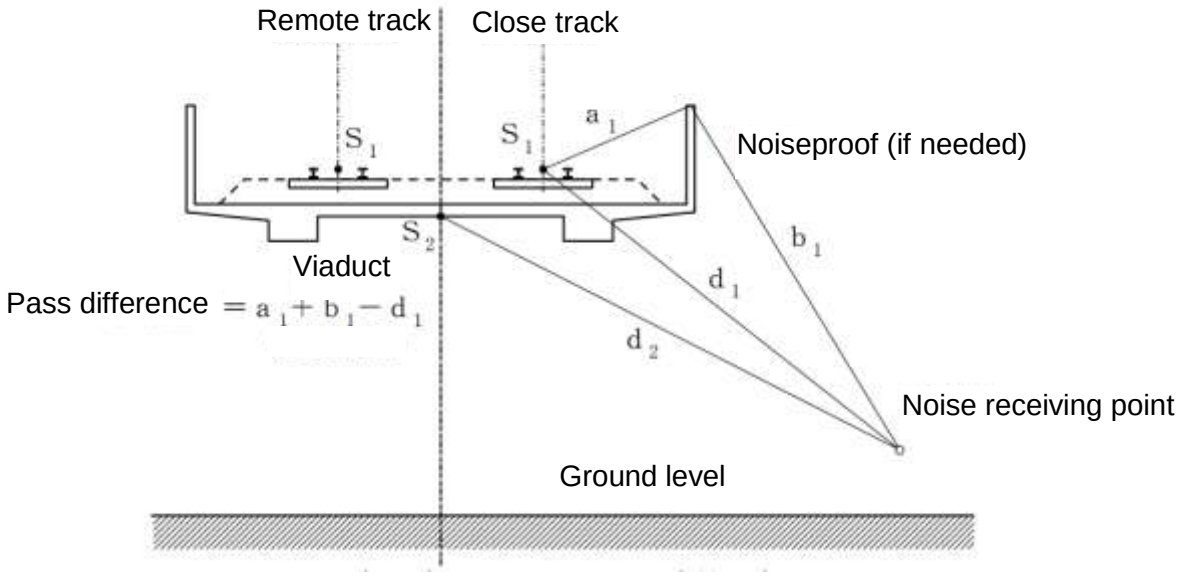


Figure 6-6 Explanation of Noise source, Noise receiving point and Pass difference

S_1: Noise source position of Rolling noise, S_2: Noise source positon of Structure Noise

A) Rolling Noise

$$L_{Amax}(\mathrm{R}) = PWL_R - 5 - 10log_{10}d_1 + 10log_{10}\left\{\frac{\left(\frac{l}{2d_1}\right)}{1+\left(\frac{l}{2d_1}\right)^2} + \tan^{-1}\left(\frac{l}{2d_1}\right)\right\} + \alpha_1 \quad \text{-------- (1)}$$

When

$L_{Amax}(\mathrm{R})$: Maximum Rolling Noise Level (dB)

[1] Proposal of a Prediction Model for Noise of Conventional Railway, the Institute of Noise Control Engineering of Japan, 1996.

PWL_R : Power Level of Rolling Noise (dB)

$PWL_R = PWL_R\,(100) + 30log_{10}\,(V/100)$

Slab track : $PWL_R\,(100)$ = between 100 and 105 dB

Ballast track : $PWL_R\,(100)$ = between 95 and 100 dB

Steel beam ballast less track : $PWL_R = 25\log_{10}V + 61$

d_1 : Distance from track central point to Noise receiving point (m)

l : Length of train (m)

V : Train speed (km/h)

α_1 : Shield attenuation by noise proof (if needed) (dB)

B) Structure Noise

$$L_{Amax}(C) = PWL_c - 5 - 10log_{10}d_2 + 10log_{10}\left\{\frac{\left(\frac{l}{2d_2}\right)}{1+\left(\frac{l}{2d_2}\right)^2} + \tan^{-1}\left(\frac{l}{2d_2}\right)\right\} + \Delta L_c \quad \text{-------- (2)}$$

When $L_{Amax}(C)$: Maximum Structure Noise Level (dB)

PWL_c : Power Level of Structure Noise (dB)

$PWL_c = PWL_c\,(100) + 20log_{10}\,(V/100)$

Concrete Viaduct : $PWL_c\,(100)$ = between 83 and 87 dB

Truss ballasted track : $PWL_c = 13\log_{10}V + 69$

d_2 : Distance from central point of Viaduct's undersurface to Noise receiving point (m)

ΔL_c : Correction value (dB)

If: r < 4h, $\Delta L_c = 0$

: r > 4h, $\Delta L_c = -10log_{10}\left(\frac{r}{4h}\right)$

r : Horizontal distance between Viaduct's central point and Noise receiving point (m)

h: Height of Viaduct's under surface (m)

C) Rolling stock device noise

$$L_{Amax}(M) = PWL_M - 5 - 10log_{10}d_1 + 10log_{10}\left\{\frac{\left(\frac{l}{2d_1}\right)}{1+\left(\frac{l}{2d_1}\right)^2} + \tan^{-1}\left(\frac{l}{2d_1}\right)\right\} + \alpha_1 \quad \text{-------- (3)}$$

When

$L_{Amax}(M)$: Maximum Rolling stock device Noise Level (dB)

PWL_M : Power Level of Rolling stock device Noise (dB)

$PWL_M = 60log_{10}\,(6.53V/100) + \beta$

β : Slab track = 67 dB, Ballast track = 62 dB

α_1 : Shield attenuation by noiseproof (if needed) (dB)

D) Maximum Noise level

Maximum Noise level under train passage is calculated by synthesizing Rolling Noise, Structure Noise and Rolling stock device noise (Calculation formula (1), (2) and (3)).

$$L_{Amax} = 10log_{10}\left(10^{\frac{L_{Amax}(R)}{10}} + 10^{\frac{L_{Amax}(C)}{10}} + 10^{\frac{L_{Amax}(M)}{10}}\right) \text{ -------- } (4)$$

iv) Correlation between L_{Amax} and L_{AE}

Correlation between L_{Amax} and L_{AE} is calculated by a formula as follows.

$$L_{AE} = L_{Amax} + 10log_{10}(l/(1000V/3600))$$

v) Calculation of Equivalent Noise level

Equivalent Noise level is calculated based on the L_{AE} of each train passing direction and its number.

$$L_{Aeq} = 10log_{10}\left[\left(\sum_{i=1}^{n} 10^{L_{AEi}/10}\right)/3600\right] \text{ -------- } (5)$$

When L_{AEi} : Single event noise exposure level of each train passing direction and its number

n : Number of train

vi) **Prediction Condition**

Noise prediction for railway is implemented in accordance with the below condition.

Table 6-6 Prediction Condition for Railway

Item		Condition
Prediction Point		Representative points of Viaduct, Embankment and Flat
Train Service	Number per hour	2.5
	Speed	Viaduct: 120 km/h Embankment: 50 km/h Flat: 30 km/h (To stop stations at both side of the River)
	Length	Approx. 300 m
Rolling Noise	PWL_R	Viaduct: 113 dB, Embankment and Flat: 100 dB
Structure Noise	PWL_c	Viaduct: 96 dB
Rolling stock device Noise	PWL_M	109 dB

vii) **Result of Noise prediction**

From Table 6-6 and Calculation Formula (1), (2), (3), (4) and (5), the assessment shows the equivalent noise level, which is the national standard unit, from train passage without any noise proof such as trees in the Eco-Park, any buildings etc.. Noise prediction results in three structural sections show as Figure 6-7 with sectional noise contour.

Viaduct Section

According to the result, Noise source level from train passage was predicted as approximately 84 dB within 1 meter. But fortunately, there is no residence along the proposed alignment because the viaduct section is only on the Jamuna River. Accodring to the Noise attenuation model which is Calculation formula (1), Equivalent noise source level might be reduced to approximately 26 dB even in case of the closest residence (approx. 750m) from viaduct section. Therefore, no mitigation measure is required.

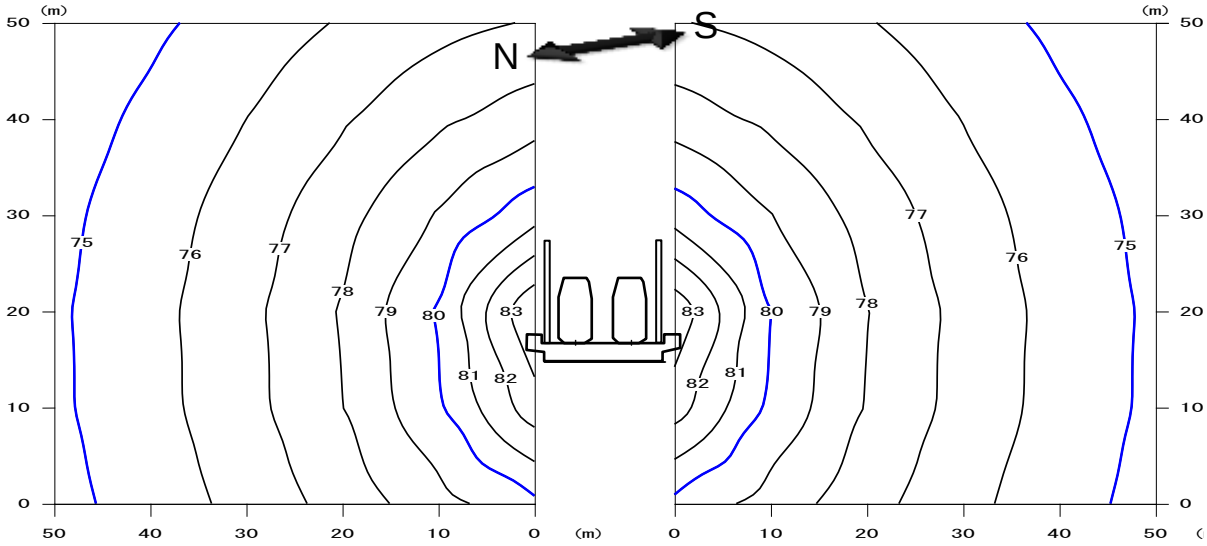


Figure 6-7 L_{Aeq} from train passage at viaduct section

Embankment Section

A respective embankment section on both side of the River is to be installed from both heads of the proposed bridge to both side stations; Bangabandhu satu east and Bangabandhu satu west, which are stop stations for every train and the closest residence from the proposed alignment would be the residential towers, whose height is approximately 45 meters at the cantonment on the east side. The distance would be approximately 125 meters. According to the result, Predicted Noise revel at the 125 m distance from the alignment would be less than 50 dB because of train speed - 50km/h, as Equivalent Noise level shown as Figure 6-8, which is within National Standards for Sound - 50 dB in daytime. Therefore, no mitigation measure is required.

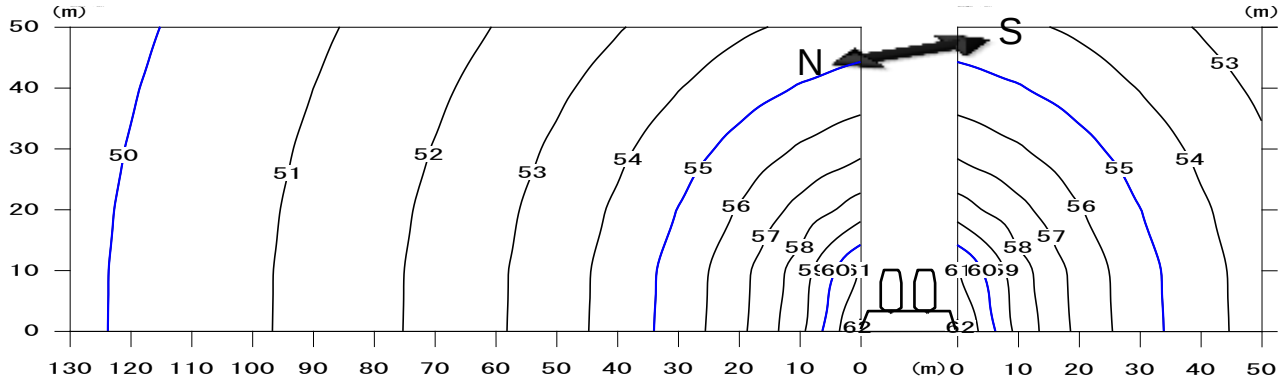


Figure 6-8L_{Aeq} from train passage on east embankment section

Flat Section

Since the proposed flat section would not be almost modified from the existing section, a noise level would be affected by augmentation of train speed. However, the speed would not also be increased in order to stop the stations on both side of the River. Therefore, the speed is set as 30 km/h in the prediction. The closest residence from the proposed alignment would be normal houses, on both side of the River, whose distance from the alignment is approximately 50 meters. The result of noise prediction is shown as below. According to the result, Predicted Noise revel would be covered below 50 dB, at any height as Equivalent Noise level shown as Figure 6-9, which is within the Standards for Sound - 50 dB in daytime. Therefore, no mitigation measure is required.

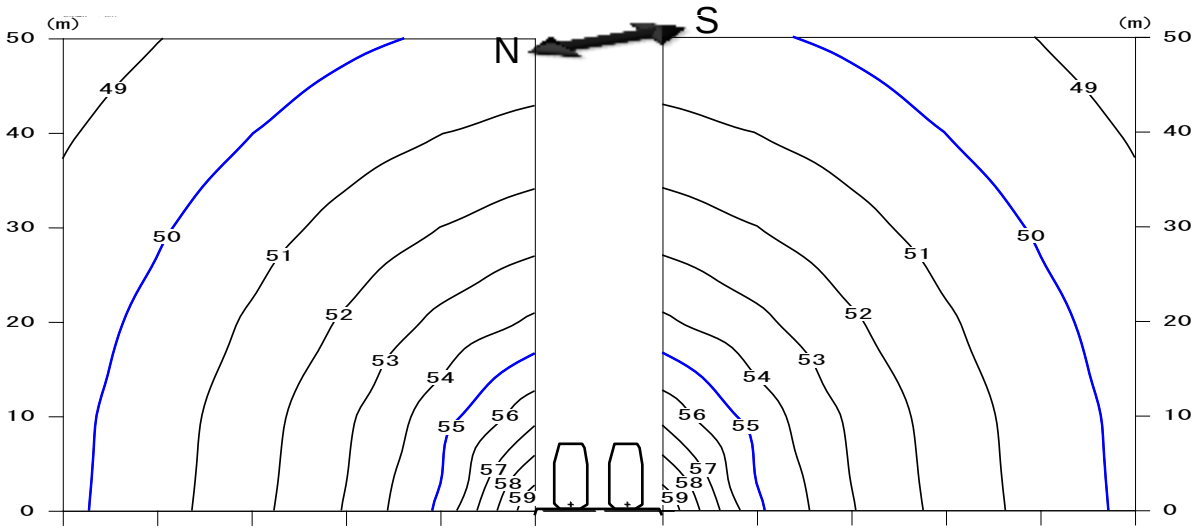


Figure 6-9 L_{Aeq} from train passage on Flat section

6.2.2 Vibration

In this assessment of vibration on the operation stage, Figure 6-10 which shows relation between distance and vibration level, at the train speed 150 miles/hour (= 240km/hour), from

the study Transit Noise and Vibration Impact Assessment of FTA (Federal Transit Administration, USA), must be one of the effective tools because there is no established prediction method regarding Railway's vibration internationally. In accordance with the graph and following equation, adjusted vibration level can be calculated by using below equation (6) and (7) in case of the train speed - between 50 miles/hour (= 80km/hour) and 150 miles/hour.

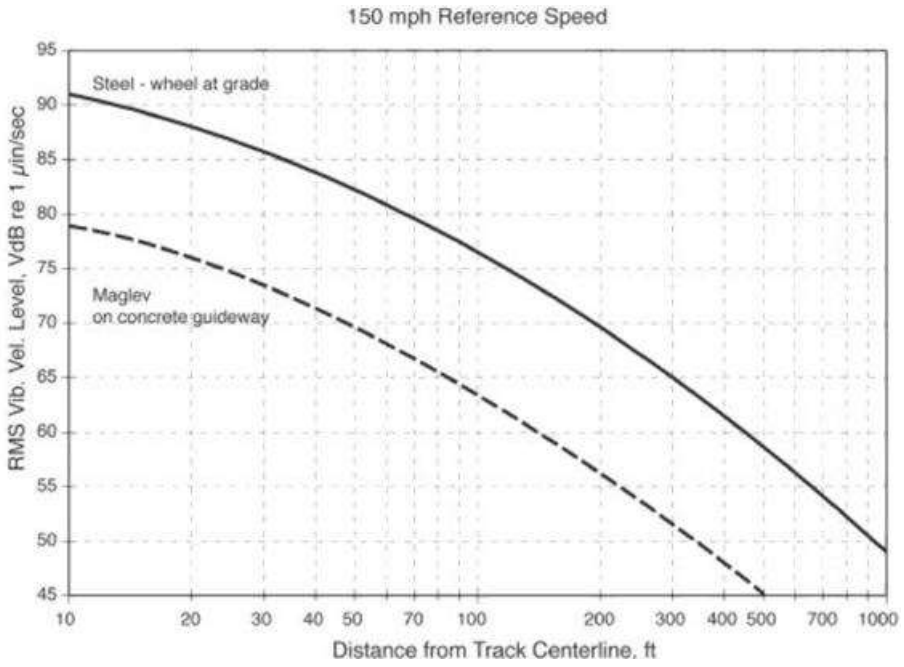


Figure 6-10 Borne Vibration Curve-Generalized Ground

Source: High-Speed Ground Transportation Noise and Vibration Impact Assessment (2005), Federal Railroad Administration, U. S. Department of Transportation

$$\text{Adjustment (V dB)} = 20log_{10}\left(Speed/Speed_{ref}\right) \text{ --------- (6)}$$

When $Speed_{ref}$: 240 km/hour

Since calculated vibration level is in V dB unit, a conversion from dB to in/sec should be implemented by using below equation;

$$\text{Lv} = 20log_{10}\left(V/V_{ref}\right) \text{ --------- (7)}$$

Lv = Vibration level in V dB unit

V = Vibration level in in/sec

$V_{ref} = 1.0 \times 10^{-6}\ in/sec$

According to the equation (6), adjustment vibration level is calculated as -6 dB in case of train speed of 120 km/hour. Therefore, when Vibration level is 65 dB at distance of 300 feet

from track centreline in case of 240 km/hour, it should be predicted as 59 dB, at same distance in case of 120 km/hour, which almost corresponds with 1.0 $\times 10^{-3}$ in/sec by using the equation (7). Herein below, as minimum distance from track centreline to residence would be approximately 50 meters, the vibration level could be predicted as 0.00631 in/sec, which almost corresponds with 0.16 millimetre/sec. The level is within the standard by Department of Industry, innovation and Science, Australian government, Issue BS-6472-2:2008, as shown in Table 6-7. Therefore, no mitigation measure is required.

Table 6-7 Forecasted Construction Vibration Level in Vulnerable Areas

Vulnerable Area		Approx. Distance (meter)	Vibration Level in PPV		
			PPV (in/sec)	PPV (mm/sec)	Standard Value in Australia (mm/sec)
1	Residential Area	50	0.00631	0.160	0.3
2	Jamuna Ananda Park	535	0.000398	0.0101	2.5
3	Jamuna Resort Wild Life Museum	330	0.000631	0.0160	2.5
4	Combined Cycle Power Plant	1,500	-	-	2.5
5	Power Grid Company of Bangladesh (PGCB)	1,130	-	-	2.5
6	Ponchoshona Resort	620	0.0002	0.00508	2.5

Source: Standard value for Ground vibration limits for human comfort by Department of Industry, innovation and Science, Australian government, Issue BS-6472-2:2008
Peak component particle velocity at Daytime
Residential : 0.3 mm/s
Offices : 0.6 mm/s
Occupied non-sensitive sites, such as factories and commercial premises : 2.5 mm/s

7 CHAPTER -ENVIRONMENTAL IMPACTS

7.1 Introduction

Construction is not an environment friendly process by nature, construction and operations have massive direct and indirect impacts on the environment. Some of the adverse impacts can be attributed to the construction activities in the projects even though they are short lived. The integration of environment into developmental planning is the most important tool in achieving sustainable development of an area. Construction of any developmental project is considered as one of the main sources of environmental pollution in the world. It has massive direct and indirect effects on the environment. The development project should be planned in such a manner that it has maximum number of positive impacts and bare minimum negative impacts on the environment.

It is expected that construction damages the fragile environment because of adverse impacts of construction and non-implementation of mitigation measures at the time of project execution. The adverse impacts include resource depletion due to the raw material extraction, waste generation and the disposal of the hazardous and construction waste, tree removal, emission of greenhouse gasses from the equipment's used for the construction and last but not the least the impacts on the human health.

An EIA Study comprises of based on the review of the proposed civil works, review of similar environmental reports, baseline monitoring, local population and stake holder's consultations, these above aspects would throw light on the likely social and environmental impacts caused due to the project implementation. The proposed Bangabandhu Railway Bridge project will gives better connectivity and faster movement for local population and for their goods.

7.2 Impact during Pre-Construction Stage

During the Pre-Construction Phase the environmental quality will remain intact as there will not be any physical activity. The major environmental and social impacts which are anticipated would occur during the construction phase. For a bridge project the major activities which can be envisaged are material transportation, labour camps, construction yards, activities related to construction etc. The construction activities can be listed out as piling, cutting and filling with material for foundation of bridge, may generate loose mud and soil which will increase the turbidity of the water body. Solid waste and effluents generated from the construction yards and labour camps may contribute to the environmental

degradation. Even though the impacts caused during the construction are of temporary nature and can be mitigated by applying of suitable mitigation measures.

The environmental impacts can be listed out to be positive and negative impacts for any developmental projects. The major positive impacts are to the local population and the positive impact will be giving an economic boost for the project area. The developmental projects have been associated with some negative impacts which can be fixed with suggested mitigation measures with timely implementation. The rest of the sections in the chapter will envisage the positive and negative impacts caused by the proposed bridge project.

7.3 Impact during Construction Stage

During the construction phase, heavy equipment will be used extensively during the bridge construction including bulldozers, excavators, asphalt mixers, formworks, and fabrication equipment. The construction and other equipment requires to be identified thoroughly, according to their capability and other desired functions. The foundation and the superstructure design will need to be considered. The sitting of this construction equipment's would require significant amount of space. In addition, it may also be necessary to temporarily acquire land, i.e. for the duration of project construction; for storage of the quarried material before crushing, crushed material, cement, rubble, etc. In addition to the above space provisions should be made for the hazardous materials like the petroleum, oil and lubricants and the proper disposal of used POL material should also be given due importance.

The labour camps and the safety aspects provided to the work force should be taken utmost importance during construction stage. The sanitary waste disposal, kitchen wastes from labour camps should be systematically disposed as per the district authority's directives. The provision of basic amenities for the labour like the drinking water, first aid facility and the fire extinguishers should be given utmost importance during the construction stage. The details of the impacts and its mitigation measures will be discussed in the following paragraphs.

The environmental Impacts are broadly divided into positive and negative impacts. The positive impacts include the following:

- Hauling material along a public road
- Dredging of trench/channel to bring barges to piling areas.

- Deposit earthwork materials for approach roads
- Construction of super structure
- Construction of substructure
- Disposal of waste
- Construction camps and its management.

The construction period, the section of the EMP lists out the impacts which requires immediate mitigation measures, where should it be applied, when to be applied and whom should apply, this is clearly detailed in the EMP Document. The EIA document identifies the likely impacts caused and suggests the mitigation measure to be taken up at the time of the project execution. The EMP details the responsibility and the training needs for a smooth implementation of the project.

7.3.1 Impact on Terrestrial flora and fauna

The local flora and fauna are likely to be impacted from the project activities of bridge construction and the allied activities. The proposed alignment passes through the Bangabandhu Eco Park on the Western Bank, which requires tree cutting. The alignment was given for the tree enumeration and species identification. Removal of trees may have impact on the amphibians, reptiles, and mammals and birds which were traced during the survey work. Overall impact of the project on terrestrial fauna is very minimal because of all wildlife movable. The construction activities of the project are to have low and temporary impact on the habitat of the aquatic life.

7.3.2 Impact on Migratory Winter Birds

Char land with their mudflats and sandy beaches are the major staging grounds for migratory birds within the project area. During the construction period if the construction activities coincide with the arrival of migratory birds that utilize the habitat, potential disturbance occur. Construction activities such as piling, dredging will impart potential negative impacts on the migratory birds. Noise from different vehicles and equipment and movement of workers will affect the migratory birds. To reduce air noise levels, mitigation measures such acoustic enclosure will be placed to cover the hammer and the exposed pile to reduce the air noise level. The air noise level can be reduced to about 60 dBA with these measures to minimize potential impacts on the birds. Although a triggered bird species has been identified during the bird survey, it was recognized that this bird species use the project area as flying route as their habitat does not exist in and around the proposed railway bridge site. Therefore, it is predicted that birds will slightly impact due to construction of the railway

bridge. However, if birds are affected due to construction activities, they may re-route their flying route and will also move their habitat temporarily during construction period and will high possibility to come back after completion of the work.

7.3.3 Impact on Dolphins

1. Pile driving should be conducted during non–seasonal time (winter, summer, pre-monsoon and post monsoon) as during the monsoon periods the movement of dolphins are quite high as the water level increases considerable high to minimise the impact on the dolphins. The water depth in the Jamuna also increases.
2. Before starting of piling 500 meters radius should be monitored around the piling area. If dolphins are observed in the area, than the piling work should be delayed until they left the area.
3. As per the Joint Nature Convention Committee a soft start, using a low energy start to the operations would give dolphin an opportunity to leave the area. The contractors are recommended to adopt these mitigation measures during pile driving activities.
4. Gradually ramp up the sound levels to scare the dolphins and other cetaceans away before piling proper commences.
5. Use pingers upstream and downstream to chase away dolphins and other cetaceans. Monitor area for these creatures to ensure they are well away from the piling site – scare them away if they are two close to the site using pingers.
6. In order to avoid impacts on these species, the construction works will be limited within the designated sites to the contractors. Regular monitoring of the worksite for animals trapped in, or in danger will be done and contractor will use a qualified person to relocate them
7. Acoustic enclosure will be placed to cover the hammer and the exposed pile to reduce the air noise. The air noise levels can be reduced to about 60 dB with these measures.
8. Monitor work areas for endangered reptile and bird species to ensure they are well away from the piling site

7.3.4 Impact on the Benthic Organisms

Construction of the project have the potential to affect benthic macro-invertebrates and fish due to loss of habitat from dredging, pier installation (e.g., pile driving, installation of cofferdams and fendering), the temporary change in bottom habitat resulting from dredging and subsequent placement of armoring, temporary increases in suspended sediment due to dredging and other sediment disturbing construction activities, and hydro acoustic effects on fish and benthic macro-invertebrates, as discussed in detail below

- There will be permanent and temporary impacts to benthic macroinvertebrates due to dredging and armoring.
- Temporary increases in suspended sediment and changes to the hydro-acoustic environment have the potential to affect benthic macroinvertebrate resources.
- While the dredging would result in the loss of individual macroinvertebrates, it is not expected to result in adverse impacts to these species at the population level within the Jamuna River. The majority of the bottom habitat and associated benthic macroinvertebrates within the area impacted is the soft sediment community. Recolonization by benthic organisms adapted to softer sediments could be expected to begin within a few months after completion of construction in any given area.
- *Benthic Macro invertebrates,-* construction activities expected to contribute to sediment resuspension include dredging, vessel movements, cofferdam construction, pile driving and demolition of the existing bridge.

7.3.5 Impact on Fish

Noise and Vibration through Pile Driving and dredging activities will affect the fish and other aquatic fauna. There will be temporary reduction of the benthic fauna within the dredged area would not substantially reduce foraging opportunities for the river's fish populations. Once construction is completed, the dredged channels would be restored over time to their original elevations by action of natural sedimentation, and the river's benthic community would recolonize those areas as well. The rate of this transformation would begin at approximately 1 foot per year, likely decreasing as the bed nears it natural pre-dredged elevation. These impacts would occur, in part, as a result of a localized reduction in benthic fauna. The construction period would minimize the potential for impacts to fish spawning. Thus, there will be temporary reduction in the number of fish species.

- Behavioral responses by fishes to increased suspended sediment concentrations include impairment of feeding, impaired ability to locate predators and reduced breeding activity.
- Decrease in dissolved oxygen concentrations in the surrounding waters and effects on growth rate.
- Effects on fish associated with noise from pile driving include damage to body tissue that can potentially result in death, sub-lethal effects that could result in temporary decreases in fitness, or to temporary or long-term changes in behavior.
- The degree of damage to fish and their hearing organs from pile driving is related to the received level and duration of the sound exposure

There is hardly any seasonal migration in the Jamuna River at Bangabandhu bridge site.so there will be no impact on Hilsa Fish. Hilsa fish breeding in the river Jamuna expected during the month of October. In the month October, there will no limitation on water flow of the river Jamuna. Hilsa breeding takes place in the upstream and in the confluence sites and moves to the downstream of the River.

7.3.6 Impact on Tree cutting

Local flora and fauna are likely to be impacted from the project activities of rail alignment. As the alignment passes through the Bangabandhu Eco Park on the western bank, there is sizeable trees will be removed from the park. The removal of trees and earth work may have impacts on endangered and vulnerable species of wildlife. However, the overall project impacts on the terrestrial flora and fauna is low and of temporary nature.

The construction activities of the project may have temporary impacts on the aquatic flora and faunal species. The dredging work at the pier location, barge access etc. during the construction stage may affect the aquatic fauna and flora. However, the impacts caused during the construction are short lived and can be regenerated once the construction work is completed.

7.3.7 Air Quality

Vehicles and stationary equipment will impact air quality at the construction site through emissions from the engines and equipment, fugitive emissions due to material handling, etc. Operation of crushers, concrete batch plants, construction work and movement of vehicles along unpaved road will generate dust & gaseous emission and impact air quality. The burning of waste will also affect air quality. In absence of proper fuel, construction workers at the project site may use wood for fuel burning.

Emissions from construction sites include those generated from the diesel engines operating vehicles and machinery. Diesel-fired engines emit particulate matter (soot) and gaseous emissions such as carbon monoxide, sulfur oxides, nitrogen oxides and organic compounds including polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) the latter being associated with the odor of diesel emissions.

The major air emission expected from construction activities is dust, that is, particulates. Health studies have established a relationship between fine particulates and respiratory

problems, especially for people within 'high-risk' groups such as children, asthmatics and the elderly.

During construction phase, there will be increased vehicular movement for transportation of various construction materials to the project site. Large quantity of dust is likely to be generated due to movement of trucks, dumpers and other heavy vehicles. The unpaved roads would give out more dust. Additionally, loose construction material loaded on trucks in open condition also adds to air pollution in the area. Movement of vehicles also generates dust. During the construction phase will visualise large, substantial increase in traffic will have serious impacts on air quality. Therefore, sufficient mitigation measures should be required to be implemented to minimize the impact on health of the people living being in the vicinity of the project area.

The following impacts are envisaged on air quality:

- Pollution due to fuel combustion in various equipment's
- Emissions from various crushers and other construction plants
- Fugitive Emissions from material handling and transportation
- The emission from the dumpers and other construction vehicles.

The contractor will be responsible for careful handling and storage of materials and operation of equipment in order to reduce the air pollution including the dust. Attention to be paid by the contractor for handling of petro chemicals in order to avoid environmental hazards and risks. The generator of 500 Kw capacities will emit the following air pollutants. Table 7-1 gives the air emissions from the 500 kW generators.

Table 7-1 Air pollutants from 500kW Generator

Sl.No	Parameters	Daily Emission	Annual Emission
1	Particulate Matter	5	1,923
2	Nitrogen Dioxide	83	30,310
3	Sulphur Dioxide	4	1,572
4	Carbon Dioxide	7,392	2,895,180
5	Carbon Monoxide	3,204	1,169,460
6	Total Organic Carbon	108	39,245

Source: Based on USEPA Ap42 Table 3.3.-1, 1997.

Mitigation Measures

- Placing of dust arresters surrounding the crusher and the construction yards will prevent the dispersion of the dust to a great extent.
- Spray water on the stones while unloading from the truck/dumper.
- Spray water at the primary crusher feeder chute.
- Spray water at the transfer points from one belt conveyor to another.

- Payload area of trucks will be covered by tarpaulins when transporting crush to prevent fall out of fines and emissions of dust
- Facility for regular cleaning and wetting of the ground should be provided.
- Trees of native species should be planted to develop a green belt within and along the boundary of the premises of construction yards and the labour camps.
- Impacts due to Movement of Vehicles, sprinkle water on the road surface in settled areas when dust levels rise, particularly in the dry season.
- Maintain all construction vehicles to minimize toxic vehicle emissions.
- Set and enforce speed limits, especially near schools, hospitals, sensitive zones and populated areas.
- Install appropriate signs warning drivers to slow down in settlement areas.
- Arrange flagmen to control the traffic at the construction waste disposal areas.
- Proper training to be imparted to the workers involved in the construction activity.
- The wind breakers are well maintained

Generators and compressors and other equipment should be shut down when not in use. The access roads for the construction yards should be sprinkled with water not to whirl dust. Vegetation of the pile is an excellent option whenever soil is likely to be exposed for a long period of time (greater than four weeks), or whenever works are completed in an area. Note there is also a requirement by the Department of Planning for dust control measures to be left in place until at least 70% vegetative cover has been established.

Alternatively, mulched green wastes can be temporarily laid over the stockpile and removed when required, and retained for later landscaping purposes.

7.3.8 Impact on the Noise and Vibration

The noise levels created by construction equipment will vary greatly depending on factors such as the type of equipment used, the specific model, the operation being performed, and the condition of the equipment. The equivalent sound level (L_{eq}) of the construction activity also depends on the fraction of time that the equipment is operated over the time period of construction. Noise levels are generated by individual pieces of construction equipment and specific construction operations from the basis for the prediction of construction-related noise levels. A variety of information exists related to sound emissions related to such equipment and operations.

Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, blasting operations, etc., produce variable and sporadic noise levels and often produce impact-type noises.

Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations which spread through the ground and diminish in strength with the distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations, with varying results ranging from no perceptible effects at the lowest levels, low rumbling sounds and fellable vibrations at moderate levels and slight damage at the highest levels. Ground vibrations from construction activities very rarely reach the levels that can damage structures, but can achieve the audible and fillable ranges in buildings very close to the site. A possible exception is the case of old, fragile buildings of historical significance where special care must be taken to avoid damage. The construction vibration criteria include special consideration for fragile buildings. The construction activities that typically generate the most severe vibrations are blasting and impact of pile driving. Vibration levels for construction equipment have been published based on measured data near various types of equipment. Since the primary concern with regard to construction vibration is building damage, construction vibration is generally assessed in terms of peak particle velocity (PPV).

Pile Driving: Pile driving may produce noise levels in excess of acceptable limits, even when feasible noise reduction methods are used. Various dampening and shielding methods discussed later can attain some reduction. However, such methods rarely reduce the noise level to an acceptable level for the sensitive receptors close to the site. As an alternative to driving piles, it is possible to use vibration or hydraulic insertion techniques. Drilled or augured holes for cast-in-place piles are another alternative that may produce noise levels significantly lower than the traditional driving method.

Compressors: While most compressors are powered by diesel or gasoline engines, many are contained or have baffles to help abate noise levels. Electric compressors are significantly quieter than diesel or gasoline engine powered compressors.

Mitigation Measures

Less noisy equipment: One of the most effective methods of diminishing the noise impacts caused by individual equipment is to use less noisy machinery. By specifying and/or using less noisy equipment, the impacts produced can be reduced or, in some cases, eliminated. Source control requirements may have the added benefits of promoting technological advances in the development of quieter equipment.

Mufflers: Most construction noise originates from internal combustion engines. A large part of the noise emitted is due to the air intake and exhaust cycle. Specifying the use of adequate muffler systems can control much of this engine noise.

Shields: Employing shields that are physically attached to the particular piece of equipment is effective, particularly for stationary equipment and where considerable noise reduction is required.

Dampeners: Equipment modifications, such as dampening of metal surfaces, are effective in reducing noise due to vibration. Another possibility is the redesign of a particular piece of equipment to achieve quieter noise levels.

Aprons: Sound aprons generally take the form of sound absorptive mats hung from the equipment or on frames attached to the equipment. The aprons can be constructed of rubber, lead-filled fabric, or PVC layers with possibly sound absorptive material covering the side facing the machine. Sound aprons are useful when the shielding must be frequently removed or if only partial covering is possible.

Enclosures: Enclosures for stationary work may be constructed of wood or any other suitable material and typically surround the specific operation area and equipment. The walls could be lined with sound absorptive material to prevent an increase of sound levels within the structure. They should be designed for ease of erection and dismantling.

Selection of Equipment: Newer equipment is generally quieter than old equipment for many reasons, including technological advancements and the lack of worn, loose, or

damaged components. Some equipment manufacturers have made their equipment quieter in recent years and have achieved significant reductions over older equipment. In some cases, the use of over- or under-powered equipment may be an unexpected source of excessive noise. The types of engines and power transfer methods also play a significant role in achieving lowered equipment noise. The use of electric powered equipment is typically quieter than diesel, and hydraulic powered equipment is quieter than pneumatic power.

Stationary source: positioning stationary noise sources such as generators and compressors as far away as possible from noise sensitive areas should be considered. Temporary barriers can be employed and/or enclosures can be built around noisy equipment. These techniques can significantly reduce noise levels and, in many cases, are relatively inexpensive. These barriers can typically be constructed on the work site from common construction building material (plywood, block, stacks, or spoils). Enclosures are often constructed from commercial panels lined with sound absorbing material to achieve the maximum possible shielding effect.

To be effective, the length of a barrier should be greater than its height, the noise source should not be visible, and any barrier should be located as close as possible to either the noise source or the receiver. In addition, providing increased distance between a noise source and a noise receiver can also be considered a form of abatement.

- Electric powered equipment, rather than diesel powered mechanical equipment would be utilized;
- Use of impact devices such as jackhammer, pavement breakers and pneumatic tools should be limited and shrouds would be utilized to limit noise exposure;
- Construction staging areas would have appropriate noise attenuation installed around the areas and would be configured to minimize backup alarm and other noises; Contractors and subcontractors would be required to properly maintain and service

  their equipment and install quality mufflers so they meet noise specifications;
- Sound attenuating curtains or shrouds would be used on the pile driving hammers to reduce noise when operating in close ecologically sensitive area
- Movable noise attenuation measures would be erected around pumps, trucks, and other noisy equipment when operating in close proximity to residential areas. Typical Noise levels are given in the below Table 7-2.

Table 7-2 Noise Levels from the various Equipment while operating

Sl.No	Equipment	Noise Level (dBA) with 50 feet from the source
1	Air Compressor	81
2	Backhoe	80
3	Ballast Equalizer	82
4	Ballast Tamper	83
5	Compactor	82
6	Concreate Mixer	85
7	Concrete Pump	82
8	Concrete Vibrator	76
9	Crane Derrick	88
10	Crane Mobile	83
11	Dozer	85
12	Generator	81
13	Impact Wrench	85
14	Jack Hammer	88
15	Loader	85
16	Pile Driver (impact)	101
17	Pile Driver (Sonic)	96
18	Pump	76
19	Rail Saw	90
20	Shovel	82
21	Truck	88

Source: the EPA Report Measured data from railroad construction equipment taken during the northeast corridor improvement project and other measured data.

Pile Driving Activity

- Using cofferdams and silt curtains, where feasible, to minimize discharge of sediment into the river.
- Using a vibratory pile driver to the extent feasible particularly for the initial pile segment.
- Limiting the periods of pile driving to no more than 10-12 hours/day. (in rare circumference it is possible that piling may extend further than 12 hours depending on the practicality of driving)
- Monitoring locations to characterize the hydro-acoustic field surrounding pile driving operations, which also includes a nearfield component to evaluate the performance of underwater noise attenuation systems that are integral to the project.
- Monitoring water quality parameters such as temperature and suspended sediment concentrations in the vicinity of the pile driving.
- Pile tapping (i.e. a series of minimal energy strikes) for an initial period to frighten fish so that they move from the immediate vicinity of pile driving activity.

Bridge Construction and Dredging

Since the proposed bridge alignment spans extensive shallows, it would be necessary to dredge an access channel for tugboats and barges to utilize during construction of the approach spans. These vessels would be instrumental in the installation of cofferdams, pile driving, the construction of pile caps and bridge piers, and the erection of steel truss superstructure and other components. As noted earlier, temporary, access platforms would be constructed near the construction areas to provide access for construction vehicles. The impacts caused by dredging can be mitigated by the following measures:

- Dredging would only be conducted during non-monsoon seasons.
- Use of an environmental bucket with no barge overflow unless the contractor develops a method of treating the overflow water to ensure that any discharge does not result in a substantial visible contrast with the receiving water
- Armoring of the channel to prevent re-suspension of sediment during the movement of construction vessels, installation and removal of cofferdams and pile driving

The approximate vibration levels produced. This data is gathered from the EIA report of Padma River. Table 7-3 gives the vibration level.

Table 7-3 Vibration Levels of the Equipment Used

Sl.No	Equipment	PPV at 25 feet (in/sec)	Approximate L at 25 feet
1	Pile Driver (impact)	Upper range: 1.518	112
		Typical:0.644	104
2	Pile Driver (Sonic)	Upper range:0.734	105
		Typical: 0.170	93
3	Large bulldozer	0.089	87
4	Caisson drilling	0.089	87
5	Loaded Trucks	0.076	86
6	Jack Hammer	0.035	79
7	Small bulldozer	0.003	58
RMS Velocity in decibels (VdB) re 1 u inch/second			

Mitigation Measures for Vibration

- Route heavily loaded trucks away from the residential streets, if possible select streets with fewest homes, if no alternatives are available.
- Operate earth moving equipment on the construction lot as far away from vibration-sensitive sites as possible
- Avoid night time activities. People are more aware of vibration in their homes during the night time hours.

- Avoid impact pile driving where possible in vibration sensitive areas. Drilled piles or the use of a sonic or vibratory pile driver causes lower vibration levels where the geological conditions permit their use.
- A mathematical model developed for the noise and vibration which attached in the appendix.

7.3.9 Impact due to Water Levels and Chars

General

The movement of the river channels has been restricted over time with the construction of erosion protections structures (hard points, dykes, spurs, and groynes) for the Existing Jamuna Multipurpose Bridge; particularly on the west bank. These protection works and the construction of the Jamuna Bridge guide bunds have already influenced the hydraulic and morphologic conditions within the reach of the bridge.

Between the braided channels within the study area there are a number of islands (Charlands) that are vegetated and relatively stable. During the Annual Average flood events, the water will extend across most of the braided belt but these islands remain exposed (Figure 7-4). At the bridge, the Annual Average flood waters do not cover the entire region between the guide bunds and the semi-permanent islands remain exposed (Figure 7-4).

During high magnitude flood events the islands up and downstream of the bridge and those between the guide bunds are inundated (Figure 7-5) and the flood waters extends for kilometres outside of the braided belt onto the floodplains (except where confined by flood embankments, the guide bunds, and the approach roads). At the bridge, the flood waters are “funnelled” through the gap between the guide bunds which results in an acceleration of the flow as the flow converges and a de-acceleration as it leaves. At higher magnitude floods (bankfull or greater) the presence of the RTW causes local variations in the water surface profile. In turn, this has affected the local flow conditions and morphology.

The introduction of the Jamuna Multipurpose Bridge crossing has already affected the longitudinal characteristics of the river within the reach containing the bridge and the river is adjusting as it attempts to restore an equilibrium profile.

The average water surface slope (gradient) of the river within the reach containing the bridge is approximately 6.5 cm/km. However, during flood events the bridge section or zone between the guide bunds becomes a regulating section that acts as a funnel which results in

a local gradient drop higher than the river average and corresponding higher velocity. Sediments are generally transported through this zone with local erosion and deposition resulting from changes in channel alignment. Soon after the guide bund construction, a planform has developed within this reach where the dominate flow path runs immediately adjacent to one of the guide bunds and a secondary flow path is generally located along at least a portion of the other guide bund. This has resulted in the establishment of a large char in the centre of the river.

In order to assess the incremental impact (change) to existing flood levels due to the construction of the proposed Rail Bridge a 2D hydrodynamic model was developed as described in Section 1.9 of the Hydrology Report. The assessment on change of flood levels (WLs) as discussed below.

Impact to flood levels (WLs)

The impact of the proposed Rail Bridge on flood water levels was assessed using the 2D hydrodynamic and morphological numerical modelling results by comparing the 100 year flood levels with the Rail Bridge to flood levels without Rail Bridge (Existing Conditions).

Table 7-4 shows that the change in water levels in the right and left main channels is 0.03m (at 701120.4 m Northing) and 0.09m (at 706841.9m Northing), respectively some 2.6 km & 7.9 km upstream of the propose Rail Bridge centreline, respectively. For the right channel, the afflux dissipates about 14km (712909.1m Northing) upstream of the Rail Bridge Centreline, while on the Left Channel the afflux dissipates about 9km upstream (707794.8m Northing). In this case the area occupied by the bridge piers is the only contributor to the increase in water level due to the reduction in conveyance area and local head losses. However, the channel geometry will adjust to compensate for the reduced conveyance area and the major of the impact caused by the piers will be local head losses.

Table 7-4 Jamuna River - Change in Water Levels for 100 year Flood Event

Northing (m)	Without Rail Bridge (m PWD)	With Rail Bridge (m PWD)	Afflux (m)	Northing (m)	Without Rail Bridge (m PWD)	With Rail Bridge (m PWD)	Afflux (m)
Right Channel				Left Channel			
718541.1	15.60	15.60	0.00	718371.6	15.68	15.67	-0.02
718053.5	15.59	15.59	0.00	717857.9	15.66	15.65	-0.02
717640.3	15.57	15.57	0.00	717330.9	15.63	15.61	-0.01
717186.0	15.56	15.56	0.00	716857.4	15.61	15.59	-0.01
716767.7	15.55	15.55	0.00	716346.7	15.59	15.58	-0.02
716350.8	15.53	15.53	0.00	715863.9	15.58	15.56	-0.02
715971.7	15.52	15.52	0.00	715384.8	15.56	15.54	-0.02

Northing (m)	Without Rail Bridge (m PWD)	With Rail Bridge (m PWD)	Afflux (m)	Northing (m)	Without Rail Bridge (m PWD)	With Rail Bridge (m PWD)	Afflux (m)
Right Channel				Left Channel			
715611.5	15.49	15.49	0.00	714838.8	15.52	15.50	-0.02
715198.8	15.45	15.46	0.00	714373.9	15.47	15.46	-0.02
714771.7	15.40	15.40	0.00	713913	15.41	15.39	-0.02
714281.3	15.38	15.38	0.00	713407.6	15.40	15.38	-0.02
713831.6	15.34	15.34	0.00	712988.1	15.38	15.36	-0.02
713445.6	15.31	15.31	0.00	712562.5	15.35	15.34	-0.02
713182.6	15.29	15.29	0.00	712412.6	15.34	15.33	-0.02
712909.1	15.26	15.27	0.01	712268.9	15.33	15.31	-0.02
712609.2	15.26	15.27	0.01	712197.2	15.33	15.31	-0.02
712206.9	15.24	15.25	0.00	711754.9	15.32	15.30	-0.02
711785.8	15.21	15.22	0.01	711205.9	15.27	15.25	-0.02
711507.4	15.19	15.20	0.02	710759.9	15.21	15.19	-0.02
711047.7	15.17	15.17	0.00	710282.3	15.16	15.14	-0.02
710579.8	15.15	15.14	-0.01	709710.2	15.10	15.07	-0.03
710096.6	15.10	15.10	0.00	709255	15.05	15.03	-0.02
709601.3	15.06	15.07	0.01	708941.9	15.02	15.01	-0.01
709138.9	15.04	15.05	0.01	708722.4	15.01	15.00	-0.01
708573.8	15.00	15.02	0.01	708516.9	15.00	15.00	-0.01
708095.9	14.97	14.98	0.01	708287.5	15.00	14.99	-0.01
707610.8	14.91	14.93	0.02	707794.8	14.99	14.99	0.00
707087.3	14.88	14.89	0.01	707294.4	14.97	14.98	0.01
706586.0	14.83	14.84	0.01	706841.9	14.88	14.97	0.09
706166.9	14.80	14.81	0.01	706428.5	14.89	14.94	0.05
705701.6	14.77	14.78	0.01	705958.7	14.81	14.83	0.03
705234.1	14.74	14.75	0.01	705432.3	14.78	14.80	0.01
704712.8	14.71	14.72	0.01	704978	14.77	14.79	0.02
704248.9	14.68	14.69	0.01	704588.3	14.74	14.76	0.03
703821.5	14.66	14.66	0.00	704087.5	14.68	14.69	0.02
703357.0	14.63	14.63	0.00	703620.9	14.59	14.58	-0.01
702914.4	14.60	14.61	0.00	703235.8	14.47	14.46	-0.01
702525.0	14.57	14.58	0.00	702855.6	14.45	14.46	0.01
702124.5	14.52	14.53	0.01	702420.7	14.44	14.45	0.01
701813.8	14.47	14.48	0.01	701943.0	14.43	14.44	0.01
701476.3	14.41	14.44	0.02	701522.6	14.42	14.43	0.01
701120.4	14.37	14.40	0.03	701121.8	14.41	14.41	0.01
700762.4	14.35	14.37	0.02	700694.7	14.37	14.36	-0.01
700440.3	14.33	14.35	0.02	700286.6	14.29	14.28	-0.01
700098.5	14.31	14.33	0.02	699831.1	14.22	14.19	-0.03
699794.8	14.29	14.31	0.02	699363.8	14.16	14.12	-0.04
699474.3	14.27	14.29	0.01	698863.4	14.12	14.09	-0.03
699262.2	14.25	14.26	0.01	698192.5	14.03	13.90	-0.13
699052.5	14.23	14.22	0.00	697814.0	13.94	13.85	-0.08
698809.1	14.19	14.16	-0.03	697360.5	13.87	13.78	-0.09
698504.6	14.13	14.06	-0.07	696859.7	13.81	13.74	-0.08
698192.5	14.03	13.90	-0.13	696404.9	13.77	13.70	-0.07
697814.0	13.94	13.85	-0.08	695874.4	13.75	13.69	-0.07
697360.5	13.87	13.78	-0.09	695405.5	13.74	13.68	-0.07
696859.7	13.81	13.74	-0.08	694897.4	13.72	13.67	-0.05
696404.9	13.77	13.70	-0.07	694416.9	13.67	13.65	-0.02
695874.4	13.75	13.69	-0.07	693943.6	13.62	13.61	-0.01
695405.5	13.74	13.68	-0.07	693488.5	13.43	13.41	-0.02
694897.4	13.72	13.67	-0.05	692998.7	13.29	13.26	-0.03
694416.9	13.67	13.65	-0.02	692528.3	13.27	13.21	-0.07
693943.6	13.62	13.61	-0.01	692018.0	13.26	13.22	-0.04
693488.5	13.43	13.41	-0.02	691518.6	13.27	13.21	-0.06
692998.7	13.29	13.26	-0.03	691080.0	13.27	13.20	-0.07
692528.3	13.27	13.21	-0.07	690590.8	13.25	13.20	-0.04

Northing (m)	Without Rail Bridge (m PWD)	With Rail Bridge (m PWD)	Afflux (m)	Northing (m)	Without Rail Bridge (m PWD)	With Rail Bridge (m PWD)	Afflux (m)
Right Channel				Left Channel			
692018.0	13.26	13.22	-0.04	690104.6	13.24	13.20	-0.04
691518.6	13.27	13.21	-0.06	689621.0	13.21	13.19	-0.02
691080.0	13.27	13.20	-0.07	689138.4	13.19	13.18	-0.01
690590.8	13.25	13.20	-0.04	688656.5	13.17	13.16	-0.01
690104.6	13.24	13.20	-0.04	-	-	-	-
689621.0	13.21	13.19	-0.02	-	-	-	-
689138.4	13.19	13.18	-0.01	-	-	-	-
688656.5	13.17	13.16	-0.01	-	-	-	-

The shaded cells are the approximate location of the "Existing" and propose "Rail Bridge"

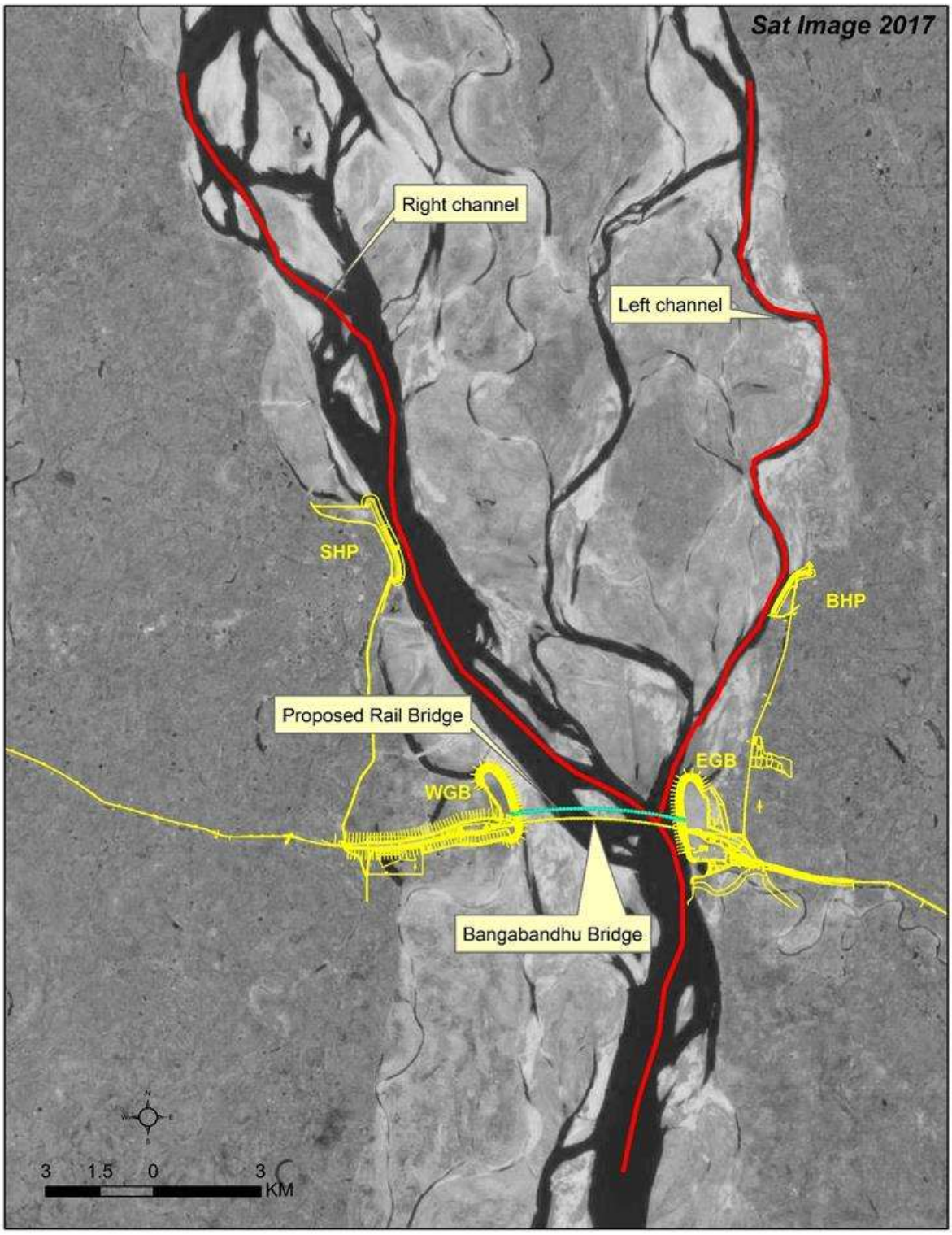


Figure 7-1 Jamuna River Channels for Long-Section WL Assessment

Figure 7-2 and Figure 7-3 shows the water level profiles comparison for with and without Rail Bridge scenarios for Right and Left River Channel profiles, respectively for the 100 year flood event.

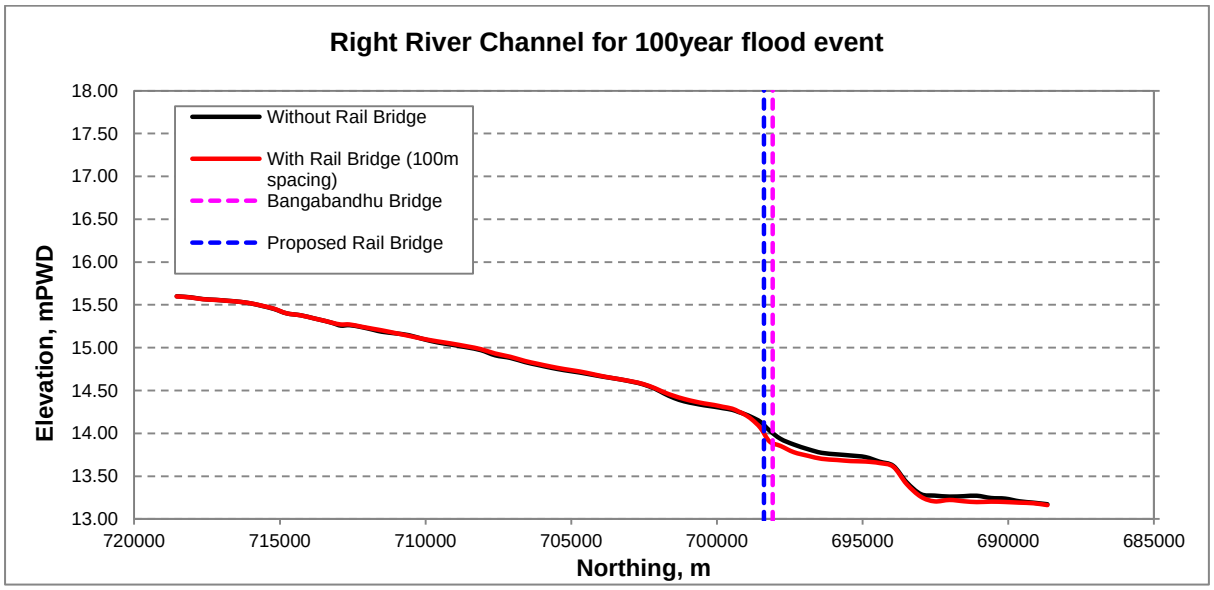


Figure 7-2 Jamuna Right Channel Surface Water Elevation for 100 year flood Event

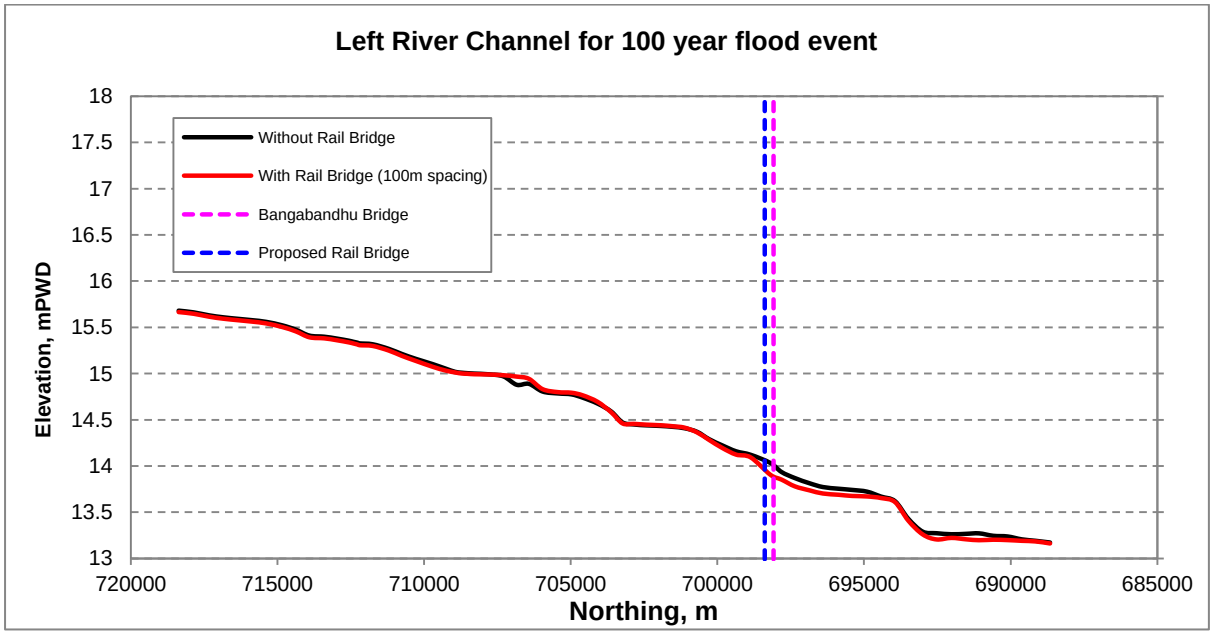


Figure 7-3 Jamuna Left Channel Surface Water Elevation for 100 year flood Event

Figure 7-4 and Figure 7-5 shows the change in water level (Afflux) for the Annual Average flood event (2.33-year return period) and for the 100-year flood events, respectively. These maps show that the incremental impact to water levels is minimal. The Blue colour in the map means the impact is zero or less while the Green colour means an increase in water by approximately 10cm or less.

Figure 7-4 show that the charlands are above the Annual Average flood level while during the 100-year flood event all charlands within the study area are under water (Figure 7-5).

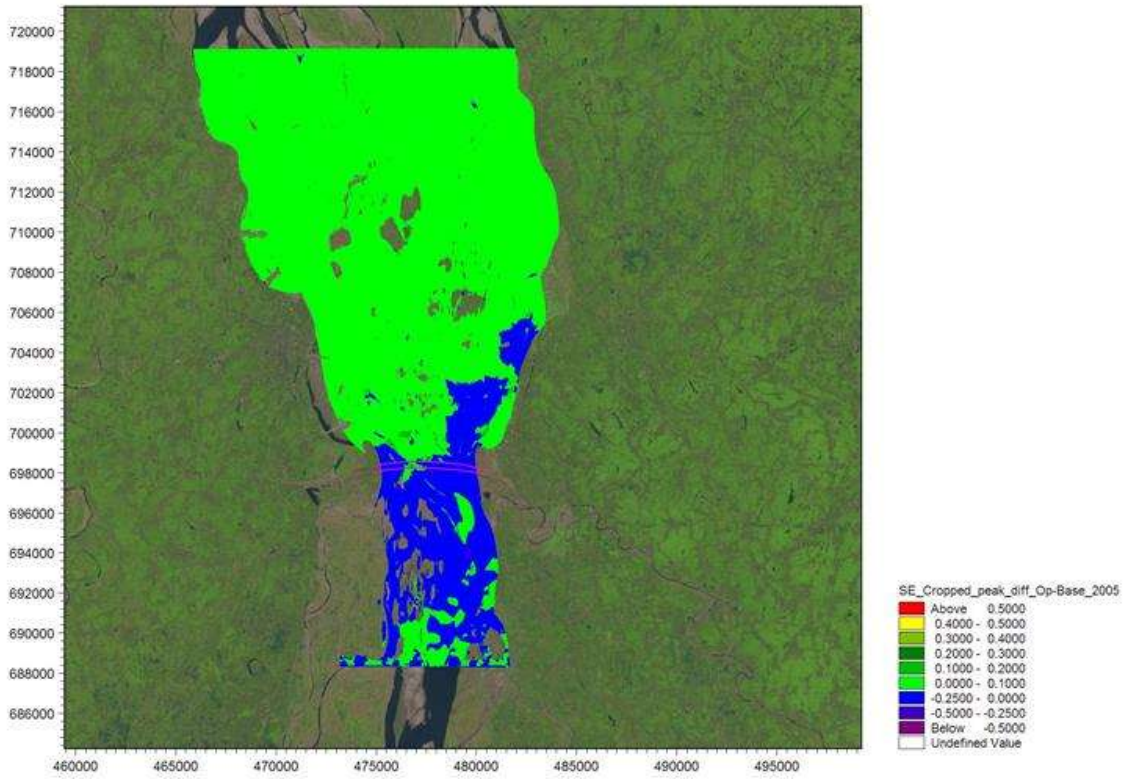


Figure 7-4 Jamuna River Change (Afflux) in Flood Levels for the Annual Average Flood Event

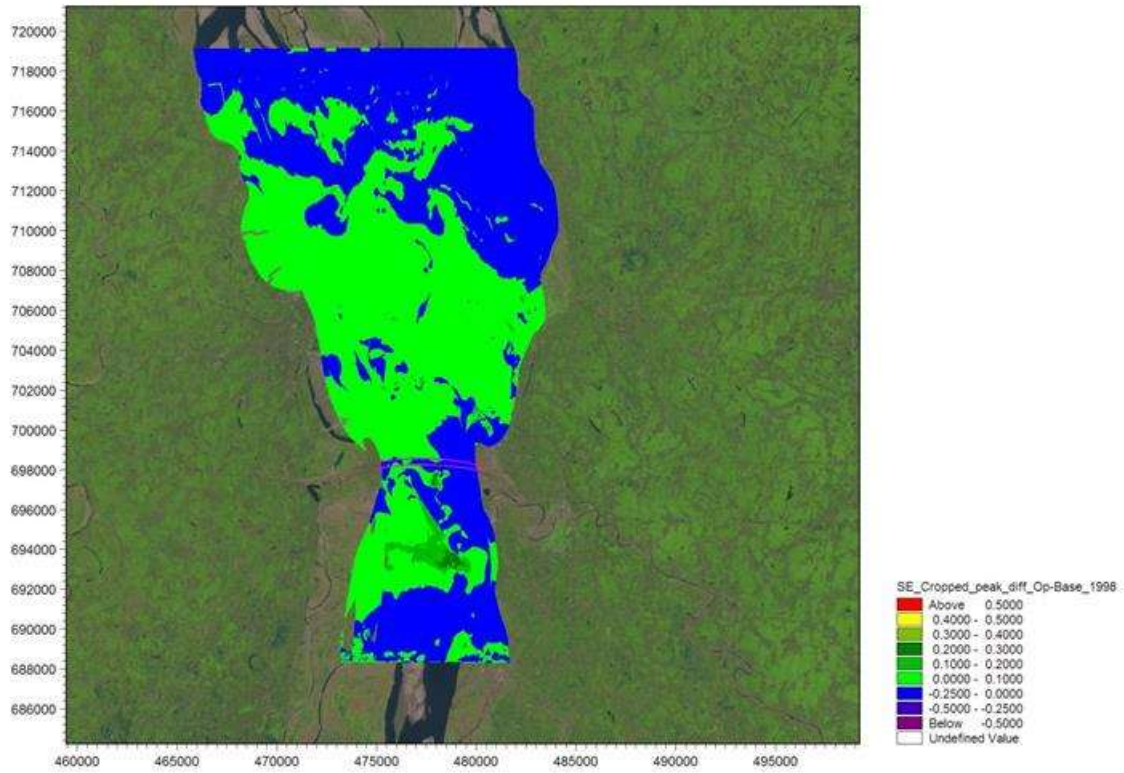


Figure 7-5 Jamuna River Change in Flood Levels (Afflux) for 100 year Flood Event

Based on the preliminary 2D hydrodynamic and morphological modelling results assessment, the water level pattern and flow distribution at the existing bridge will not be substantially affected by the presence of a new bridge located 300 m upstream. Rather, the effects of the proposed Rail Bridge on flood levels would be barely minimal.

Similarly, the flood inundation maps (Figure 7-5) shows that during an annual average flood event the charlands would not be inundated (Figure 7-4) while the charlands may get inundated during the 100-year flood event.

7.3.10 Impacts on the Community

Noise and Vibration

Although the noise levels are of temporary, construction activities can create noise levels sufficient to cause community annoyance and interfere with daily activities. Similarly, construction activities can cause vibration levels that may result in structural damage which leads for the community annoyance or interference with construction activities. Construction noise differs from traffic noise in a number of ways, including the following:

- Construction noise continues for a temporary time period.
- Construction activities generally take place for a limited period of time at any specific location;
- Construction noise may be intermittent and variable depending upon the type of construction activities taking place at a specific location and time period; and
- Construction noise is sporadic in nature, whereas traffic noise occurs continuously over the life of a facility.

7.3.11 Boat Traffic in Jamuna River

Fishing in Jamuna River is quite common. Fishing in this region is a big occupation. The construction of Bangabandhu Railway Bridge may give rise to some impacts on the fisher men community and public awareness should be brought about among them.

- Delivery of construction materials by vessel would increase usage of the navigation channel;
- Scow movements related to dredging would increase usage of the navigational channel;
- Construction of the main spans' substructure and superstructure would result in some restrictions to navigation; and
- Dredging would affect the fish population and increase suspended solids in the water.

7.3.12 Vehicular Traffic

Major construction projects and related activities have the potential impacts to inconvenience or disturb persons who reside near the areas adjacent to construction. Temporary impacts to adjacent neighborhoods include:

- Traffic congestion and detours;
- Disrupted access to residences and businesses;
- Loss of roadside parking;
- Disruption of utility services;
- Presence of construction workers, equipment, materials and staging areas including potential concrete batch;
- Noise and vibrations from construction equipment and vehicles;
- Airborne dust and possible mud on roadway surfaces; and
- Removal of or damage to vegetation

7.3.13 Community Awareness Program

Before the start of the project the local population should be well aware of the upcoming project. There should be regular interaction with the local population and make them understand the project activities.

- ✓ Notify the public of construction activities that may be perceived of as noisy and intrusive prior to starting construction; and
- ✓ Project Manager of contractor should establish a contact with local population in sorting out problems.
- ✓ The supervision consultant and contractor should handle problems arise out of the project and it should be amicably settled.

7.3.14 Movement of Construction material

There will be impact on the surrounding areas due to the truck movement carrying the construction material. The traffic management issues are also arising due to the movement of fully loaded trucks on the haul roads and on the regular roads. This movement of trucks may give raise to the increase in the dust levels. The traffic control should be prime importance for the contractor and for the executing body, BR, Government of Bangladesh. Heritage and Culture

The proposed bridge alignment is not passing through any heritage and cultural places. There are no impacts as such on the proposed bridge alignment.

7.3.15 Land Acquisition Resettlement and Rehabilitation Issues

There is no land acquisition or Resettlement and rehabilitation issues at the site. The entire alignment passes on the BBA Land, so there is as such there are no social problems associated with the project

7.3.16 Construction Camps

The construction camps will be placed on either side of the project. The mitigation measures to be applied for the pollutants emissions. The following measures to be adopted at the site

There are certain provisions which are compulsory to be provided at the construction sites as per the labour regulations. They are as follows:

- Every construction site should have supply of drinking water.
- Sanitary and washing facilities or showers are minimum requirement at each of the construction site.
- Accommodation for taking meals and for shelters during interruption of work due to adverse weather conditions.
- The provision of toilet or sanitary facilities, at the construction camps and the sanitary facilities should have proper flushing facility.
- If a minimum number of workers as prescribed are employed in any shift, at least one suitably equipped first aid room or station under the charge of the qualified first aid personnel or a nurse should be provided at a readily accessible place for treatment of minor injuries and as a rest place for seriously sick or injured workers.
- The equipment should be maintained in good working condition.
- The equipment should be operated by workers who have received appropriate training in accordance with national laws and regulations.
- The drivers and operators of vehicles and materials handling equipment should be medically fit, trained and tested and of a prescribed minimum age as required by the government rules and regulation.
- Suitable scaffolds from the ground shall be provided for the work force, who are working at elevated heights, if a ladder is used a proper foot holds and hand holds shall be provided on the ladder.
- Safety provisions shall be brought to the notice of all concerned by displaying or notice board at a prominent place at the work locations.
- The contractor shall be responsible for observance, by his sub-contractors, of the foregoing provisions.

- At every workplace, there shall be maintained in readily accessible place first aid appliances including an adequate supply of sterilized dressing and cotton wool as prescribed in the factory rules.
- The contractor should take adequate measures for the control of malaria, jaundice, Chickongunia, dengue etc.
- To be avoided child labor
- Grey water discharge after filter and appropriate drainage system in the camp
- The contractor should educate the work force about HIV/AIDS and launch awareness campaign among the work force.
- There should be proper enforcement of the labour laws at the work place.
- All vehicles used in the construction yard should have reverse horns
- There should be proper demarcation of work areas with sign boards showing the work areas should be placed.
- The signboards should be in local language.
- Suitable warning should be displayed at all places where contact with or proximity to electrical equipment can cause danger.
- Persons having to operate electrical equipment should be fully instructed as to any possible danger of the equipment concerned.
- All the electrical equipment should be inspected before it is taken into use to ensure that it is suitable for its purpose.
- Every construction site an adequate supply of wholesome drinking water should be provided.
- Sanitary and washing facilities or showers
- Facilities for changing and for storage and drying of clothing.
- Shelters for taking meals and to stay during interruption of work due to adverse weather conditions.
- Drinking water for common use should only be stored in closed containers from which the water should be dispensed through taps or cocks.
- The transport tanks, storage tanks and dispensing container should be designed, used, cleaned and disinfected at suitable intervals in a manner approved by the competent authority.
- Water that is unfit to drink should be conspicuously indicated by notices prohibiting workers from drinking it.
- A supply of drinking water should never be connected to a supply of water that is unfit to drink.

- Cloakrooms should be provided to the workers at easily accessible places and not to be used for any other purpose.

7.3.17 First Aid

The employer should be responsible for ensuring that first aid, including the provision of trained personnel, is available. Arrangements should be made for ensuring the removal for medical attention of workers who have suffered an accident or sudden illness. The manner in which first aid facilities and personnel are to be provided should be prescribed by national laws or regulations, and drawn up after consulting the competent health authority and the representative organizations of employers and workers concerned.

- ✓ First-aid kits or boxes, as appropriate, should be provided at the workplaces, including isolated locations and the motor vehicles used for construction like dumpers and tippers.
- ✓ First-aid kits and boxes should not contain anything besides material for first aid emergencies.
- ✓ First- aid kits and boxes should simple with clear instructions to be followed, be kept under the charge of a responsible person qualified to render first aid and be regularly inspected and kept properly stocked not running short of medicines.

7.3.18 Fire fighting

There should be firefighting facility at construction locations. The staff should face any emergency situations without many problems. There should be adequate measures as listed below:

- ✓ Secure storage areas should be provided for flammable liquids, solids and gases such as liquefied petroleum gas cylinder, paints and other such materials in order to deter trespassers.
- ✓ Smoking should be strictly prohibited and no smoking notices be predominantly displayed in all places containing readily combustible or flammable materials
- ✓ Only suitably protected electrical installations and equipment, including portable lamps, should be used.
- ✓ Oil rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place.
- ✓ Adequate ventilation should be provided.
- ✓ Combustible materials such as packing materials sawdust, greasy/oily waste and scrap wood or plastic should not be allowed to accumulate in work places but should be kept in closed metal containers in a safe place.

- ✓ Regular inspections should be made to places where there are fire risks. These include the vicinity of heating appliance, electrical installation, and conductors, stores of flammable and combustible material, hot welding and cutting operations
- ✓ Places where workers are employed should, if necessary to prevent the danger of fire, be provide suitable and sufficient fire-extinguishing equipment, which should be easily visible and accessible
- ✓ An adequate water supply at ample pressure.
- ✓ Fire-extinguishing equipment should be properly maintained and inspected at suitable intervals by a competent person.
- ✓ Where appropriate, suitable visual signs should be provided to indicate clearly the direction of escape routes in case of fire.
- ✓ The escape routes should be kept clear at all times.

7.3.19 Construction Waste disposal

The waste is generated from the construction activities and from the construction camps should be systematically disposed of. Some of the measures are as follows:

- A waste disposal site should be away from human settlement, because of incidence of health hazards.
- Generally barren lands are preferable for this purpose.
- A disposal site should be away from water streams.
- The place should be away from any archaeological and historical monuments
- It should be easily accessible from the main highway.
- A preliminary environmental and social study will help in taking proper precautionary measures for selecting a location for waste disposal.
- No dumping on private property is carried out without written consent of the owner.
- No dumping should be allowed on wetlands, forest areas, and other ecologically sensitive areas.
- The truck used should be spill proof as they move through settlements.
- There should be direction showing boards to the disposal site
- All the workers working at the disposal yard should be provided with safety attire.
- The waste carrying trucks should be properly covered by tarpaulin.
- The worker working at this area should be given proper training regarding the health hazards associated with the work.

7.3.20 Waste from Labour Camps

Disposing off the solid waste generated from the construction labour camp. The main waste generated from the kitchen comprise of the organic waste (eggshells, discarded foods, vegetable peels, meat and bones), inert materials like (polyethylene bags, and mineral water bottles) and wastewater flowing out of the construction yard. The waste water from the toilet should flow into the septic tank. Improper management may give rise to number of health problems and will give rise for the vectors to grow there. Uncontrolled solid waste dump sites could be breeding ground for vermin, and as such could pose a vector borne disease. Uncontrolled solid waste dump sites invariably attract casual dumping by others. This could encourage improper disposal of hazardous wastes, thereby posing a hazard to soil and groundwater quality. Some of the garbage management techniques are given below:

- Solid waste shall be regularly collected and disposed of in disposal sites approved by local authorities.
- For decreasing the use of inorganic fertilizer in the agricultural land, organic fertilizer may be produced from solid waste and distributed among the farmers for use in their crops land.
- Segregation of waste depending on the nature of the material should be conducted. Special attention should be given to diverting hazardous wastes for proper management in accordance with applicable regulatory requirements.
- Composting of appropriate organic wastes should be considered.
- The solid waste should be segregated in to recyclable wastes, inert wastes and plastic wastes. Most of the plastic resins can be recycled by applying pressure and high heat. These separate most resins into monomers that refined and re-polymerized.
- The construction wastewater and kitchen waste water will be sent out to two settling pits and once settled the water will be used for watering surrounding plantations. The settled material will be either used as fertilizer (from kitchen waste) or disposed to disposal sites approved by local authorities. Accumulated construction waste from the settling pit would comprise mainly of inert materials like silt.
- The waste water pit should be totally barricaded
- The garbage dump site to be provided with a safety barricading.
- The project will not develop a project-specific garbage dump site. Rather, solid wastes shall be regularly collected and disposed of in disposal sites approved by local authorities.

7.3.21 Impacts on Water Quality

The major sources of water pollution during project construction phase are as follows:

- Sewage from Construction work camps/colonies
- Effluent from Construction Plants and Workshops
- Disposal of solid waste

Mitigation Measures

- The sewage will be treated appropriately.
- The effluents will be suitable treated before letting out and it should be reused for the green belt development
- No disposal of cut spoils into gullies or watercourses.
- A waste disposal site should be away from human settlement, because of incidence of health hazards.
- Generally barren lands are preferable for this purpose disposal after obtaining the necessary permissions.

7.3.22 Sewage from Construction Worker Camps

The project construction is likely to last for a period of 2-3 years. Most of the employees/workers during construction phase are likely to be employed from outside the project area. The construction phase, also leads to mushrooming of various allied activities to meet the demand of immigrant Construction Worker population in the project area. Additionally drivers and labour associated with transportation of material will also stay in the area on temporary basis. There will be increased quantum of wastewater and sewage is generated, which requires immediate treatment.

Mitigation Measures

The construction wastewater and kitchen waste water will be sent out to two settling pits and once settled the water will be used for watering surrounding plantations. The settled material will be either used as fertilizer (from kitchen waste) or disposed to disposal sites approved by local authorities. Accumulated construction waste from the settling pit would comprise mainly of inert materials like silt.

7.3.23 Effluent from Construction Plants and Workshops

As discussed earlier, two major construction plants viz. aggregate processing and concrete mixing and major repair workshops will be established, apart from minor workshops and other construction equipment. Water is used and in these construction plants and

wastewater generated contains suspended solids. Similarly, from workshops, major pollutant will be oil and grease. Discharge of untreated wastewater will have serious impact on water quality of receiving water body. Turbidity and oil & grease levels will increase substantially in small tributaries, especially, in lean season.

Mitigation Measures

- Treatment in settling tanks before discharge to any water body or for land application.

7.3.24 Negative Impacts on Socio-Economic Environment

There are certain negative impacts due to influx of outside population. Workforce will reside in that area and also there will be large influx of drivers and other workers on temporary basis. This influx of people in otherwise isolated area may lead to various social and cultural conflicts during the construction stage. There may be incidence of new disease pattern in the area.

7.3.25 Labour Issues

The labour problem arises with bringing external labour force for work and likely impacts caused due to the new work force at the site. This was given in the following paragraphs
The use of local labour during the construction will increase benefits to the local community by providing employment opportunities and economic benefits. Increased traffic during construction will be managed through coordination between the contractor, and various authorities. Contractors will communicate to the public through community consultation regarding the scope and schedule of construction, as well as certain activities which causing disruptions or access restrictions.

The sitting of construction camps has the potential to cause conflict with the local population if done without consideration for local tradition and customs. The influx of a large number of outside workers into small villages may lead to conflict. The employment of local labour on the project will go some way to decreasing the risks but there will still need to a sizable proportion of the workforce recruited from outside the area. Construction camps must therefore be sited well away from local communities so to minimize interactions between the workforce and the local populations.

The construction sites are likely to have limited public health impacts due to their isolated location. However, contractors will ensure that no wastewater is discharged to local water bodies and that no site-specific landfills will be established at the construction camps. There

will be a potential for diseases to be transmitted, exacerbated by inadequate health and safety practices. Each contractor will therefore be required to recruit an environmental, health and safety manager to address such concerns in the work sites and liaise/work with the labourers. Some of the mitigation measures are suggested are listed below:

Mitigation measures

- Provision of adequate healthcare facilities (first aid) within construction sites;
- Training of all construction workers in basic sanitation and healthcare issues, general health and safety matters, an on the specific hazards of their work;
- Personal protection equipment for workers, such as safety boots, helmets, gloves, protective clothing, goggles and ear protection;
- Clean drinking water facility to all workers;
- Adequate protection to the general public, including safety barriers and marking of hazardous areas;
- Safe access across the construction site;
- Adequate drainage throughout the camp to ensure that disease vectors such as stagnant water bodies and puddles do not form; and
- Septic tank and garbage bins will be set up in construction site, which will be periodically cleared by the contractors to prevent outbreak of diseases.
- Where feasible the contractor will arrange the temporary integration of waste collection from work sites into existing waste collection systems and disposal facilities of nearby communities.

7.3.26 Hazardous Materials & Waste Management

During the construction period, a wide range and substantial volumes of waste may be generated including gravel; concrete; miscellaneous structures such as culverts, poles and cables; steel; organic material, such as cleared vegetation, timber; and soil. In addition, there will be oils, fuel, grease (POL Products) and chemicals from plant, equipment and vehicle servicing. Any hazardous materials that are used will also need to be stored and handled correctly to prevent spills and pollution. The following hazardous materials and waste management measures will be implemented during construction:

- All areas designated for the storage of fuels, oils, chemicals or other hazardous liquids shall have a compacted base and be surrounded by a bund to contain any spillage. These areas shall be covered by a roof structure to minimize the potential for infiltration and contamination of rainwater. Alternatively, ventilated containers and individual spill

pallets could be used, dependent on the volume of hazardous materials

- Areas designed for the storage of hazardous materials are to be clearly designated and storage of such materials outside these areas strictly prohibited.
- An Emergency Spills Contingency Plan shall be prepared as part of the Contractors EMP.
- Apply any waste minimization and management strategies as nominated;
- Dispose of waste to nominated project disposal sites;
- Ensure that the waste management measures are implemented on the project site;
- Prepare and implement a hazardous waste management plan for the disposal of waste oil, batteries and other hazardous materials;
- Ensure that topsoil is stockpiled for used in post construction landscaping;
- Chip and mulch vegetation cleared and reuse it as an organic base for re-vegetation; ensure that materials, which may cause land/water contamination or create odour problems, are not disposed of on the site;
- Keep work areas tidy
- Ensure that there is the adequate provision of correctly marked waste containers made available at convenient locations for the disposal of wastes
- Ensure adequate toilet and ablution facilities are provided for the duration of the contract. Domestic sewage and sullage from these facilities shall be subject to suitable treatment prior to discharge into environment. Under no circumstances untreated wastes shall be discharged into the environment.

7.3.27 LNG Pipeline

It is a cryogenic liquid that is odourless by nature, and is clear, non-corrosive and non-toxic. It is composed principally comprise of methane, together with ethane, propane and other heavier hydrocarbons. When LNG is warmed up, it re-gasifiers (transforms back into a gas). The usage of LNG is undoubtedly creating a positive impact on the environment. It is an ideal fuel with low carbon economy. It contributes to the sustainable development. LNG has lower risk in case of a leakage. The industries use LNG due to its fewer emissions of greenhouse gasses. Leakage from LNG, the available literature on LNG emphasises a number of positive features of this form of gas. Since LNG is odourless, colourless, non-combustible, non-corrosive and non-toxic, it will not pollute land or water resources. LNG is stored under ambient pressure; in case of tank/pipeline rupture will not cause any explosion. LNG vapours (primarily methane) are harder to ignite than other types of flammable liquid fuels. If LNG spills on the ground or on water, it will warm, rise and dissipate into the atmosphere. However, potential hazards include an ignition source near LNG vapours (which can cause a fire) and the risk of contact with an extremely cold substance. The LNG

pipeline is passing under the Proposed Railway Bridge across the Jamuna River. LNG is a cryogenic liquid (its boiling point at atmospheric pressure is -162°C (-259°F) that is not flammable in liquid form. However, forms as the LNG warms, and under certain conditions could result in vapor cloud. Uncontrolled release of LNG could lead to jet or pool fire if pool fires if an ignition source is present, or to a methane vapor cloud that is potentially flammable (flash fire) under unconfined or confined conditions if an ignition source is present. LNG spilled directly onto a warm surface such as water could result in a sudden phase change known as a Rapid Phase Transition. Fire and explosion hazards at LNG facilities may result from the presence of combustible gases and liquids, oxygen, and ignition sources during loading and unloading activities, and/or leaks and spills flammable products. Possible ignition sources include sparks associated with the buildup of static electricity, lightning, and open flames.

Mitigation Measures

- Design, construct, and operate LNG facilities according to internationally recognized standards and practices for the prevention and control of fire and explosion hazards.
- Prepare a formal fire response plan supported by the necessary resources and provide fire training and response as part of workforce health and safety induction/training. Training should include the use of fire suppression equipment and evacuation, with advanced fire safety training provided to a designated firefighting team.
- Properly equip facilities with fire detection and suppression equipment that meets internationally recognized technical specifications for the type and amount of flammable and combustible materials stored at the facility.
- Water is not suitable for fighting LNG fires, as it increases the vaporization rate of LNG.
- The LNG pipelines to be designed as per the international regulations, so as to control any gas leakage due pipe failure. The thick ness of the pipeline should be as per the international prescribed thickness.
- Install a cathodic protection system to prevent or minimize corrosion of the buried pipeline and aboveground facilities. The effectiveness of the cathodic protection system would be monitored during regularly scheduled cathodic protection surveys in accordance to the Government's Mandate.
- Cathodic protection surveys usually require walking along the pipeline right-of-way with monitoring instruments.

- Establishing and maintaining communications with local fire, police, and public officials in coordinating emergency response. keeping personnel, equipment, tools, and materials available at the scene in case emergency;

7.3.28 Environmental Mitigation Measures

Implementation Responsibilities: The implementation of the project is mainly based on the client and the contractor. The details of the implementation agencies are further elaborated in the EMP which forms a part of the EIA. The present section envisages about the likely impacts caused by the project and the mitigation measures are proposed. The environmental impacts along with the mitigation measures are given in a tabular form.

7.3.29 Workforce training

Training the construction workforce in awareness of air emissions can be carried out at all levels (workers, foremen, managers) and can be included in site induction courses. For example, workers can be trained to limit the surface area of an activity to reduce the scale of emissions e.g. dust or fumes from construction activities. Training could encourage workers to consider the timing of activities in relation to prevailing wind conditions, especially activities such as spray painting or sand blasting. Precaution to be taken at the wild life areas will also be considered.

7.3.30 Access Roads

The access roads are required for reaching the construction sites the construction of the access roads have their positive and negative impacts. They are as follows:

The likely impacts are:

- ✓ Clearing of site
- ✓ Removing of top soil
- ✓ Earth filling and compaction
- ✓ Waste disposal
- ✓ Tree cutting
- ✓ Provision of drainage.

The negative impacts include:

- Deterioration of air quality
- Removal of trees.

The trees would be cut along the approach road. The trees will be compensated by additional plantation at the identified location.

The top soil will be preserved and it will be used at a later stage of the project. Drainage will be provided so that the water does not get accumulated. The air quality will be affected due to the removal of trees.

7.3.31 Personal Protective Equipment

The most important aspect is the safety at the site while working on bridge projects. The following paragraphs throw light on the safety issues.

All employees must be provided with appropriate personal protective equipment (PPE) as specified by OSHA regulations and as necessary to control or eliminate hazardous exposures that may cause injury or illness. Personal protective equipment includes all clothing and other work accessories designed to create a barrier against workplace hazards. Selection of the proper type of personal protective equipment is important for protecting employees from workplace hazards. Employees and workers should receive training on how to use the PPEs.

To prevent injuries and illnesses, supervisors/foremen must implement and enforce the use of personal protective equipment on all company construction projects. Any employee who wilfully refuses to use or wilfully damages the prescribed personal protective equipment should be subject to the company safety enforcement policy

- The contractor shall provide all necessary safety appliances such as safety goggles, helmets, masks to the work force working at the construction site.
- Clear or colored goggles, a screen, a face shield or other suitable device when likely to be exposed to eye or face injury from airborne dust or flying particles, dangerous substances, harmful heat, light or other radiation and in particular during welding, flame cutting, rock drilling, concrete mixing or other hazardous work.
- Foot wear of an appropriate type when employed at places where there is the likelihood of exposure to adverse conditions or injury from falling or crushing objects, hot or hazardous substances, sharp-edged tools or nails etc.
- Distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure to danger from moving vehicles.
- Every worker should receive instruction and training regarding the general safety and health measures common to the construction site like general rights and duties of workers at the construction site, measures for good housekeeping, location and proper use of welfare amenities and first aid facilities provided in the construction

site, proper use and care of the items of personal protective equipment and protective clothing provided to the worker, general measures for personal hygiene and health protection, fire precautions to be taken, action taken in case of emergency and requirement of relevant safety and health rules and regulations.

- Hearing protection in accordance with national laws and regulations, this can be worn with safety helmet.
- In case of vibration, suitable protective gloves to be provided to the workers.
- Monitoring and control of the working environment and planning of safety and health precautions should be performed as prescribed by national laws and regulations.
- Electrician should be supplied with sufficient adequate tools and personal protective equipment such as rubber gloves, mats and blankets.
- Waterproof clothing and head covering when working in adverse weather conditions.
- For noise exposures above 90 decibels all employees must use hearing protection and must be included in a hearing conservation program Hearing protection devices (ear plugs or muffs) must be fitted or determined individually by a competent person. Ear muffs or plugs should be used for operations where the employee is exposed to excessive noise levels for extended periods of time. Cotton is not an acceptable substitute for prescribed hearing protection.
- To access high and low places on jobsites, a variety of equipment may be used such as ladders, scaffolding, suspended platforms, aerial lifts, stairways, and climbing lines. The use of these access systems often presents fall hazards. In addition, employees may be exposed to falls while working on elevated structures, climbing onto and off of equipment, and even while walking by falling through holes or by slipping or tripping.
- To protect employees when they are exposed to fall hazards, some form of fall protection must be used. The most common forms of fall protection are guardrails, personal fall arrest systems, hole covers, and safety nets. Any one or all of these forms of fall protection may be used on construction worksites. The current OSHA standards also require that employees receive training regarding fall protection issues, and that the training is documented. An alternate fall arrest program may be implemented in cases where none of the traditional methods of fall protection are feasible.
- *Safety Nets* - Safety nets need to be provided for all workplaces 25 ft. (7.6 m) or more above surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical. Safety nets must extend 8 ft. (2.4

m) beyond the edge of the surface where employees are exposed. Nets shall be hung no more than 25 ft. (7.6 m) below the work surface with sufficient clearance to prevent user's contact with the surfaces or structures below. Safety nets must be impact load tested prior to commencing operations.

- *Training* - All employees must receive training on the nature of the fall hazards at the site and on how to avoid falls. Employees should be familiar with the use of all personal fall arrest systems and must wear the equipment when necessary.

7.3.32 Employment Generation

The construction activity requires both skilled and unskilled workers at different levels and thus creates ample job opportunity for the local population during the construction phase. There will be huge demand of construction labour and different professional. There will be significant number of labour will come from the neighbouring districts. The project gives vast business opportunities for the small vendors also they can carry out their business. The products grown can be transported to other parts of the country in a much faster way.

There are power plants and industrial parks in Sirajganj District, the present rail bridge construction by the BR; Government of Bangladesh will give an economic boost for the overall area. There will be tremendous employment generation in this area. The sarees produced in Tangail can reach to other neighbouring international markets.

7.3.33 Economic Development

The Bangabandhu Railway Bridge will be vital for the economic development. The Bangabandhu Bridge technical issues can be addressed by constructing this bridge, the connectivity between East and west becomes much easier and the locomotives can run at normal speed and have no fright restrictions. The travel time from Dhaka to Sirajganj will be cut down drastically. The present traffic jams on the roads can be avoided to a great extent. The two districts Tangail and Sirajganj can be developed to an industrial destination and can offer more employment opportunities to the local population,

7.3.34 River Training Works

There will be significant positive impact with the implementing river training works. The protection works bring significant positive impact for the local population living on either side of the bank. The bank erosion can be controlled to a great extent.

River training refers to the structural measures which are taken to improve a river and its banks. River training is an important component in the prevention and mitigation of flash

floods and general flood control, as well as in other activities such as ensuring safe passage of a flood under a bridge

Guide banks are constructed in a river in order to: confine the flow to a single channel, improve the distribution of discharge across the width of a river thus controlling the angle of attack by a flash flood, protect weirs, barrages, or other hydraulic structures constructed in the river such as intakes from flash floods, control the meander pattern of a river, control overtopping of natural embankments in a flash flood and protect adjacent land from flooding, reduce erosion of banks by the water current, prevent sliding of soil as a result of the draw down effect of the flood water level, facilitate smooth transportation of water, and prevent piping of water through the banks.

7.3.35 Deterioration of Surface Water Quality

The developmental activities will generate several types of waters during the construction activities. The disposal of these wastes without treatment will degrade the water quality. The surface water quality has a significant impact on the aquatic flora and fauna. Keeping these important issues in mind the waste water and solid waste should not be disposed into the surface water.

7.3.36 Impacts due to the activities at Sirajganj

The Bangladesh Small and Cottage Industries Corporation (BSCIC) will soon start the construction work of an industrial park, costing Tk 6.28 billion, at Saydabad area in Sadar Upazila of Sirajganj district. The park will build on 400 acres of land, aiming to boost investment and create employment in the northern districts of the country. After the construction of Bangabandhu Bridge over the Jamuna River, Sirajganj has gained more importance and become an attraction for the investors due to the developed communication system. On the environmental front Effluent Treatment Plants (ETP), Central Effluent Treatment Plant (CETP) and dumping ground will also be installed in the park to prevent environmental pollution. The Bangladesh Government will be spending 1.00 billion BDT for providing the facilities. These industrial parks will provide job opportunities for more than 0.1 million people. About 500 acres of Char land and low lands are being used for the construction of new 450 Mw Saidabad Power Plant is going to be constructed adjacent to the Jamuna River. The char lands will be raised. This power project would create new job opportunities to the local population. The site located in a close proximity to Dhaka- Sirajganj Highway and rail Corridor. Some of the char lands are used for agriculture purpose. This is coming up next to the industrial park. All this activity will impact the river waters to a great

extent. With exiting power plants and the upcoming power plants would impact the surface water quality to a great extent. The development will give economic boost for the districts and will generate employment for the local population. The industrial clusters which are planned are next to the west bank of Jamuna. There will be considerable increase human population. This should be monitored by the Bangladesh Industries Department, Government of Bangladesh. If the environmental issues are not considered serious right from the beginning than it is going to impact the fisheries, birds, dolphins and the water quality of the Jamuna River.

Recommendation: As the proposed railway line passes through the Bangabandhu Eco Park and there will be cutting of trees. Another Eco park can be developed at one of the Char lands which are not getting inundated during the floor of Jamuna River and it can be developed in an Eco park and the surrounding area can be developed into a dolphin sanctuary. The place can be used as a restricted area. Native plants with profuse branching pattern can be used and it should be under the Department of Forests, Government of Bangladesh. The elevation of the Char land can be further improved by using the dredged material.

7.3.37 Sand Mining

Most of the land of Bangladesh is alluvial lowland of three large rivers flowing in Bangladesh they are Ganga, Jamuna and Meghna River. Sand mining is crucial for the sustenance of man; provides job opportunities and income; and enhances local economy. However, sand needs to be mined in a more responsible and sustainable manner. Sand mining contributes to construction of buildings and infrastructure development and provides both economic and social benefits. However, intensive sand mining with disregard to environmental protection significantly erodes these gains and creates a series of socio-economic and environmental problems.

Environmental Impacts

- Excessive sand-and-gravel mining causes the degradation of rivers. Instream mining lowers the stream bottom, which may lead to bank erosion.
- Sand mining is a threat to bridges, river banks and nearby structures. Sand mining also affects the adjoining groundwater system and the uses that local people make of the river.

- Sand mining results in the destruction of aquatic and riparian habitat through large changes in the channel morphology. Impacts include bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability. These physical impacts cause degradation of riparian and aquatic biota and may lead to the undermining of bridges and other structures
- Sand mining generates extra vehicle traffic, which negatively impairs the environment. Where access roads cross riparian areas, the local environment may be impacted.

Mitigation Measures

Compliance with legislation and regulations on sand mining is mandatory and necessity for responsible and sustainable sand mining.

- Proper site selection for sand mining
- Zoning of mining area for mining areas
- Modifying operational practices of sand mining
- River is not used for navigation or recreation or fishing
- Settlement along riverbanks (within 500 m or assessed high risk areas)
- Controlling the runoff and discharges

Avoiding Mining

- Avoid mining activities during the following periods:
- During or immediately after heavy rains
- During non-breeding season of fishes
- Avoid night time for sand mining
- No sand mining very near to the guide bunds

Sediment Treatment

- Construction of sedimentation ponds at the processing sites to regulate, trap the sediments
- Preparation of drainage ways and the outlet water to be handled concentration of the treated runoff.
- Slope protection and turfing on the exposed slopes to minimise the soil erosion
- A sedimentation pond is a basin and barrier made either of earth, rock or concrete
- Ponds should be properly designed to sufficiently trap and accommodate sediments transported by surface runoff.
- Ponds should be maintained by removing the deposited material at appropriate intervals.

- Sediments removed from the ponds should not be placed or disposed near the waterways

7.4 Impacts during Operational Stage

Though all post-construction activities will pose low, temporary, and localized impacts, there are increased risk air pollution, dust, noise pollution and vibration from the movements of locomotives, surface water pollution due to increased waste from operation of locomotives and accidental spill of hazardous material and increased safety risks.

7.4.1 Air Quality and Dust

The main atmospheric pollution during the operating period will come from the operation of rollingstocks. However, the combination of better equipment, more pollution control devices on the locomotives as the fleet is renewed and cleaner fuel will help to reduce any risk of increased air pollution and the emissions from the railway operation are not expected to result in the Project air shed exceeding National Air Quality Standards. Nevertheless, an air quality monitoring programme will be undertaken to establish changes in emissions as the train traffic increases over the first operating year. Air quality sampling will therefore take place during Years 1, 6, 7 and 8 of the operating period.

The LNG pipeline is passing under the Proposed Railway Bridge across the Jamuna River. LNG is a cryogenic liquid (its boiling point at atmospheric pressure is -162°C (-259°F) that is not flammable in liquid form. However, forms as the LNG warms, and under certain conditions could result in vapor cloud and cause air pollution. However, design, construct, and operate LNG facilities according to internationally recognized standards and practices for the prevention and control of any accidental LNG leakage will prevent any unwanted events.

7.4.2 Noise and Vibration

Noise and vibration pollution is one of the most significant negative impacts of the operation of a rail bridge. Moreover, Railway travel noise is compound of various noise types; Rolling noise, Structure noise and Rolling stock device noise. However, train noise along this corridor has been a fact of life for many years and the proposed rail bridge and embankments are located a far away from human settlements and therefore, noise modelling result in three structural sections namely viaduct section, embankment section and flat section are within the national noise level guidelines. However, noise impact on the migratory birds and other species of surrounding environment could be a concern.

Though the noise level has been predicted to be within the national standard, the risk of increased noise in operation stage can be mitigated through the use of rubber padding under sleepers, replacement of brake shoes with disc braking systems, minimal use of the train whistle particularly at night, and maintenance of a smooth rail lines through regular grinding. These steps will reduce train noise even in new establishment near the tracts.

A noise monitoring programme will be undertaken during Years 1, 6, 7 and 8 of the operating period to establish effects on sensitive receptors and to install attenuation features as required. It is defined in the EMP and a cost for noise modelling has been added to the budget.

By considering the minimum distance from track centreline to residence as approximately 50 meters, the vibration level has been predicted as 0.00631 in/sec, which almost corresponds with 0.16millimetre/sec. The level is within the standard by Department of Industry, innovation and Science, Australian government, Issue BS-6472-2:2008. However, vibration within 50 m of track side will be an issue, causing windows to rattle and poorly constructed walls to crack when a train passes. Noise and vibration attenuation designs related to sleeper pads, ballast placement and train operating limits will also help to keep noise and vibration as unobtrusive as possible.

7.4.3 Soil and Surface water quality

Soil and surface water could be polluted during the operating period from untreated sewage effluent discharged by passing trains as well as from accidental spillage of hazardous material. There is of course the issue of accidental spillage of oil and other noxious chemicals, after a train accident. Therefore, a spill contingency plan and good maintenance of track and rolling stock will help reduce the risk of such accidental spills, and permit rapid action if an accident does occur. Moreover, Garbage is thrown and sewage discharged onto the tracks from trains leads to chronic contamination of the surface water. Proper waste disposal facilities within the train and establishment of strict fine for garbage throwing will reduce the chance of throwing waste materials outside. In addition, retrofitting trains with sewage collection tanks to be pumped out at collection stations for delivery to STPs will also reduce chance of soil and surface water pollution.

7.4.4 Health & Safety

A number of Level Crossing are present at this project. Without proper management the level crossing will frequently cause severe injuries resulting in even deaths. Operation of at-grade rail crossings often creates serious traffic congestion regardless of location, sometimes blocking traffic even after the train has passed. Problems at level crossings are:

an increased number of trains running over the existing unimproved facility aggravating traffic congestion increased annoying vibration and noise, inadequate road traffic/lane control structures on either side of the level crossings permitting chaotic queuing and lane blockages, and long delays once a train has passed. To mitigate these problems, crossings will be assessed in term of provision of maximum line of sight and moved where possible. Vehicular traffic management systems at level crossings will also be upgraded. Provision of flag men at the level crossing should be ensured to curtail the local population moving across the level crossing Warning signs and gate lights will be installed and warning bells will be operated by the approaching train. Warning signs and disclaimers will be posted at all unauthorised crossings. Fencing along the railway track should be considered if required.

Fire and explosion hazards are also present as the LNG pipeline is passing under the Proposed Railway Bridge across the Jamuna River. Therefore, a formal fire response plan supported by the necessary resources should be planned. Provision of fire training and response as part of workforce health and safety induction/training should be ensured. Training should include the use of fire suppression equipment and evacuation, with advanced fire safety training provided to a designated firefighting team. Moreover, properly equipped facilities with fire detection and suppression equipment that meets internationally recognized technical specifications for the type and amount of flammable and combustible materials should be stored at the facility.

7.4.5 Scouring at pier location

Construction of the bridge may induce changes in the erosion and scour. Soil erosion from project sites and subsequent siltation may affect agricultural lands in the immediate vicinity. There is a chance of negative impact related to scouring at pier locations of main bridge. Natural scour occurs at certain points on a natural channel under the influence of varying flows, sediment transport, channel shifting and other fluvial processes. Local structure-induced scour results from interference with natural flows by bridge piers and abutments, river training structures etc. Where a structure is in place, it is not always easy to distinguish between natural and structure-induced effects. The deepest scour is usually, but not always, associated with the highest flows in the river, at least up to the bank-full stage. Once bank-full conditions are exceeded the flow may tend to straighten out and the velocity may not increase appreciably. Therefore, on braided or highly Anabranches River the worst scour condition may occur near bank full conditions.

The design and configuration of a bridge substructure will impact on scour development at the bridge piers and abutments. Local scour at piers can lead to severe damage to footings.

Routine investigation conducted by BBA identified scours on the existing guide bunds apparently due to the construction of the Bangabandhu Bridge. The proposed rail bridge may also cause similar scouring on the guide bunds. While pier design is dependent on site specific factors such as the superstructure, soil conditions and construction procedures, the pier's influence on the flow should also be considered. Hydrodynamically shaped piers help reduce the generation of turbulent flow. Poor flow alignment will contribute to increased erosion. A river will respond to alterations to flow conditions through erosion until an equilibrium state is reached. Therefore, regular inspection of the scouring condition at bridge site is necessary.

7.4.6 Employment Opportunities

The people who are involved in helping people for crossing the Jamuna River will lose their lively hood. The major impact will on the boat man who would be losing their lively hood should be provided with income restoration measures.

7.4.7 Mobility

Operation of the bridge will bring positive Impact on the mobility of local population. By getting the Railway Bridge, it will improve the movement faster and improve the nation economy. Proper manned level crossing should come up along the alignment, as the train movement will be faster.

7.5 Summary of Impacts

- Change in the land use can be observed at Sirajganj as the industrial parks are built up on the Char land formed in the Jamuna River.
- There will be considerable impact on the water quality of the Jamuna River. The industrial units may pollute the waters of the Jamuna River and the fish production may drastically reduce in this portion of the river.
- There will be loss of flood plains due to the construction activity.
- There may be loss in the fish catch due to the construction work. This might affect the local fisher men folk.
- Industrial Waste generated from the upcoming industrial units will be generating waste water at various stages of the industrial process; unless the waste water is not properly treated before disposing that will contaminate the soil and the water quality.
- There will be movement of local population towards the industrial areas to reduce the commuting time; this will lead to more problems like the generation of sanitary waste, waste water generation, biological waste etc.

- The air quality will also be affected due to the use of generators, increase in transportation vehicles and construction of residential accommodation would adversely impact the air quality.
- The noise levels will also go considerably due to the large population movement.

This section provides a summary of impacts from the proposed Railway Bridge Project across Jamuna River. The environmental impacts during the construction and operation period are shown via matrix presentation with the environmental graded according to their: the given tables show the impact rating. Table 7-5 and Table 7-6 show the impact matrix

- Magnitude
- Type
- Extent
- Duration

Table 7-5 Matrix with Definition of Magnitude, Type, Extent and duration of environmental impacts

Magnitude	Definition
3+	Major positive benefit
2+	Significant improvement
1+	Moderate improvement
0	No change
1-	Negative impact within acceptable level
2-	Significant negative impact, preventive measures are feasible
3-	Major Negative impact, preventive measures are extensive and/ or impossible
Type	Definition
Direct	As increase in workplaces during construction
indirect	as increase in trade locally from the project by workers etc.
Extent	Definition
Local	Can be observed within 1 km distance
Regional	Can be observed beyond 1 km
Duration	Definition
Short term	Impact with duration < year
Long term	Impact with duration > year

Table 7-6 Matrix with Graduation of Environmental Impacts Related to Design Construction and Operation

Environmental Parameters	Impacts based on magnitude			Comments
	Design Phase	Construction Phase	Operation Phase	
Land use	8	0	0	There will not be much change on the land use pattern
Landscape of the project area	10	0	0	The land scape of the project area will not be much impacted
Protected Area	12	0	0	The protected area like Bangabandhu Eco-Park Will face a lot of tree cutting.
Noise	14	-3	-1	During the construction there will be higher noise levels. During the operation stage, the noise levels

Environmental Parameters	Impacts based on magnitude			Comments
	Design Phase	Construction Phase	Operation Phase	
				are reduced but the more number of train's movement generates noise levels.
Air	15	-2	-1	During the construction the air quality will be affected due to the equipment used
Soil and water	16	-1	0	There will not be any impact during construction, but not during the operation stage.
Vegetation and fauna	18	-3	0	There will be heavy impact with tree cutting, but operation stage new plantation would come
Material and waste	20	-1	0	There will be impact during the construction stage.
Socio-culture	22	+1	+1	There will be employment opportunity during the construction stage. The movement becomes faster after the project implementation.
Occupational health and safety	23	-1	+1	The construction works increase risk for accidents

7.6 Impact Assessments

Impacts assessment depicted in the table throws light on issues such as infrastructure, transportation and communication. Health and Education facilities, socio economics, culture, better connectivity and tourism have the most/major positive significant impact. In addition, industry and agriculture have the positive impact. From this Railway bridge construction project, the above issues would be beneficial and give an economic boost for the project area. These parameters have positive impacts; with no mitigation measures are required or recommended.

However, air, surface water quality and noise levels have the most/major negative impact besides, soil, water, tree cutting and occupational health & safety have the moderate negative impact because of the project activities. Furthermore, climate, solid waste and waste and wet land habitats have the minor negative impact from this Railway bridge construction project. These issues might be problematic, concerned with environmental issue, for the study area if necessary mitigation measures would be taken into consideration

The remaining study was on environmental parameters such as topography, land, fauna, and protected areas. Landscape and areas of cultural value have no impacts from the activities of the Railway bridge construction project.

Graduation matrix of the environmental impacts is given in the below Table 7-7

Table 7-7 Matrix with graduation of environmental impacts in terms of magnitude, type, extent duration

Parameters	Magnitude (Weight, W)	Factor (F)	Total Impact T=W*F	Type	Extent	Duration
Topography	1	0	0			
Climate	-2	1	-2	Indirect	Regional	Long
Air	-3	3	-9	Direct	Local & Regional	Short
Soil	-2	3	-6	Direct	Local	Short
Sediments	-2	3	-6	Direct	Local	Short
Water	-2	3	-6	Direct	Local	Short
Waste generation	-3	3	-9	Direct	Local	Short/Long
Land use	-1	3	-3	Direct	Local	Short
Industry	2	3	6	Direct	Local & Regional	Short/Long
Agriculture	1	3	3	Direct	Local & Regional	Short/Long
Infrastructure	2	3	6	Direct	Local & Regional	Short/Long
Transportation	2	3	6	Direct	Local & Regional	Short/Long
Vegetation	-1	3	-3	Direct	Local	Short/Long
Fauna	-1	3	-3	Direct	Local	Short/Long
Protected	-2	3	-6	Direct	Local	Short/Long
Wetlands	-2	3	-6	Direct	Local	Short/Long
Landscape and areas of cultural value	1	3	3	Direct	Local	Short/Long
Demography	1	3	3	Direct	Local	Short/Long
Health	1	3	3	Direct	Local	Short/Long
Education	1	3	3	Direct	Local	Short/Long
Tourism	1	3	3	Direct	Local	Short/Long
Occupational Health	3	3	9	Direct	Local	Short/Long
Safety	-1	3	-3	Direct	Local	Short/Long
Representation of Factor						
Not Significant (+1)	Moderate Significant (+2)	Significant (+3)	Major Negative (-3)	Moderate Negative (-2)	Minor Negative (-1)	

It is expected that the mitigation measures mentioned in the EMP will be effective to reduce the adverse impacts and enhance the beneficial impacts. The following Table 7-8 presents the matrix with graduation with graduation of environmental impacts in terms of magnitude type, extent and duration after proper implementation of mitigation measures as suggested in the EMP. The further impacts are depicted in the below Table 7-9 and impact rating is given in Table 7-10.

Table 7-8 Matrix with graduation of environmental impacts After Implementation of EMP

Parameters	Magnitude (Weight, W)	Factor (F)	Total Impact T=W*F	Type	Extent	Duration
Topography	1	0	0			
Climate	-2	1	-2	Indirect	Regional	Long
Air	-1	3	-3	Direct	Local & Regional	Short
Soil	-1	3	-3	Direct	Local	Short
Sediments	-1	3	-3	Direct	Local	Short
Water	-1	3	-3	Direct	Local	Short

Parameters	Magnitude (Weight, W)	Factor (F)	Total Impact T=W*F	Type	Extent	Duration
Land use	0	3	0	Direct	Local	Short
Industry	2	3	6	Direct	Local & Regional	Short/Long
Agriculture	1	3	3	Direct	Local & Regional	Short/Long
Infrastructure	2	3	6	Direct	Local & Regional	Short/Long
Transportation	2	3	6	Direct	Local & Regional	Short/Long
Vegetation	-1	3	-3	Direct	Local	Short/Long
Fauna	-1	3	-3	Direct	Local	Short/Long
Protected	-1	3	-3	Direct	Local	Short/Long
Wetlands	-1	3	-3	Direct	Local	Short/Long
Landscape and areas of cultural value	1	3	3	Direct	Local	Short/Long
Demography	1	3	3	Direct	Local	Short/Long
Health	1	3	3	Direct	Local	Short/Long
Education	1	3	3	Direct	Local	Short/Long
Tourism	1	3	3	Direct	Local	Short/Long
Occupational Health	3	3	9	Direct	Local	Short/Long
Safety	0	3	0	Direct	Local	Short/Long

Table 7-9 Impact Matrix- Railway Bridge Project

Anticipated Impacts / Affected Activities		Pre/During Construction							Operation				
JICA	EIA Study-2017	During Construction	Land acquisition	Alteration of ground	Tree cutting	Construction Vehicles & Equipment's	Traffic restriction at Construction Site	influx of construction labour	Operation Stage	Influx of settlers	Commercialisation and industrialisation of the area	Employment Generation	Increasing of traffic volume
Air Pollution	Air Quality	B-	D-	D-	B-	B	B	D-	B-	B-	D-	D+	D-
Water Pollution	Water Quality	B-	D-	B-	B-	B-	B-	D-	D-	B-	D-	D+	D-
Waste	Solid Waste	B-	D-	D-	B-	B-	B-	B-	D-	D-	D-	D+	D-
Soil Contamination	Soil Quality	C-	D-	D-	B-	B-	B-	B-	D-	D-	D-	D+	D-
Ambient Noise & Vibration	Ambient Noise	B-	D-	D-	D-	B-	B-	D-	B-	B-	D-	D+	D-
Ground Subsidence		B-	D-	D-	D-	B-	B-	D-	D-	D-	D-	D+	D-
Odour		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Sediment Quality	Sediment Quality	B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Protected Area	Eco-Park	B-	D-	B-	B-	B-	D-	D-	B-	D-	D-	D+	D-
Ecosystem	Ecology, biodiversity/ construction labour camps	B-	D-	B-	B-	B-	D-	D-	B-	D-	D-	D+	B-
Hydrology		B-	D-	D-	D-	D-	D-	D-	B-	D-	D-	D+	D-
Topography & Geology	Topography soil and geology	B-	D-	D-	B-	D-	D-	D-	B-	D-	D-	D+	D-
Involuntary resettlement		B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
The Poor		B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Indigenous and ethnic people		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Local economy such as employment & livelihood	Quality life of the fisheries	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Land use and utilization of local resources	Land use/Fisheries	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Waste usage	Water Quality	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Existing social infrastructures and services	Utility services and community severance	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-

Anticipated Impacts / Affected Activities		Pre/During Construction							Operation				
JICA	EIA Study-2017	During Construction	Land acquisition	Alteration of ground	Tree cutting	Construction Vehicles & Equipment's	Traffic restriction at Construction Site	influx of construction labour	Operation Stage	Influx of settlers	Commercialisation and industrialisation of the area	Employment Generation	Increasing of traffic volume
social institutions such as local decision making institutions		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Misdistribution of benefit and damage	Quality life	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Local conflict of interests		B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Cultural heritage	Archaeological/heritage	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D+	D-
Land Scape	Aesthetics and landscape	B-	D-	D-	D-	D-	D-	D-	B-	D-	D-	D+	D-
Gender		C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
Right of Children		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
Infectious diseases like HIV/AIDs		B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
Labour Environment including work safety		B-	D-	D-	D-	D-	D-	B-	D-	D-	D-	D-	D-
Accidents	Accidents hazards and safety	D-	D-	D-	B-	B-	D-	D-	D-	B-	D-	D-	D-
Cross boundary impacts and climate change		B-	D-	D-	B-	D-	BI	B-	C-	C-	D-	D-	D-

A: Serious Impact Expected out of the Project

B: Some adverse impacts are expected

C: Serious impacts are not expected

D: Few impacts are expected (+ Positive/- Negative)

Table 7-10 Impact Rating- Railway Bridge Project

Impact	Pre/During Construction	After Construction	Reasons for Rating	
			Construction Phase	Operation phase
Air Pollution	B-	B-	Temporary negative impacts are expected on air quality due to construction machinery and vehicles	Negative impacts can be expected due to the usage of the facility
Water Pollution	B-	D-	Turbidity of surface waters may be due to the dredging activity and construction works	No serious impacts are anticipated during the operation stage
Waste	B-	D-	Construction waste, sanitary and organic waste from the labour camps	Waste generation due to the increase in the population at the project site
Soil Contamination	C-	D-	Soil gets impacted due to the construction activity, material dump site leakage of oil from the equipment affect the soil quality	There will not be any serious threat on the soil
Ambient Noise & Vibration	B-	B-	Noise generated while pile driving and the construction activities	The noise and vibration level will be higher during the operation stage also, as number of trains will be increased
Ground Subsidence	B-	D-	Excess ground water pumping may cause ground subsidence	There will be impact on the land subsidence
Odour	D-	D-	No activity would give raise to odour problem	No Odour problem
Sediment Quality	B-	D-	The bridge work causes a lot of impact on the sediment due to dredging activity	No impact on sediment
Protected Area	B-	B-	There will be loss of trees due to the construction activity, number of plants to be removed at the Bangabandhu Eco Park	Loss of vegetation, the migratory birds may look for alternate habitat
Ecosystem	B-	B-	The activity on the railway alignment will impact the ecosystem	The activity on the rail alignment will impact the ecosystem
Hydrology	B-	B-	Construction of a bridge changes hydrology	Construction of a bridge changes hydrology
Topography & Geology	B-	B-	No serious impacts can be expected during the construction of the bridge	No serious impacts
Involuntary resettlement	B-	D-	During the construction there will be people move to site looking for opportunity	During the operation settlement may come for settling
The Poor	B-	D-	Impacts will be there poor people the cost of living will go up	The poor people may get opportunity and can earn money during the operation stage
Indigenous and ethnic people	D-	D-	There may be few impacts on indigenous people	There no impacts
Local economy such as employment & livelihood	D-	D-	There will be employment opportunities	There will be employment opportunity

Impact	Pre/During Construction	After Construction	Reasons for Rating	
			Construction Phase	Operation phase
Land use and utilization of local resources	C-	D-	The fisheries may be affected due to the construction of Bridge	The impact may be reduced once the construction is over
Waste usage	D-	D-	Impacts will be during the construction of the bridge and the water quality will be affected, but the impact is temporary.	There are very few impacts on the local population
Existing social infrastructures and services	D-	D-	There are no impacts	There are no impacts
social institutions such as local decision-making institutions	D-	D-	There are no impacts	There are no impacts
Misdistribution of benefit and damage	D-	D-	There will not be any notable impacts	There will not be any notable impacts
Local conflict of interests	B-	D-	The conflict among locals for the employment	There will be employment opportunity
Cultural heritage	D-	D-	There will not be any impacts	There will not be any negative impact
Land Scape	B-	B-	The landscape may change during construction	The landscape will change.
Gender	C-	D-	The male dominated society	No impact
Right of Children	D-	D-	Few impacts are expected	Few impacts are expected
Infectious diseases like HIV/AIDs	B-	D-	AIDs/HIV due to labour migration	Few impacts are expected
Labour Environment including work safety	B-	D-	Construction work force should abide by the relevant laws	No impacts
Accidents	D-	D-	There will be mild impacts	There will be mild impacts
Cross boundary impacts and climate change	B-	C-	Tree cutting, operation of construction equipment increase greenhouse	The vehicular traffic may increase. The movement of trains increase. Economy will go up.

7.6.1 Assessment of Projects as per JICA

The objective of environmental scoping is to identify significant environmental impacts for the proposed Railway bridge construction project. In this process of the environmental scoping, collection of existing data from all possible sources was carried out. Then, an environmental reconnaissance was conducted with below check in hand to identify and delineate the significant effect of the project and eliminate the others from considerations. The mitigation measures were proposed for the identified environmental impact items. It is noteworthy that the checklists including 30 general environmental impacts were prepared referring JICA guidelines.

7.6.2 Conclusion

The project will be beneficial to the local population, but there should be timely mitigation of adverse impacts. The responsibility is on every one in addressing the adverse impacts. A matrix was prepared as per the JICA guidelines to predict an impact rating.

8 CHAPTER- SOCIAL CONSIDERATIONS

8.1 Introduction

In order to meet the increasing national and sub-regional traffic demand, GoB recognizes the urgent need to construct a dedicated railway bridge over the Jamuna River parallel to existing Bangabandhu Bridge with the provision of dual gauge double track. Accordingly, the Project envisaged construction of a 4.8 km railway bridge over the river and 11.3 km railway. Proposed New railway bridge (Bangabandhu Railway Bridge) will be constructed parallel to and approximately 300 m upstream of the existing Bangabandhu Bridge, which will be connecting north eastern part of Bangladesh and is considered as an important part of the international and future regional transport networks. The construction works also includes Renovation & Remodeling of Bangabandhu Setu East (BBE) Station and Bangabandhu Setu West (BBW) Station with Computer Based Interlocking (CBI) Signaling System.

8.2 Objective

JICA Guidelines for Environmental and Social Considerations (April 2010) applied to the Project which is considered as category 'A' to ensure environmental and social impacts of the Project is considered and effectively assessed in accordance with JICA Guidelines. The overall objective of social considerations within the framework of EIA is to assess the social impacts of the Project.

8.3 Scope

The general scope of work for social considerations includes:

- Involuntary resettlement;
- Gender;
- Communicable diseases like HIV/AIDS/STD;
- Potentiality of human trafficking.
- Children's rights;
- Occupational Safety, Environment Health and Safety (EHS) including PPE at work sites;
- Vulnerable social groups and ethnic minorities;
- Stakeholder engagement.

8.4 Approach and Methodology

In order to achieve the objectives as per the scope of work the following methodologies were applied:

- Reconnaissance survey at Project sites;

- Public consultation meetings;
- Focused group discussions;
- One-to-one interview/ Key informant interviews with government officials and locals.

Mainly qualitative information was gathered by applying the participatory approach and observation methods.

8.5 Findings

8.5.1 Involuntary Resettlement

The alignment of proposed Bangabandhu Railway Bridge cross through a newly emerged low-lying Charland (sand bar) in the middle of Jamuna River without any human settlement. As per draft detailed design, the Bridge Construction does not require any land acquisition or displacement of any people thus requiring almost little social consideration. The proposed starting point and end point of the Rail Bridge was visually surveyed. It passed through the protected cantonment area of the Bangladesh Army at the East part; and at the West, it passes through the existing Eco-park which is also government land. Hence, no squatter and encroacher on the land was found so there is no possibility of any displacement of people and loss of private property. It was confirmed during discussion with a number of people of that area. From visual survey and discussion, it was confirmed that no substantial social and economic impact will result in due to the construction of new bridge.

Bangabandhu East and West Railway Bridge Stations and the layout of the existing yards of the stations were visually verified in this regard for the purpose of assessment of any potential socioeconomic impact. The renovation and remodeling of both the stations will create no socioeconomic impact. Some temporary food stalls and tea stalls popped up at both North and South sides of the East and West Stations, a few shops emerged at the other side of the rail lines of the East Station. The shops are within the boundary of the Bangabandhu Railway Station East and west. However, the stalls are quite temporary and do not have any permission or, agreement with BR, and can be removed with 1-week notice during construction or renovation of the railway stations.
Hence there will be no requirement of involuntary resettlement.

8.5.2 Loss of income and livelihood in Charland

Normally char land rises in the dry season, and submerges in monsoon and there is scope of agriculture and fishing for seasonal farmers and fishermen. However, the Project areas in the river close to the existing bridge and the construction site area restricted to access to

common people due to army monitors for the security of the area as such there is no livelihood practices in the risen char land within the project area in the dry season.

8.5.3 Gender

Gender aspects must be considered when designing and planning for transport infrastructure and services. The reflection of gender concern in the transport sector is essential to ensure that transportation is equitable, affordable and accessible to resources and opportunities required for development for both gender. For women, transport provides access to various resources and opportunities, such as employment, education, health, political processes, personal safety and the avoidance of harassment.

Positive impacts: The project will generate substantial direct short and long-term employment opportunities in the construction works. These jobs during the construction as well as maintenance will bring gains in terms of incomes, skill development and empowerment of both male and female. The Project has promoted an inclusive process through consultation and FGDs and therewith promoted the active participation of women in the design phase of the project. This will continue through the implementation phases, as well, to keep building confidence amongst women. The Project has the opportunity to build skills for women either for jobs directly related to construction works or through targeted livelihood building measures. Health and safety awareness programs will also allow women to gain knowledge to improve their health status and avoid risks.

Negative Impact: The project has no direct benefit to gender improvement because there will be no involuntary resettlement and displacement. However, women will be benefited along with men with the implementation of this project.

Recommendations: During one-on-one interview and discussions the women participants suggested upgrading and improving the sanitation and potable water supply facilities in the Bangabandhu East and West Rail Stations. They also recommended for a separate rest room for women, however as both the stations are only operational but not for passenger exchange. So these facilities are not available.

8.5.4 HIV/AIDS/STD

Transport infrastructure projects supplements to increase people's mobility; and movement and mobility some time create scope to transmit or spread communicable diseases such as STI/HIV/AIDS. Protecting health in the transport sector has three dimensions: improving

overall safety as well as safe travel, reducing local air pollution, and containing the spread of HIV/AIDS/STD. Vulnerability at the time of construction and after development may increase STDs and HIV/AIDS transmission as well as drug abuse.

Although the overall prevalence of HIV in Bangladesh is low but it is a high-risk country for HIV/AIDS due to its geographical location and some other factors. This is due to low level of knowledge and low use of contraception's at the time of risky sexual activity, unsafe blood transfusion, high incidence of sexually transmitted diseases among vulnerable groups, the return of expatriates and workers working in different countries, and the high levels of HIV/AIDS in the two neighboring countries, India and Myanmar. The Project (Bangabandhu Railway Bridge) is considered as an important part of the international and future regional transport networks. Bangladesh has the potential to become a transport and transshipment center for the sub-region connecting India, Myanmar, and the landlocked countries Bhutan and Nepal. It will be an important link in the planned Trans Asia Railway network. Considering the above circumstances, the country's vulnerability is very high compared to other parts of South Asia, and infection rates within the vulnerable groups are increasing, thereby leading to an ever-greater possibility that the diseases will spread to the general people.

However, the Project construction sites planned to be within the highly protected areas which will be implemented in a controlled. Eventually, risks of transmission of communicable diseases like HIV/AIDS/STD are low; although vulnerability and risk is still there during the construction phase.

Recommendations: STDs and HIV/AIDS education need to be provided particularly among the local community at the time of construction phase and post-construction maintenance phases. Formal, informal and special service provision with awareness programmes may be implemented to support and educate people concerning STDs in the project area during the implementation and maintenance phase. Campaigns and mass media can be used to increase the knowledge and awareness among the community, especially among vulnerable groups and women. The migrant workers and staff account for a significant number of HIV cases, hence they are subject to mandatory HIV testing soon after entering Bangladesh.

8.5.5 Human Trafficking

Human trafficking has been used to denote a wide range of human rights abuses and crimes that combine the recruitment, movement and sale of people into an exploitative condition. It is not a new phenomenon rather then it continues as a set of activities and effects to the society. It is not only a national problem but also a global issue. Human beings are trafficked through transports, mainly using railways, road and water transports. Therefore, assessing impacts of transport infrastructure project on human trafficking is an essential part of social considerations.

The Project (Bangabandhu Railway Bridge) is considered as an important part of the international and future regional transport networks. Hence, human trafficking becomes an eventual phenomenon of improved human mobility due to regional transport networks. Furthermore, human trafficking vulnerable groups are mainly poor people, people who are involuntarily displaced; and among them are women, girls and children. Risk of human trafficking is non-significant during the construction period.

Recommendations: Raise public awareness about potential trafficking around construction camps. Introduce good behavior codes for construction contractors. Create awareness about potential human trafficking among the railway staff, rail police, passengers and the local sub-contractor staffs.

8.5.6 Children's rights

Children's right is one of the important parts of universal human right and a very delicate part of JICA Guidelines for Environmental and Social Considerations that recommends children's right should uphold,

According to UNICEF, risk of child labor is work in dangerous or unhealthy conditions that could result in a child being killed, or injured and/or made ill as a consequence of poor safety and health standards and working arrangements. Some injuries or ill health may result in permanent disability.

Recommendations: The Project involves no child labor at any stage of implementation; rather children will be benefitted along with the passengers when the bridge will start rendering service.

8.5.7 Occupational safety, EHS including PPE at work sites

Safe working environment is one of the basic rights of the workers. Occupational safety and health is an important component of modest work agenda. It means that the condition of workplace where workers work should be free from all kinds of hazards and risks. Safe work environment ensures safety and health for everyone at work preventing hazards and risks.

It is important that occupational safety and health is properly maintained in compliance with ILO standard. Environmental health and safety including PPE as per JICA Guidelines for Environmental and Social Considerations will also be maintained at all stages of the Project implementation process. The construction works of the main Bridge (Bangabandhu Rail Bridge) as well as other structures indeed, are hazardous and not risk free. As such sufficient safety and mitigation measures must be undertaken by the contractors.

8.5.8 Vulnerable social groups and ethnic minorities

Bangabandhu Railway Bridge Construction crosses through a newly emerged low-lying char land (sand bar) in the middle of Jamuna River without any human settlement. The proposed starting point and end point of the Rail Bridge was visually surveyed. It passed through the protected cantonment area of the Bangladesh Army at the East part; and at the West, it passes through the existing Eco-park which is also government land. Hence, no vulnerable social group and ethnic minorities were identified in the Project area.

8.5.9 Stakeholder engagement

Stakeholder Engagement is a means to bridge the gap between the affected persons, Project beneficiaries and the acquiring and requiring bodies, implementing agencies, etc. However, there is no affected person due to project inception. Apart from affected persons, other primary and secondary stakeholders were engaged in order to participate in the project implementation process through public consultations, FGDs, meetings with relevant government officers, consultations with locals and information discloser meetings in order to express their views and concerns those will be reflected in the project planning and design. As a part of stakeholder engagement, 4 public consultation meetings, 10 FGDs were conducted. Moreover, 12 government officers of different departments, 60 local persons from different occupations were consulted individually during the pre-detailed design stage of the Project. The outcome of the stakeholder engagement is stated in the Chapter 7 of EIA report as Public Consultations.

Stakeholder engagement will be done again after the detailed design as a part of project information discloser. Approved EIA will be disclosed to the public through website, hence, stakeholder engagement strategy and plan for the Project will be prepared and submitted as per JICA's requirement.

Concluding remarks- The Project will not create significant social impact as there is no land acquisition and involuntary resettlement. The Project implementation will not displace any person, because the alignment passes through the protected area that belongs to Bangladesh Army and Eco-park owned by the government(BBA) and Department of Forest). The other social impacts discussed above are quite non-significant.

8.5.10 Involuntary Resettlement and Lessons Learnt from Erosion and Flood Policy under the Construction and Operation of the existing Bangabandhu Multipurpose Bridge

Before the construction of the existing Jamuna Multipurpose Bridge the width of the river at Jamuna Bridge site was about 11 km. This 11 km width was constricted to 4.8 km at the bridge site by constructing two Guide Bunds at the east and west river banks to control and confine the river flow in one channel. As the river was constricted to 4.8 km, during and immediately after the construction of the bridge some erosion in the upstream and downstream river banks and charlands has occurred in that time. After the commissioning of the existing Jamuna Multipurpose Bridge twenty years have passed and the river channel has now taken a stable shape. During this long-period after construction no substantial evidence of erosion/scour of charlands at upstream or downstream or at the river bank at the east or west side of the river was observed. BBA undertakes annually an extensive river channel, banks and charlands monitoring as part of the operation and maintenance program of the existing Jamuna Multipurpose Bridge.

The proposed Railway Bridge is 300 meters upstream of the existing Jamuna Multipurpose Bridge and is located well within the existing Guide Bunds on both river banks. As the proposed Railway Bridge will not further constrict the river channel, it will also not cause any substantial impediments to the present river flow and thus will not cause any incremental erosion/scour of charlands and riverbanks at upstream or downstream of the bridge.

Furthermore, there will be no impact on peoples' livelihood because there is no human settlement in the charlands within the area of the proposed Railway Bridge. As some of the charlands rise in the dry seasons and submerge in the monsoon, there is a scope for

seasonal agriculture, livestock raring and fishery activities that can be used. However, the access to the area within the Bridge domain is restricted by the BBA and Cantonment Authority who are in charge of security of the existing bridge. Therefore, local farmers and fishermen cannot enter to the charlands even in dry seasons. As such, there is no room for involuntary resettlement or any livelihood impact.

However, Hydrological and Morphological studies are being conducted using mathematical modelling, to ascertain the effects of the Proposed Railway Bridge on the existing bridge, the existing river training works, river bank erosion and charlands within the project area. Preliminary findings clearly indicate that the construction of the proposed Railway Bridge will not have any adverse effect on the upstream and downstream river banks and Charlands.

9 CHAPTER-STAKEHOLDER ENGAGEMENT PLAN

9.1 Introduction

Stakeholder Engagement is a means to bridge the gap between the affected persons, Project beneficiaries and the acquiring and requiring bodies, implementing agencies, etc. The project intends to engage stakeholders at all stages from preparatory to operational period to develop sound partnership and ownership of the stakeholders from different level. The stakeholder engagement will follow a participatory planning process in order to gain local inputs in decision-making and policy development in relation to detailed design of the project, during the project implementation stage, including information sharing and disclosure among the stakeholders. However, there is no directly affected person due to project inception, but, there are indirectly impacted persons, households and communities. Apart from indirectly impacted people, other primary and secondary stakeholders will be engaged in order to participate in the project planning, design and project implementation process.

9.2 Objectives

The key objectives of the stakeholder engagement are:

- To obtain the opinion and recommendations from the stake holders during the detailed design stage of the project to reflect in project planning and design;
- To engage stakeholders at all stages from design stage to operation stage for developing sound partnership and ownership of the stakeholders from different level;
- To share and disclose project information among the stakeholders; and
- To promote transparency, sustainability, and prevent possible delays of project implementation process through amicable conflicts management.

9.3 Scope of Work

Following the objectives, the scope of work for stakeholder engagement plan is as follows:

- Identify project stakeholders, especially primary stakeholders;
- Develop the consultation and participation mechanisms to be used during different stages of the project;
- Undertake the activities to disseminate project information during project design and preparation for engaging stakeholders;
- Confirm disclosure of the EIA Report and other project document to concerned stakeholders and include arrangements to disclose any subsequent plans;

- Disclose the planned information (including the type of information to be disseminated and the method of dissemination) following the appropriate approach and methodology. The types of information are as follows:

a) Stakeholder engagement planning and process;
b) Project background and related information based on concerned project documents;
c) Information related to project implementation (process, transparency and accountability) including timeline;
d) Positive impacts due to project implementation;
e) Potential negative impacts.

- Finally the results of consultations with the stakeholders will be summarized and documentation will be made about the concerns raised and recommendations made by them in the stakeholder engagement/consultation.

9.4 Approach and Methodology

In order to achieve the objectives and as per scope of stakeholder engagement plan the following approach and methodology will be applied to implement the plan.

9.4.1 Approach

People have the right to total project information will be the principal approach of stakeholder engagement plan. Subsequently, a systematic step-wise approach will be followed in order to guide the stakeholder engagement process. The stockholder will be informed of the project, will have knowledge of the project area and receive perceptions of the people in the project area. To achieve those following steps will be taken:

- First, local meetings in the Project area must be focused on potential project interventions.
- Second, the team will have to make efforts to understand the baseline conditions including the history of local culture and norms.
- Third, the listing of the key issues related to project impacts and substantial mitigations will be the focus of the stakeholder engagement.
- Fourth, particular attention will be paid to the women and the very poor through separate focus groups discussions.
- Finally, the consultation team will assess the responses and attitudes of the people to the Project impacts and planned mitigation measures.

9.4.2 Methodologies and tools to be used

Multiple tools and methods will be used during the implementation of stakeholder engagement plan. These include: Key Informant Interviews (KII), Participatory Rural Appraisals (PRA), Focus Group Discussions (FGD) with various occupational/interest groups, Stakeholder Consultation Meeting (SCM), Issue Specific Consultation Meetings (ISCM), Information and Communication Meetings (ICM) within the project affected area.

The use of a wide range of methods will be helpful to involve all types of stakeholders and engage them in meaningful consultations. Some of the PRA tools will be used during community consultation meetings included group discussion, participatory mapping and seasonality.

9.4.3 Classification of stakeholders

Bangladesh Railway (BR) is the Executing Agency (EA) of the Project under the Ministry of Railway. The Deputy Commissioner of Tangail and Sirajganj discharges the local administrative as well as law and order issues. The Bangabandhu Railway Bridge and other facility users/beneficiaries, indirectly affected/impacted persons/households have primary stakes to the interventions for construction of the Bangabandhu Railway Bridge and other structures. Secondary stakeholders of the project include Project Owner/Executing Agency (BR), Deputy Commissioners and their supporting agencies, Local Government representatives, Project consultant, NGOs, Civil Society Organizations, and other related government agencies.

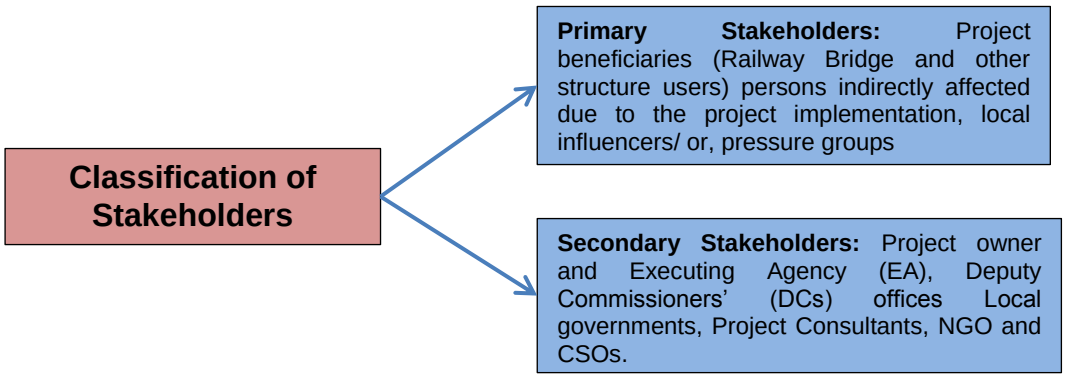


Figure 9-1 Classification of Stakeholders

9.4.4 Initial assessment on social impacts

The alignment of proposed Bangabandhu Railway Bridge crosses through a newly emerged low-lying Charland (sand bar) in the middle of Jamuna River which has no human settlement. As per draft detailed design, the initial assessment through reconnaissance survey shows that the Bridge Construction does not require any land acquisition or displacement of any

people thus requiring almost little social consideration. The proposed starting point and end point of the Rail Bridge was visually surveyed. It passed through the protected cantonment area of the Bangladesh Army at the East part; and at the West, it passes through the existing Eco-park which is also government land. Hence, no squatter and encroacher on the land were found so there is no possibility of any displacement of people and loss of private property. From the initial assessment, it was confirmed that no substantial social and economic impact will result in due to the construction of new bridge.

The findings of the initial assessment on social considerations in accordance with the JICA Guidelines for Environmental and Social Considerations (April 2010) has been described in the social aspects Chapter of the EIA report

9.5 Terms of Reference for the socioeconomic survey

9.5.1 Objective

The key objectives of the social survey are to assess social considerations in accordance with the JICA Guidelines for Environmental and Social Considerations (April 2010) and, livelihood analysis of the people/community within the project influencing area.

9.5.2 Scope of work

The general scope of work for the social survey will include, but not limited to:

1.00 Socio-economic profile of the people and communities potentially or, indirectly impacted by the project within the project influencing area. Baseline data (20%) need to be collected on:
1.01 Household demographic information;
1.02 Marital status;
1.03 Education and literacy;
1.04 Religion and ethnicity;
1.05 Occupation (primary and secondary);
1.06 Living status (Housing pattern);
1.07 Operated land and land utilization plans, if any;
1.08 Access to safe drinking water and sanitation facilities;
1.09 Access to other civic facilities;
1.10 Income and expenditure;
1.11 Risks and disaster management;
1.12 Assess vulnerability: women headed households, disabled; ultra-poor and other vulnerability.

2.00 Transportation and mobility
2.01 Types of transport, use frequency and purposes;
2.02 Number of households/ persons involved in this sector.

3.00 Seasonal migration
3.01 Duration of season (Which months?);
3.02 From which areas (Districts, Upazila, unions and villages) and distance accordingly;

3.03 Main purposes of migration

4.00 Livelihood and labour market status
4.01 Status of the local labor market, sectors, and wage pattern; numbers of persons involved as per sector; seasonality of employment and its' types in the survey area;
4.02 Livelihood pattern: agriculture, livestock raising, fishing, business and trade and others; number of households/ persons involved;
4.03 Use of child labor (sectors), wage differentiation and number of children involved as per sector;
4.04 Use of women labor (sectors), wage differentiation and number of women involved as per sector;

5.00 Gender issues
5.01 Early marriage;
5.02 Access to resources
5.03 Types of discrimination and the level of participation in family decision making process regarding education, marriage, and access to health services.

6.00 Health and hygiene
6.01 Occurrences and extent of common diseases in the Charlands (PIA);
6.02 Prevalence and preventive measures on HIV/AIDS and STD;
6.03 Availability of medication and treatment facilities, access to health service facilities;

7.00 Human trafficking
7.01 Incidence of human trafficking;
7.02 Probability of human trafficking due to Project intervention and preventive measures to be undertaken.

8.00 Stakeholder engagement through public consultation and Project discloser.

9.5.3 Methodology

In order to achieve the objectives and as per scope of work following methodology will be used in conducting the social survey:

1. Structured Questionnaires to gather quantitative data;
2. Checklists for qualitative data collection through KII, Focus Group Discussions;
3. PRA tools for seasonality mapping and livelihood analysis
4. Checklists for Stakeholder consultations meetings

9.5.4 Sampling

Randomly but stratified 20% samples of the populations will be selected for structured questionnaire survey to gather quantitative data.

Focused groups will be selected based on specific occupational and vulnerable communities for qualitative information collection

Key informants will be selected from different strata of the social groups, elites, government and local government representatives.

9.6 Grievance redress mechanism

The fundamental objectives of this mechanism are to resolve grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the social and environmental action plans. Another important objective is to democratize the development process at the local level and to establish accountability to the likely to be impacted people. Based on consensus, the procedure will help resolve issues/conflicts amicably and quickly, saving the aggrieved persons resorting to expensive, time-consuming legal actions.

9.6.1 Grievance redress committee

Grievance Redress Committees (GRCs) will be established at two levels: (i) Union/Municipal level and (ii) Project Level. At the Community level, GRCs will be formed with representatives from Executing Agency (BR), local elected representatives from the Local Government Institutions (LGI), Likely to be impacted Persons representatives (women representative in case of women APs), and local NGO. GRC decisions will be on a majority basis and will be publicized among the local communities. Where the complaining parties are not satisfied with the GRC decisions, they can go to the Project Director (PD, BRBCP, BR) for resolution.

It is expected that there will be very little or, no grievances because the Project does not require any land acquisition or displacement of any people from their properties thus requiring almost little social consideration. However, if there is any aggrieved person due to project inception the GRC at local and project level can resolve his/her problem(s).

9.6.2 Schedules

Table 9-1 Work Schedule

Sl. No.	Activities	Month 1				Month 2				Month 3			
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
1.	Tools development for survey, consultation												
2.	Questionnaire survey												
3.	Qualitative information collection												
4.	Public consultation meetings (6)												
5.	FGDs (10)												
6.	PRA (Seasonality and livelihood mapping) 2												
7.	KII and other 1 to 1 consultations												
8.	Data processing												
9.	Draft report												
10.	BR/JICA comments												
11.	Final report submission												

10 CHAPTER-ENVIRONMENTAL MANAGEMENT PLAN

10.1 Introduction

An EMP, also referred to as an impact management plan, is usually prepared as part of EIA reporting. It translates recommended mitigation and monitoring measures into specific actions that will be carried out by the project proponent. Depending upon particular requirements, the plan may be included in, or appended to, the EIA report or may be a separate document. The EMP will need to be adjusted to the terms and conditions specified in during project approval stage. It will then form the basis for impact management during project construction and operation.

The main components of the EMP are:

- Summary of the potential impacts of the proposal;
- Description of the recommended mitigation measures;
- Statement of their compliance with relevant standards;
- Allocation of resources and responsibilities for plan implementation;
- Schedule of the actions to be taken;
- Programme for surveillance, monitoring and auditing; and
- Contingency plan when impacts are greater than expected.

- **Summary of Impacts**: The predicted adverse environmental and social impacts for which mitigation is required should be identified and briefly summarised. Cross referencing to the EA report or other documentation is recommended.

- **Description of mitigation measures:** Each mitigation measure should be briefly described with reference to the impact to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should be accompanied by, or referenced to, project design and operating procedures which elaborate on the technical aspects of implementing the various measures.

- **Description of monitoring programme**: The monitoring program should clearly indicate the linkages between impacts identified in the EIA report, measurement indicators, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions.

- **Institutional arrangements**: Responsibilities for mitigation and monitoring should be clearly defined, including arrangements for co-ordination between the various actors responsible for mitigation.

- **Implementation schedule and reporting procedures:** The timing, frequency and duration of mitigation measure should be specified in an implementation schedule, showing links with overall project implementation. Procedures to provide information on the progress and results of mitigation and monitoring measures should also be clearly specified.

- **Cost estimates and sources of funds:** These should be specified for both the initial investment and recurring expenses for implementing all measures contained in the EMP, integrated into the total project costs, and factored into loan negotiations.

10.2 Significance of EMP

Environmental Protection and Sustainable Development have been the cornerstones of the policies and procedures governing the industrial and other developmental activities in Bangladesh. The DoE, Government of Bangladesh has taken several policy initiatives and enacted environmental conservation legislations to prevent indiscriminate exploitation of natural resources and to promote integration of environmental concerns in developmental projects. An EMP is a site-specific plan developed to ensure that all necessary measures that are identified and implemented in order to protect the environment and comply with the existing environmental legislations. The scope of an EMP will vary depending on the scale and type of the development project.

The EMP addresses the environmental management requirements as per the Government of Bangladesh and the Safeguard Policy of the JICA. The EMP provides the following aspects:

- ✓ Provides information on the potential environmental impacts of the proposed project.
- ✓ Provides magnitude and duration of the environmental impacts.
- ✓ Provides information on required mitigation measures with budget to minimize the impacts.
- ✓ Formulate environmental management and monitoring plan for the entire cycle of the project.
- ✓ Capacity development plan for the executing agency.

- ✓ Identifying the institutional support for effective implementation of mitigation measures.

EMP is suggested on the basis of the identified impact in the EIA. EIA is a planning tool that is now generally accepted as an integral component of sound decision-making tool.

10.3 The Purpose of EMP

The EMP is most effectively developed when impacts are evaluated by detailed EIA Study supported with baseline studies for the project. Impact evaluation signifies the importance for the Mitigation measures suggested during the impact analysis or assessment. The EMP envisages the following aspects for smooth implementation of the project. The salient features are as follows:

- Encourage good management practices through planning and commitment to environmental and social issues concerning any developmental project;
- To provide rational and practical environmental and social guidelines that will assist in minimizing the potential environmental and social impact of activities;
- Helps in minimizing disturbance to the environment (physical, biological and ecological, socioeconomic, cultural, and archeological,)
- Combat all forms of pollution through monitoring air, noise, land, water, waste, natural resources and social issues.
- Protection of sensitive and endangered flora and fauna;
- Prevent land degradation;
- Comply and adhere to all applicable laws, regulations, standards and guidelines of the Bangladesh and the safeguard policy Japan International Cooperation Agency, for the protection of the environment and social aspects.
- Adopt best practicable waste management for all types of waste (liquid and solid) with objective on prevention, minimization, recycling, treatment or disposal of wastes;
- Describe all monitoring procedures required to identify impacts on the environment and social aspects;
- Train and bring awareness to employees and contractors with regard to environmental and social obligations and compliance.
- Reduce environmental and social risk and provide better Health, Safety and Environment (HS&E)
- Bring in awareness among the workers and local population about AIDs and STI.

- Gender sensitization is also considered as a major component in the implementation activity.

The developed EMP addresses the environmental and social impacts during the design, construction and operational phases of the project. EMP outlines the key environmental management and safeguards that will be initiated by the project proponent to manage the project's key environmental and social concerns.

The EMP will be the main tool with which the BR will manage the environmental and social impacts by applying both mitigation and monitoring measures in a technically credible and timely manner. The mitigation measures are considered successful when the impacts have either been eliminated or residual effect complies with the environmental quality standards, policies and the legal requirements set by the DoE. Mitigation measures are tracked via the monitoring program.

The contractor shall be responsible for preparing the detailed documentation related to implementing this EMP. This should include information regarding the scheduling personnel, reporting and auditing requirements, training and detailed procedures for implementing the EMP. The Contractor's EMP and associated work plan shall be approved by the BR prior to the commencement of construction.

10.4 Environmental Clauses

All environmental clauses to be addressed in the EIA & EMP document to be provided to the contractor at the time of construction. All the environmental consideration should be considered at the time of the designing phase of the project. The focus should be on the design work on minimizing the impacts on the environment. The supervision consultant should see that the implementation is done as per the provided guidelines in the EMP.

10.5 Environmental Legislation

The Ministry of Environment and Forest, Government of Bangladesh was responsible for control of environmental pollution comes under the jurisdiction of DoE with in the Ministry of Environment and Forest (MoEF). This Ministry of Environment and Forests is the principal Government institution to deal with the environmental activities in Bangladesh. It is the final body for all the matters relating to National Environmental Policy and regulatory issues. It was created with stated goal to play a key role in planning, reviewing, monitoring and environmental initiates and ensuring that environmental concerns are properly integrated into national development process. The Ministry of Environment and Forests overseas the

activities of the following technical/implementing agencies under it: DoE, Department of Forests, Bangladesh Forest industries Development Corporation, Bangladesh Forest Research Institute, Institute of Forestry, University of Chittagong, Forestry Division of Bangladesh Agricultural Research Institute and National Herbarium.

The Bangabandhu Railway Bridge may be requiring some of the clearance from the other line Departments of the Government for smooth implementation of the project. The following NOC/ Clearances are listed for project implementation.

10.6 Permission and Clearances for Project Implementation

Prior to the start of the project execution the contractor has to obtain the necessary clearances/ permission to be obtained by the below departments. The supervision consultant and the BR can help the contractor by giving him the needed guidance. Table 10-1 shows the permission requirement.

Table 10-1 Permission and Clearances for Project Implementation

Sl. No	Permissions/ Clearance	Authority in Bangladesh giving the permissions
1	Permission for establishment of Construction Yard	Bangladesh Bridge Authority
2	Ground water usage for Construction	Bangladesh Bridge Authority
3	Surface Water usage for construction	Bangladesh Bridge Authority
3	Drinking Water facility for the construction yards, labour camps	Bangladesh Bridge Authority
4	Permission for establishment of Construction equipment	DoE/ BBA
5	Pollution Under Control Certificates for the Construction Vehicles	Bangladesh Road Transport Authority (BRTA)
6	Permission for construction waste disposal	Union Parishad
7	Permission for medical waste disposal	Union Parishad
8	Permission for sanitary waste disposal	Union Parishad
9	Permission for obtaining construction material	Local Government Engineering Department (LGED)
10	Permission for obtaining construction material (sand)	Locally collection
11	Permission for obtaining electrical supply	Bangladesh Power Development Board
12	Permission for setting up a generator	DoE/ BBA
13	Permission for obtaining Hazardous Material storage (POL)	Ministry of Environment and Forest (MoEF)
14	Permission for obtaining Hazardous material disposal	DoE
15	Labour permissions	Department of Labour/Department of Inspection for factories and establishment (DIFE)
16	Permission for having the Borrow areas and quarry sites.	Department of Environment
17	Permission for tree cutting	Department of Forests
18	Permission for the use to transportation Vehicles	Bangladesh Road Transport Authority (BRTA)
19	Working in Jamuna River	Bangladesh Inland Water Transport Authority
20	If the land belongs to Ministry of Railways	Bangladesh Railways

10.7 Environmental Impacts

Major environmental issues are is to do with noise as far as the Bangabandhu Railway Bridge is concerned. The other related impacts are the deterioration of air quality, deterioration of surface water quality, increased number transportation vehicles and economically the area gets developed. The other impacts are detailed below:

- ✓ Noise due piling
- ✓ Noise from hoisting of deck slab.
- ✓ Noise from traffic and transportation around the construction area.
- ✓ Noise from loading and haulage
- ✓ Increase in the suspended solids and surface water quality in Jamuna River
- ✓ Impact of noise on the Migratory Birds and Dolphins
- ✓ Impact of Dredging on the aquatic fauna
- ✓ Deterioration of air quality due to the increased vehicle numbers
- ✓ Generation of construction waste
- ✓ Dredging impacts on the benthic fauna
- ✓ Massive tree cutting at the Bangabandhu Eco Park
- ✓ Over all a positive thrust on the economy of the project area
- ✓ Employment generation for locals
- ✓ Waste water generation from the construction yards

In addition to the above, creating new paths for access to the bridge approach and the bridge alignment will destroy landscape and existing environmental conditions in the Bangabandhu Eco Park. Construction activities are inevitable to carrying the equipment to the site and carrying the construction material to the site is a must and this will lead for adverse impacts on the environment. This would leave a scar on the Bangabandhu Eco Park. The faunal species should look for alternate places.

10.8 Stage Wise Environmental Management Measures

10.8.1 Design Phase

The project activities will be executed in a phased manner. The time period is split into Design Stage, Construction Stage and Operation Stage. BR identifies seven impacts which if not properly addressed could lead to impact during the other two phases or totally eliminate the objective of completing an EIA. These included, having a tree replacement plan in place, minimising the land requirements by fine tuning where the new bridge and crossing over the Jamuna River. There is no cultural or historical place at the proposed site except there will be cutting of vegetation.

The EMP underscores BR's action to make sure the designs and alignments are sensitive to local conditions and wishes. The design stage will be concentrated mainly on the alignment and ground truthing of the entire project area. The necessary permissions should be obtained from the statutory departments from the respective government departments by the Project Proponent BR; the Environmental Clearance from DoE, No Objection Certificate (NOC) from BBA, Bangladesh Water Development Board Bangladesh Inland Transport Authority, and Department of Forests.

The environmental issues during construction stage generally involve environmental degradation, occupational safety and public health issue. The Contractor is required to comply with the state laws with respect to environment protection, pollution prevention, forest conservation, resettlement and health and safety issues and any other applicable law. Environmental pollution during the construction phase will be curtailed by implementing the mitigation measures. Control of pollution during this construction stage is of considerable importance. The EMP is an important component in a project and it requires to be implemented throughout the life cycle of the Project, and the activities are to be guided, controlled, monitored and managed as per the provision provided in the contractor.

10.8.2 Operation Stage

The operation stage would throw light on various operational problems related to the bridge construction and operations and the railways movement. The issues to be addressed during the operation stage and are discussed with all the management measures. Mitigation measures are given in the below Table 10-2.

Table 10-2 Environmental Management Plan, Mitigation

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
Design Stage						
Permissions	Without Permission, the project should not be taken off.	Permissions and Clearances are required from various departments. a) DoE. b) Department of Forests. c) Bangladesh Inland Water Transport Authority. d) Bangabandhu Bridge Authority e) District Authority of Tangail and Sirajganj.	For the project	Before the start of the project	Design Consultant, BR	BR
Land acquisition	There is no further land acquisition for the bridge and associated activities	Not Applicable	All through the project	Not Applicable. The land belongs to BR and BBA.	BR/BBA	BR/BBA
Tree removal	There will be an impact on the trees	1. Reduce the tree cutting to the extent possible 2. Obtaining necessary approvals 3. The debris will be suitable disposed of. 4. Revegetate the area as early as possible. 5. Supply fuel to the worker and train them not to use the wood as a fuel	Bangabandhu Eco Park- as the alignment passes through the park.	Pruning or cutting would start during construction stage. Only marking will be made during design stage.	Department of Forest, Government of Bangladesh and the Consultant	Department of Forest, Government of Bangladesh and BR and the Consultant.
Migratory Birds	There will be an impact on the Migratory Birds	1. The trees with the nests to be identified during the design stage, 2. Try to protect the tree from cutting. 3. Supervisory staff should instruct work force not to disturb the migratory bird nests. 4. Workers to be provided with adequate knowledge about this migratory bird issue.	Bangabandhu Eco Park- as the alignment passes through the park.	Pruning or cutting would start during construction stage. Only marking will be made during design stage.	Department of Forest, Government of Bangladesh and the Consultant	Department of Forest, Government of Bangladesh and the Consultant
Aquatic flora and fauna	There will be considerable impact on the aquatic flora and fauna as it is being a	1. Care to be taken during the dredging activities. 2. Environmental buckets to be used for dredging	Jamuna River	This will appear during the construction stage	Consultant and BR	Consultant and BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
	bridge project and there will be piling	3. During the piling necessary measures like pingers should be used to drive away the aquatic fauna. 4. Utmost care to be taken not to release any obnoxious materials into water				
Employment Opportunities	The local population will be benefited with employment opportunities	1. There will be economy boost in these two districts. 2. Ancillary business will also develop along the project area.	This development would take place on either side of the proposed bridge	During the implementation of the project	Local NGOs and BR	BR
Heritage and culture	There will not be any impact on the heritage sites.	Neither heritage place, grave yards nor mosque are coming on the way of the alignment.	As such there is no problem at this stage	During the implementation of the project.	Local NGO and BR	BR
Safety at the level crossing	Operations at the level crossing have frequently caused severe injuries	1. Provision of a flag men at the level crossing to curtail the local population moving across the level crossing 2. Fencing along the railway track to be thought about	Problems occurred with animals being killed at the level crossing	Should be considered even at this stage.	BR	BR
Labour	Poorly prepared labour standards leading to recruitment of child labour and the wage policy	Due consideration to be given at the stage of project implementation. It should be made in accordance to the labour act amendment 2015.	This would be considered at the stage construction	At the project execution stage	Department of Labour and BR	BR
Construction Stage						
Permissions	The permissions	The contractor should obtain the necessary permission before the start of the project	For the entire project stretch	This is strictly applicable at the project construction stage.	Contractor and will be monitored by the supervision consultant and BR	BR
Air Emissions	Air pollution is caused by number of factors in a construction activity	1. New equipment's to be used for constructions 2. The material carrying trucks to be properly maintained. 3. The haul roads and the access roads to be sprinkled with water to supress the dust. 4. The generators used should be provided with the mufflers to	This is applicable at the construction yards and at the haul roads.	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
		reduce the air emissions 5. Vegetative cover should be developed around the construction yard to curtail the dust emissions. 6. The stock piles to be properly covered so to curtail the dispersion of the air pollutants 7. Fugitive emission from the equipment to be curtailed by proper maintaining. 8. Cover the loaded trucks with tarpaulin. 9. Enclose the transfer points where ever possible 10. Operate particulate matter control equipment (i.e., cyclone, bag house during filling of silos 11. Equip crushers and screens with particulate matter control equipment				
Noise Levels	In a Bridge construction Project, the major impact will be emitted from the equipment used	1. Maintain equipment in good working condition. 2. Equipment with proper silencers and mufflers 3. Schedule the construction activity 4. The noise generating equipment should be placed away from the human settlements 5. Minimize the vehicle idling 6. Install a perimeter fencing surrounding the construction yard. 7. Install portable acoustic barriers 8. Design a noise management schedule so that it will not disturb the local population	This is applicable at the construction yards.	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Impact on Community	1. Traffic congestion and detours; 2. Disrupted access to residences and businesses;	1. Notify the public with the construction activity 2. There should be a regular public contact 3. The contractor and supervision	This is applicable at the construction yards	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
	3. Loss of roadside parking; 4. Disruption of utility services; 5. Presence of construction workers, equipment, materials and staging areas including potential concrete batch; 6. Noise and vibrations from construction equipment and vehicles; 7. Airborne dust and possible mud on roadway surfaces; and 8. Removal of or damage to vegetation 9. Delivery of construction materials by vessel would increase usage of the navigation channel; 10. Scow movements related to dredging would increase usage of the navigational channel; 11. Construction of the main spans'	consultant should handle any community problems				

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
	substructure and superstructure would result in some restrictions to navigation; and 12. Dredging would affect the fish population and increase suspended solids in the water.					
Hydrology-Drainage	Waste water and spills will be contaminating the surroundings	1. Ensure efficient, safe and sustainable use of water resources. 2. Proper wastewater treatment before re-using it for gardening 3. Use of settling tanks at construction yards for removal of sediments from the wastewater. 4. Prevent waste water carrying hydro carbons and potential contaminants to the nearby water resources	This is applicable at the construction yards	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Health & Safety	Personal and occupational health issues from unsanitary toilets, potable water and sanitary washing areas can lead to common diseases out breaks in the workers camps. Construction work creates areas of water stagnation. These water ponding will be ideal place for the mosquitos breeding	1. Undertake regular clearing of stagnant water ponds. 2. Maintain drinking water quality at the labour camps 3. Well maintained sanitary facility for the work force. 4. Provision of first aid facility at the project site. 5. Proper drainage facilities to prevent water stagnation in the construction yard 6. Adequate medical facilities for the work force. 7. Vaccination for the entire work force working at the site.	All work areas and construction camps	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Migratory Labour	The labour will come from different areas and from other countries	1. The labour should be given proper training not to mingle with local population.	All work areas and construction camps	This should be implemented once the project	Contractor and will be monitored by the supervision	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
		2. The labour should be properly vaccinated before they start their work. 3. The working culture to be made aware for all the workers. 4. Necessary training will be imparted for the AIDs and HIV.		construction stage	consultant and BR	
Work site safety management	Poor safety over sight and management of workers by the contractors leads to accidents and unsafe working conditions	1. Contractor must at all times insure the local people requiring moving from one side to other side of the construction areas. 2. Construct sites to be access control for the local population	All construction areas	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Personal Protective Equipment(PPE)	Contractor to provide the necessary personal protective equipment and enforce the work force to use the same to prevent accidents	1. Work force will be provided with appropriate personal protective equipment like the helmets, boots, reflective jackets, ear muffs, goggles, gloves and safety belts to prevent fall from heights. 2. The workforce will be given the proper training for the use of personal protective equipment. 3. The workforce will be enforced to use the PPE at the site.	All construction areas	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Tree Cutting	There will be tree cutting involved at the site. The tree felling will be at the Bangabandhu Eco Park.	1. Workforce will be informed of the importance of native flora and vegetation 2. Drainage or runoff from construction areas will be managed so that it does not does not cause erosion or sedimentation 3. Operations will be such as to minimize the risk of soil erosion 4. All rubbish, materials heaps or other debris will be removed 5. Marked trees will be uprooted during the construction stage	At Bangabandhu Eco Park Area.	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Dolphins	Bridge construction works and piling will	1. Pile driving should be conducted during non –seasonal time as	At Jamuna River during piling.	This should be implemented once	Contractor and will be monitored by the	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
	disturb the Dolphin movement	during the monsoon periods the movement of dolphins are quite high as the water depth increases considerable. 2. Before starting of piling 500 meters radius should be monitored around the piling area. If dolphins are observed in the area, than the piling work should be delayed until they leave the area. 3. As per the Joint Nature Convention Committee a soft start, using a low energy start to the operations would give dolphin an opportunity to leave the area. 4. The contractors are recommended to adopt these mitigation measures during pile driving activities. 5. Gradually ramp up the sound levels to scare the dolphins and other cetaceans away before piling proper commences. 6. Use pingers upstream and downstream to chase away dolphins and other cetaceans. . Monitor area for these creatures to ensure they are well away from the piling site – scare them away if they are two close to the site using pingers. 7. In order to avoid impacts on these species, the construction works will be limited within the designated sites to the contractors. 8. Regular monitoring of the worksite for animals trapped in, or in danger will be done and contractor will use a qualified person to relocate them. 9. Acoustic enclosure will be placed to		the project construction stage	supervision consultant and BR	

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
		cover the hammer and the exposed pile to reduce the air noise. The air noise levels can be reduced to about 60 dB with these measures. 10. Monitor work areas for endangered reptile and bird species to ensure they are well away from the piling site				
Migratory Birds	Higher noise levels and its impact on the migratory birds	1. The equipment used should be giving lesser noise levels 2. The equipment to be maintained properly 3. The trees having the nests to be safe guarded. 4. The workforce should be trained not to disturb the migratory birds.	At Jamuna River Char lands.	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Fish	The bridge construction will give a negative impact on the fish species	1. Change in behavioral responses by fishes to increased suspended sediment concentrations include impairment of feeding, impaired ability to locate predators and reduced breeding activity. 2. Decrease in dissolved oxygen concentrations in the surrounding waters and effects on growth rate. 3. Effects on fish associated with noise from pile driving include damage to body tissue that can potentially result in death, sub-lethal effects that could result in temporary decreases in fitness, or to temporary or long-term changes in behavior. 4. The degree of damage to fish and their hearing organs from pile driving is related to the received level and duration of the sound exposure.	At Jamuna River during piling.	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR
Benthic Fauna	The bridge construction	1. There will be permanent and	At Jamuna River	This should be	Contractor and will	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
	dredging will be a major activity which is going give a negative impact on the benthic fauna	temporary impacts to benthic macroinvertebrates due to dredging and armoring. 2. Temporary increases in suspended sediment and changes to the hydro-acoustic environment have the potential to affect benthic macroinvertebrate resources. 3. While the dredging would result in the loss of individual macroinvertebrates, it is not expected to result in adverse impacts to these species at the population level within the Jamuna River. The majority of the bottom habitat and associated benthic macro-invertebrates within the area impacted is the soft sediment community. 4. Recolonization by benthic organisms adapted to softer sediments could be expected to begin within a few months after completion of construction in any given area. 5. *Benthic Macroinvertebrates,* construction activities expected to contribute to sediment resuspension include dredging, vessel movements, cofferdam construction, pile driving.	during piling.	implemented once the project construction stage	be monitored by the supervision consultant and BR	
Labour camps	Labour camps will give impacts on the local population	1. The labour camps will be placed away from the local population 2. Proper training will be imparted about the sanitation facilities 3. The waste from the labour camp will be deposited in an organised manner. 4. Drinking water facility for the labour	At construction yards.	This should be implemented once the project construction stage	Contractor and will be monitored by the supervision consultant and BR	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
		in labour camps.				
Solid Waste	The waste from the construction will cause impact on the local population	1. The construction waste will be disposed at the specified areas identified by the Client 2. Bio-degradable waste will be disposed of separately. 3. Medical waste will be disposed of at the specified location and will be incinerated.				
Operation Stage						
Air & Dust Pollution	Degradation of local air quality due to increased train traffic.	1. Maintain locomotives according to factory specifications. 2. Ensure the combination of better equipment, more pollution control devices on the locomotives as the fleet is renewed and cleaner fuel.	Project Site	BR	BR	Air & Dust Pollution
Noise & Vibration Pollution	Though the noise and vibration predicted to be within the standard limit at 50m from the alignment, there is chance of increased noise and vibration if the proper management of the rolling stocks fails or more nearer sensitive receptors.	1. Replacement of brake shoes with disc braking systems; 2. Minimal use of train whistles particularly at night, and maintenance of a smooth rail through regular grinding; 3. The replacement of old locomotives with new quieter locomotives; and 4. Install noise attenuation features at the sensitive sites - e.g., berms. Plantings and noise barriers-based on noise monitoring recognising existing train noise.	Project Site	BR	BR	Noise & Vibration Pollution
Health & Safety	A number of Level Crossing & the LNG pipeline passing under the Proposed Railway Bridge have risk of fatal accidents	1. Installation of modern railway crossing and gate systems. Pedestrian foot over bridges will be building and increased as the need develops. Training to crossing guards will be enhanced. 2. Prepare a formal fire response plan supported by the necessary resources and provide fire training and response as part of workforce	Project Site	BR	BR	Health & Safety

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
		health and safety induction/training. Training should include the use of fire suppression equipment and evacuation, with advanced fire safety training provided to a designated firefighting team. 3. Properly equip facilities with fire detection and suppression equipment that meets internationally recognized technical specifications for the type and amount of flammable and combustible materials stored at the facility.				
Soil and Surface water pollution	Soil and surface water could be polluted during the operating period from untreated sewage effluent discharged by passing trains as well as from accidental spillage of hazardous material	1. A spill contingency plan and good maintenance of track and rolling stock will help reduce the risk of such accidental spills, and permit rapid action if an accident does occur. 2. Proper waste disposal facilities within the train and establishment of strict fine for garbage throwing will reduce the chance of throwing waste materials outside. In addition, retrofitting trains with sewage collection tanks to be pumped out at collection stations for delivery to STPs will also reduce chance of soil and surface water pollution.	Project Site	BR	BR	Soil and Surface water pollution
Scouring at pier location	Local structure-induced scour results from interference with natural flows by bridge piers and abutments, river training structures etc.	Regular inspection of the scouring condition at bridge site is necessary.	Project Site	BR	BR	Scouring at pier location
Employment Opportunities	Jobs for the local population. The people who are involved in helping people for	The major impact will on the boat man who would be losing their lively hood should be provided with income restoration measures.	This would come on completion of the project	BR	BR	BR

Environmental Issues	Likely Impacts	Mitigation Measures	Location	Timing/Duration	Responsibility	Supervision
	crossing the Jamuna River will lose their lively hood					
Mobility	Positive Impact on the mobility of local population	1. By getting the Railway bridge, it will improve the movement faster. 2. The positive impact on the nation economy. 3. Proper manned level crossing should come up along the alignment, as the train movement will be faster. 4. There should be fencing along the rail corridor to prevent accidents. 5. The number of train movement can be increased.	Project Site	BR	BR	BR

10.8.3 Camp Site Management

There are certain provisions which are compulsory to be provided at the construction sites as per the labour regulations like every construction site should have supply of drinking water, shelters should be provided for taking meals, during interruption of work due to adverse weather conditions, the equipment should be operated by workers who have received appropriate training, The drivers and operators of vehicles and materials handling equipment should be medically fit, trained and tested and should have a prescribed minimum age, the contractor should take adequate measures for the control of malaria, and the contractor should educate the work force about HIV/AIDS and launch awareness campaign among the work force. There should be proper demarcation of work areas with sign boards. The signboards should be in local language. There labour officer over viewing the safety of the workers.

10.8.4 House Keeping

The construction yard, the premises should always be kept clean and tidy. The dirtiness of the construction yard is a symbol for laid down attitude of the contractor. Loose materials which are not required for use should not be placed or allowed to accumulate on the site so as to obstruct means of access to and egress from workplaces and passageways. Workplaces and passageways that are slippery, owing to oil or other causes should be cleaned up or strewn with sand, saw dust, ash or the like. In addition to the above issues the following points also given due importance during the construction stage: They are:

- Housekeeping practices are reflective of the site health and sanitation program.
- Housekeeping practices on this project is extremely important. In order to reduce the risk of fire, prevent injuries and reduce the risk of an inspection, housekeeping must be maintained.
- Waste shall be discarded in a suitable container.
- Sawdust and rags should be placed in a metal (approved) container with tight (proper-fitting) lid.
- All waste containers (inside the building) shall be emptied at least daily.
- Corridors and other walk / work areas shall not be used for storage.
- Shall be labelled properly (without abbreviation). The name of the chemical and the appropriate hazard must appear on the “appropriate” container.

10.8.5 Drainage Management Plan

Construction activities on site have potential to cause erosion and the mitigation of sediment into adjoining lands and waters. Construction activities include:

- Land clearing
- Earth works
- Haulage operations
- Piling
- Construction of coffer dams
- Soil stock piling and temporary storage.

There is wide range of techniques designed to reduce the risk of damaging the soil and to fit the project into its environment with minimal adverse impacts. Simple techniques such as replanting will be an effective solution in many situations, whereas more as sophisticated techniques, such as retaining wall, are used only in the most difficult cases.

Replanting cleared areas and slopes is the most effective action to be taken in reducing erosion and stability problems. It should be under taken as early as possible in the construction process, before erosion becomes too advanced, to be most affective, it should be done immediately disturbance takes place. Vegetation should be selected to serve a specific engineering function.

Engineering functions of vegetation includes its abilities to:

- Catch and retain material moving over the surface.
- Armor the surface against the erosion and abrasion by intercepting raindrops
- Support the slope by propping from the base
- Reinforce the soil profile by increasing its shear resistance
- Drain the soil profile by drawing water out through the roots and releasing it to the air by transpiration
- Facilitate infiltration of water through the soil profile, thereby reducing the proportion of water flowing over the soil surface
- Grasses can effectively limit surface erosion. A photograph of the project corridor is attached for the kind information.
- Shape the slope surface for maximum seedling survivability
- Choose the right varieties, according to the soil type, climate, ease of maintenance, and desired engineering function. Local varieties are always preferable.

10.8.6 Waste Management Plan

Construction projects generate different types of solid wastes like the construction wastes, sanitation waste, biodegradable wastes (vegetables peels), plastics wastes (non-biodegradable) and the medical wastes from construction yard health center. The waste generated should be properly segregated before the disposal. Some of the measures are as follows:

- A waste disposal site should be away from human settlement, because of incidence of health hazards.
- Generally barren lands are preferable for this purpose.
- A disposal site should be away from water streams.
- The place should be away from any archaeological and historical monuments
- It should be easily accessible from the main highway.
- A preliminary environmental and social study will help in taking proper precautionary measures for selecting a location for waste disposal. The study should point out a proper location which is away from the human settlement, forestry area, and away from water resources
- No dumping on private property is carried out without written consent of the owner.
- No dumping should be allowed on wetlands, forest areas, and other ecologically sensitive areas.
- All the workers working at the disposal yard should be provided with safety attire.
- The waste carrying trucks should be properly covered by tarpaulin.
- The worker working at this area should be given proper training regarding the health hazards associated with the work.

10.8.7 Medical Waste

The medical waste should be disposed away from the human settlements and water source. Generally medical waste disposal is done by digging a pit and it is given a lining with a geo textile, so that the waste will not come in touch with the nearby ground water aquifers. Once the medical waste is placed in plastic bag and buried in the pit and closed with earth and compacted. The other method is medical wastes and plastic bags are incinerated.

Garbage and Wastewater disposal

Disposing off the solid waste generated from the construction labour camp. The main waste generated from the kitchen comprise of the organic waste (eggshells, discarded foods, vegetable peels, meat and bones), inert materials like (polyethylene bags, and mineral water bottles) and wastewater flowing out of the construction yard. The waste water from the toilet

should flow into the septic tank. Improper management may give rise to number of health problems and will give rise for the vectors to grow there. Some of the garbage management techniques are given below:

- Uncontrolled solid waste dump sites could be breeding ground for vermin, and as such could pose a vector borne disease.
- Solid waste shall be regularly collected and disposed of in disposal sites approved by local authorities. A ban on burning of garbage will also be stipulated while handling the garbage
- Composting of appropriate organic wastes should be considered.
- The solid waste should be segregated in to recyclable wastes, inert wastes and plastic wastes.
- The construction wastewater and kitchen waste water will be sent out to two settling pits and once settled the water will be used for growing plantation. The settled material will be used as manure. The construction waste would comprise of mainly of inert materials like silt.
- The wastewater pit should be totally barricaded.
- The plastics can be incinerated away from the human settlements as the plastics generate a lot of dioxins which are carcinogenic in nature. The work force should be provided with proper personal protective equipment.

10.8.8 Hazardous Material

Safe handling of fuel is everyone's responsibility. One can take steps to ensure their own safety and health, as well as that of those around and the environment is protected. Improper handling of fuel and hazardous material can result in serious injury or death caused by fire, explosion, or asphyxiation. Fuel released into the environment can contaminate soil and groundwater resulting in costly cleanups. Contaminated groundwater supplies may sicken people and animals who unknowingly drink the polluted water. Gasoline vapors are harmful to human health even at low concentrations and are potentially dangerous at high concentrations. Hazardous materials must be stored based on their compatibility. Materials are stored in accordance to their hazardous nature. Hazardous substances should be stored in an orderly manner with older products most accessible and the newer products least accessible. Good housekeeping must be practiced in areas where hazardous products are stored. All hazardous materials must be properly labelled including their exact contents, hazardous properties, date of receipt, and if appropriate, date of expiration. Hazardous substances should be stored in original containers in which they were packaged at the

manufacturing plant. If this is not practical, these products should be transferred according to manufacturers' recommendations into containers that are constructed to withstand the effects of the product over the maximum storage time. Incompatible materials must not be stored such that they may come in contact with each other. If incompatible materials are allowed to mix then dangerous conditions will persist in the area.

10.8.9 Handling Hazardous Material

Whenever it is feasible, engineering controls must be used to reduce employee exposures to hazardous materials. The two most common engineering controls are the use of local exhaust and general ventilation. These measures limit an employee's exposure to airborne contaminants. When engineering controls are not available, or they fail to adequately reduce hazards, other personal protective equipment is required. Examples of personal protective equipment include: safety glasses, hearing protection, gloves, respirators, etc. Personal protection devices must be provided and worn in accordance with the manufacturer's recommendations indicated on the label of the product or as stated in the Material Safety Data Sheet for the product. Hazardous chemical spills can be handled effectively when plan of action has been developed. Spill procedures should include the following general procedures:

- If the spilled material is flammable, turn off ignition and heat sources.
- Attend to any person who may have been contaminated or affected.
- Notify individuals in the area about the spill.
- Evacuate nonessential personnel.
- Avoid breathing vapors of spilled material. Establish an exhaust or ventilation, if it is safe to do so. Air handling units are not to be used because they re-circulate the hazardous vapors. Contact EH&S for information about the proper ventilation or exhaust required.
- If a spill is relatively large, or involves a highly toxic material, a carcinogen or flammable material, contact EH&S for assistance in cleaning up the spill and disposing of the hazardous waste resulting from the clean-up.

10.8.10 Dredged Material Disposal Plan and Char land Development.

The dredged material should be disposed of on Char land. Which can be developed to an Eco Park at a later stage and it should be kept away from the human intervention. It should be used for development of native vegetative species. The park area should come under the Department of Forests, Government of Bangladesh. The animal can be transferred into the newly found area. No human population travel to that area. No animal grazing will be

permitted. The people who are breaking the rules and regulation will be penalised. Only forest department officials are allowed to visit the area. The water levels surrounding this char land should be kept deep so that Dolphins can make the area into another home. The area should be given sanctuary status.

10.8.11 River Training Works

River training, apart from various types of earth works, is basically achieved by the following structures:

- ✓ Sills
- ✓ Weirs
- ✓ Spur-dikes (most of the time called groynes but this word is not used here to avoid confusion with groynes in marine structures)
- ✓ Longitudinal dikes, depending on their function also called guide banks or guide bunds
- ✓ Bank protection (revetments, hard points)

An intermediate type of structure may be indicated as river bed or submerged spur dikes, in fact sills constructed in the river bed, to achieve control of the river cross-section in a vertical sense. Sills and weirs will be treated in a future version of these notes. River training works may have to be carried out for flood protection, to maintain a navigable channel, and last but not least to prevent bank erosion and/or outflanking of a bridge or weir. River training works consist of structures and various types of earth works.

10.8.12 Disposal of Hazardous Material

Hazardous wastes undergo different treatments in order to stabilize and dispose of them.

- ➢ Recycling
- ➢ Neutralization
- ➢ Incineration, destruction
- ➢ Hazardous waste landfill
- ➢ Pyrolysis

10.8.13 Punitive Measures & Fines

Over and above the statutory fines, which may be applicable, the client/ Consultant shall be authorised to impose spot fines on the Contractor for failure to comply with environmental specifications contained in the EMP, including but not limited to the transgressions detailed below.

- ➢ Littering on site

- Lighting of illegal fires on site
- Persistent or un-repaired oil leaks. Any persons, vehicles or equipment related to the Concessionaire's operations found within the designated "no – go" areas.
- Openings in fences that are used to delineate the site.
- Excess dust, or excess noise and/or vibration emanating from the site.
- Possession or use of intoxicating substances on site. Any vehicles being driven in excess of designated speed limits.
- Unauthorised removal and/or damage to fauna, flora or heritage objects on site.
- Causing of illegal pollution incidents.
- Hazardous chemical/ oil spills.
- Unauthorised damage to sensitive environments.
- Unauthorised damage to cultural, historical or heritage sites.
- Unauthorised removal/damage to indigenous trees and other vegetation.
- The causing of unnecessary or unreasonable erosion.
- Unauthorised explosions or explosions that exceed prescribed time limits and time periods.

A list of transgressions, along with the appropriate fines has been included in the Bid document. Such fines will be issued in addition to any remedial costs, which may be incurred by the Concessionaire as a result of non-compliance with the Environmental Specifications and /or legal obligations.

10.8.14 Performance Indicators

A performance indicator or key performance indicator is commonly used to evaluate success in particular activity. The construction industry is vital for the development of any nation. In many ways the pace of economic growth of any nation can be measured by the development of physical infrastructure, such as buildings, roads and bridges. Construction project development involves numerous parties, various processes, different phases or stages of work and a great deal of input from both the public and private sectors with the major aim being to bring the project to a successful conclusion.

The levels of success in carrying out construction project development activities will depend heavily on the quality of the managerial, financial, technical skills and organizational performance of the respective parties while taking into consideration the associated risk monument, the business environment and economic and political stability.

Transport is complex and government agencies, the private sectors and the public must work together to address problems like mobility, reliability, safety, security, infrastructure management, environmental impacts, sustainability and economic growth.

Performance measures are designed to be a quantifiable tool that can determine how well a project or system is meeting defined goals and objectives. Well-developed performance measures can benefit planners by providing information needed to make decisions.

Moreover, the performance measures assist an agency in community decisions to the public, increasing accountability to use resources where they are needed and improving the operational condition of transport system.

The selection of indicators depends on the purpose of the corridor performance measurement exercise for advocacy and bench marking purposes, comprehensive measures such as total transport time, costs and the variance need to be sought.

10.9 Institutional and EMP Implementation Arrangement

10.9.1 Institutional Arrangement

At all times during the preparation and construction of the Project, BR's Project Director will have the final say on all administrative and technical decisions. The key agencies or units which will have to play major roles in the implementation of the EMP are:
Bangladesh Railway's newly proposed Environmental and Social Safeguards Unit (ESSU);
The Contractor; The Engineer (usually an international firm) also known as the Construction Supervision Consultant (CSC); and Bangladesh Department of Environment (DoE).

The implementation oversight to fall safe guard items in the EMP and in deed the construction contract will be with BR and its ESSU. When the Engineer is appointed, BR's technical management of the work will be delegated to the Engineer, but with final approval always passing through BR, with annual audit reports submitted to JICA who may undertake periodic in section trips to confirm that safeguards are being fully implemented.

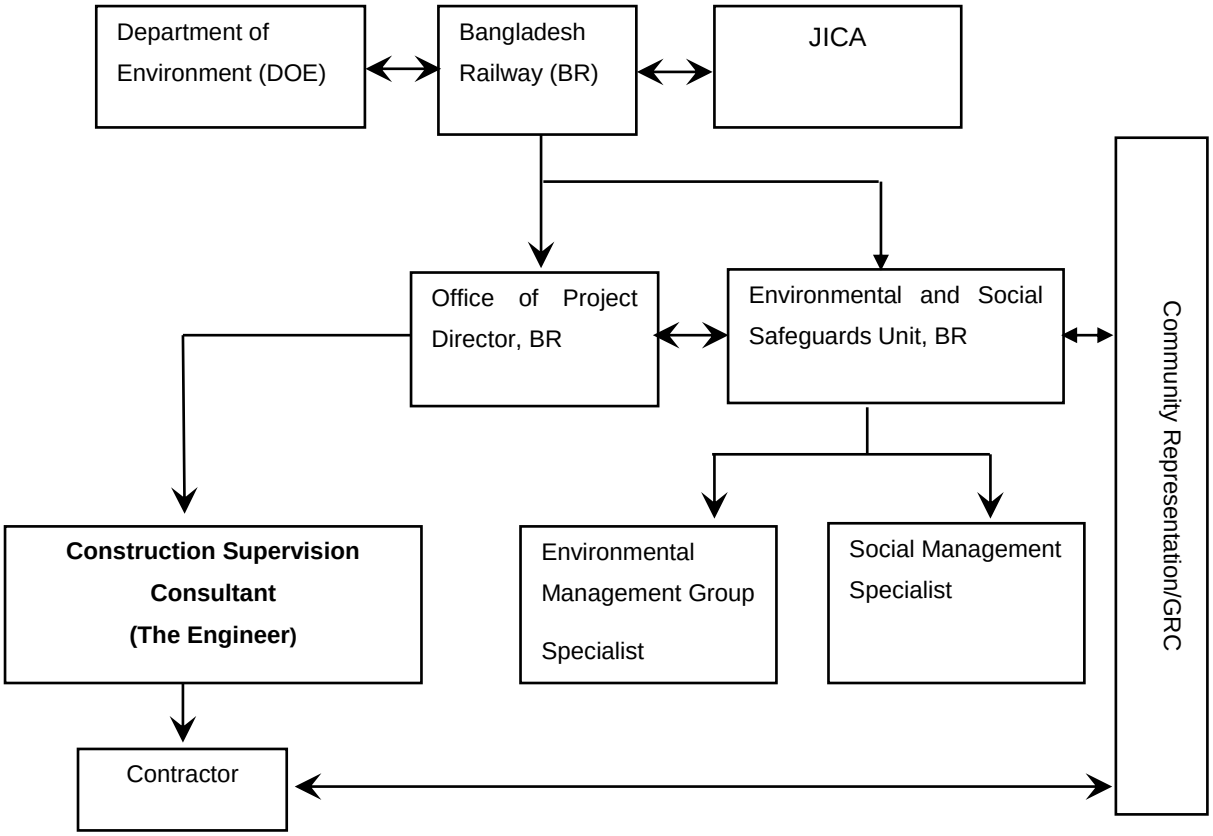


Figure 10-1 Safeguards Implementation and Reporting Work Flow

BR's Environmental and Social Safeguards Unit (ESSU)–The objective of an ESSU is to build enough technical capacity within BR to permit it to oversee environmental and social safe guard matters arising from donor projects and to respond with technical knowledge to specific safeguard issue triggered by Project activities, or community complaints. Secondly, the ESSU should be able to manage consultants and oversee consultant deliverables. Thirdly it will need to be able to fully address EIA requirements for the pre-construction and operating periods of the Project when The Engineer is no longer on the job. The ESSU will have to be able to assess environmental data, analyses it and define actions required to address non-compliant findings in a credible and timely manner. Finally, the ESSU should be able to provide training as needed to both contractors and BR staff in all aspects of environmental and social safeguards management. Therefore, the ESSU's main tasks will be the following:

- Oversee the implementation of the EMP.
- Implement the EMP.
- Supervise and monitor the progress of the consultants engaged by BR for addressing safeguard requirements such as air quality or resettlement plan implementation monitoring.

- Liaise with all regulatory agencies, including DoE and the public.
- Prepare all manners of safeguard monitoring and compliance reports.
- Provide training to contractors and BR staff.

BR is in the early stages of planning such a unit with in its organization. During this planning stage BR will appoint at least one safeguards person to look after the project safeguard needs, and be the direct contact for safeguard matters between stakeholders, regulators, donors and BR.

BR's Regional Offices and Staff–The day-to-day oversight to the construction work on this Project has not been decided but will likely are done by the Regional BR Office and its Chief Engineer in charge. Therefore, the Engineer will work closely with the BR's Regional office.

Construction Supervision Consultants/The Engineer–The proposed framework for implementation of the Project shall utilize consultancy services from both international and national companies for the overall management and supervision of construction work and for preparation of the EA documents.

Contractor(s)–A contractor selected on the basis of international competitive bidding shall carryout construction work based on a contract containing a set of environmental clauses, conditions and /or specifications. The contract or will need to demonstrate environmental capacity in the proposal submitted to BR, and be prepared to have that person(s) participate in the mandatory pre-construction training exercise delivered by BR's ESSU or its consultant.

Other GoB Organizations–The organizations involved in regulating the Project are Department of Environment (DoE), Bangladesh Water Development Board (BWDB), Roads and Highways Department (RHD)and Department of Forest (DF), Bangladesh Inland Water Transport Authority (BIWTA), and local administration (UNO, DC, Police, etc.). They will provide supporting services as required.

10.9.2 EMP Implementation Arrangements

The approved EIA and the certificate from DoE will trigger the implementation phase for the EIA, i.e., the actions to mitigate and monitor the predicted impacts resulting from the building and operation of the Project.

BR is committed to exploring the establishment of an ESSU and has included that as an action item in the Project's feasibility study .BR will address this internally, to establish if such a staff compliment is available. The EMP has been integrated into the contract specifications, making it a mandatory set of tasks for the contractor to implement. By preparing and approving the EIA and its EMP, BR has already confirmed its commitment to

following through on the EMP. Until an ESSU is established BR will assign at least one safeguards specialist to deal with Project safeguard matters.

During the pre-construction period BR will be responsible for implementing the all mitigation and monitoring measures, according the time table defined in the EMP and submitting a final monitoring checklist–prior to the start of construction.BR will ensure that the contractors receive all relevant safeguard documents and that a training workshop be held to help the contractors understand the EMP, how to prepare their mandatory workloads deliver the required documentation.

The Contractors will implement all mitigate and monitoring actions, providing environmental safeguard compliance update as a section of the overall Project monthly progress report. The contractor will also submit semi-annual summaries of surveys, findings and compliance. During the pre-mobilization workshop BR or its Engineer will review all these requirements (which are all defined in the EIA and its EMP). Construction bid documents have been prepared with a specific environmental bill-of-quantity section, allowing for unambiguous calculation of environmental penalties.

Monthly and quarterly progress reports on EMP implementation shall be prepared by the contractor in cooperation with the Engineer appointed by BR. All reports to be submitted to BR via the Engineer. The quarterly reports will include a compliance monitoring checklist reporting on the progress of all 20 construction-period actions. Incidents of significant contamination/ pollution caused by the contractor's activities shall be reported.

Recommendation shall be made for mitigation of environmental damage and for prevention of any recurrences. During the construction period (Four years) the Engineer will prepare annual environmental due-diligence reports, based on the monthly and quarterly submissions by the contractor.

10.10 Green Development Plan and Plantation Procedures

The proposed Bangabandhu Railway Bridge Project required felling of trees in Bangabandhu Eco-Park. There will be 3700 trees will be uprooted in the project area. This tree cutting would give rise to number of impacts. Some of the significant impacts are as follows:

(1) In-creased ambient temperature,

(2) Decreased air quality,

(3) Increased water run-off,
(4) Decreased quality of run-off water,
(5) Altered weather patterns,
(6) Aesthetic beauty and
(7) Soil deterioration

Elevated ambient temperatures are a combination of decreased tree canopy and emission from automobiles and industrial sources. A primary cause of temperature elevation is the removal of vegetation, particularly trees, during developmental project. In most situations, "clear cutting" is used when selective removal of trees would accommodate the development and reduce the number of trees removed, as a result of excessive tree removal, increased air temperature in the rural areas.

Much of the harmful pollutants like ozone, sulphur dioxide, suspended particulate matter, respirable particulate matter and nitrogen dioxide, come from anthropogenic activities. Vegetation improves air quality by providing a cooling effect through transpiration water loss from their leaves and by filtering atmospheric pollutants through their leaves. By decreasing both the temperature and the amount of pollutants in the atmosphere, trees can have a positive effect on air quality. Trees are capable of re-moving both large (2.5-10 um) and small (1-2.5 um) particulate material, as well as ionic material (including those containing sulphate, phosphate, nitrate, chloride, calcium, potassium, magnesium, and sodium).

Trees were able to remove large quantities of each type of material. The effect of the vegetation and soil is to slow the movement of water and to provide an opportunity for water to enter the ground. Development removes trees and other vegetation that soften the impact of rain. As a result, rain hits the ground with greater force and compact the soil surface. This reduces the amount of water that can enter the soil and increases water "run-off." Impervious structures reduce percolation of water into the soil and promote run-off. The result is large volumes of water entering the storm water system or creeks in a short period of time.

The quality of water in the streams and rivers is deteriorating. Water that does not percolate into the soil will eventually flow into the water sheds and waterways. Rain water that hits the surface is usually clean, unless we have high levels of atmospheric pollutants. When clean water impacts the ground in natural areas, much of it percolates into the soil and eventually

into the water table. Water that does not percolate will flow toward low areas after it is filtered by grass and other vegetation.

Rain water also washes the pollutants from the air before they enter the water-ways. Vegetative areas are essential to filter the water before it enters watersheds. Cleaning water through vegetative filters helps avoid the higher cost of artificial filtration.

9.7.1. Mitigation Measures

- The trees, which are uprooted due to the road widening, should be compensated by additional plantation.
- Sign boards should be fixed at every hundred meters and heavy penalties will be levied on unauthorized cutting.
- A forestation and tree plantation will be taken up by the various stakeholders to maintain the ecological balance. The country is very sensitive about logging.
- The road stretch passing through forest areas should have proper precautionary measures like specified speed limits, provision of reflectors, sign boards indicating prohibition of honking.

An important aspect of the vegetative cover is proper choice of the plant depending on the soil conditions and meteorological aspects of the area. It is also presumed that the selected plants will be grown as per normal horticultural practices and the authorities responsible for plantation, will also make adequate provisions for watering and protection of saplings.

The following horticultural practices to be adopted for plantation:

a) Initial preparation of soil is required for planting any sapling.
b) Before planting, the surface should be firmed by treading or drawing a light roller.
c) Pits measuring about 1 meter in diameter and 75 cm deep should be dug to receive the plants.
d) About 8-10 kg natural manure should be added to each pit before the planting time.
e) After planting a sapling a basal dose of manure (10-12 kg) to be given once a year.
f) Newly planted sapling requires frequent watering during dry season.
g) The best time of planting sapling would be during the monsoon periods May to September of a year.
h) Once the root system is established than the care can be reduced for the plants.
i) Different types of plants need different types of soils for their optimum growth and development.

j) The soil pH is an important factor in determining plant growth. The soil preference of plants may vary some require slightly acidic soils and others prefer alkaline conditions.
k) The water holding capacity and nutrient levels of the soils are also important for the growth of the plants.
l) Water is needed for nutrient uptake, photosynthesis, cell formation, cell elongation, transpiration.
m) Water is the most vital constituent of living plant and constitutes up to 90% or more of the total fresh weight.
n) Daily light watering is needed only for about a week after transplanting, thereafter, the correct method is to flood the beds first and then weeding and hoeing are done after a couple of days when the soil is just moist. The soil is then allowed to dry before the next flooding.
o) During dry season one deep soaking at an interval is far better than frequent sprinkling.
p) Cleaning of plant basin by cutting and removal of grass and weeds and disposal of muck, cut grass, weeds, polythene pieces, polythene bags, cloth pieces, stones, leaves and prunes.
q) During routine and periodic maintenance operations a visual inspection will be carried out for the entire stretch once in three days.
r) Watering of plants @45 liters each plant (having a basin to hold approximate 15 liters of water at a time. Newly planted sapling will require watering alternate days @ 15 liters per plant.

Green vegetative cover plays a vital role in pollution abatement. A green vegetative cover should be developed at both East and West Bangabandhu Setu stations and at the training center. The local population is very much interested for fruit bearing plants and native varieties. The vegetative foliage acts as a sink in absorbing the pollutants emitted from various anthropogenic sources.

10.11 Roles and Responsibilities

10.11.1 Contractor (Construction Manager)

The responsibilities are:

1. Incorporate the EMP into project-specific work procedures and construction activities.

2. Ensure all personnel are inducted, briefed and/or trained in EMP implementation requirements
   - Support a performance assessment of the EMP
   - Ensure suppliers and the sub-contractors on site comply with environmental requirements
   - Advise the Site Environmental Officer on environmental issues and risk of non-conformances of site works and activities
   - Joint Environmental inspection to be organised with the Environmental officer.
   - Halt construction activities in the event of substandard environmental performance or in the presence of unacceptable environmental risks.
   - The occupational safety issues are to be given the first priority.

10.11.2 Project Engineers

- See that the proper Implementation of the EMP on site
- Report to the Site Environmental Officer on environmental issues and non-conformances
- Ensure that site personnel are aware of their environmental obligations
- Take corrective action to resolve non-conformances.

10.11.3 Environmental Officer

- The Environmental Officer should possess a degree in Environment with 10 years' experience in transportation projects,
- Be on site during all construction activities.
- Undertake daily and weekly site inspections, as and when required as per the EMP
- Conduct site specific environmental awareness training
- Investigate and report on any environmental incidents and ensure that appropriate action is taken
- Complete environmental checklists and report to the Environmental Manager
- Undertake environmental monitoring requirements as required by approvals, licenses and permits.

10.11.4 Project Manager (Supervision Consultant)

- Over all in-charge of the project activities.
- Regular inspection of project site will be taken up along with the Environmental Expert.

- The Project Manager will take action on the site people by stopping the work if there is non-conformity in implementation of EMP.
- The PM will oversee the submissions of Environmental Reports to the Client as well as for the funding agents.

10.11.5 Environmental Expert

- Over all responsible for the environmental/Health/ Occupational Safety activities at the site.
- The Environmental Expert should check whether the contractor got all the required permissions.
- The Environmental Expert should follow up with the contractor regarding the submission of the weekly and monthly environmental reports
- The Environmental Expert should make site inspection thrice a week.
- The Environmental Expert should see that the Environmental Status Report is submitted to the Client.
- The Environmental Expert should conduct regular training programs to the Contractor Staff and the Staff from the Client.
- The Environmental Expert should possess a Post-Graduate Degree/Doctoral Degree with 15 years of experience in infrastructure or transportation projects.

10.12 Environmental & Social Unit

BR Environmental and Social Safeguard Unit shall oversee the project implementation of EMP and the environmental clauses contained in the construction contract. The Environmental and Social Unit will be working during design stage/ construction/operation stages. They will be monitoring the activities at the project site.

10.13 Other Government Organization

The other Government Departments involved during the project implementation are the DOE, BBA, Department of Forestry, Bangladesh Water Development Board (BWDB), Local Government Engineering Department (LGED), Bangladesh Inland Water Transport Authority (BIWTA) and Local Administration (UNO, UP Chairman, and Police etc.). They support whenever their help is required in the Project implementation.

10.14 Training Programs

Project personnel and the persons with intermittent inputs have to receive suitable environmental training to ensure they are aware of their responsibilities and are competent

to carry out their work in an environmentally acceptable manner. Environmental requirements will be explained to staff during a Training Program to be held prior to beginning construction activities. Additionally, ongoing instruction will be provided during 'toolbox' meetings, where project issues are discussed. The meetings are usually held at or near project site, on the morning before work begins. Important information and instructions discussed during the meeting would be recorded.

- Promoting awareness of site-specific environmental topics reporting and responsibilities for environmental incidents Contingency and emergency planning.
- Environmental responsibilities and reporting procedures Environmental policies
- Information within the EMP and related documents, including significant project aspects, impacts and controls
- Environmental objectives and targets for the job site
- Project regulatory requirements and consequent staff responsibilities.

The training will be imparted for the project staff for smooth implementation of the project.

10.15 Grievance Addressed in the EMP

Implementation of mitigation measures during the constriction stage requires an effective interaction with the local population. The grievances or the suggestions given by the local population should be strictly considered during the construction stage. All the mitigation measures suggested by the local population should be implemented in addition to the environmental mitigation measures suggested during the preparation of EMP

Grievance Redress Committees (GRCs) will be organized in two Upazila within the Tangail and Sirajganj administrative areas. The Project will likely trigger both environmental (as defined in this EIA) and social impacts and therefore the GRC will need to be able to address both. Prior to the start of construction, BR will meet with Upazila heads to request each to nominate committee members who could form part of the GRC, and meet when complaints are received. Complaints from different Upazila would trigger a change in the people involved, but generally with the same roles. Once the complaint reaches the GRC, the GRC has two weeks to render a decision, based on discussion with all parties involved and following the four steps described in Chapter VII. Besides grievances for the affected person, construction workers grievances will also be ensured through individual contractual agreements.

Generally, the GRC Comprise of the following personnel

- Regional Director or Representative
- Upazila Parishad Chairman 0r Senior Representative
- Female member of Concerned ward
- Local NGO Representative
- Department of Environment Representative
- GRC Committee Member (Environment)
- Representative from the area where grievance was filed GRC Committee

When dealing with environmental matters, the GRC should have five permanent members, with the DoE representative replacing the local NGO and a female representative of the affected people. In order to convene a GRC meeting a quorum of three people will be required. Further, the GRC would only be convened if direct communication between the contractor, the complainant and the Engineer cannot solve the issue quickly. Once the complaint reaches the GRC, the GRC has two weeks to render a decision, based on discussion with all parties involved.

10.16 Construction Workers Grievance

At construction sites, work camps and on-the-job, laborers and other unskilled hired employees of the contractor have little recourse when either their living conditions are badly degraded, they are not paid according to agreement, or basics, such as potable water, are not supplied. Under this contract, as part of the written agreement with each hired worker, the contract or letter of assignment with the work, will include the name and contact information of who within BR and/or the Engineer the person can contact with their concerns and a second statement indicating that the contractor will not penalize the worker for reporting a complaint. If the worker is penalized, the Contractor will be levied with a fine equal in value to the worker's contract duration from the time of the incident to the end of the contract period. This fine will be paid to the complainant. In the contractual agreement the employee will be provided specific contact information for a responsible person within BR and the Engineer who will address their grievances.

10.17 Budgeting

There are major impacts by implementing this project. However there is budget provision to handle the mitigation measure caused during the construction of the project. Like the reclamation of construction areas and labour camps and debris disposal and landscaping requires certain budget. The amount required for this reclamation activities are given in the budget provided. The budget is attached in the table given below.

The training program will be done for the entire project and will be held at various stages of the project cycle. The major issues which will be focused during the training are the efficient environmental monitoring of the project implementation and social aspects. Each of the training aspects will be dealt for two day work shop. The training program is borne in the project cost. The below Table 10-3 shows cost for monitoring

Table 10-3 Cost for Monitoring in the 1st year and the subsequent years

EMP No.	Mitigation and Monitoring Items As listed in the EMP	1st Year Monitoring with Cost Breakdown							Re-occurred Cost in Subsequent Years							
		No. Cycles	No. Days /cycle	No. P. BD	No. P Int'l.	Unit cost Int'l.	Unit Cost BD.	Total Cost	Total Cost							Total Costs for Mitigation and Monitoring
								1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	
Cost of Environmental Professionals		2	30	2	1	$10,000	$2,500	$12,500	$12,500	$12,500	$12,500	$12,500				$62,500
1. Pre-Construction Period																
1.1	Tree planting - see below	0	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00				$0.00
Other one-time costs																
Other Expenses (workshop materials, particip. Costs & per diems)																
Pre-construction Period								$0.00								$0.00
2. **Construction Period**																
2.2	Air quality monitoring	8	32			800		$25,600	$25,600	$25,600	$25,600	$25,600				$128,000
2.3.1	Top soil stripping, storage and reuse for landscaping of resettlement areas	will include in engineering cost														
2.3.2	Regular watering, grass turfing	will include in engineering cost														
2.4.1	Surface water monitoring	6	24			600		$14,400	$15,409.44	$16,358.66	$17,397.44	$18,509.13				$82,074.67
2.4.2	Groundwater quality monitoring	4	" 8			600		$4,800.00	$5,136.48	$5,452.89	$5,799.15	$6,169.71				$27,358.22
2.5	Noise Quality Monitoring	8	32			100		$3,200.00	$3,424.32	$3,635.26	$3,866.10	$4,113.14				$18,238.82

EMP No.	Mitigation and Monitoring Items As listed in the EMP	1st Year Monitoring with Cost Breakdown							Re-occurred Cost in Subsequent Years							
		No. Cycles	No. Days /cycle	No. P. BD	No. P Int'l.	Unit cost Int'l.	Unit Cost BD.	Total Cost	Total Cost							Total Costs for Mitigation and Monitoring
								1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	
2.6	Waste Management							$5,000.00	$5,350.50	$5,680.09	$6,040.78	$6,426.78				$28,498.15
2.7	Tree Replacement Program							$6,000.00	$6,420.60	$6,816.11	$7,248.93	$7,712.14				$34,197.78
Other Expenses																
Transportation								$1,500.00	$1,605.15	$1,704.03	$1,812.23	$1,928.03				$8,549.44
Communication								$200.00	$214.02	$227.20	$241.63	$257.07				$1,139.93
Reporting and Report Production								$2,500.00	$2,675.25	$2,840.05	$3,020.39	$3,213.39				$14,249.07
Construction Period Total								$63,200.00	$67,630.32	$71,796.35	$76,355.42	$81,234.53				$360,216.61
3. Operating Period																
3.3	Ambient Air Quality Monitoring	8	16			800							$12,800.00	$12,800.00	$12,800.00	$38,400.00
	Surface Water															
3.6	Noise Level Monitoring	8	32			100							$3,200.00	$3,200.00	$3,200.00	$9,600.00
	Misc															
	Expenses															
	Operation Period Total							$0.00					$16,000.00	$16,000.00	$16,000.00	$48,000.00
	Total Costs:															**861,022.70**
	All MITIGATION AND MONITORING		**Totals**													
	Cost of Env Professionals -Int+Ntl (Pre-Cons to Oper.)		**$62,500**													
	Pre-Construction Period		**$0**													
	Construction		**$346,000**													
	Operating Period		**$48,000**													
	Total		**$456,500**													

EMP No.	Mitigation and Monitoring Items As listed in the EMP	1st Year Monitoring with Cost Breakdown							Re-occurred Cost in Subsequent Years							
		No. Cycles	No. Days /cycle	No. P. BD	No. P Int'l.	Unit cost Int'l.	Unit Cost BD.	Total Cost	Total Cost							Total Costs for Mitigation and Monitoring
								1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	
	Contingency Costs @ 6% of total		**$27,390**													
	Grand Total		**$483,890**													

Note: P=People
All amounts in USD

The budget for the mitigation measures during the construction and operation stages stage till the completion of the project. Budget is given the below Table 10-4. The operation costs are for the first three years, but the construction cost will be there till the end of the construction period.

Table 10-4 Budget for Construction stage and Operation stage

Sl. No	Environmental Component	Item	Unit	Amount in USD
Construction Stage				
1	Drainage congestion	Provision of opening	L.S	200,000
2	Erosion and erosion Control	Protection works	L.S	200,000
3	Air and dust emission	suppression	L.S	100,000
4	Noise	Noise Barrier	L.S	200,000
5	Solid waste	Disposal	L.S	300,000
6	Occupational Health and safety	Provision of PPE	L.S	50,000
7	Sanitation	Provision facilities	L.S	200,000
8	Traffic	Control of traffic	L.S	250,000
9	Tree Plantation	Green development	L.S	100,000
10	Training	Training and awareness	L.S	100,000
Total				1,700,000
Operation Stage				
1	Green Vegetation	Two stations/ training center	L.S	150,000
2	Waste Management	Two stations	L.S	150,000
3	Sanitation at the Stations	Two Stations	L.S	100,000
Total				400,000/-

9.7.2. Progress Monitoring and Reporting Arrangement

The successful supervision requires a mechanism to determine when the executing agency is carry out the project in conforming to EMP identify problems to develop plans for corrective action.

The monitoring and evaluation of management measures envisaged are critical activities in implementation of the project. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides necessary feedback for the project management to keep the program on schedule. The rational for reporting system is based

on accountability to ensure that the measures proposed as a part of EMP get implemented in the project. The major players in the implementation process are:

Bangladesh Railways: The Client is over all responsible for the implementation of the environmental mitigation measures and execution of the project and the sole responsibility would lie with the Project Management Consultant recruited by the Client in implementing the EMP and other project related activities and will interact with the client on a regular basis and inform the client about the progress.

Project Management Consultant: Will be involved in implementation of the mitigation measures with developing the required training material for the client. The various tasks to be performed during the project cycle are:

- Monitoring of the progress of the project on the implementation of the environmental provisions as per planned schedule.
- Supervising and implementing the mitigation measures.
- Assist the engineers at the site by providing appropriate mitigation measures.
- Documenting the experience in implementation of the environmental process.

The overall responsibility will be on the Environmental Management Cell in the Project Management Consultant. The environmental expert in the Environmental Management Cell will have the following responsibilities:

- Review the preparation of Environmental Assessment documents for the project.
- Liaise with the central and state Environmental Departments and with the Department of Labour
- Continuous interaction with the NGOs and local community in implementing the EMP.
- Preparation of the environmental compliance reports for the ministry and for the funding agency at regular intervals.

10.17.1 Reporting

Three types of environmental reports will be submitted to the Client (BR) and funding agency (JICA). All environmental data should be reflected in the Reports. The following reports are required to prepare during the construction stage of the project.

- Monthly Environmental Report
- Quarterly Environmental Report
- Annual Environmental Report

These reports should be prepared jointly by the environmental officer of the contractor and the environmental specialist of the supervision consultant. The report should follow the format given by the funding agencies and the DOE. The report should cover all activities which are taking place at the construction sites at that particular period and implementation of mitigation measures carried out by the contractor. All these information should go into the report.

10.18 Construction of Environmental Management Plan

EMP (CEMP) will be site specific to minimize and mitigate the construction effects on:

- The environment
- Existing surrounding communities
- Local residents

The CEMP will be prepared each phase of the construction work. This will be prepared in accordance specific environmental issues, constrains and will be area specific. The CEMP will be a part of the Environmental Specialists of the Supervision Consultant.

The generic and site-specific CEMP will include the following points:

- Organizational chart showing responsibilities of the staff involved in construction and supervision. The chart would throw light on various tasks involved in the construction activity.
- Procedures will be drafted out for the environmental training for the site staff and the permanent staff.
- Liaise with the local communities in sorting out the problems.
- Procedures for environmental information dissemination.
- Developing procedures for addressing the non-compliance and corrective actions.
- Procedures for dealing unexpected incidences during the construction like effect on air quality due to dust, effect on ecology (flora and the fauna), noise and vibration and landslides, sensitive receptors etc.
- Vehicular access routes and plants and machinery.
- Detailed time program for the construction work for sites.
- Environmental monitoring parameters and frequency should be spelt out at the time of CEMP preparation

The CEMP will ensure that best environmental practice is achieved throughout the development and all the sensitive environmental and residential receptors are protected as far as possible.

10.19 Conclusion

The EMP should be strictly implemented right for the start of the project. The Client, Supervision Consultant should monitor the mitigation measures on a regular basis. The grievance should be handled immediately at the site. The project should be made environmentally sustainable fashion.

11 CHAPTER- PUBLIC CONSULTATION

11.1 Introduction

"To consult" means to seek information or advice, for consideration. In the present context, consultation is essentially a tool or mechanism for citizens' participation – which can inform and assist the local authority in its decision-making process. If the project considers that there is a "spectrum" of decision making (as illustrated), consultation sits somewhere between notification and negotiation. While it may require something less than negotiation, it nevertheless encompasses abroad range of situations in which the public may have some input and active participation.

Public Consultation is a tool for managing two-way communication between the project proponent and the local population. It's a tool to improve decision-making and build understanding by actively involving individuals, groups and organizations with a stake in the project. This involvement will increase a project's long-term viability and enhance its benefits to locally affected people and other stakeholders. Stakeholder engagement is an integral part of EIA good practice and is a statutory requirement of the national EIA legal framework in Bangladesh and within the JICA Guidelines (2010) on Environmental and Social Considerations. The consultation program for the Project is based on informal consultation and participation with the affected people, and is designed to be both fair and inclusive. Consultation activities have been conducted during the environmental survey in May to August 2017.

11.2 Tools used

Five tools have been used and they are:

a. Public Consultation Meeting (PCM)
b. Focus Group Discussions (FGDs)
c. Consultation with relevant Government Officer`s
d. Consultation with Locals
e. Information Disclosure Meeting

11.3 Public Consultation Meeting (PCM)

Presentations, panel debates, keynotes, workshops, and lectures are all examples of information sharing meetings. The primary goal of these meetings is for the speaker to share information with the attendees.

While there are several types of information sharing meetings, they usually feature two main roles: the presenter(s), and the audience members.

Presenter: Often, the presenter is in a position of authority, like a manager passing on information or instructions to subordinates, or a subject matter expert sharing her knowledge with those present. The role can also fall on a keynote speaker, members of a panel, or project leader, to name just a few.

Audience members: Audience members make up the bulk of participants in information sharing meetings. Depending on the meeting size, there may be as many as hundreds, or even thousands, of audience members present. Their level of interest, and motivation to absorb the information shared, is highly dependent on their motivation for attending. In some cases, they have chosen to attend out of their own interest, while in other cases they are required to attend by their employer, professor, or other authority.

11.4 Focus Group Discussions

A focus group discussion (FGD) is a good way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest. The group of participants is guided by a moderator (or group facilitator) who introduces topics for discussion and helps the group to participate in a lively and natural discussion amongst them.

The strength of FGD relies on allowing the participants to agree or disagree with each other so that it provides an insight into how a group thinks about an issue, about the range of opinion and ideas, and the inconsistencies and variation that exists in a particular community in terms of beliefs and their experiences and practices.

FGDs can be used to explore the meanings of survey findings that cannot be explained statistically, the range of opinions/views on a topic of interest and to collect a wide variety of local terms. In bridging research and policy, FGD can be useful in providing an insight into different opinions among different parties involved in the change process, thus enabling the process to be managed more smoothly. It is also a good method to employ prior to designing questionnaires.

11.5 Consultation with relevant Government Officer`s

Consultation is a formal process by which the Commission collects input and views from stakeholders about its policies. Consultation is a continuous process and formal stakeholder consultations complement the Commission's broader interaction with stakeholders (e.g. meetings or exchanges or through existing permanent platforms for dialogue). The term

'stakeholder consultation' applies to all consultations with stakeholders in the process of the evaluation or the preparation of a policy initiative or the implementation of an existing intervention.

11.6 Consultation with Locals

Consultation conducted with different professional at different level under project jurisdiction area. Consultation conducted with fishermen, farmers, teacher, business holder, shopkeeper, smith, tailors, tea store ownership and so on and gathered information on environmental impact of existing bridge and biodiversity in the project area their opinion on BRBC project.

Two Public Consultations Meetings were organized on 23rd July 2017 followed by 10 FGDs in next three days. The objective of the public consultation was to ensure that a participatory approach takes place, which in turn documents concerns of all stakeholder groups and makes sure that such concerns are considered, responded to, and incorporated into the decision making process of the development. Stakeholder consultation needs to be a two-way communication process that imparts information to stakeholders, but also obtains additional and on-the-ground information from them.

11.7 Objectives

The specific objectives of this report to:

- Summarize Developer, national and international legal & policy requirements for stakeholder engagement;
- Describe and identify the stakeholders affected and/or with an interest in the Project;
- Summarize stakeholder engagement and consultation conducted to date; and
- Describe how the views and issues raised have informed and influenced the development of the Project

11.7.1 Public Consultations Meetings (PCM)

As discussed earlier, 2 public consultations meetings were conducted on 23rd July 2017. A total 133 no of participants were present in those meetings. Detailed information of those PCMs is given in Table 11-1

Table 11-1 Details about Conslutation

S / N.	Date	Place	Total Participants
1	23 July 2017	Bangabandhu Bridge East station, Tangail	67
2	23 July 2017	Bangabandhu Bridge West station, Sirajganj	66
3	17th August 2017	Sadar Upazila, Sirajganj	24
4	17th August 2017	Bhaupur Upazilla Sirajganj	40

Public Consultation Meeting - 1

Summary of the PCM-1

The key note presentation was presented by Dr. Tajul Islam, Environmental Specialist from Development Design Consultants (DDC). He informed the audiences about the Bangabandhu Railway Bridge Construction Project (BRBCP), where the project will take place, what are the main parts of the project: what activities will take place and how the activities will be performed. Later he shared the draft environmental survey report with the audience. Mr. Kushal Roy (Senior Environmental Specialist) moderated the session and took questions and comments from the audience. The main comments and experiences are summarized as follows:

1. *Lack of commitment from authority and bad experiences of land acquisition*: Most of the comments came from audience's side was the bad experience of the local people with the bridge construction authority during the construction of the existing Bangabandhu Bridge. They said they gave away their land for the bridge because it will contribute to the country's economy and a lot fellow countryman will be benefited. The then authority promised compensation for their land, which they used to own and farm to grow food for their family year-round. But in most cases, the authorities did not keep their promise. Three cases are evident: A) in most cases, most of the locals did not get any compensation at all. Additionally, they spent a lot of money to knock the authority time and time over in search for their compensation; B) the locals who got compensation, got it via installments over years. Thus, it was not fruitful for them, and the money was spent for nothing; C) only a few locals were benefited, or more appropriately, were able to use the money to either buy asset or invest it against business. They could do it, because they were educated and had some sense about what to do. But most of the people in area who gave their land to the authority are uneducated, therefore suffered a great loss. However, education was not the major factor for their loss, the audience commented. It was the authority's lack for commitment and lack of commitment that made these people suffer. Local communities were given with "red card" and "green card" signifying their loss. They were supposed to get compensation in future. But the card holders did not get the promised compensation except a few who had good connection with the higher politicians.
2. *River erosion:* River erosion has been the greatest disaster for the local community. The audience said that the existing bridge has a guide bund (protective embankment) of few kilometers. The area is protected from river erosion and flooding. Unfortunately, both the areas are under BBA and a Military Cantonment. But both end of the guide bund (north

and south) are prone to disastrous erosion. Many people lost their homestead to the river and are forced to shift their family to a safer place. For example, to the north of the bridge in Tangail side, people from northern parts shifted to areas like Sirajganj where erosion is lesser. Since this area is now over populated, health, hygiene, sanitation condition etc. are in quite measurable condition. The BBA promised that, there will be no harm to people or to their assets. But the locals have suffered a lot and continued suffering from river erosion and its causal effects. Locals wanted the bridge for greater good, but they also wanted to be socially secured, which is a failed promise.

3. *Lack of involving local labor force:* Another promise from the authority was that local labors would be working for the bridge construction project on priority basis. This is also an un-kept promise. Locals thought involving local unskilled labor would solve their unemployment problem for some time. But their hopes faded when local labors were ignored in most cases.
4. *Negative Impacts of the existing bridge:* The first complain about construction of the bridge came from audience was about the noise. They said the noise of the construction scared the local birds away. The pillars of the existing bridge are also negatively impacting fish breeding and fish migration route. Many juvenile fish species accidentally dash with the pillars and die. Thus we are losing many fish, potential fish catch and fish species. The audience demanded that the authority should take proper steps and mitigation plan for the upcoming bridge construction. It is possible that more parks like the existing Eco Park can be built. If it is possible, the authority can use viaduct over the protected forest site in the Eco-park part to avoid cutting of those protect trees which are a good nesting ground for many bird species.
5. *Unprotected railroad:* this was one of the major concerns of the locals who shared their experience. The railroad near the bridge is completely unprotected. There is no fence to protect the road. Also there are several crossings near the bride up until almost 10km towards Tangail. All these crossings are unprotected. There is no signal system or no safety gate. Cattles and sometimes humans make accidents each and every day. Death of cows and goats becomes the news every day. The audience demanded that the railroad should be fenced at both side and the rail crossings should be more protected avoid such incidences. Cattles are important household assets to locals and loss of cattle are almost unbearable for poor people.
6. *Waterlogging:* Waterlogging has become a new and major threat in the region. The audience was quite animated on this issue. According to their opinion, after the construction of the bridge river erosion took place outside the guide bunds. Hence

flooding has become common. Now a day due to illegal grabbing some of the local channels including the Dhawleshwari River has dried up. Thus flood water does not have any route for proper drainage. These ways local are suffering a disastrous waterlogging problem. They suggested that if a canal is dug between Kholasia to bridge no.18 (about 3km long), this water can be perfectly drained to Jamuna. Since a bridge is going to be constructed and some land development will take place, the authority can include such a plan in their design. The audience demanded that authority should be thinking responsibly on this issue before designing the bridge.

7. *Lack of educational institutes and health facilities:* Locals said that they face a huge lack of hospitals and proper government health facilities in the locality. They demanded that, if the existing and upcoming bridge is indicators of development, development cannot be sustainable without development of their life standards. A hospital is an immediate need for the locality. Locals also said that, there is a need of educational institutes for school going children in the locality. That's why they demanded establishment of few schools in the locality.

Figure 11-1 First Public Consultation Meeting took place in Tangail at 10.00AM on 23rd July 2017.

Public Consultation Meeting - 2

Summary of the PCM-2

The PCM 02 started off very late from the schedule time due to bad weather. However, like PCM 01, in PCM 02 the key note presentation was presented by Dr. Tajul Islam, Environmental Specialist from Development Design Consultants (DDC). He informed the audiences about the Bangabandhu Railway Bridge Construction Project (BRBCP); where the project will take place, what are the main parts of the project, which types of activities will be taken place and how the activities will be performed. Later, he shared the draft environmental survey report with the audiences. Mr. Kushal Roy (Senior Environmental Specialist) moderated the session and took questions and comments from the audience.

Although the participants were higher in number in the second PCM, comments and experience sharing was very low compared to the east side. The main comments and experiences are summarized as follows:

Figure 11-2 Second Public Consultation Meeting took place in Sirajganj at 03.00PM on 23rd July 2017

1. *Compensation problem*: Like the Tangail side PCM, here locals also raised their voice against the un-kept promise of the authority. They said only few could make proper use of the compensation for their lands which they gave for the bridge. People had to make liaison with the government officers and politicians and spend money to get their compensation.
2. *Lack of rail crossing and foot over bridge:* Locals said that there is lack of over bridge and rail crossing in the vicinity despite of the busy road approaching the bridge. There are a number of schools in the vicinity where children go by themselves. They have to cross the busy road during day time when the approach road to the bridge becomes very busy. So there is a big risk of serious accidents, even deaths. The designers of the existing bridge did not think of this. In this connection they demanded a few foot over bridge and proper railway cross crossing.
3. *River erosion*: Audience informed that there is river erosion going on to the northern side of the guide bund. Although these areas are under the upcoming economic zones and BSCIC industries, but river erosion is still affecting people. They demanded a guide bund to the northern part of the existing guide bund.
4. *Flooding and water quality*: Flooding is natural to these areas. During monsoon and post-monsoon people are used to flooding which actually rises up to 2-3 feet or even more. Also the water of drink has some odor. Many people prefer rainwater over groundwater because of odor. Locals commented proper land elevation is needed in the vicinity.

Because Jamuna River is drying up ad river bed is silting up, flooding is becoming more and frequent and serious.

Focus Group Discussion (FGD)-detail

Ten Focus Group Discussions (FGDs) were conducted, 5 each for the both side of the bridge. These FGDs were conducted between 24th and 26th July 2017. Detailed information of these FGDs is given in the below Table.

Table 11-2 Detailed information of the 10 FGDs conducted

FGD NO.	Date	Place	Participants		
			Female	Male	Total
1	24 July 2017	Char Sarotia, Sirajganj	16	0	16
2	24 July 2017	Khas Biara Madrasa, Tangail	10	0	10
3	25 July 2017	Garilabari patharghata, Tangail	0	14	14
4	25 July 2017	Soyadabad, Sirajganj	0	12	12
5	25 July 2017	Punarbsan, Sirajganj	0	17	20
6	25 July 2017	East Mohonpur	0	11	11
7	25 July 2017	Soyadabad bazar	0	12	12
8	26 July 2017	Sirajkandi bazar	0	11	11
9	26 July 2017	Nengra bazar	0	13	13
10	26 July 2017	Gobindasi bazar	0	11	11

Summary of the FGD- 01

- River erosion has been reduced inside the guide bund
- There is arsenic in some tube wells
- There is proper sanitation coverage in the area
- Too much iron in the drinking water
- Drinking water exhibits fishy smell
- During seasonal flooding few plants die every year, e.g. jackfruit, papaya etc.
- Rainwater is better than ground water
- During flooding people have no place to go, a shelter would be nice
- Fish in Jamuna die during winter (dry season) due to water pollution from dyeing and processing factories
- Hospital is quite far from the vicinity
- Demanded employment of local labors during construction, because only few people got chance to work for the previous construction project (i.e. Bangabandhu Railway bridge)

Summary of the FGD - 02

- After resettlement (due to construction of existing bridge), the area became too dense with people. Basic facilities are lacking in the area. Even there is no open space for children to play. Access to road has been the primary and major problem here.

- Waterlogging problem is prominent in this area. It has been a long time demand from these people to dig a channel or drain the excess water.
- After land acquisition, many people could not buy new land, because of lack land after the construction of Bangabandhu Bridge. Many people have lost their land and homestead due to river erosion also, which has been accelerated after the construction.
- There is no nearby hospital. This is also an urgent need.
- Transportation has also been a recent major problem. The only fast transportation system in the locality is the CNG driven three wheelers. But recently they are prohibited by the local authorities to run on main roads. Therefore, they are forced make break journeys. They demanded construction of link roads with the bridge approach road so that locals can travel with ease.
- Only very few locals were used as labor/workforce during last construction of the Bangabandhu bridge. They demanded these time locals should be prioritized as unskilled labors.
- Proper rail crossing and fence around both side of the railway is a necessity. This has been a major issue since the construction of the existing bridge, people and cattle get killed almost every month
- River erosion is very high outside of the guide bund. The guide bunds should have been more technical and long so that local people do not suffer from river erosion invoked by the bridge

Summary of the FGD – 03

- Needs road improvement and access
- The existing bridge and some misdeeds of the fishermen- both are responsible for the declining fish stock. Fishermen use current jal (entangling net) and use poison to catch fish which kill juvenile fish
- River training work has protected some area but created river erosion with massive magnitude in large area
- Very poor sanitation facilities
- Population density has increased a lot due to river erosion. People are migrating to much safer places after losing their homestead which is creating more sanitation problem, road access problem and lack of open space
- There is a lack of hospital and other govt. health facilities
- Local laborers should be prioritized when construction work starts. The previous contractors took money in exchange of using locals as laborer

Summary of the FGD - 04

- River erosion is now a major problem. Many lost their land and homestead into river
- Foot over bridges are need on the approach road
- River fish is declining due to the bridge
- Corruption in disbursing compensation for land from local people

Summary of the FGD - 05

- River erosion is increasing at south
- After the construction of existing bridge, govt. assistance has been minimum for those who gave their land
- Fish catch is declining due to the bridge's construction. Birds are also scared away.
- There is a hospital in the community, but quality of service is questionable
- No problem with drinking water

Summary of the FGD - 06

- The authorities were aggressive during land acquisition and compensation. People had to suffer and lost their homestead and land, but did not get the money as compensation
- River training work and bridge has increased river current which is negatively impacting fish catch
- Over bridge is need over rail roads and approach road
- There is some waterlogging in the area which needs to be addressed

Summary of the FGD - 07

- Over bridge is needed at both sides of the bridge
- People need alternative livelihoods due to loss of agricultural land and fish catch. Government needs to take initiative

Summary of the FGD - 08

- River training works has accelerated river erosion in the area
- An over bridge is need at the approach road
- There is lack of fodder in the area due to declining agricultural land
- Alternative livelihoods are necessary, government has to take initiatives. NGO development activities are not so visible in the area

Summary of the FGD – 09

- Due to river erosion local people are getting homeless
- A protection bund (embankment) is needed covering Gobindasi bazar towards the bridge. This might help in protecting from river erosion
- The bridge created navigation problem in the river as well as is responsible from fish loss

Summary of the FGD - 10

- A town protection embankment is necessary
- An over bridge is needed at the approach road
- Railway should be protected with fence so that cattle do not have to die.

11.8 Consultation with Government Officer`s

1. Dr. Syed Nazmul Ahsan, Director Environmental Clearance, and discussed about the environmental clearance procedures. In addition to this we have discussed regarding the Terms of Reference for the Bangabandhu Railway Bridge. He advised us to follow up the Padma Bridge EIA Report.
2. Dr. Md. Ataur Rahman, Deputy Director, Department of Archaeology, Ministry of Cultural Affairs, Government of Bangladesh. The outcome of the project is that there are no notable archaeology sites surrounding Bangabandhu Bridge. They would like to conduct fresh excavation in this region.
3. Md. Aminul Islam Khan, Deputy Director, DoE, Tangail. He feels that BR should follow the previous terms of reference, which was issued, there cannot be different set of terms of reference as the project location is not changed, only the funding agent changed. Any help required for us will be provided by him
4. Mr. S M Anamul Hoque, Joint Director, Department of Labour, Government of Bangladesh. This department handles the labour unions, labour wages and the occupational safety and security will be looked after by the Inspector General of Factories which comes under the same Department of Labour.
5. Md. Shamsuzzaman Bhuiyam, Additional Secretary, Inspector General, Department of Inspection for Factories & Establishment, 23-24, Kawran Bazar, Dhaka and Md. Mahfuzur Rahman Bhuiuan, Deputy Inspector General, Department of Inspection for Factories & Establishment, 23-24, Kawran Bazar, Dhaka. The Department feel that there should be stringent measures as far as labour safety issues and at the same time they feel that there is a requirement for capacity building. They requested us that we should conduct a training workshop on health and occupational safety at the site once the construction started and they also requested us to have a regular interaction with the local department
6. Md. Harun Dr. Rashid Khan, Assistant Chief Conservator of Forests, Forest Management Planning Unit, Forest Department, Agargaon, Dhaka, explained things regarding the tree cutting at Bangabandhu Eco Park. The procedure is once the alignment is finalised than the BR will inform the Department of Forests. The Forest

Department will make a survey of the alignment and will issue a No-Objection Certificate to BR for cutting the trees.

7. Md. Fakural Islam, Senior Upazila Fisheries Officer, Sirajganj Sadar, Sirajganj. He feels the proposed bridge will not affect the environment adversely, but the industrial park and special economic zone developed adjacent to the Jamuna River will adversely impact the surface waters and will decrease the fish population. Current nets usage is also increasing in this area. The fishing nets size ranges from 2000 meters to 5000 meters. The Upazila Magistrate generally penalise those using the current nets.
8. Krishibid Md. Rostom Ali, Upazila Agriculture Officer, Upazila Agriculture Office, Sirajganj Sadar, Sirajganj. The agricultural officer feels that the use of chemical fertiliser is quite high in this area. The pesticides and insecticides are also used quite frequently to safe guard the agricultural crops. Farmer field school is ongoing program to aware the farmer on pest control.
9. Md. Sajedul Rahman, Extension Officer, BSCIC, Sialkol, Sirajganj, they explained the development taking place on the banks of Jamuna River. There will be an industrial park and a special economic zone will be developed near to the Jamuna Bank. These units will provide job opportunities for about a lakh people. The industrial units will be textiles, chemicals and agricultural implements.
10. A. M. Shahidual Islam, Senior Agriculture Officer, Kalihati, District Tangail, feels that there is tremendous use of agricultural chemicals to the plants. The pesticide and insecticides use for the plants are quite high in the char land and other agricultural lands. He said that specific dose use in the crops which is harmful to the soil and water even beneficial insect. Farmer practices the organic fertilizer in their crops. Integrated pest management and integrated crops management also practices for pest control.
11. Md. Abdul Kuddus, Senior Fisheries Officer, Kalihati, District Tangail feels that Jamuna Fertiliser is one of the major factory which are affecting the fish production. Mostly this factory discharges waste directly into the Jamuna River. The sluice gates at Bhuapur are also adversely affecting the fish during breeding and hamper the brood fish migration.
12. Mr. Ali Ahmed- Station master west side of Bangabandhu Bridge discussed on drinking water, rest room and sanitation.

11.9 Consultation at Individual level

Stakeholder consultations were done among people from many professions. The method followed for stakeholder consultation was personal interview. People were asked about their opinions on the project and its impact. Interviewees are comprised of fisherman, farmer, shopkeeper, teacher of school, college, madrasa (religious school), land owner, service holder, business man, taxi driver, rickshaw driver, van puller, Masjid Imam (religious leader), word councilor (elected representative), women leader, house wife etc. These people are from the both side of Bangabandhu Railway Bridge east side Nikrail union under Tangail district and west side Saydabad union under Sirajganj district. Table 11-3 summarizes opinions collected. It was found that:

- Most of the people were benefited by the establishment of Bangabandhu Multipurpose Bridge (MJMP).
- Jamuna River is polluted by discharge from Jamuna fertilizer factory, open defecation, agrochemicals used in the char-agricultural land, effluent from power plant etc.
- Around 30 types of agrochemical are in use in the crops land that wash away into the river

Table 11-3 Summary of the consultation with locals through individual interview

S/N	Name	Profession	Address	Opinion/comment
1	Mr. Abdul Matin Sarker	Chairman	Nikrail Union Perished, Bhuapur, Tangail	• Unskilled people should get chance to work in the project • Local people should be given priority during the selection of worker.
2	Md. Nobidul Islam	Chairman	Saydabad Union, Sirajganj Sadar, Sirajganj	• Government has given permission to establish industry in the 5 km radius in the Project. • Jamuna fertilizer factory discharge their waste water into Jamuna River directly. • Because of the discharge of untreated water the river water becomes polluted severely in the upstream of this bridge location. • Economic zone will be established in the west site of Bridge. • BSCIC will be established in the north site of Bangabandhu Eco-park
3	Md. Farukul Islam	Service	Upazila Sr. Fisheries Officer Sirajganj Sadar, Sirajganj	• There will be fish migration problem due to the new bridge construction. • Due to the Eco park development during the existing road bridge construction some fish habitat and migration route was damaged. • Supplementary support would be provided during the construction as like hilsha breeding period for the fishermen. • Fisheries Officer regularly visits the river with mobile court and fines the fishermen for using current net. • In fact the Char people depend of current jal for fishing as well as for their living. • There is no history of Dolphin catch using fishing net in this area. • Fisheries Department does not have any particular project on dolphin. • The river might get polluted severely in the future

S/N	Name	Profession	Address	Opinion/comment
				because of the proposed industrial park in the west bank of the river.
4	Md. Rustom Ali	Service	Upazila Agriculture Officer Sirajganj Sadar, Sirajganj	• A new bridge will be very helpful for safe journey.
5	Md. Imran Hossain Khan	Service	Sub-Asst. Agriculture Officer Sirajganj Sadar, Sirajganj	• Rice, jute, nut, maize, sesame, wheat, pulse, potato, and chili are the main crops in the area as well as in the char land. • Farmers in this area use all kind of pesticides • In the Char land there is no practice of IPM/ICM • Weed is the main problem in char land for agricultural practice • Farmers are in char land use comparatively more organic compounds • Shallow tube well is used for irrigation • No arsenic (As) contamination in the char land area • People use ring slab latrine in the char area • Char land is increasing in this area after Bangabandhu Bridge construction.
6	Md. Selim Uddin	Service	Sub-Asst. Agriculture Officer Sirajganj Sadar, Sirajganj	
7	Mr. Provat Kumar Das	Service	Station Master Bangabandhu Bridge West Station	• A new separate Rail Bridge is essential for safe journey as well as the sustainability of the present road bridge. • Government is losing money from the fright due to the lacking of passage for the fright locomotive through the present bridge.
8	Mr. Abdul Motaleb	Farmer	Village- Sirajkandi Union-Nikarial, Bhuapur, Tangail	• He was rehabilitated from another location. • He was benefited after rehabilitation • In the previous location there was no electricity, pucca road for communication.
9	Mr. Selim	Service	Village- Sirajganj Union-Nikrail, Bhuapur, Tangail	• Community people expect the earliest construction of Bangabandhu Rail Bridge since they are already benefited after the construction of Bangabandhu Jamuna Multipurpose Bridge with better communication facilities.
10	Md. Abdul Mannan	Farmer	Ballab bari, Goalabari, Kalihati, Tangail	• Triple cropped practice is available in the char land in a year, mainly rice, jute and sesame.
11	Mr. Badsa Mia	Business	Char Hamziri, Durgapur, Kalihati	• Their source of income has increased
12	Mr. Sadek Ali	Milk Trader	Jogar char, Goalibari, Kaluhati, Tangail	• Mostly Tobacco practices in this char • Because of new char land our grazing land is also increased
13	Md. Kismot Ali	Fishermen	Mohonpur, Nikrail, Bhuapur, Tangail	• Because of developing new Char land the fisheries resources are decreasing with losing their habitat area.
14	Mr. Rabiul Islam	Tobacco producer/ farmer	Beyaramarua , Nikrail, Bhuapur, Tangail	• Tobacco production or practices increase because sandy soil is good for tobacco production.
15	Mr. Kazi Sadikul Islam	Teacher	Gazibari, Goalibari, Kalihati, Tangail	• Before construction the Bangabandhu Bridge Elenga area was inundated in every year; however, after construction the bridge problem has been solved.
16	Imam Sikdar	Fisherman	Village-Gollabari, Union-Goalibari Kalihati, Tangail	• Fisheries resources decrease because of different types of destructive gears (Bernagini, moijal, beta fashi)/ current net uses for fishing in the Jamuna River.
17	Abul Kasem	Teacher	Village-Gollabari, Union-Goalibari Kalihati, Tangail	• For the establishment of Bangabandhu Railway Bridge decrease the breadth of Jamuna River, henceforth develop char land and decrease the flow of water.
18	Abul Hossen	Farmer	Village-Gollabari, Union-Goalibari Kalihati, Tangail	• Agrochemical uses in the crops of char land and chemical washed away into the river and polluted the river of Jamuna.
19	Nadim Haider	Trader	Charpolsia, Nikrail,Kaliti, Tangail	• Owing to establish the Bridge decrease the river bank erosion otherwise expand river bank erosion and up to Elenga will eroded
20	Abdul Hai	Boatman	Goalibari,Khalihati	• Due to establishment of bridge their source of income

S/N	Name	Profession	Address	Opinion/comment
			Tangail	decrease
21	Jafar Ali Sikdar	Traders	Mulkadichar, Belkuri, Sirajganj Sadar	• All land property grasp by Jamuna River but now rehabilitee.
22	Sajeda Begum	Teacher	Mulipara, Soidabad, Sirajganj Sadar	• She has got benefit because of due to establishment of Bangabandhu Railway Bridge this area under rural electrification and develop road communication
23	Anjumara Khatun	Housewife	Charpolsia, Nikrail,Kaliti, Tangail	• There is no possibility of river bank erosion, now they are safe
24	Saleha Begum	Shopkeeper	Chotrogacha, Purbomohonpur Soidabad, Sirajganj Sadar	• Load shedding is available
25	Salma Begum	Housewife	Chotrogacha, Purbomohonpur Soidabad, Sirajganj sadar	• Having scope for agricultural practices especially vegetable production on their own lands.
26	Kamrun Nahar	Ward member	Mulipara, Soidabad, Sirajganj Sadar	• Due to development of road communication source of income has increased in this area.
27	Lutfun Nahar	Women leader	Berulia,Nikrail, Kalihati, Tangail	• Jamuna River polluted by development infrastructure and industrial discharge into the river.
28	Abdul Razzak	Potter	Goalibari, Khalihati Tangail	• They are benefitted by the establishment of Bangabandhu Railway Bridge • Their expectation on Jamuna Railway Bridge.
29	Abul Kasem	Black Smith	Charpolsia, Nikrail,Kaliti, Tangail	• Their source of income have increased
30	Abu Taher	Tea shopkeeper	Chotrogacha, Purbomohonpur Soidabad, Sirajganj sadar	• Their working opportunities have increased.
31	Aminur Rahman	Shopkeeper	Charpolsia, Nikrail,Kaliti, Tangail	• Their demand is easy access to roads
32	Abdul Jalil	Rickshaw Puller	Goalibari,Khalihati Tangail	• They are happy that there is no possibility to river bank erosion.
33	Mr. Hasem	Van puller	Village- Sirajkandi Union-Nikarial, Bhuapur, Tangail	• Their income have increased but road remain busy
34	Mr. Belal	Farmer	Chotrogacha, Purbomohonpur Soidabad, Sirajganj sadar	• Jamuna is polluted and damaged
35	Omar Faruque	Fisherman	Beyaramarua , Nikrail, Bhuapur, Tangail	• Destructive gear uses in the Jamuna River, even 4-5 km long current jal use in the Jamuna although it is illegal • Government has banned current jal.
36	Md. Rafiqul Islam	Tailor	Goalibari,Khalihati Tangail	• Their sources of income have increased • Expectation of Jamuna Rail Bridge.
37	Mr. Hapizul	Fish Traders	Beyaramarua , Nikrail, Bhuapur, Tangail	• Fisheries resources decrease in the Jamuna because of increase the pollution in the char land
38	Mearz Ali Sheikh	Fruit supplier	Beyaramarua , Nikrail, Bhuapur, Tangail	• Comparative local fruits production is decreased because people demand on timber trees.
39	Md. Tofael	Shopkeeper	Village- Sirajkandi Union-Nikarial, Bhuapur, Tangail	• Their livelihood improved
40	Abdul Mazid	Boatman	Goalibari,Khalihati Tangail	• Decrease their source of income because of the establishment of Bridge
41	Monowara Begum	Housewife	Chotrogacha, Purbomohonpur Soidabad, Sirajganj sadar	• Having scope of vegetable production
42	Suneka	Teacher	Beyaramarua ,	• Existing Rail Bridge is in risk, so immediately need

S/N	Name	Profession	Address	Opinion/comment
	khatun		Nikrail, Bhuapur, Tangail	another rail bridge.
43	Chaina khatun	Worker		• Their demands according to skill get opportunity in the construction work.
44	Nurul Sheikh	Bus driver	Village- Sirajkandi Union-Nikarial, Bhuapur, Tangail	• Traffic jam also occurs time to time • Their demand is road extension.
45	Sayera begum	House wife	Chotrogacha, Purbomohonpur Soidabad, Sirajganj sadar	• 100 % sanitation yet not in the char area.
46	Shampa Khatun	Teacher	Goalibari,Khalihati Tangail	• Sand mining is the major problem and Jamuna is dead
47	Anotoyria Begum	Ward councilor	Char Hamziri, Durgapur, Kalihati	• Open defecation common in this locality. • Lack of sanitary latrine
48	Hazera Khatun	Leader	Beyaramarua , Nikrail, Bhuapur, Tangail	• Jamuna Urea fertilizer directly discharge into the Jamuna river
49	Jamnnatul Ferdous	Union member	Charpolsia, Nikrail,Kaliti, Tangail	• BSCIC is going to establish Industrial park in the west site of Jamuna.
50	Amona Begum	Housewife	Char Hamziri, Durgapur, Kalihati	• Having scope to culture the vegetables in the char land.
51	Josnera Begum	Housewife	Chotrogacha, Purbomohonpur Soidabad, Sirajganj sadar	• Aware people about sanitation because of some households have no ring slab.
52	Dilara Begum	Member	Goalibari,Khalihati Tangail	• People are interested in separate rail bridge
53	Abu Kalam	Station Master east site	Beyaramarua, Nikrail, Bhuapur, Tangail	• Train cross the bridge very slowly because of bridge is in risk.
54	Iqbal Hossain	Farmer	Charpolsia, Nikrail,Kaliti, Tangail	• Agrochemical use in the agricultural crops for pest control, after raining washed away into the river
55	Abu Sofian	Farmer	Charpolsia, Nikrail,Kaliti, Tangail	• Soil quality decreased because of agrochemical use, industrial discharge and open defecation etc.

11.10 Summary of the Information Disclosure Meeting at Sadar Upazila

The Information Disclosure Meeting was presided over by Upazila Nirbahi Officer (UNO) and was attended by other Officers and Chairman and Vice Chairman of Sadar Upazila. The locals also attended in small number. The meeting was held on the 17th August at the Meeting Hall at the UNO Office around 11 Am.

The consultant team explained the project and enlisted the likely caused on environment and the mitigation measures to be adopted during implementation stage. The presentation on the environmental survey results were presented to the audience.

The summary of the comments/suggestions shared by the audience are enclosed here:

a) The local population and the officials gathered at the meeting are very happy for the proposed bridge project. They are looking forward for the project for a long time.

b) The Fisheries Officer feels that there should not be any oil spills in the surface water, as it affects the breeding of Hilsa Fish. The breeding season is in the month of October.
c) Generally the Hilsa fish migrates in one direction. They generally travel to the confluence points for breeding purpose.
d) The fishery officer feels that the construction work may hamper the dolphin breeding.
e) The fishery officer feels that the work force should not catch fish during the October month. The work force should be informed about this period not to catch Hilsa.
f) The bridge implementation should follow the stipulated period of time,
g) The Chairman Union Parishad requested that the new pillars which would come for the Bangabandhu Railway Bridge should be placed parallel to the existing Bangabandhu Bridge.
h) The Agricultural Officer feels that the agro chemical use is bare minimum, as it is required for the better pest management.
i) Local population should get the job preference.
j) The officials and the local population feels this Railway Bridge will give better connectivity between the eastern and western districts.
k) Guide bund should be further strengthened on the Western Bank.

These were some of the major comments given by the officials, and the local population attended the meeting.

11.11 Summary of the Information Disclosure Meeting at Bhaupur Upazila

The Information Disclosure Meeting was opened by the Member of Parliament and later presided over by Upazila Nirbahi Officer (UNO) and was attended by other Officers, Union Parishad Chairman and Chairman and Vice Chairman of Bhaupur Upazila. The locals also attended in small number. The meeting was held on the 17th August at the Meeting Room at the UNO Office around 04.00 Pm.

The consultant team explained the project and enlisted the likely caused on environment and the mitigation measures to be adopted during implementation stage. The presentation on the environmental survey results were presented to the audience.

The comments/suggestions given by the officials and the other people representatives are given below.

a) The borrow pits used for the construction purpose can be leased out by BR for the local population for growing fish (fish farming) and for development of vegetation.
b) The skilled and unskilled labour should be chosen from the local population.
c) The channelling of water near char lands might prevent flooding and loss of property.
d) River Training was also mentioned by one of the officials and was explained by the consultant team regarding the activities taking place at the project site.
e) Erosion Control Measures to be adopted at the Eastern Bank.
f) The audience fear that there may be new Char lands may be formed due to the up-coming railway bridge.
g) Guide bunds should be further strengthened on the eastern bank.
h) As eco-park will be used for the railway alignment passing, so the local population requested to develop new Eco Park on either side of the Bridge.
i) The audience fell it will give a better connectivity for the east and west. It will develop the regional cooperation among the South Asian Nations.

Over all it was a positive interaction among the local population, officials and public representatives. The outcome of the Information Disclosure Meeting will be fruitful during implementation of the project.

12 CHAPTER-ENVIRONEMNTAL MANAGEMENT ACTION/ MONITORING PLAN

12.1 Environmental Management Action Plan

The Environmental Management Action Plan has prepared to minimise to avoid high and medium ranked adverse environmental impacts identified during the three stages of the project cycle, during pre-construction stage, construction stage and operation stage. Each adverse impact is addressed during the implementation stage of the project.

- Dredged Material Management Plan
- Air quality management
- Noise and vibration management
- Community EMP
- Tree Plantation
- Biodiversity Management Plan
- Public Health Management Plan
- Livelihood and income restoration plan
- The environmental management action plan envisages the mitigation measures implemented at various adverse impacts identified during the EIA study.

The following table depicts about the mitigation measures for the various adverse impacts.

Table 12-1 mitigation measures for the various adverse impacts

Environmental Mitigation Plan to be Monitored • Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
Design Stage		
Bridge construction and its impacts	Loss of Plantation on the western Bank of Jamuna River	1. Only marked trees to be cut. 2. Workforce should not disturb the migratory birds. 3. Only required trees to be up rooted.
	Migratory route for the dolphins and aquatic fauna	1. The dolphins should not be disturbed during the construction work to the extent possible 2. All precaution should be taken not to disturb the fish during the spawning season.
	Safety risks due to un expected accidents	Ensure all safety norms at place during the construction.
	Noise and vibration	Equipment which produce less noise should be used during the construction period
Construction Stage		
Mobilization of equipment's and workforces	Accident risks from mobilizing construction equipment	1. To the extent possible, avoid the mobilization of heavy equipment's at night. 2. Over-width and over-length vehicles should display adequate warnings such as flashing lights, signs, and flags on extending parts of equipment.

Environmental Mitigation Plan to be Monitored		
• Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
Impact on health and Social Well-being of Local Communities	Negative impact on the health and social well-being of local population due to the introduction of workforce from other places	1. Conduct special briefing or on-site training on environmental, occupational safety and health requirements of the project workers. 2. Strictly supervise workers not to interfere with local affairs or quarrel with local people. 3. In case of complaints from local people on the issues caused by workers and complains will be solved as soon as possible, under collaboration of Environmentalist of the CSC
	Accident risk from mobilizing	The followings for safety will be provided to workers. 1. Warning and/or Precaution Signs on safety. 2. Helmets. 3. Instruction on health and safety. 4. Establishment of all relevant safety measures required by law and good engineering practices. 5. Provision of first aid facilities at the construction sites.
	Outbreak of disease	1. The Contractor will have all his workers undergo a regular medical check on their arrival on Site. 2. Necessary vaccinations should be given to the workers. 3. Site construction camps at least 50 m far away from rivers and as far as possible from local communities. 4. Provide enough water supplies for workers, and ensure sufficient sanitation for the camp: the proper drainage systems, and the proper location for solid waste disposal. 5. Make medical treatment available for workers. Provide workers mosquito nets and malaria-prevention medication.
	Depletion of natural resources through demand for building materials, fuel, and food for workers	1. Do not harvest wood resources within protected area. 2. Where local materials must be used, make agreements with local communities about the areas or the volume that can be harvested without significant impact. 3. Support community development by paying an adequate price for any local resources used. 4. All supplies for building camps will be brought from outside the area. 5. Do not allow construction camps to become permanent settlements. 6. Camps will be removed and the area brought back to pre-construction condition prior to Project completion. 7. Upon completion of construction, consideration will be given to transferring camp structures to local people for community or government use. 8. Conduct awareness-raising campaigns on tree conservation to workers.
	Erosion from the construction place.	1. Where spoil disposal in vegetated sites cannot be avoided, select areas with scrub, bamboo, or herbaceous growth over areas of healthy forest. 2. No disposal into gullies or watercourses. 3. No disposal by direct tipping of spoil into water. 4. Plantation will be developed on spoil dumps to maintain the soil stability.
	Loss of riverside vegetation	1. To the extent possible, avoid clearing riverside vegetation during access road construction on the western bank. 2. Revegetate riverbanks where clearing is unavoidable. Action plan should be immediate
	Improper disposal of solid waste	1. Segregation of wastes shall be observed. 2. Organic (biodegradables) shall be collected and disposed of on site by composting (no burning on site). 3. Recyclables shall be recovered and sold to recyclers. 4. Residual and hazardous wastes shall be disposed of in disposal sites approved by local authorities.
	Damage to river/stream beds	1. Rock and gravel won from rivers shall be removed over

Environmental Mitigation Plan to be Monitored • Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
	and banks due to extraction of construction material	some distance so as not to disrupt river flow or damage or undermine riverbanks. 2. No sand mining will be carried out in Jamuna River 3. Reinstate banks by providing stable slopes and vegetation cover.
	Pollution due to use and storage of hazardous substance	1. Hydrocarbon, toxic material will be stored in adequately protected sites to prevent soil and water contamination while vehicle maintenance and refuelling will be confined to areas in construction sites designed to contain spilled lubricants and fuels. 2. Fuel depot shall be provided with impervious flooring and bund/containment wall to keep spilled fuel/lubricant within the depot; 3. Used oil and other toxic and hazardous materials shall be disposed of in an authorized facility off-site. 4. Spill waste will be disposed at disposal sites approved by local authorities. 5. Adequate precaution will be taken to prevent oil/lubricant/ hydrocarbon contamination of channel beds. Spillage, if any, will be immediately cleared with utmost caution to leave no traces 6. All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation 7. The personnel in-charge of these sites will be properly trained and these areas will be access controlled and entry will be allowed only under authorization
	Occupational health and safety	1. Workers shall be provided with appropriate personal protective equipment (PPE) such as safety shoes, hard hats, safety glasses, ear plugs, gloves, etc. 2. The contractor shall orient workers on health and safety issues related to their activities as well as on the proper use of PPE. 3. Where worker exposure to traffic cannot be completely eliminated, protective barriers shall be provided to shield workers from traffic vehicles. Another measure is to install channelling devices (e.g., traffic cones and barrels) to delineate the work zone. 4. Workers shall be provided with potable water supply. 5. Provision of distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure of workers to danger from moving vehicles. 6. Monitoring and control of the working environment and planning of safety and health precautions should be performed as prescribed by national laws and regulations. 7. Construction camps shall be provided with adequate drainage to avoid accumulation of stagnant water. 8. HIV/AIDS awareness and prevention program shall be implemented under the Project. 9. The following facilities shall be provided at the workers' camps: 10. Washing facilities or showers shall be provided at the workers' camps. a. Toilets/sanitation facilities with proper flushing provisions in accordance with local regulations to prevent any hazard to public health or contamination of land, surface or groundwater. These facilities shall be well maintained to allow effective operation. b. Accommodation for taking meals and for shelters during

Environmental Mitigation Plan to be Monitored		
• Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
		interruption of work due to adverse weather conditions. c. First aid room or station under the charge of the qualified first aid personnel or a nurse should be provided at a readily accessible place for treatment of minor injuries and as a rest place for seriously sick or injured workers. 11. Construction equipment shall be operated by workers who have received appropriate training in accordance with national laws and regulations. 12. The drivers and operators of vehicles and materials handling equipment shall be medically fit, trained and tested and of a prescribed minimum age as required by the government rules and regulation. 13. Suitable scaffolds from the ground shall be provided for the work force, who are working at elevated heights, if a ladder is used a proper foot holds and hand holds shall be provided on the ladder. 14. The safety belts and nets will be provided at the bridge construction area. A safety officer will be provided at all the working / construction areas. 15. Safety provisions shall be brought to the notice of all concerned by displaying or notice board at a prominent place at the work locations. 16. The contractor shall be responsible for observance, by his sub-contractors, of all health and safety provisions. 17. The contractor should take adequate measures for the control of malaria/ chikungunya/ dengue. 18. All vehicles used in the construction yard should have reverse horns 19. There should be proper demarcation of work areas with sign boards showing the work areas. The signboards should be in local language. 20. Suitable warning should be displayed at all places where contact with or proximity to electrical equipment can cause danger. 21. Persons having to operate electrical equipment should be fully instructed as to any possible danger of the equipment concerned. All the electrical equipment should be inspected before it is taken into use to ensure that it is suitable for its purpose. 22. Water transport tanks, storage tanks and dispensing container should be designed, used, cleaned and disinfected at suitable intervals in a manner approved by the competent authority. 23. Water that is unfit to drink should be conspicuously indicated by notices prohibiting workers from drinking it. 24. Secure storage areas should be provided for flammable liquids, solids and gases such as liquefied petroleum gas cylinder, paints and other such materials in order to deter trespassers. 25. Smoking should be strictly prohibited and no smoking notices be predominantly displayed in all places containing readily combustible or flammable materials 26. Only suitably protected electrical installations and equipment, including portable lamps, should be used. 27. Oil rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place. 28. Fire-extinguishing equipment should be provided at construction camps, asphalt plants, storage areas for combustible materials and other areas where fire hazards are found. Such equipment shall be properly maintained and

Environmental Mitigation Plan to be Monitored • Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
		inspected at suitable intervals by a competent person.
	Public health and safety risks	1. Barriers (e.g., temporary fence), shall be installed at construction areas to deter pedestrian access to the roadway except at designated crossing points. 2. The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is in operation. 3. Speed restrictions shall be imposed on Project vehicles and equipment when traversing areas with sensitive receptors (residential, schools, temples, etc.).
	Loss of vegetation and habitat through road widening, realignment of right-of-way, quarries and borrow pits	1. Utmost care will be observed to avoid unnecessary damage to vegetation. 2. There will be no new quarries within provincial and district protected areas. 3. Do not cut trees outside of the construction zone. 4. In case of new quarries operation, the quarries will be approved by the Environmental monitoring Authorities.
	Impacts on wildlife through interruption of migratory routes and other habitat disturbances	Strict monitoring in this area will be used to prevent opportunistic "salvage" logging or illegal timber harvest.
	Encroachment on water supply systems from road construction activities	Contractors will pay a fee to villagers for damage to water systems, perhaps based on number of days without water until the system is fixed. Fees might be specifically targeted towards women or women's groups, since they are usually the ones who will have the main burden of carrying water when the system is down.
	Dust/air pollution	1. Maintain all construction vehicles to minimize toxic vehicle emission. 2. Appropriate, scheduled road maintenance will be needed to retain a sealed surface, continuing the improved situation. 3. Sprinkle water on the road surface to prevent dust emission at residential areas.
	Creation of stagnant water bodies in borrow pits, quarries	1. Incorporate adequate drainage and fill in borrow pits and quarries. Before doing this activity the local concern should be considered. The village authorities should also be consulted. 2. Maintain borrow pits and quarries by landscaping them after operation by growing the native species.
	Noise and vibration	1. All construction vehicles/ equipment will have mufflers and they will be properly maintained. 2. Inform people of the possible vibration before using vibrating equipment used due the construction activity. 3. Construction yards shall be located away from settlement areas. Batching and aggregate crushing plants shall be located on the down wind direction of sensitive areas such as schools, hospitals or human settlement etc. In unavoidable circumstances, the time of the operation of the plant shall be limited. The necessary permission should be obtained from the local government officials. 4. Activities that will generate high noise levels will be scheduled to coincide with period when people are least likely to be affected. Construction activities will be strictly prohibited between 10 P.M. and 6 A.M. in the residential areas.
	Traffic disruption during construction	1. Employ "flag men" to regulate the traffic flow at every construction area. 2. Where ever possible provide enough space for one-way traffic flow. 3. Since the boat traffic will also increase during construction stage, the boats of the contractor should not obstruct the

Environmental Mitigation Plan to be Monitored		
• Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
		fishermen boats.
	Ground and water contamination by oil, grease, fuel, bitumen, etc.	1. Collect, store and dispose of materials in accordance with local law or standard acceptable practice.
	Construction/traffic related dust and noise impacts in the settlement area	1. Avoid use of vehicles with excessive exhaust or noise emission, install and maintain equipment silencers 2. Regularly sprinkle water on road surfaces in village areas during dry season, maintain the speed of the vehicles and maintain construction vehicles, cover haulage trucks with tarpaulins to prevent spillage. 3. The speed regulations should be strictly observed at the schools and at the settlement areas.
	Environmental and Social disruption from construction Camp	1. Hire as many local people as possible and train them 2. Site construction camp should minimize adverse impacts by better management practices. 3. Implement malaria control, HIV/AIDS education 4. Plan and carry out post construction site clean-up.
	Water quality impacts	1. Work in rivers will be scheduled during non-monsoon season and work duration shall be as short as possible. 2. Construction storage/stockpiles shall be provided with bunds to prevent silted run-off. 3. Stockpile areas and storage areas for hazardous substances shall be located away from water bodies. 4. Washing of machinery and vehicles in surface waters shall be prohibited.
Setting up and operating an asphalt plants, bitumen operation area	Water pollution by oil, grease, and fuel around gas stations and parking areas	1. Locate storage areas for diesel and bitumen at least 500 meters from watercourses and from human settlement. 2. Employ safe practices in filling bitumen distributor tanks and in heating bitumen. Do not allow smoking or fire of any kind in the vicinity of bitumen and kerosene blending tanks. Provide a carbon dioxide fire extinguisher at the bitumen tank site for fire-fighting. 3. Collect and recycle all lubricants and take precautions to prevent accidental spills. 4. Develop and implement plans for safe storage of all toxic and potentially toxic materials into construction planning and design.
Operation of construction camps	Solid waste from the construction camps	1. Provide garbage tanks and sanitary facilities for workers. Waste in the specific tanks should be cleared regularly so that vector borne infections can be prevented. 2. The waste water from the construction camps should be settled and treated prior letting it out. The wastewater should not be let down into nearby surface waters. 3. Garbage will be collected in a tank and be disposed of periodically. 4. Special attention will be paid to the sanitary condition of camps.
Increased vehicular traffic	Accidental risk of toxic materials spills from increased vehicular traffic and commerce	1. Incorporate plans for safe storage of all toxic and potentially toxic material into traffic planning. 2. Regulate transport of toxic materials. 3. Set and enforce speed limits, especially near schools and settlement areas and sensitive locations.
	Accidental Risk of Injury or Loss of Life to People and Livestock from Increased Traffic Volume and Speed	1. Install appropriate signs warning drivers to slow down in settled and livestock areas. 2. Arrange flag man/women in controlling the traffic. 3. The persons controlling should have proper training.
Operation Stage		
	Air & Dust Pollution	1. Maintain locomotives according to factory specifications. 2. Ensure the combination of better equipment, more pollution control devices on the locomotives as the fleet is renewed and cleaner fuel.

Environmental Mitigation Plan to be Monitored		
• Design stage mitigation measures to be implemented by the design consultant • Construction stage mitigation measures to be implemented by contractors supervised by the CSC and the Client • Operation stage mitigation measures to be implemented by BR, Government of Bangladesh		
Activities	**Environmental impacts**	**Mitigation Measures**
	Noise & Vibration Pollution	1. Replacement of brake shoes with disc braking systems; 2. Minimal use of train whistles particularly at night, and maintenance of a smooth rail through regular grinding; 3. The replacement of old locomotives with new quieter locomotives; and 4. Install noise attenuation features at the sensitive sites - e.g., berms. Plantings and noise barriers-based on noise monitoring recognising existing train noise.
	Health & Safety	1. Installation of modern railway crossing and gate systems. Pedestrian foot over bridges will be building and increased as the need develops. Training to crossing guards will be enhanced. 2. Prepare a formal fire response plan supported by the necessary resources and provide fire training and response as part of workforce health and safety induction/training. Training should include the use of fire suppression equipment and evacuation, with advanced fire safety training provided to a designated firefighting team. 3. Properly equip facilities with fire detection and suppression equipment that meets internationally recognized technical specifications for the type and amount of flammable and combustible materials stored at the facility.
	Soil and Surface water pollution	1. A spill contingency plan and good maintenance of track and rolling stock will help reduce the risk of such accidental spills, and permit rapid action if an accident does occur. 2. Proper waste disposal facilities within the train and 3. Establishment of strict fine for garbage throwing will reduce the chance of throwing waste materials outside. In addition, retrofitting trains with sewage collection tanks to be pumped out at collection stations for delivery to STPs will also reduce chance of soil and surface water pollution.
	Scouring at pier location	1. Regular inspection of the scouring condition at bridge site is necessary.
	The economic boost	1. By the implementing of this project will develop better connectivity between east and west side. 2. The trains can run in better speed and carry more fright. 3. The heavy traffic plying on the Bangabandhu Bridge can be curtailed to some extent. 4. There will be employment generation once the project is implemented.
	Accidents	1. There should be proper manned level crossing as the speed of the train would increase. 2. The railway track should have fence on either side to prevent the accidents 3. There should be foot over bridges to cross the construction areas
	Impact Migration	1. The construction work may give a negative impact on the migratory birds. 2. The dolphin movement may be curtailed to some extent as the construction work disturbs the surface waters and the higher noise levels also affects the movement of dolphins

12.2 Construction Labour

The contractor will establish a code and conduct for the construction workers. Construction workers should be established Code of Conduct , emphasizing appropriate behaviour, drug and alcohol abuse is strictly prohibited and follow the relevant laws and regulations, thus

reducing the impact on the community. Code of Conduct propaganda notification should be implemented to every worker. Construction worker code of conduct should be notified to the local community. Failure to comply with Code of Conduct shall be subject to disciplinary action. Code of Conduct includes but is not limited to the following measures:

- All staff shall comply with national laws and regulations
- dangerous goods and hazardous site is prohibited weapons;
- the site is prohibited pornographic materials and gambling activities;
- Do fights;
- Do not obstruct the immediate vicinity and the local people 's life and production;
- respect local traditional culture , customs and traditional activities ;
- designated areas only smoking;
- proper dress and personal hygiene standards;
- suitable accommodation sanitation;
- When you visit the neighbourhood and the local people, should comply with the relevant code of conduct.

12.3 Emergency Plan for the Gas Pipeline

The gas company GSTL should develop the emergency response plan in case of accidents. As the pipelines also passes along with the bridge. For the gas pipe line project, the GSTL requires to develop emergency response procedures, including: emergency command structure and related responsibilities and tasks cooperative unit, select technology and handling emergency procedures, equipment, equipment configuration and layout, human and material resources to ensure and deployment, dynamic monitoring system of the accident, after the accident reporting system.

1. Strict control of natural temperature, a regular pigging, excluding water and dirt inside the tube in order to reduce corrosion of the pipeline;
2. Pipe wall thickness measurements should be taken every three years, severe thinning of the pipe wall, timely maintenance and replacement, burst pipes to avoid accidents
3. Pipeline safety inspection every six months protection systems (such as shut-off valve, safety valve, venting systems, etc.), so that the pipe can be overpressure in the safe handling, so that the scope of damage is reduced to a minimum.
4. For crossing rivers and other sensitive areas of the pipe should be inspected once every three years.
5. In the flood period, special attention should be paid to the pipeline crossing the river;
6. Regular inspection and maintenance of the gas pipelines.
7. Personnel should be well trained in handling any accidents in the gas pipelines.

The emergency staff from the GTCL should be placed in both the stations (Bangabandhu Setu East and Bangabandhu Setu West station with all equipment so that they can handle any eventuality.

12.4 Environmental Monitoring Plan

The environmental monitoring is important for assessing the baseline environmental quality and also during the construction and operation of the project. The monitoring plays vital role to assess the deterioration of environmental quality and extent of implementation of the mitigation measure. It plays a judgemental role about the efficacy of the implementation.

During the construction stage the following aspects are to be considered. They are: 1. Air quality monitoring, water quality, noise levels. The monitoring should be continued all through the project till the completion of the project. The frequency of the monitoring should be once in three months. The monitoring should continue also during the operation stage to establish the baseline environmental quality.

During the construction of the project requires regular monitoring of environmental parameters. The major parameters to be considered are the air quality, water quality, soil, noise and vibration. The monitoring should be carried out by an organization which is recognised in the environmental field. The frequency of sampling, sampling parameters and the location are given in the following tabular forms. The sampling should be carried out once in three months in the following sampling locations:

- Construction Yards
- Labour Camps
- Construction Sites
- Settlement Areas
- Sensitive locations.

The Table 12-2 and Table 12-3 are shown below given the monitoring during the construction and operation stage.

Table 12-2 Environmental Monitoring Matrix Construction Stage

Sl. No	Environment Item	Parameters	Sampling Location	Frequency
1	Water Quality (surface)	pH, Total Organic Carbon, Total Phosphorous, Total Suspended Solid, oil and grease, Dissolved Oxygen and fecal coliforms and E.coli	Upstream and downstream of Jamuna River. Three samples each should be collected	Once in Three months during the construction period
2	Water Quality (ground)	Total Dissolved Solid, Chlorides, heavy metal, As, Fe, Mn, and S	Three samples to be collected on either side of	Once in Three months during the

Sl. No	Environment Item	Parameters	Sampling Location	Frequency
		and E.coli and fecal coliforms	the bank	construction period
3	Air quality	Carbon Monoxide, Oxides of Nitrogen, Nitrogen Dioxide, PM2.5 and PM_{10}, O_3 and SO_2.	Three sample each on the East and Western Bank and sampling should be carried out at the Bangabandhu Eco Park	Once in Three months during the construction period
4	Noise and Vibration	The noise should be measured one hour duration during the day time and 15 minutes duration during the night time	Three sample each on the East and Western Bank and sampling should be carried out at the Bangabandhu Eco Park	Once in Three months during the construction period
5	Soil Sampling	The soil will be tested for nitrogen, phosphorus, potassium, Sulphur, calcium, magnesium, iron, manganese, copper, zinc, boron and molybdenum.	Eastern Bank, Western Bank, Construction yards, labour camps	Once in Six months during the construction period
6	Drinking Water	Coliforms, pH, chlorides, arsenic, dissolved oxygen, suspended solids, dissolved solids and heavy metals.	Labour Camps	Once in three months during the construction period

Table 12-3 Environmental Monitoring Matrix Operation Stage

Sl. No	Environment Item	Parameters	Sampling Location	Frequency
1	Water Quality (surface)	pH, Total Organic Carbon, Total Phosphorous, Total Suspended Solid, oil and grease, Dissolved Oxygen and fecal coliforms and E.coli	Upstream and downstream of Jamuna River. Three samples each should be collected	Once in six months during the operation period
2	Water Quality (ground)	Total Dissolved Solid, Chlorides, heavy metal, As, Fe, Mn, and S and E.coli and fecal coliforms	Three samples to be collected on either side of the bank	Once in Six months during the construction period
3	Air quality	Carbon Monoxide, Oxides of Nitrogen, Nitrogen Dioxide, PM2.5 and PM_{10}, O_3 and SO_2.	Three sample each on the East and Western Bank and sampling should be carried out at the Bangabandhu Eco Park	Once in Three months during the operation period
4	Noise and Vibration	The noise should be measured one hour duration during the day time and 15 minutes duration during the night time	Three sample each on the East and Western Bank and sampling should be carried out at the Bangabandhu Eco Park	Once in Three months during the operation period
5	Soil Sampling	The soil will be tested for nitrogen, phosphorus, potassium, Sulphur, calcium, magnesium, iron, manganese, copper, zinc, boron and molybdenum.	Eastern Bank, Western Bank, Construction yards, labour camps	Once in year during the operation period

12.5 Conclusion

If the Environmental management Action Plan is mutinously implemented the adverse impacts caused by the project is easily mitigated. BR should implement the environmental safeguarding by an environmental specialist who could handle all possible impacts caused

during the construction and operation stage. The Environmental Specialist will be reporting to the BR and will overview all the project activities. The moto should be that the development should not affect the environment and vice versa that environment should not hamper the development. There should be right mix among the issues.

13 CHAPTER-CONCLUSIONS AND RECOMMENDATIONS

The Project involves the construction of duel gauge double track Rail Bridge over Jamuna River in parallel to existing Bangabandhu Bridge, approach roads and construction yards. Therefore new impacts will take place along the construction right of way.

Most of the impacts associated with the Project will occur during the construction period since a long bridge, 4.8 km, will be constructed over the Jamuna River and approach roads, around 5 km on either side of the bridge, and construction yards will be put in place and requiring thousands of tons of fill materials.

The problems arising when the contractor does not follow environmentally responsible operating procedures or does not provide proper housing or clean, hygienic quarters for the workers is also addressed in detail.

The EIA identified three mitigation actions needing to be addressed during the pre-construction period, another 10 during the construction period and six during the operating period of the new rail line. To track the mitigation work an air, noise and surface water quality monitoring programme will be started during the construction period and carried through into the operating period for operating years.

There is little chance that impacts will extend much beyond the 50 or 100 m wide corridor of impact centered over the rail line, given that all work will be strictly confined to the railways existing Right of Way. Careful implementation of the preconstruction mitigation measure will make the likelihood or scale of the construction period impacts less.

The establishment of BR's Environmental and Social Management Unit will be essential and will make the job of implementing environmental safeguards much easier and more credible, since some expertise will reside in BR, overseeing the entire EIA procedure, instead of it being only with outside Consultant.

No red-flag environmental safeguard issues were identified and all likely impacts can be prevented or mitigated to an acceptable level.

BR will fully implement the EIA's environmental management plan and quarterly monitoring will be used to adjust the monitoring programme defined in the EIA. Should problems be noted with the data, BR will recommend immediate actions, and the annual reporting will be used to adjust mitigation actions. These activities, coupled with the timely reporting will

provide the appropriate level of environmental oversight and demonstrate to the JICA that the natural environment is being protected while the rail line is built and the system becomes operational.

The potential impacts on the Jamuna River was examined, focusing on pile driving in water, use of drilling lubricants, work camp operation near the shore and work over a navigation channel. All of these possible impacts were addressed in EMP and deal with all possible mitigation measures that might endanger the river's aquatic environment, which will be implemented during construction and operational periods.

BR concludes that this EIA is complete and addresses all relevant likely impacts and proposes a full set of time-bounded mitigation and monitoring actions, including assignment of responsibility. The application of the detailed EMP will insure that the nature and socio-cultural environmental are not unduly affected by the work or the operation of the Jamuna rail bridge and four crossing lines. Therefore BR recommends that an environmental approval be granted by DoE, and that no additional studies be required.

Appendix-1: Checklist for the Bridge and railway

Check List for the Bridge

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	1) EIA and Environmental Permits	a) Have EIA reports been already prepared in official process?	Y	a) Yes
		b) Have EIA reports been approved by authorities of the host country's government?	N	b) The present project was considered during the feasibility stage (2013-2014) and obtained EIA Terms of Reference from Department of Environment, Government of Bangladesh, which is the basis to prepare EIA report for DOE, GoB.
		c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	c) There is no condition imposed to prepare the EIA report as the report has not yet been submitted to Department of Environment. The feasibility stage was funded by the ADB. The same terms of reference was used for the present study to update the existing EIA Report. It will be submitted for obtaining the necessary environmental clearance.
		d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	Y	d) Beside ECC from DoE, No-objection certificates were obtained from the relevant departments including Bangladesh Bridge Authority, Bhuapur Upazila Nirbahi (Administrative) office, Nikrail Union Parishad, Soidabad Union Parishad, Forest Department, Bangladesh Water Development Board, Bangladesh Inland Water Transport Authority, and District Land Acquisition Office.
	2) Explanation to the Local Stakeholders	a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	Y	a) Public Consultation meeting and information disclosure meetings conducted in the month of July and August respectively and noted all of their comments and suggestions. Both programs have been advertised in the local papers for concerns the local community. Local journalist also participated in the programs and findings of meeting published in the papers.
		b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	Y	b) Local population demand for the provision of fence along the rail corridor and provision of railway gates at the unmanned level crossings. The local population also requested for a foot over bridge on traffic points and other important places , which is under consideration by the project design team
	3) Examination of Alternatives	Have alternative plans of the project been examined with social and environmental considerations?	Y	Various alternatives routes were investigated during the ADB feasibility study. The best option was considered for the railway bridge

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				construction. The options were seen at the downstream and up stream of the River Jamuna. The environmental issues were properly weighed before finalizing the final alignment.
2 Pollution Control	1) Air Quality	a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken?	N	a) Not applicable- It will be applicable on either side of the bridge
		b) If air quality already exceeds country's standards near the route, is there a possibility that the project will make air pollution worse?	N	b) The air quality data shows there is increase in the particulate and gaseous pollutant concentrations when compared to the air quality results of July 2013 and February 2014, which was generated during the period of feasibility stage. The value of O_3 exceeds both DOE and IFC standards in this location. Findings of JICA study on ambient air quality compare with DOE standard and EHS Standards of IFC. The air quality levels are very much within the standards.
	2) Water Quality	a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	N	a) Chances are less to occur as soil will not run off from bridge site as there is no earthmoving activities involved. There will be water pollution due to the construction activity, but it will be of temporary nature. The bridge construction would give out a lot of suspension of sediment in the River Jamuna. It will be of temporary nature.
		b) Is there a possibility that the project will contaminate water sources, such as well water?	N	b) There is a minimum possibility that the project will contaminate water sources, as a dedicated environmental monitoring system has been proposed for the project during construction period. Wastewater may flow from the construction yards and from labour camps which requires to be treated before letting it to go. The surface water monitoring was quite good and the results are less than the DoE standards.
	3) Noise and Vibration	a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	Y	a) Noise will be a major problem at the time of the construction as the piling activity emits a large noise levels, but it is a temporary impact. The ambient noise level is satisfied with the DoE standards.
		b) Do low frequency sound from the vehicle and train traffic comply with the country's standards?	Y	b) The noise monitoring was carried out which was lower than the prescribed levels. The higher noise levels can be attributed to the heavy traffic movement on the corridor.
3 Natural Environment	1) Protected Areas	Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there	N	Not Applicable

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		a possibility that the project will affect the protected areas?		
	2) Ecosystem	a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	a) Not Applicable
		b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	Y	b) Ganges River Dolphin (endangered species as of IUCN Red Book) uses the bridge area as migration route during monsoon. An UK based NGO declared Jamuna and its floodplain as roasting ground for migratory birds during November to February every year and the floodplain area is not close to proposed bridge area.
		c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	Y	c) Although the above-mentioned issue is not significant, EIA report suggests certain mitigation measures on this issue. The implementation of the mitigation measures will be monitored during construction period.
		d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock?	Y	d) Yes, adequate protection measure has been taken care off in EIA report.
		e) Is there a possibility that installation of bridges and access roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	N	e) There will be limited impact due to installation of bridges and access roads.
	3) Hydrology	Is there a possibility that hydrologic changes due to the installation of structures will adversely affect surface water and groundwater flows?	N	There will not be any notable impacts on the hydrological aspects of the river because of proper design.
	4) Topography and Geology	a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	N	Not Applicable
		b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil	N	

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		runoff?		
4 Social Environment	1) Heritage	Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	There is no archeological, historical, cultural, and religious heritage are existing in the project area.
	2) Landscape	Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	Not applicable
	3) Ethnic Minorities and Indigenous Peoples	Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	N	No ethnic minorities and indigenous peoples are existing in the proposed project area.
	4) Working Conditions	a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	N	a) Chances to violate any laws and ordinances associated with the working conditions of the country are low, as the proponent, Bangladesh Railway, is a government agency.
		b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment, which prevents industrial accidents, and management of hazardous materials?	Y	b) Appropriate safety measures will be considered and it will be strictly implemented at the site. The National laws and the international laws will be strictly implemented during the project implementation. Necessary trainings like the tool box training and safety drills will be conducted at the project site.
		c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	c) The health checkups will be conducted for the labour and will be trained in the safety and health aspects.
		d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	Y	d) The implementation of the safety measures will be strictly implemented at the site.
5 Others	1) Impacts during Construction	a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	a) The notable impacts during the bridge construction are the excess noise levels both above and underwater noise due to the bridge construction, sediments suspension due to the dredging activity. Impact on the aquatic fauna like the fish and dolphins last but not the least the air quality gets disturbed due to the construction yards.
		b) If construction activities adversely affect the natural	Y	b) The river water quality gets impacted due to the construction

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		environment (ecosystem), are adequate measures considered to reduce impacts?		activity and this has limited affect to river fishes. Adequate mitigation measures will be implemented at every stage of the project to prevent adverse affection.
		c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	N	c) Adequate mitigation measures will be implemented at every stage of the project to prevent the increase the environmental issues.
	2) Monitoring	a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	a) The air quality regularly monitored during construction and operation stage. The parameters like the particulates and gaseous pollutants will be measured. Surface water quality will be measured for the chemical parameters and bacterial population. The noise monitoring will be carried out regularly to assess the levels during the construction and operation stage. Sediment sampling, testing, and analysis will also be conducted periodically. In addition, benthos, plankton, analysis will also conducted as required by the project.
		b) What are the items, methods and frequencies of the monitoring program?	Y	b) Detail method and frequency have been elaborated in the monitoring program of the EIA report.
		c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	c) Yes, the proponent already established an environmental and social safeguard unit within BR and appointed staff to look after social and environmental safeguard issues. The proponent also have adequate budget to implement the monitoring framework.
		d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	d) No such reporting system has been identified yet but typically DOE asked for it which will be identified after submission of the EIA report to DOE for environmental clearance.
6 Note	Reference to Checklist of Other Sectors	Where necessary, pertinent items described in the Roads, Railways and Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	Y	Referred JICA Railway Check List.
	Note on Using Environmental	If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes	Y	the project will not cause such problems and it will be much environmental friendly

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Checklist	factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).		

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Environmental Checklist for Railways

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	1) EIA and Environmental Permits	a) Have EIA reports been already prepared in official process?	Y	a) Yes
		b) Have EIA reports been approved by authorities of the host country's government?	N	b) The present project was considered during the feasibility stage (2013-2014) and was obtained EIA Terms of Reference awarded an environmental clearance from Department of Environment, Government of Bangladesh, which is the basis to prepare EIA report for DOE, GoB.
		c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	c) There is no condition imposed to prepare the EIA report as the report has not yet been submitted to Department of Environment. The feasibility stage was funded by the ADB. The same terms of reference was used for the present study to update the existing EIA Report. It will be submitted for obtaining the necessary environmental clearance.
		d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	Y	d) Beside ECC from DoE, No-objection certificates were obtained from the relevant departments including Bangladesh Bridge Authority, Bhuapur Upazila Nirbahi (Administrative) office, Nikrail Union Parishad, Soidabad Union Parishad, Forest Department, Bangladesh Water Development Board, Bangladesh Inland Water Transport Authority, and District Land Acquisition Office.
	2) Explanation to the Local stakeholders	a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	Y	a) Public Consultation meeting and information disclosure meetings conducted in the month of July and August respectively and noted all of their comments and suggestions.
		b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	Y	b) One of the comments from the local population is provision of fence along the rail corridor and provision of railway gates at the unmanned level crossings, which is under consideration by the project design team.
	3) Examination of Alternatives	Have alternative plans of the project been examined with social and environmental considerations?	Y	Various alternatives routes were investigated during the ADB feasibility study. The best option was considered for the railway bridge construction. One option at the downstream and other option was considered at the upstream of the river Jamuna. Beside the alignment option, superstructure, substructure, technology, and no alternative have also been examined which is provided in the EIA report.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	1) Water Quality	a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	Y	a) Chances are less to be occurred soil runoff from the bare lands as there will be no soil excavation work. The Contractor will mostly fill and compact sand and soil. However, it may possible to have water pollution due to the construction activity, but it will be of temporary nature. The bridge construction would give out a lot of suspension of sediment in the River Jamuna. It will be of temporary nature. Wastewater may flow from the construction yards and from labour camps which requires to be treated before letting it to go. The surface water monitoring was quite good and the results are less than the DoE standards.
		b) Do effluents from the project facilities, such as stations, comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	Y	b) There is a minimum possibility to discharge effluent without any treatment and or non-compliant with national guideline as a dedicated environmental monitoring system has been proposed for the project during construction period.
	2) Wastes	Are wastes generated from the project facilities, such as stations and depot, properly treated and disposed of in accordance with the country's regulations?	Y	It will be disposed at the place specified by the local authorities. Furthermore, no station will be constructed under this project.
	3) Noise and Vibration	Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	Y	Noise will be a major problem at the time of the construction as the piling activity emits a large noise levels, but it is a temporary impact. The noise monitoring was carried out which was lower than the prescribed levels. The higher noise levels can be attributed to the heavy traffic movement on the corridor.
	4) Subsidence	In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence (especially in case of Undergrounds/Subways)?	N	The ground water will be used only when it is suitable for the construction work. It is prescribed to use surface water for construction purpose as the surface water quality of Jamuna River satisfied national standards. A minimum groundwater extraction may be required. Therefore, there is limited possibility that the extraction of groundwater will cause subsidence.
3 Natural Environment	1) Protected Areas	Is the project site located in protected areas designated by the Country's laws or international treaties and conventions? Is there a Possibility that the project will affect the protected areas?	N	The Bangabandhu Eco-Park will be affected by this project as there will be uprooting of about 3700 trees belonging to 15 species. This was a manmade eco-park. The trees will be replaced by plantation of 12,000 trees. The project site is not located in and around a protected area designated by the country's laws. Therefore, there is no chance to affect the protected areas due to the construction of project.
	2) Ecosystem	a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats	N	a) The proposed project site encompasses common native species especially in eastern side of the rail bridge in

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(e.g., coral reefs, mangroves, or tidal flats)?		Bangabandhu Eco-Park area.
		b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	Y	b) Ganges River Dolphin (endangered species) uses the project area as migration route during monsoon. An UK based NGO declared Jamuna and its floodplain as roasting ground for migratory birds during November to February every year and the floodplain area is not close to proposed bridge area.
		c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N	c) Although the above-mentioned issue is not significant, EIA report suggests certain mitigation measures on this issue. The implementation of the mitigation measures will be monitored during construction period.
		d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of Wildlife and livestock?	Y	d) Yes, adequate protection measure has been taken care off in EIA report.
		e) Is there a possibility that installation of rail roads will have impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	N	e) There will be limited impact due to installation of rail roads.
		f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	N	f) There is a minimum possibility to have such damage to natural environment.
	3) Hydrology	Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	N	There will not be any notable impacts on the hydrological aspects of the river.
	4) Topography and Geology	a) Is there a soft ground on the route that may cause slope failures or Landslides? Are adequate measures considered to prevent slope failures or Landslides, where needed?	N	a), b), c) As such there will not be any major disruptions in the topographic and geological aspects by implementing the project. The waste disposal will be done in accordance to the direction given by the local authorities and the supervision consultants. Adequate measures will be taken up for handling the soil erosion problems. Adequate measures have been suggested in EIA report that will be monitored during construction period.
		b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	N	
		c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil	N	

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		runoff?		
4 Social Environment	1) Resettlement	a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	N	a) No involuntary resettlement will cause. The project does not have any land acquisition problems as the Railway track passes through the Bangladesh Bridge Authority Land. So there are no problems of land and there are no settlements at the project area.
		b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	N	b) Not required.
		c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	N	c) Not required.
		d) Are the compensations going to be paid prior to the resettlement?	N	d) Not required.
		e) Are the compensation policies prepared in document?	N	e) Not required.
		f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	N	f) There is no project affected persons identify in the project area.
		g) Are agreements with the affected people obtained prior to Resettlement?	N	g) No required.
		h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	N	h) Not required.
		i) Are any plans developed to monitor the impacts of resettlement?	N	i) No, as no people living in the right of way.
		j) Is the grievance redress mechanism established?	N	j) Not required.
	2) Living and Livelihood	a) Where railways are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts?	N	a) Rail Line is already in place and there is a little possibility that the project will affect the existing means of transportation and associated workers. No significant impacts will be caused due to the construction of the project as existing rail line and bridge are in place. The project is addressing all possible impacts caused to the local population.
		b) Is there any possibility that the project will adversely affect the living conditions of inhabitants other than the affected inhabitants? Are adequate measures	N	b) No, there is a little chance that the project will adversely affect the living conditions of local inhabitants. Mostly the local labour would come from the project area. There will

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		considered to reduce the impacts, if necessary?		not be any livelihood loss due to the implementation of this project. Adequate medical facilities will be provided to the local population.
		c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	N	c) Chances are low that diseases such as HIV will be brought due to immigration of construction workers associated with the project. However, HIV awareness program will be arranged during the project period. The labour will be trained about the AIDs and HIV infections and other sexually transmitted infections.
		d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., by causing increases in traffic congestion and traffic accidents)?	Y	d) There will be traffic congestions at the project site, as the number of trucks will go up. Therefore, better traffic management practices would bring down the accidents at the project site.
		e) Is there any possibility that railways will impede the movement of inhabitants?	N	e) There should be foot over bridges at some places as it facilitates the inhabitants
		f) Is there any possibility that structures associated with railways (such as bridges) will cause a sun shading and radio interference?	N	f) The bridge will not cause any shading or radio frequency by implementing this project.
4 Social Environment	1) Heritage	Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	There is no heritage sites around the project area, so problem does not arise
	2) Landscape	Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	The project will not affect the local landscape.
	3) Ethnic Minorities and Indigenous Peoples	a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	N	a), b) There are no ethnic minorities/ indigenous population at the site.
		b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	N	
	4) Working Conditions	a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	N	a) Chances to violate any laws and ordinances associated with the working conditions of the country are low, as the proponent, Bangladesh Railway, is a government agency.
		b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous	Y	b) Appropriate safety measures will be considered and it will be strictly implemented at the site. The National laws and the international laws will be strictly implemented during the project implementation. Necessary trainings like the tool box training

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		materials?		and safety drills will be conducted at the project site.
		c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	c) The health checkups will be conducted for the labour and will be trained in the safety and health aspects.
		d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	Y	d) The implementation of the safety measures will be strictly implemented at the site.
5 Others	1) Impacts during Construction	a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	a) The notable impacts during the bridge construction are the excess noise levels both above and underwater noise, due to the bridge construction, sediments suspension due to the dredging activity. Impact on the aquatic fauna like the fish and dolphins last but not the least the air quality gets disturbed due to the construction yards. The river water quality gets impacted due to the construction activity and this in turn affects the fish.
		b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	Y	b) Adequate mitigation measures will be implemented at every stage of the project to prevent adverse impact to the environment including ecosystem
		c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	Y	c) Adequate mitigation measures will be implemented at every stage of the project to prevent adverse impact to the social environment.
		d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	Y	d) Yes, adequate measures will be considered to reduce traffic congestion if it is due to the project implementation
	2) Monitoring	a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	a) The air quality regularly monitored during construction and operation stage. The parameters like the particulates and gaseous pollutants will be measured. Surface water quality will be measured for the chemical parameters and bacterial population. The noise monitoring for both above and underwater noise, will be carried out regularly to assess the levels during the construction and operation stage. Sediment sampling, testing, and analysis will also be conducted periodically. In addition, benthos, plankton, analysis will also conducted as required by the project. The monitoring reports will be submitted quarterly to the funding agency as well as to the Government of Bangladesh. Therefore, sufficient mitigation measures

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				should be required to be implemented to minimize the impact on health of the people living being in the vicinity of the project area.
		b) What are the items, methods and frequencies of the monitoring program?	Y	b) Detail method and frequency have been elaborated in the monitoring program of the EIA report.
		c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	c) Yes, the proponent already established an environmental and social safeguard unit within BR and appointed staff to look after social and environmental safeguard issues. The proponent also have adequate budget to implement the monitoring framework.
		d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	d) No such reporting system has been identified yet but typically DOE asked for it which will be identified after submission of the EIA report to DOE for environmental clearance.
6 Note	1) Reference to Checklist of Other Sectors	Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation), (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	Y	**-Checked -Bridge Check List (12)**
	2) Note on Using Environmental Checklist	If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	Y	The project will not cause such problems and it will be much environmental friendly- A checklist for bridge is also attached.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

3)

Appendix-2: Air Quality Monitoring Results

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : Bangabandhu Bridge East Station at Union-Nikrail, Upazila - Bhuyanpur, District-Tangail, Bangladesh.
GPS Coordinate: N- 24° 23´22.60´´ & E - 89° 49´11.20´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :Rain Was Done - 04:10 PM to 06:00 PM.
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 08th June, 2017 (Start Time:12:40 PM and Off Time: 08:40 PM)
Reporting date : 20th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m³	190	45	62.01	28.19	24.84	93.43	285
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
01:00 PM	66.15 %	35.20 ^{0}C	4.2 E-W	2.9 W-S & W-N
02:00 PM	67.10 %	35.16^{0}C	3.2 N-S	2.2 S-E & S-W
03:00 PM	68.22 %	35.12^{0}C	4.4 N-S	3.1 S-E & S-W
04:00 PM	74.16 %	32.26 ^{0}C	4.7 N-S	3.3 S-E & S-W
05:00 PM	76.27 %	28.14 ^{0}C	4.5 E-W	3.1 W-S & W-N
06:00 PM	99.19 %	27.18 ^{0}C	1.4 S-N	0.9 N-E & N-W
07:00 PM	98.49 %	27.19 ^{0}C	1.0 S-N	0.7 N-E & N-W
08:00 PM	96.16 %	27.25 ^{0}C	0.7 S-N	0.5 N-E & N-W

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at Bangabandhu Bridge East Station at Nikrail, Bhuyanpur, Tangail. The value of PM_{10} was beyond the Bangladesh acceptable limit. Other measured parameters ($PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh and IFC/World Bank . The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. UV-visible Spectrophotometer has been using for NO_x SO_2, O_3, CO & NO_2. The location of sampling site was at Railway station which is closer to Dhaka-North Bengal high-way. The huge vehicles transmission of this highway might be contributed for higher level of PM_{10}. The temperature of was varied from 27.18 ^{0}C to 35.20^{0}C at the sampling site. The wind direction was varied from 0.7 Km/h (South to North) at 27.25 ^{0}C to 4.7 Km/h (North to South) at 32.26 ^{0}C of this sampling site. Due to the rainfall of this day (04:10 PM to 06:00 PM), the humidity was varied from 66.15 % to 96.16 %.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50 m far from Bangabandhu Bridge East Station (South Side) at Union-Nikrail, Upazila - Bhuyanpur, District-Tangail, Bangladesh.
GPS Coordinate: N- 24° 23´20.40´´ & E - 89° 49´10.50´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :Weather was sunny
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 09th June, 2017 (Start Time:10:00AM and Off Time: 06:00 PM)
Reporting date : 20th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m^3	110	46	62.76	28.53	24.23	16.32	272
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
10:00 AM	67.22 %	32.26^{0}C	0.6 (E-W)	0.42 W-S & W-N
11:00 AM	69.15 %	33.15^{0}C	0.8 (E-W)	0.56 W-S & W-N
12:00 PM	72.10 %	35.20^{0}C	0.6 (E-W)	0.42 W-S & W-N
01:00 PM	88.20 %	35.10 ^{0}C	0.4 (E-W)	0.28 W-S & W-N
02:00 PM	89.16 %	35.19 ^{0}C	0.9 (E-W)	0.63 W-S & W-N
03:00 PM	91.20 %	35.17 ^{0}C	2.0 (N-S)	1.41 W-S & W-N
04:00 PM	98.12%	32.22^{0}C	1.0 (E-W)	0.70 W-S & W-N
05:00 PM	88.17%	30.11^{0}C	0.8 (W-E)	0.56 E-S & E-N

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at 50 meter far away (South side) from East Railway Station at Nikrail, Bhuyanpur, Tangail. The parameters ($PM_{2.5}$, PM_{10}, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. UV-visible Spectrophotometer has been using for SO_2, O_3 CO, NO_x & NO_2. The location of sampling was at near the Dhaka-North Bengal highway. The temperature of was varied from 30.11 ^{0}C to 35.20 ^{0}C at the sampling site. The wind direction was varied from 0.4 Km/h (East to West) at 35.10 ^{0}C to 2.0 Km/h (North to South) at 35.17 ^{0}C of the sampling site. Relative Humidity was 67.22 % at time 10:00 AM and 98.12% at time 04:00 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50 m far away from Bangabandhu Bridge East Station (North Side) at Union-Nikrail, Upazila - Bhuyanpur, District-Tangail, Bangladesh.
GPS Coordinate: N- 24° 23´25.10´´ & E - 89° 49´11.30´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :Weather was sunny
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 10th June, 2017 (Start Time:06:00AM and Off Time: 02:00 PM)
Reporting date : 20th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m³	78	56	60.69	27.59	22.52	8.38	279
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature °C	Wind speed and direction Km/h	Wind speed and direction Km/h
06:00 AM	59.10 %	26.20°C	0.9 (E-W)	0.6 W-S & W-N
07:00 AM	59.20%	27.19°C	0.7 (E-W)	0.5 W-S & W-N
08:00 AM	61.16%	28.12°C	1.2 (N-S)	0.8 S-E & S-W
09:00 AM	66.13%	28.23°C	1.2 (N-S)	0.8 S-E & S-W
10:00 AM	72.14%	30.40°C	2.6 (E-W)	1.8 W-S & W-N
11:00 AM	78.36%	33.28°C	0.6 (E-W)	0.4 W-S & W-N
12:00 PM	89.20%	35.46°C	2.1 (E-W)	1.4 W-S & W-N
01:00 PM	93.42%	35.35°C	0.4 (E-W)	0.3 W-S & W-N

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at 50 m far away (North side) from East Railway Station at Nikrail, Bhuyanpur, Tangail. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of SPM, PM_{10}, $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The location of sample was at near the Dhaka-North Bengal railway line. The temperature of was varied from 26.20°C to 35.46°C at the sampling site. The wind direction was varied from 0.4 Km/h (East to South) at 35.35°C °C to 2.6 Km/h (East to West) at 30.40°C of the sampling site. Relative Humidity was 59.10 % at time 06:00 AM and 93.42% at time 01:00 PM.

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GLOBAL ENVIRONMENT
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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50m far away from Proposed Rail Bridge East Side (South) at Union-Nikrail, Upazila - Bhuyanpur, District-Tangail, Bangladesh.
GPS Coordinate: N- 24° 23´49.0´´ & E - 89° 48´02.50´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :Weather was sunny
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 10th June, 2017 (Start Time: 02:00PM and Off Time: 11:00 PM)
Reporting date : 20th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m³	144	48	75.52	34.33	12.13	12.24	289
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature °C	Wind speed and direction Km/h	Wind speed and direction Km/h
02:50 PM	91.19 %	35.18 °C	4.2 (E-W)	2.9 W-S & W-N
03:50 PM	92.23 %	35.24 °C	4.1 (E-W)	2.9 W-S & W-N
04:50 PM	96.40 %	35.15 °C	4.6 (E-W)	3.2 W-S & W-N
05:50 PM	99.13 %	35.20 °C	2.4 (N-S)	1.7 S-W & S-E
06:50 PM	96.25 %	32.12 °C	2.4 (N-S)	1.7 S-W & S-E
07:50 PM	96.21 %	28.34 °C	2.9 (N-S)	2.0 S-W & S-E
08:50 PM	95.11 %	28.24 °C	4.5 (E-W)	3.2 W-S & W-N
09:50 PM	91.16 %	28.25 °C	4.0 (E-W)	2.8 W-S & W-N

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at 50 m far away from Proposed Railway Bridge East Side (South) at Nikrail, Bhuyanpur, Tangail. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 28.24 ^{0}C to 35.24 ^{0}C at the sampling site. The wind direction was varied from 2.4 Km/h (North to South) at 32.12 ^{0}C to 4.6 Km/h (East to West) at 35.15 ^{0}C of the sampling site. Relative Humidity was 91.16 % at time 09:50 PM and 99.13 % at time 05:50 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : Proposed railway bridge East Side at Union-Nikrail, Upazila - Bhuyanpur, District-Tangail, Bangladesh.
GPS Coordinate: N- 24° 23´59.20´´ & E - 89° 48´00.30´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition: Weather Was cloudy
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 11th June, 2017 (Start Time:11:30AM and Off Time: 07:30 PM)
Reporting date : 20th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m³	71	43	43.18	21.54	19.54	113.36	241
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature °C	Wind speed and direction Km/h	Wind speed and direction Km/h
11:40 AM	81.15 %	34.21°C	7.6 (E-W)	5.4 W-S & W-N
12:40 PM	86.20%	35.50°C	7.5 (W-E)	5.3 E-S & E-N
01:40 PM	86.35%	35.46°C	2.4 (N-S)	1.7 S-E & S-W
02:40 PM	88.23%	35.40°C	2.1 (N-S)	1.5 S-E & S-W
03:40 PM	87.26%	35.20°C	2.6 (N-S)	1.8 S-E & S-W
04:40 PM	89.20%	30.50°C	2.5 (N-S)	1.7 S-E & S-W
05:40 PM	90.21%	29.23°C	3.4 (N-S)	2.4 S-E & S-W
06:40 PM	92.17%	28.13°C	4.6 (E-W)	3.2 W-S & W-N

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at Proposed Railway bridge (East side) at Nikrail, Bhuyanpur, Tangail. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 28.13^{0}C to 35.50^{0}C at the sampling site. The wind direction was varied from 2.1 Km/h (North to South) at 35.40^{0}C to 7.6 Km/h (East to South) at 34.21^{0}C of this sampling site. Relative Humidity was 81.15 % at time 11:40 AM and 92.17% at time 06:40 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : Jumuna Eco Park at Union- Soidabad, Upazila - Sirajganj Sadar, District-Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 24´33.30´´ & E - 89° 44´57.40´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition: Weather was sunny.
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 20th June, 2017 (Start Time: 09:00 AM and Off Time: 05:00 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m³	80.75	53.72	53.93	24.54	46.92	26.84	304
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ⁰C	Wind speed and direction Km/h	Wind speed and direction Km/h
09:04 AM	91.10%	26.25⁰C	4.2 N-S	2.9 S-W & S-E
10:04 AM	93.20%	26.16⁰C	2.1 E-S	1.4 N-E & S-E
11:04 AM	99.12%	26.25⁰C	1.6 E-S	1.1 S-E & S-W
12:04 PM	97.26 %	27.18⁰C	1.4 E-S	0.9 S-E & S-W
01:04 PM	96.44 %	27.14 ⁰C	0.8 E-S	0.5 S-E & S-W
02:04 PM	90.14 %	28.12 ⁰C	0.9 E-S	0.6 S-E & S-W
03:04 PM	93.21 %	27.11 ⁰C	4.1 E-S	2.9 S-E & S-W
04:04 PM	94.42 %	28.10 ⁰C	1.2 E-S	0.8 N-W & S-W

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at **50 m far from Proposed Rail Bridge West Side (South) in Soidabad, Sirajganj Sadar, Sirajganj.** The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination PM_{10}, and $PM_{2.5}$. The temperature of was varied from 24.18 ^{0}C to 25.31 ^{0}C at the sampling site. The wind direction was varied from 2.1 Km/h (East to West) at 24.26 ^{0}C to 4.6 (East to West) at 25.16 ^{0}C of the sampling site. Relative Humidity was 91.26% at time 02:20 PM and 99.25 % at time 10:20 AM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50m far from Proposed Rail Bridge West Side (South) at Union- Soidabad, Upazila - Sirajganj Sadar, District-Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 24´01.50´´ & E - 89° 45´10.20´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition: Weather was cloudy
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 19th June, 2017 (Start Time: 09:20 AM and Off Time: 05:00 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in $\mu g/m^3$	24.46	35.00	26.73	12.18	22.26	37.72	259
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
09:20 AM	99.19 %	24.26 ^{0}C	2.1 E-W	1.4 W-N & W-S
10:20 AM	99.25 %	24.18 ^{0}C	3.4 E-W	2.4 W-N & W-S
11:20 AM	97.19 %	25.10 ^{0}C	4.2 E-W	2.9 W-N & W-S
12:20 PM	97.20 %	25.16 ^{0}C	4.6 E-W	3.2 W-N & W-S
01:20 PM	97.33%	25.25^{0}C	3.1 E-W	2.2 W-N & W-S
02:20PM	91.26%	25.12^{0}C	3.2 E-W	2.2 W-N & W-S
03:20PM	91.34%	25.31^{0}C	2.6 E-W	1.8 W-N & W-S
04:20 PM	91.48 %	25.27 ^{0}C	3.1 E-W	2.2 W-N & W-S

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at Proposed Rail Bridge West Side (North) in Soidabad, Sirajganj Sadar, Sirajganj. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, &b $PM_{2.5}$. The UV-visible Spectrophotometer has been using for O_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 28.20°C to 34.21°C at the sampling site. The wind direction was varied from 0.6 Km/h (East to West) at 34.21°C to 14.0 Km/h (East to West) at 28.20°C of the sampling site. Relative Humidity was 90.11 % at time 12:29 PM and 99.35 % at time 03:25 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50m far from Proposed Rail Bridge West Side (North) at Union- Soidabad, Upazila - Sirajganj Sadar, District-Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 24´08.50´´ & E - 89° 45´08.60´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition: Weather was sunny
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 18th June, 2017 (Start Time: 09:00 AM and Off Time: 05:00 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in $\mu g/m^3$	33.72	67.79	15.95	7.25	27.15	48.92	312
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
09:44 AM	91.20 %	33.10^{0}C	2.1 E-W	1.4 N-W & S-W
10:40 AM	97.16%	33.50^{0}C	1.0 E-W	0.7 N-E & S-E
11:40 AM	96.20%	34.21^{0}C	0.6 E-W	0.4 S-E & S-W
12:29 PM	90.11 %	32.10^{0}C	2.3 E-W	1.6 S-E & S-W
01:25 PM	90.34 %	32.16^{0}C	2.6 E-W	1.8 S-E & S-W
02:25 PM	92.22 %	31.27^{0}C	1.6 E-W	1.1 S-E & S-W
03:25 PM	99.35 %	28.26^{0}C	10.2 E-W	7.2 S-E & S-W
04:25 PM	96.22 %	28.20^{0}C	14.0 E-W	9.9 N-W & S-W

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at Proposed Rail Bridge West Side in Soidabad, Sirajganj Sadar, Sirajganj. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10} & $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 29.16^{0}C to 32.13^{0}C at the sampling site. The wind direction was varied from 1.6 Km/h (East to West) at 31.10^{0}C to 4.9 Km/h (East to West) at 32.13^{0}C of the sampling site. Relative Humidity was 69.20% at time 03:48 PM and 89.11 % at time 08:48 AM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : Proposed Rail Bridge West Side at Union- Soidabad, Upazila - Sirajganj Sadar, District- Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 24´05.50´´ & E - 89° 45´09.50´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :Weather Was sunny
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 15th June, 2017 (Start Time:08:30 AM and Off Time: 04:30 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m^3	73.23	125.57	45.71	20.78	47.09	29.05	279
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
08:48 AM	89.11 %	29.16^{0}C	2.1 E-W	1.5 N-W & S-W
09:49 AM	76.11%	29.26^{0}C	4.2 E-W	2.9 N-W & S-W
10:50 AM	85.36%	31.13^{0}C	2.1 E-W	1.5 N-W & S-W
11:49 AM	84.40%	30.40^{0}C	4.6 E-W	3.2 N-W & S-W
12:49 PM	78.46%	32.13^{0}C	4.9 E-W	3.4 N-W & S-W
01:49 PM	72.11%	31.36^{0}C	3.1 E-W	2.2 N-W & S-W
02:48 PM	70.40%	31.20^{0}C	2.6 E-W	1.8 N-W & S-W
03:48 PM	69.20%	31.10^{0}C	1.6 E-W	1.1 N-W & S-W

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3- microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at 50m far from Bangabandhu Bridge West Station (North Side) in Soidabad, Sirajganj Sadar, Sirajganj. The other parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination PM_{10} & $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 26.10^{0}C to 29.19^{0}C at the sampling site. The wind direction was varied from 0.2 Km/h (East to West) at 26.15 ^{0}C to 8.4 Km/h (East to West) at 29.19^{0}C of the sampling site. Relative Humidity was 66.23 % at time 11:04 PM and 89.40 % at time 03:48 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50m far from Bangabandhu Bridge West Station (North Side) at Union- Soidabad, Upazila - Sirajganj Sadar, District-Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 23´46.90´´ & E - 89° 44´00.0´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :Weather Was cloudy
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 14th June, 2017 (Start Time:03:47 PM and Off Time: 11:47 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m^3	64.16	68.49	23.12	10.51	25.91	399.55	268
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
03:48 PM	89.40 %	29.19^{0}C	8.4 E-W	5.9 W-N & W-E
05:01 PM	78.20%	28.16^{0}C	2.1 N-S	1.5 S-W & S-E
06:00 PM	72.26%	27.10^{0}C	1.1 N-S	0.7 S-E & S-W
07:03 PM	70.50%	26.22^{0}C	1.6 E-W	1.1 W-N & W-E
08:01 PM	71.22%	26.10^{0}C	0.6 E-W	0.4 W-N & W-E
09:03 PM	70.16%	26.30^{0}C	0.4 E-W	0.3 W-N & W-E
10:00 PM	67.20 %	26.11 ^{0}C	0.7 N-S	0.7 S-E & S-W
11:04 PM	66.23 %	26.15 ^{0}C	0.2 E-W	0.1 W-N & W-E

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3 , NO_x, NO_2 & CO) have been measuring by 8 hours sampling at 50 m far from Bangabandhu Bridge West Station (South Side) in Soidabad, Sirajganj Sadar, Sirajganj. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3 , NO_x, NO_2 & CO) were below the acceptable limit set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3 ,NO_x, NO_2 & CO) . The temperature of was varied from 29.16^{0}C to 34.10^{0}C at the sampling site. The wind direction was varied from 10.5 Km/h (South to North) at 31.40^{0}C to 14.2 Km/h (South to North) at 31.11^{0}C of the sampling site. Relative Humidity was 79.20% at time 01:01 PM and 99.20% at time 08:00 AM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : 50 m far from Bangabandhu Bridge West Station (South Side) at Union- Soidabad, Upazila - Sirajganj Sadar, District-Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 23´42.20´´ & E - 89° 44´01.60´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition :**Rain Was Done - 04:10 PM to 06:00 PM**
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 14th June, 2017 (Start Time:06:50 AM and Off Time: 02:50 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m^3	65.59	34.24	25.36	11.53	29.54	10.47	287
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
06:52 AM	98.10 %	29.16^{0}C	13.2 S-N	9.33 N-W & N-E
08:00 AM	99.20%	30.10^{0}C	11.4 S-N	8.06 N-W & N-E
09:01 AM	89.16%	31.11^{0}C	14.4 S-N	10.18 N-W & N-E
10:03 AM	88.12%	31.40^{0}C	10.5 S-N	7.42 N-W & N-E
11:01 AM	87.16%	33.20^{0}C	11.2 E-W	7.91 W-N & W-S
12:01 PM	88.20%	34.10^{0}C	12.3 E-W	8.69 W-N & W-S
01:01 PM	79.20%	33.22^{0}C	11.5 E-W	8.13 W-N & W-S
02:03 PM	86.20%	31.11^{0}C	13.2 E-W	9.33 W-N & W-S

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at **Bangabandhu Bridge West Station in Soidabad, Sirajganj Sadar, Sirajganj.** The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 28.16^{0}C to 33.17^{0}C at the sampling site. The wind direction was varied from 0.2 Km/h (East to West) at 28.30^{0}C to 4.6 (East to West) at 31.20^{0}C of the sampling site. Relative Humidity was 71.20% at time 01:02 PM and 99.16% at time 08:13 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : Bangabandhu Bridge West Station at Union- Soidabad, Upazila - Sirajganj Sadar, District- Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 23´45.40´´ & E - 89° 44´01.0´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition : Weather Was sunny
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 13th June, 2017 (Start Time:08:10 AM and Off Time: 04:10 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in µg/m^3	90	22.83	17.40	7.91	14.09	31.74	301
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
08:13 AM	99.16 %	28.30^{0}C	0.2 E-W	0.1 W-N & W-S
09:02 AM	98.20%	28.16^{0}C	0.6 E-W	0.4 W-N & W-S
10:04 AM	86.10%	29.35^{0}C	0.3 E-W	0.1 W-N & W-S
11:02 AM	90.20%	32.21^{0}C	1.2 N-S	0.8 S-E & S-W
12:04 PM	91.35%	33.10^{0}C	1.6 N-S	1.1 S-E & S-W
01:02 PM	71.20%	33.17^{0}C	2.1 N-S	1.3 S-E & S-W
02:04 PM	82.19%	32.10^{0}C	2.1 S-N	1.5 N-E & N-W
03:00 PM	83.17%	31.20^{0}C	4.6 E-W	3.2 W-N & W-S

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_X), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at 50 m far from Proposed Rail Bridge East Side (North) at Nikrail, Bhuyanpur, Tangail. The parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) were below the acceptable limit which is set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10}, $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 25.22 ^{0}C to 25.40 ^{0}C at the sampling site. The wind direction was varied from 14.2 Km/h (North to South) at 25.40 ^{0}C to 16.7 Km/h (North to South) at 25.25 ^{0}C of the sampling site. Relative Humidity was 98.21 % at time 02:16 PM and 99.45 % at time 04:16 PM.

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GECL LABORATORY ANALYSIS REPORT
ON
Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment

GECL/Code (TR) :849
Project Name : Air Quality Monitoring.
Location : Jumuna Eco Park at Union- Soidabad, Upazila - Sirajganj Sadar, District-Sirajganj, Bangladesh.
GPS Coordinate: N- 24° 24´33.30´´ & E - 89° 44´57.40´´

Description of analysis : Ambient air Quality, Humidity, Temperature, Wind Speed & Wind Direction Assessment report.
Weather Condition: Weather was sunny.
Sample collector: Global Environment Consultants Ltd. (GECL Monitoring Team).
Sampling date : 20th June, 2017 (Start Time: 09:00 AM and Off Time: 05:00 PM)
Reporting date : 24th June, 2017.

Description of analysis:

Ambient Air Quality							
Name of the Parameters	PM_{10}	$PM_{2.5}$	NO_x	NO_2	SO_2	O_3	CO
Concentration Present in $\mu g/m^3$	80.75	53.72	53.93	24.54	46.92	26.84	304
DOE standard for ambient air	150	65	100	-	365	157	10000
IFC/World Bank Standard	150	75	-	200	125	160	10000 (WHO)

Temperature, Wind Speed & Wind Direction, Level Assessment				
Time	Humidity (%)	Temperature ^{0}C	Wind speed and direction Km/h	Wind speed and direction Km/h
09:04 AM	91.10%	26.25^{0}C	4.2 N-S	2.9 S-W & S-E
10:04 AM	93.20%	26.16^{0}C	2.1 E-S	1.4 N-E & S-E
11:04 AM	99.12%	26.25^{0}C	1.6 E-S	1.1 S-E & S-W
12:04 PM	97.26 %	27.18^{0}C	1.4 E-S	0.9 S-E & S-W
01:04 PM	96.44 %	27.14 ^{0}C	0.8 E-S	0.5 S-E & S-W
02:04 PM	90.14 %	28.12 ^{0}C	0.9 E-S	0.6 S-E & S-W
03:04 PM	93.21 %	27.11 ^{0}C	4.1 E-S	2.9 S-E & S-W
04:04 PM	94.42 %	28.10 ^{0}C	1.2 E-S	0.8 N-W & S-W

Abbreviation: Respirable Dust Content (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di- Oxide (SO_2), Oxides of Nitrogen (NO_x), Nitrogen Dioxide (NO_2), Carbone Mono-Oxide (CO), Ozone (O_3), µg/m3-microgram/cubic meter and DoE-Department of Environment, IFC-International Finance Corporation, UV-Ultra-violet .

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Comments: The concentration of ambient air quality parameters (PM_{10}, $PM_{2.5}$, SO_2, O_3, NO_x, NO_2 & CO) have been measuring by 8 hours sampling at **Jumuna Eco Park in Soidabad, Sirajganj Sadar, Sirajganj.** The parameters (SPM PM_{10}, SO_2, & NO_2) were below the acceptable limit which set by Department of Environment, Government of the People's of Republic of Bangladesh. The gravimetric method has been using for the determination of PM_{10} and $PM_{2.5}$. The UV-visible Spectrophotometer has been using for SO_2, O_3, NO_x, NO_2 & CO. The temperature of was varied from 26.16 ^{0}C to 28.12 ^{0}C at the sampling site. The wind direction was varied from 0.8 Km/h (East to South) at 27.14 ^{0}C to 4.2 Km/h (North to South) at 26.25^{0}C of the sampling site. Relative Humidity was 90.14 %at time 02:04 PM and 99.12% at time 11:04 AM.

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Appendix-3 : Noise Monitoring Results

DSCL

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DSCL Environmental Laboratory

Name of the Project	Bangabandhu Railway Bridge Construction Project-(BRBCP)
Project address	Union: Sayedabad, Upazila: Sirajganj Sadar, District: Sirajganj.
Description of sample	Noise Level
Sample Collector	Collected by DSCL Personnel
Sampling Date	8 - 15 June, 2017

Noise Level Analysis

Sample ID	Location	GPS Location	Land Use Category	Noise Level dB(A) (LAeq)		Bangladesh Standard dB (A)** (LAeq)	
				Day	Night	Day	Night
NM_Eco Park	Bangabandhu Eco Park	24.40916°N 89.74902°E	Silent	44.98	48.23	45	30
NM_PB_50m_NS_WS	50m far from Bangabandhu Bridge West Station (North Side)	24.40264°N 89.75235°E	Silent	51.61	56.53	45	30
NM_PB_50m_SS_WS	50m far away from Proposed Rail Bridge West Side (South)	24.40264°N 89.75235°E	Silent	61.59	56.32	45	30
NM_PB_WS	Proposed Railway Bridge East Side	24.40137°N 89.75269°E	Silent	56.34	53.69	45	30
NM_RS_50m_NS_WS	50m far away from Proposed Rail Bridge West Side (North)	24.39621°N 89.73274°E	Residential	44.67	53.69	50	40
NM_RS_50m_SS_WS	50m far from Bangabandhu Bridge West Station (South Side)	24.39517°N 89.73384°E	Residential	65.54	65.98	50	40
NM_RS_WS	Bangabandhu Bridge West Station	24.39593°N 89.73384°E	Commercial	66.74	60.43	70	60

Notes:

- *Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)*
- *Shaded cells indicate noise levels in excess of Noise Pollution Control Rules ambient noise limits for a given land use area*
- *The sound level standards for residential area at day and night are 50 dBA and 40 dBA respectively.*
- *The sound level standards for silent zone at day and night are 45 dBA and 30 dBA respectively.*
- *The sound level standards for commercial area at day and night are 70 dBA and 60 dBA respectively.*
- *Noise Level is the average noise recorded over the duration of the monitoring period.*

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DSCL Multidisciplinary Development Consultants

Notes:

- *Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)*
- *Shaded cells indicate noise levels in excess of Noise Pollution Control Rules ambient noise limits for a given land use area*
- *The sound level standards for residential area at day and night are 50 dBA and 40 dBA respectively.*
- *The sound level standards for silent zone at day and night are 45 dBA and 30 dBA respectively.*
- *The sound level standards for commercial area at day and night are 70 dBA and 60 dBA respectively.*

Noise Level is the average noise recorded over the duration of the monitoring period.

Abbreviation:

dB- decibel, RS-Rail Station, NS-North Side, SS-South Side, WS-West Side, PB-Proposed Bridge

Test Performed By:	Approved By:
Moynul Hasan Jr. Environmental Specialist	**Israt Jahan Sumi** Director

DSCL

Multidisciplinary Development Consultants

DSCL Environmental Laboratory

Name of the Project	Bangabandhu Rail Bridge Construction Project-(BRBC)
Project address	Union: Nikrail , Upazila: Bhuapur, District: Tangail.
Description of sample	Noise Level
Sample Collector	Collected by DSCL Personnel
Sampling Date	8 - 15 June, 2017

Noise Level Analysis

Sample ID	Location	GPS Location	Land Use Category	Noise Level dB(A) (LAeq)		Bangladesh Standard dB (A)** (LAeq)	
				Day	Night	Day	Night
NM_PB_50m_NS_ES	50m far away from Proposed Rail Bridge East Side (North)	24.40022°N 89.80004°E	Silent	51.04	51.74	45	30
NM_PB_50m_SS_ES	50m far away from Proposed Rail Bridge East Side (South)	24.39701°N 89.80075°E	Silent	60.04	57.25	45	30
NM_PB_ES	Proposed Rail Bridge West Side	24.39895°N 89.80075°E	Silent	63.34	50.73	45	30
NM_RS_50m_NS_ES	50m far from Bangabandhu Bridge East Station (North Side)	24.39141°N 89.81949°E	Residential	54.12	60.81	50	40
NM_RS_50m_SS_ES	50m far from Bangabandhu Bridge East Station (South Side)	24.3890°N 89.81944° E	Commercial	51.36	53.51	70	60
NM_RS_ES	Bangabandhu Bridge East Station	24.38965°N 89.81985°E	Commercial	65.34	63.56	70	60

Notes:

- *Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)*
- *Shaded cells indicate noise levels in excess of Noise Pollution Control Rules ambient noise limits for a given land use area*
- *The sound level standards for residential area at day and night are 50 dBA and 40 dBA respectively.*
- *The sound level standards for silent zone at day and night are 45 dBA and 30 dBA respectively.*
- *The sound level standards for commercial area at day and night are 70 dBA and 60 dBA respectively.*
- *Noise Level is the average noise recorded over the duration of the monitoring period.*

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DOHS Mirpur, Dhaka-1216, Bangladesh. Tel: +8804478035444
Email: dscl@dsclbd.com Web: www.dsclbd.com

DSCL Multidisciplinary Development Consultants

Notes:

- *Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)*
- *Shaded cells indicate noise levels in excess of Noise Pollution Control Rules ambient noise limits for a given land use area*
- *The sound level standards for residential area at day and night are 50 dBA and 40 dBA respectively.*
- *The sound level standards for silent zone at day and night are 45 dBA and 30 dBA respectively.*
- *The sound level standards for commercial area at day and night are 70 dBA and 60 dBA respectively.*

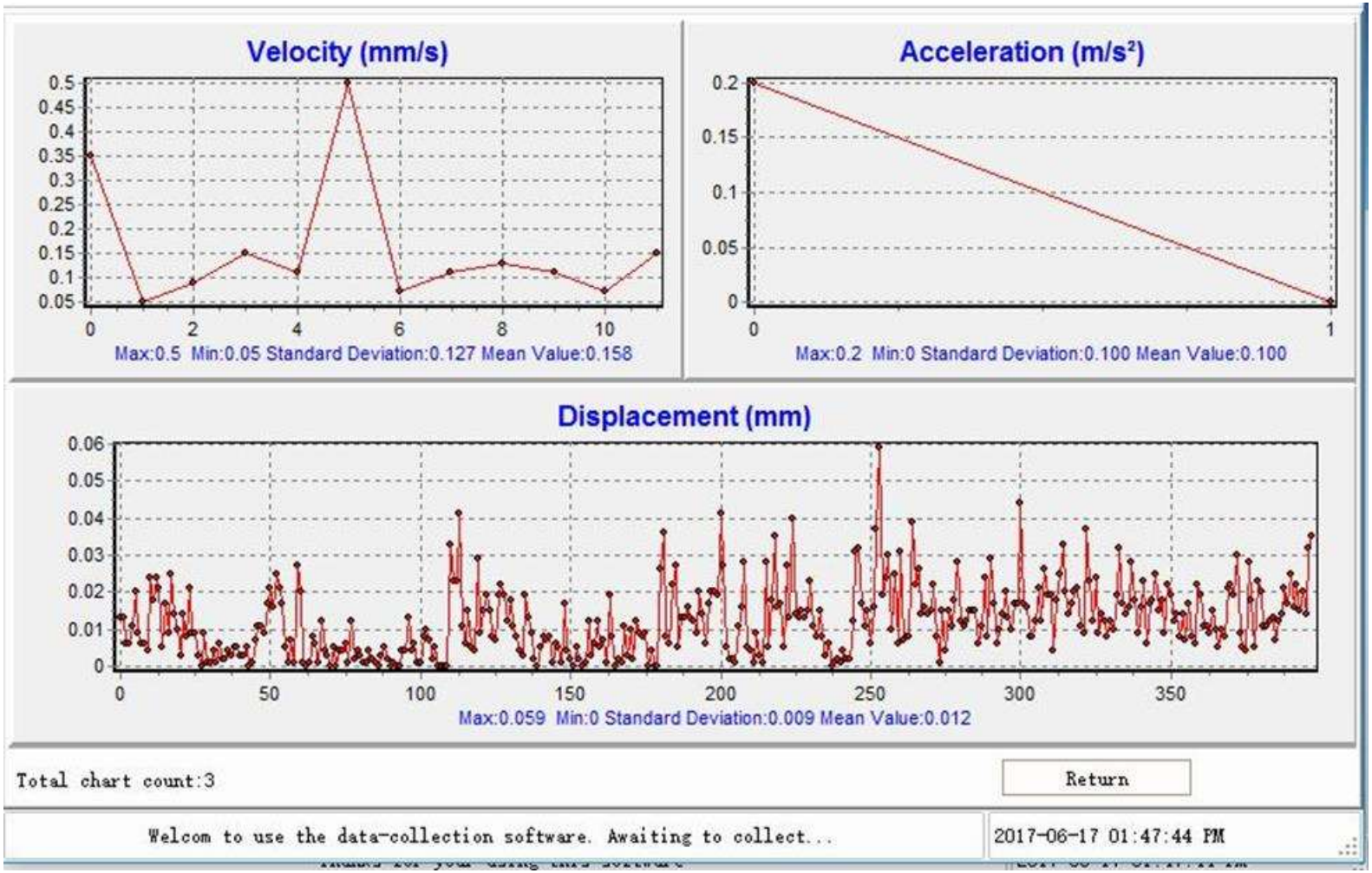
Noise Level is the average noise recorded over the duration of the monitoring period.

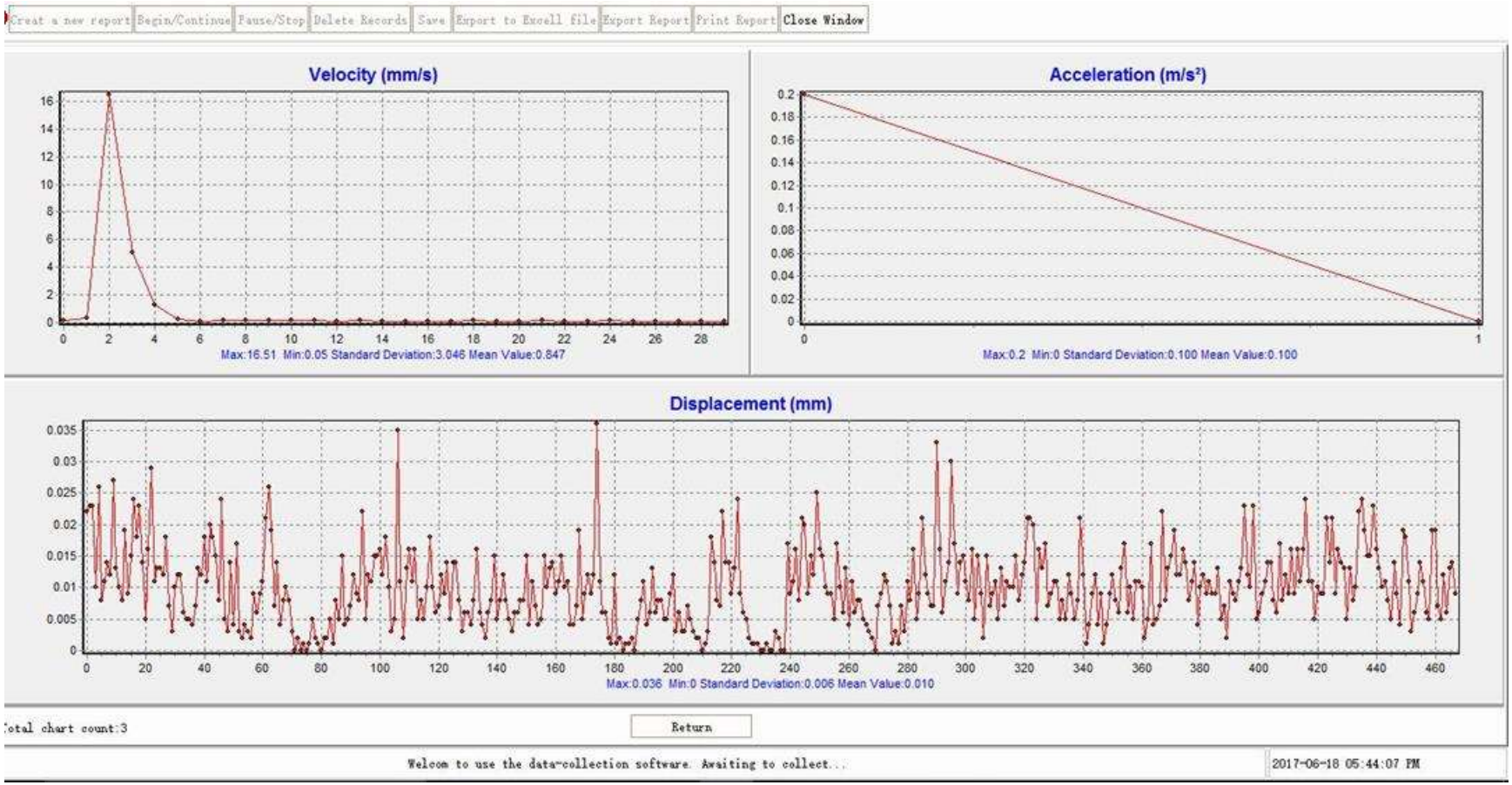
Abbreviation:

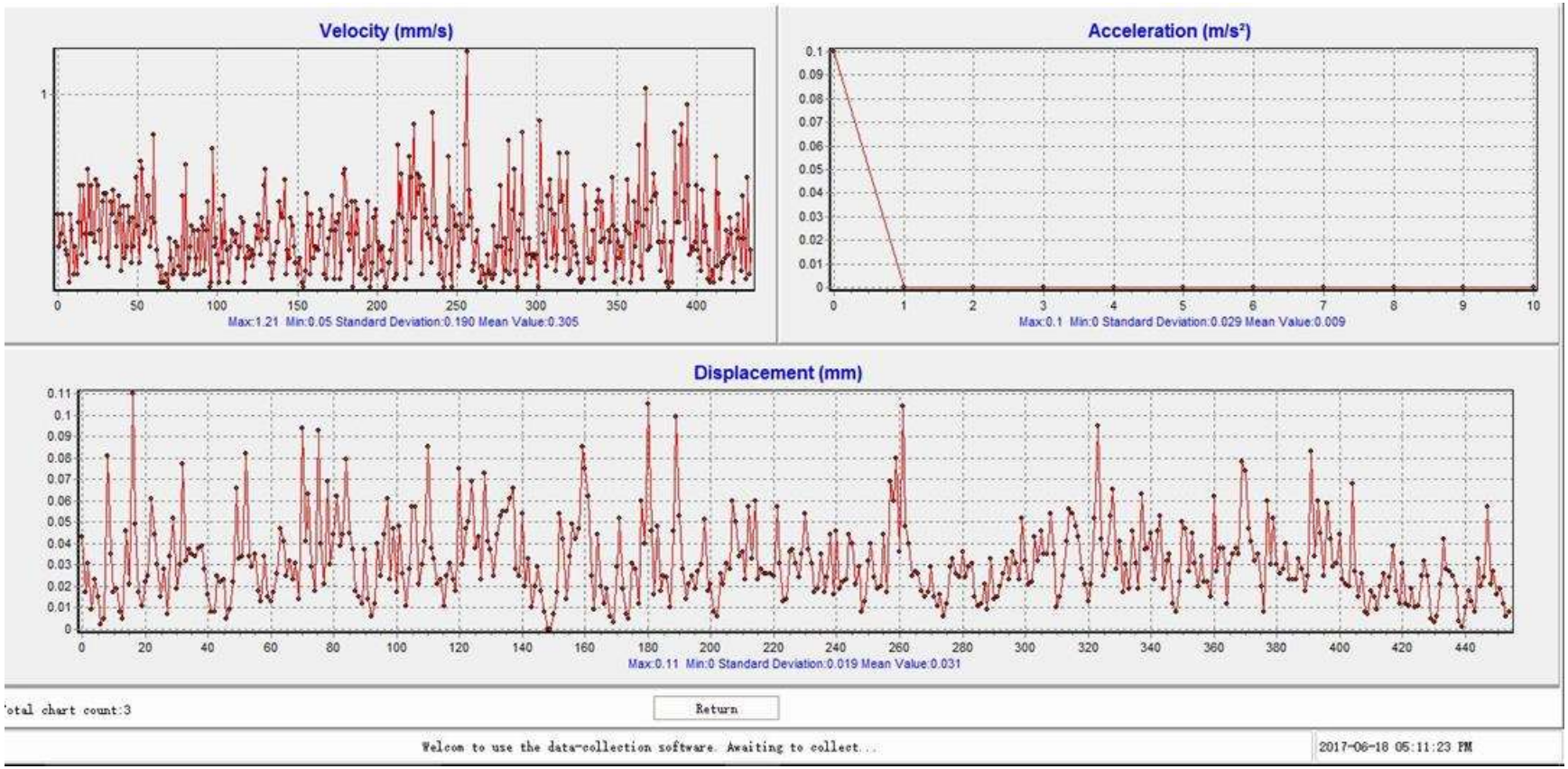
dB- decibel, RS-Rail Station, NS-North Side, SS-South Side, ES-East Side, PB-Proposed Bridge

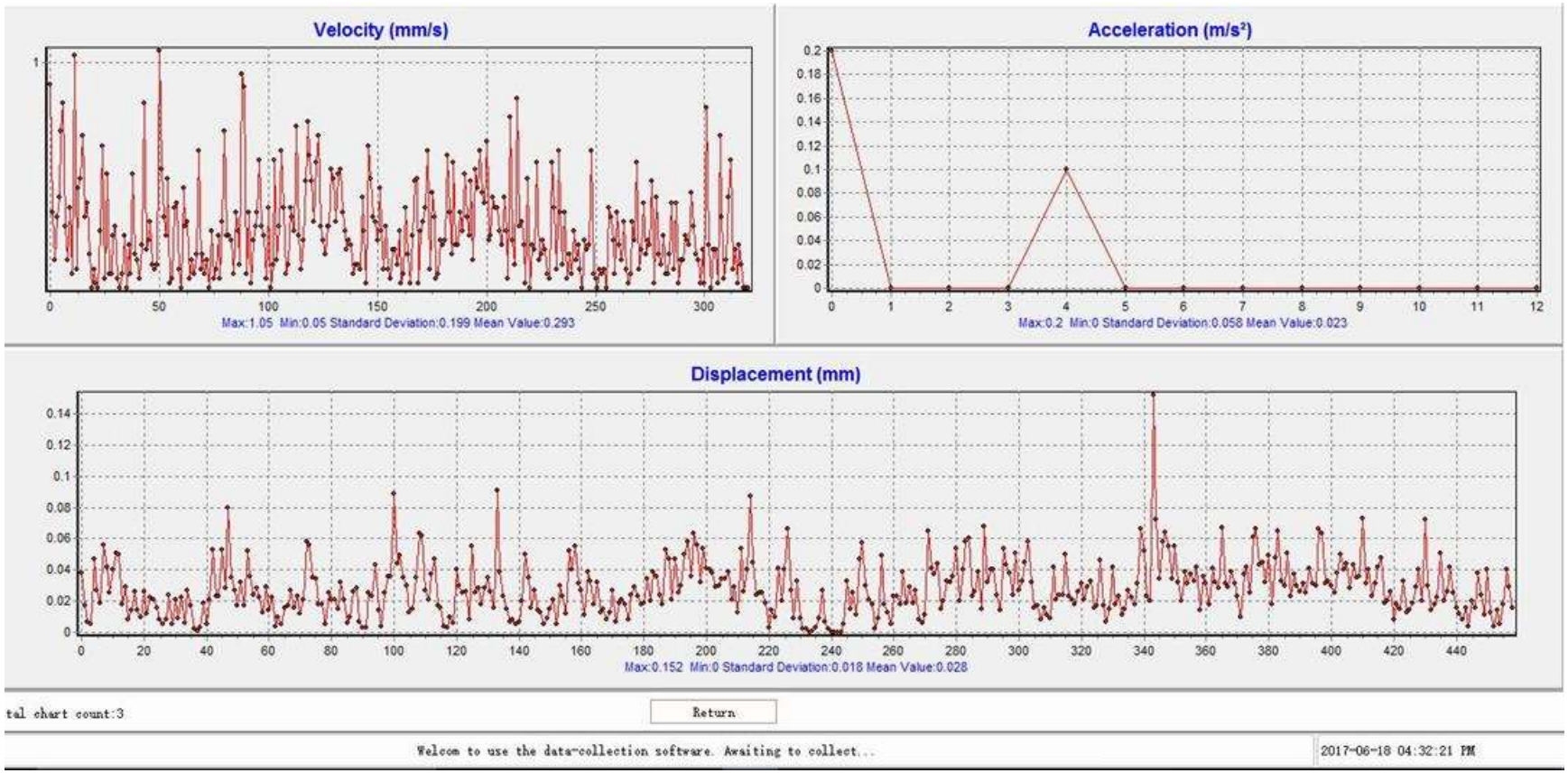
Test Performed By:	Approved By:
Moynul Hasan Jr. Environmental Specialist	**Israt Jahan Sumi** Director

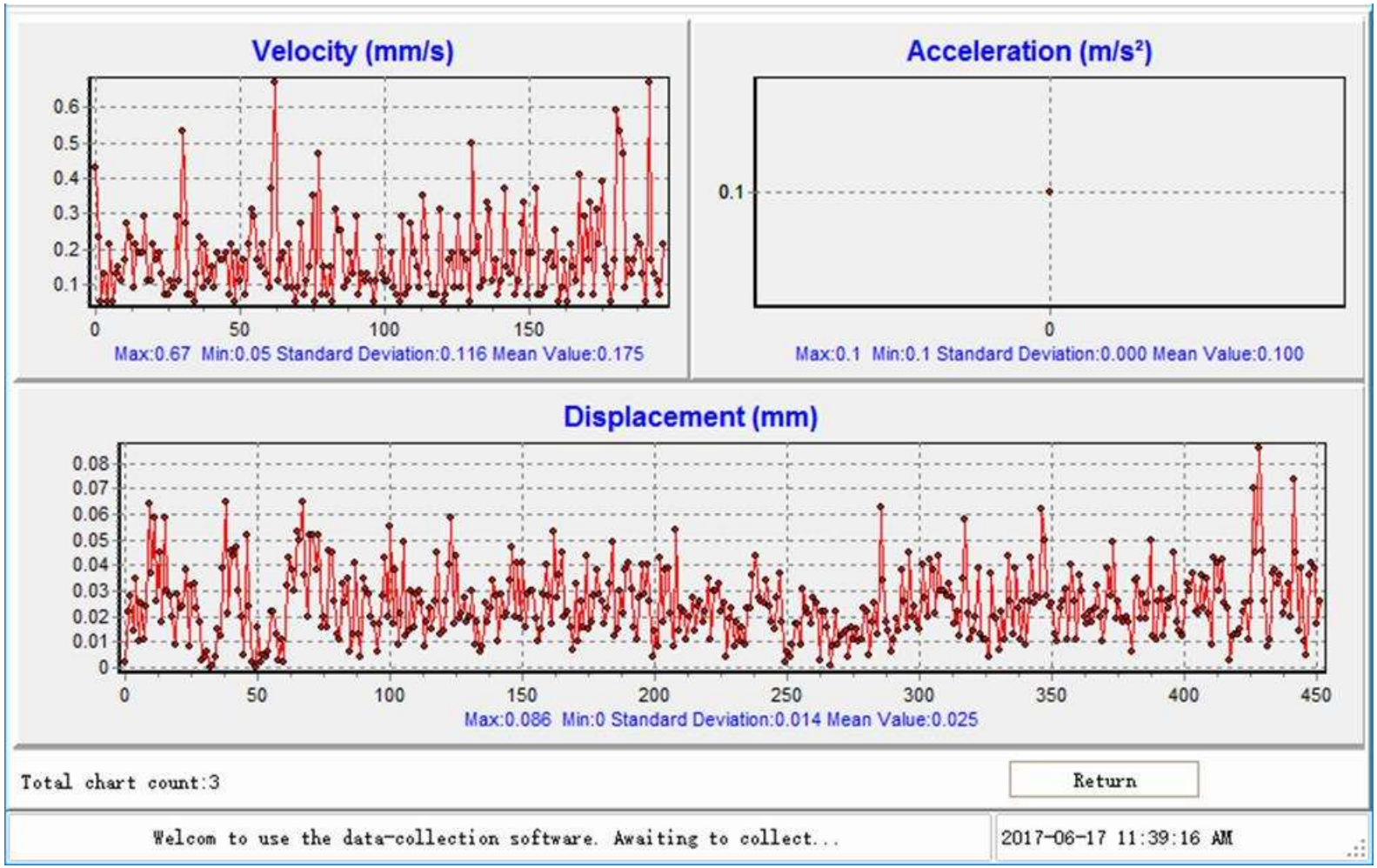
Appendix-4: Vibration Monitoring Results




Creat a new report
Begin/Continue
Pause/Stop
Delete Records
Save
Export to Excell file
Export Report
Print Export
Close Window
Velocity (mm/s)
Max:16.51 Min:0.05 Standard Deviation:3.046 Mean Value:0.847
Acceleration (m/s²)
Max:0.2 Min:0 Standard Deviation:0.100 Mean Value:0.100
Displacement (mm)
Max:0.036 Min:0 Standard Deviation:0.006 Mean Value:0.010
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-18 05:44:07 PM


Velocity (mm/s)
Max:1.21 Min:0.05 Standard Deviation:0.190 Mean Value:0.305
Acceleration (m/s²)
Max:0.1 Min:0 Standard Deviation:0.029 Mean Value:0.009
Displacement (mm)
Max:0.11 Min:0 Standard Deviation:0.019 Mean Value:0.031
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-18 05:11:23 PM


Velocity (mm/s)
Max:1.05 Min:0.05 Standard Deviation:0.199 Mean Value:0.293
Acceleration (m/s²)
Max:0.2 Min:0 Standard Deviation:0.058 Mean Value:0.023
Displacement (mm)
Max:0.152 Min:0 Standard Deviation:0.018 Mean Value:0.028
tal chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-18 04:32:21 PM


Velocity (mm/s)
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
Max:0.67 Min:0.05 Standard Deviation:0.116 Mean Value:0.175
Acceleration (m/s²)
0.1
0
Max:0.1 Min:0.1 Standard Deviation:0.000 Mean Value:0.100
Displacement (mm)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
50
100
150
200
250
300
350
400
450
Max:0.086 Min:0 Standard Deviation:0.014 Mean Value:0.025
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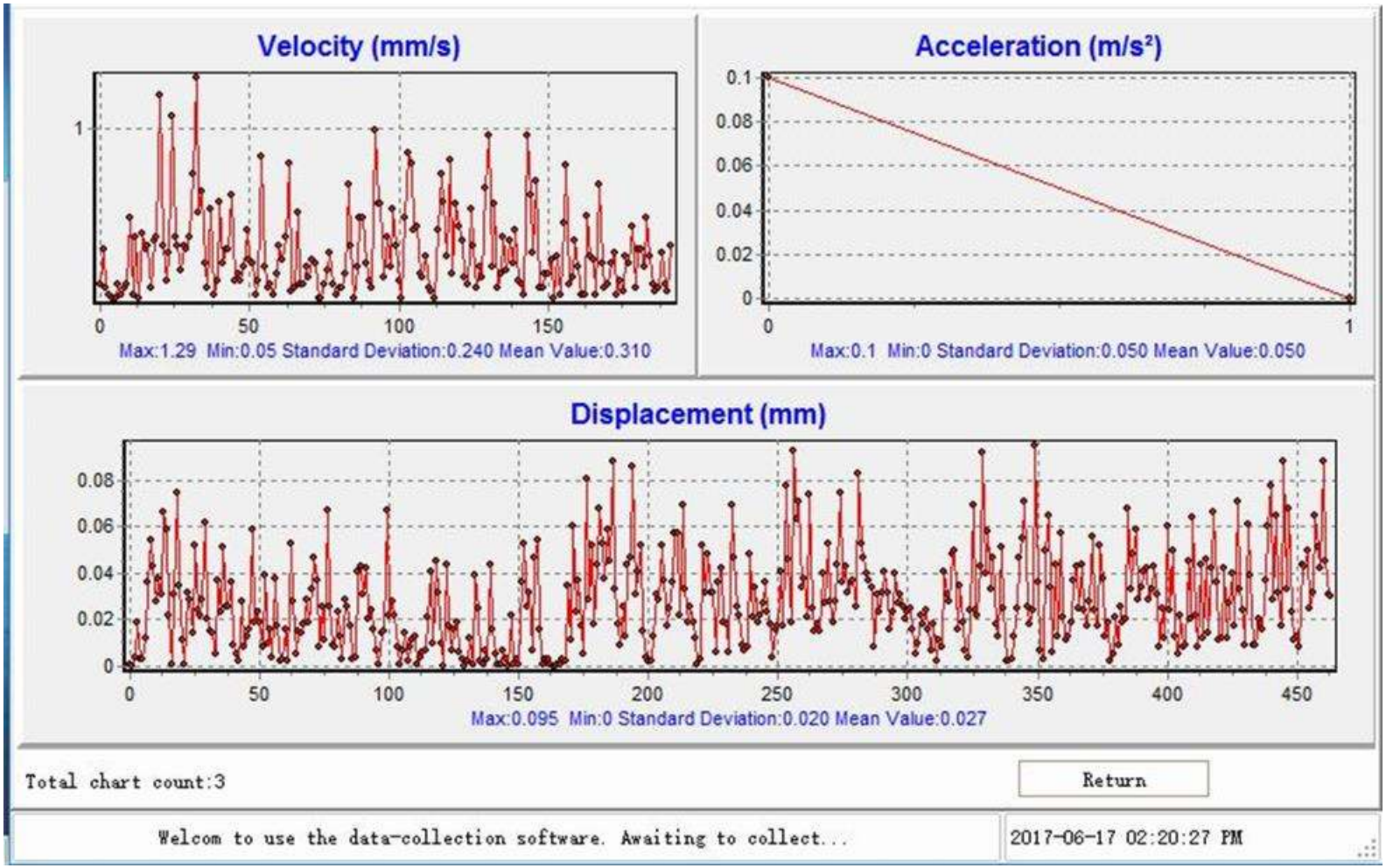
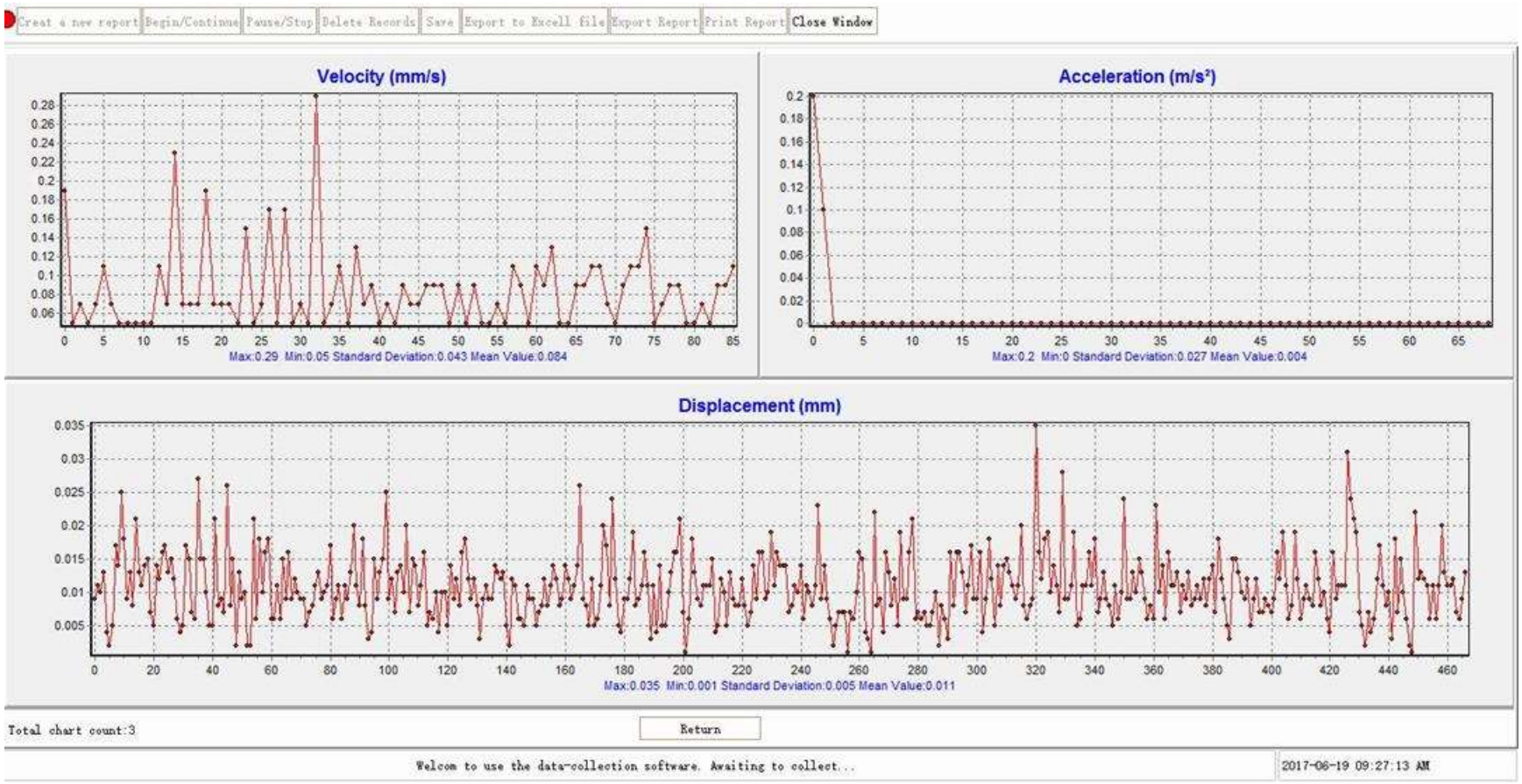
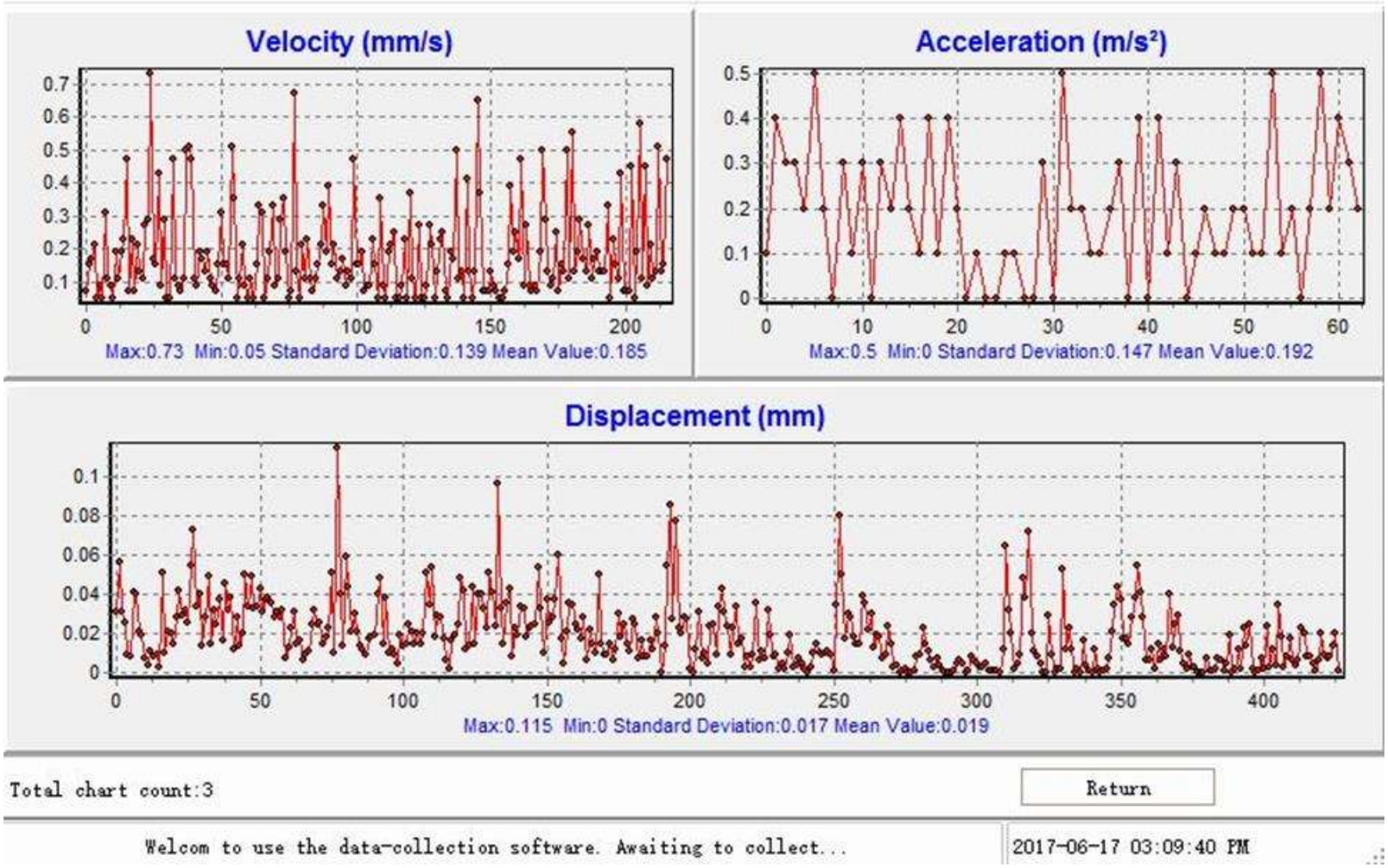
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-17 11:39:16 AM


Velocity (mm/s)
1
0
50
100
150
Max:1.29 Min:0.05 Standard Deviation:0.240 Mean Value:0.310
Acceleration (m/s²)
0.1
0.08
0.06
0.04
0.02
0
0
1
Max:0.1 Min:0 Standard Deviation:0.050 Mean Value:0.050
Displacement (mm)
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400
450
Max:0.095 Min:0 Standard Deviation:0.020 Mean Value:0.027
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-17 02:20:27 PM


Creat a new report
Begin/Continue
Pause/Stop
Delete Records
Save
Export to Excell file
Export Report
Print Report
Close Window
Velocity (mm/s)
Max:0.29 Min:0.05 Standard Deviation:0.043 Mean Value:0.084
Acceleration (m/s²)
Max:0.2 Min:0 Standard Deviation:0.027 Mean Value:0.004
Displacement (mm)
Max:0.035 Min:0.001 Standard Deviation:0.005 Mean Value:0.011
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-19 09:27:13 AM


Velocity (mm/s)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
Max:0.73 Min:0.05 Standard Deviation:0.139 Mean Value:0.185
Acceleration (m/s²)
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
60
Max:0.5 Min:0 Standard Deviation:0.147 Mean Value:0.192
Displacement (mm)
0.1
0.08
0.06
0.04
0.02
0
50
100
150
200
250
300
350
400
Max:0.115 Min:0 Standard Deviation:0.017 Mean Value:0.019
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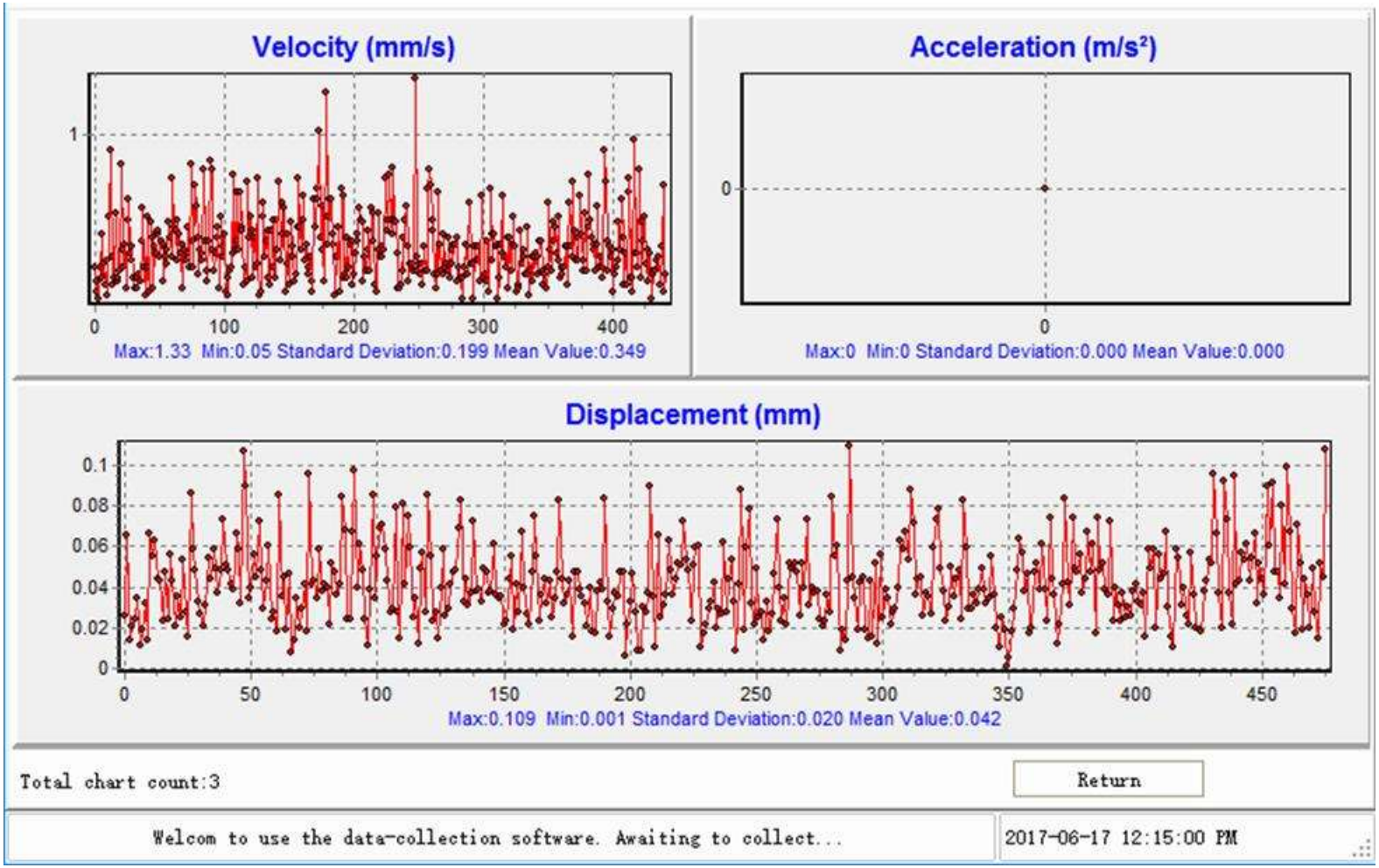
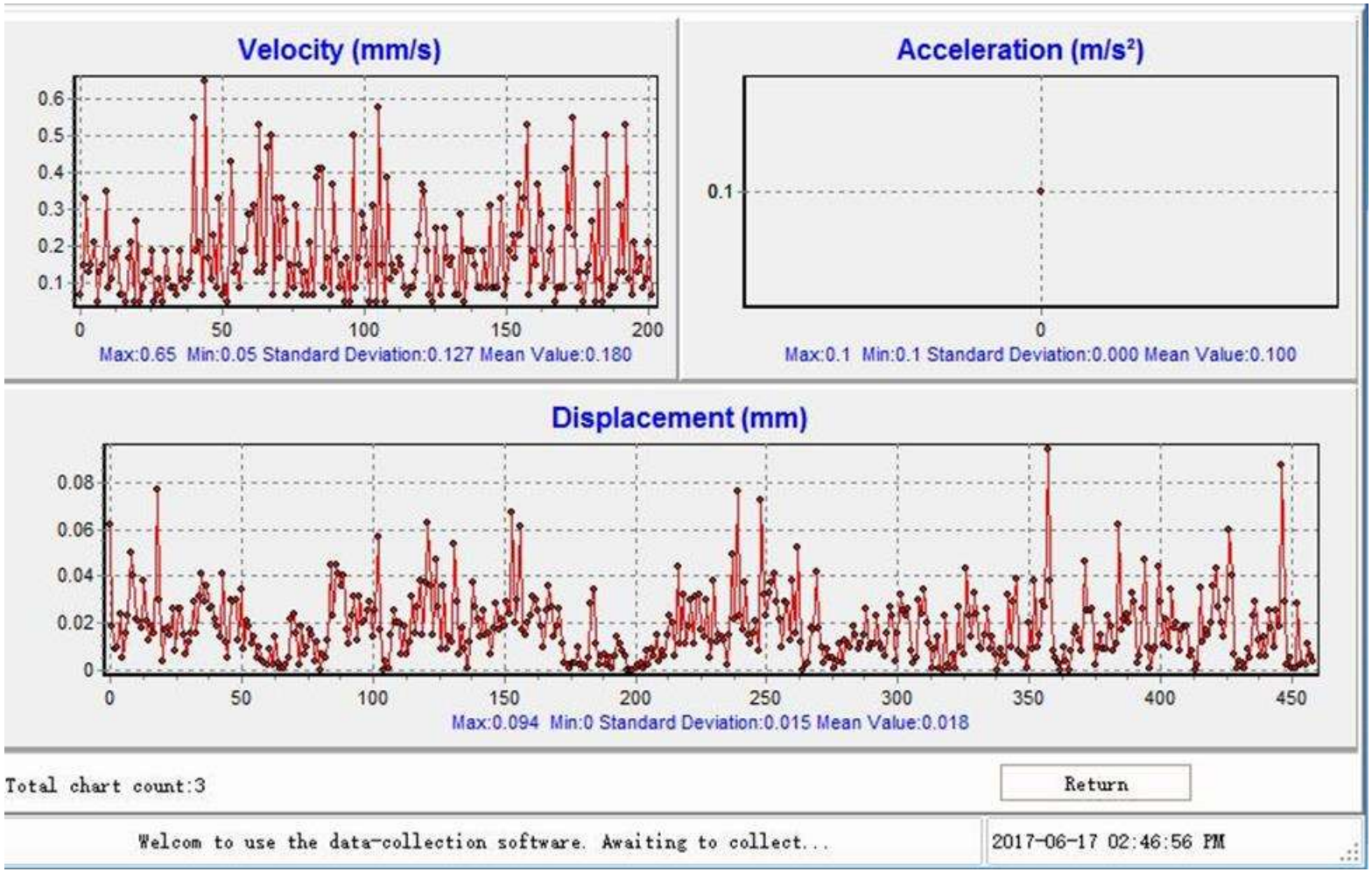
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-17 03:09:40 PM


Velocity (mm/s)
1
0
100
200
300
400
Max:1.33 Min:0.05 Standard Deviation:0.199 Mean Value:0.349
Acceleration (m/s²)
0
0
Max:0 Min:0 Standard Deviation:0.000 Mean Value:0.000
Displacement (mm)
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400
450
Max:0.109 Min:0.001 Standard Deviation:0.020 Mean Value:0.042
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-17 12:15:00 PM


Velocity (mm/s)
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0.4
0.3
0.2
0.1
0
50
100
150
200
Max:0.65 Min:0.05 Standard Deviation:0.127 Mean Value:0.180
Acceleration (m/s²)
0.1
0
Max:0.1 Min:0.1 Standard Deviation:0.000 Mean Value:0.100
Displacement (mm)
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400
450
Max:0.094 Min:0 Standard Deviation:0.015 Mean Value:0.018
Total chart count:3
Return
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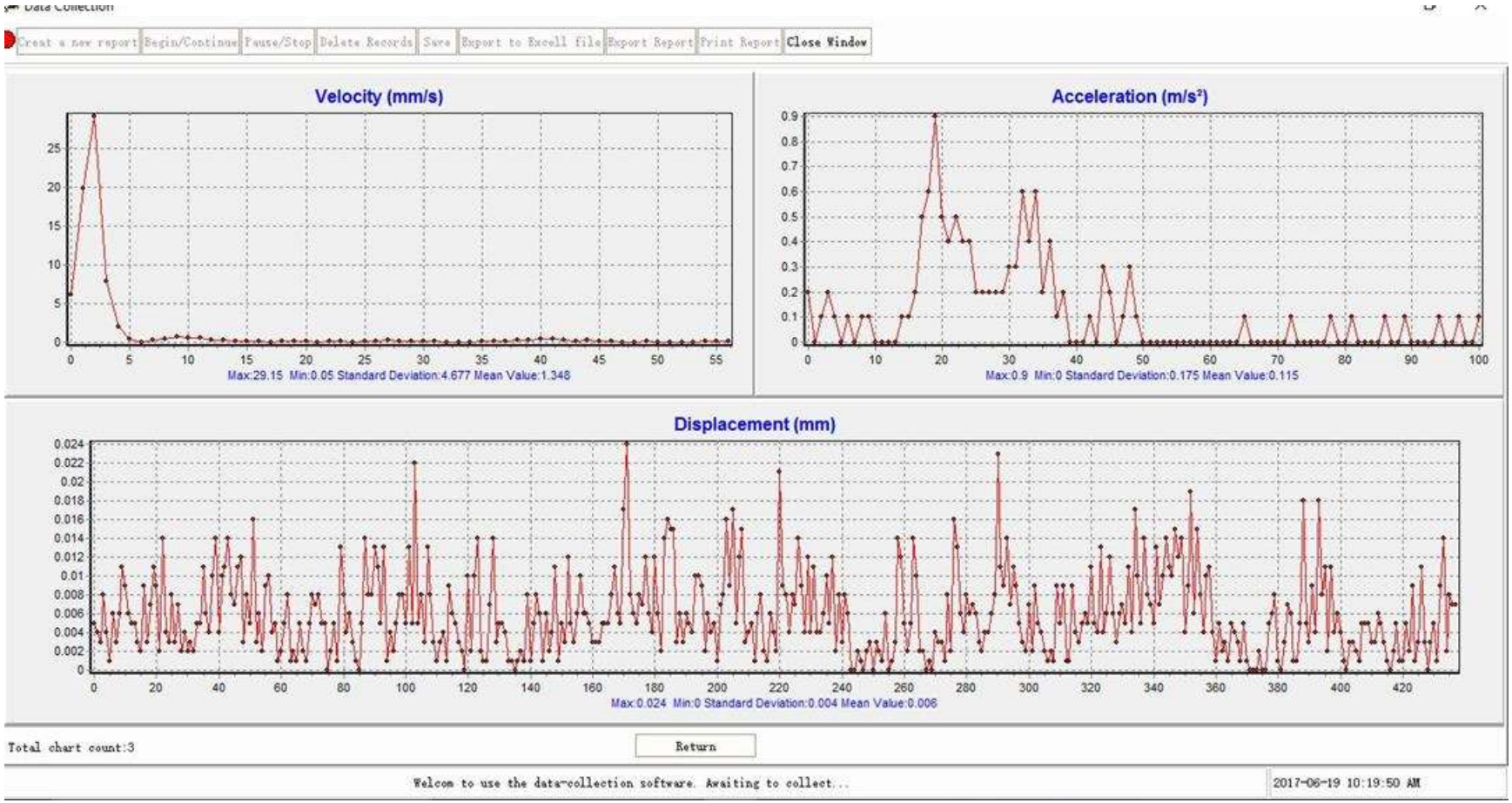
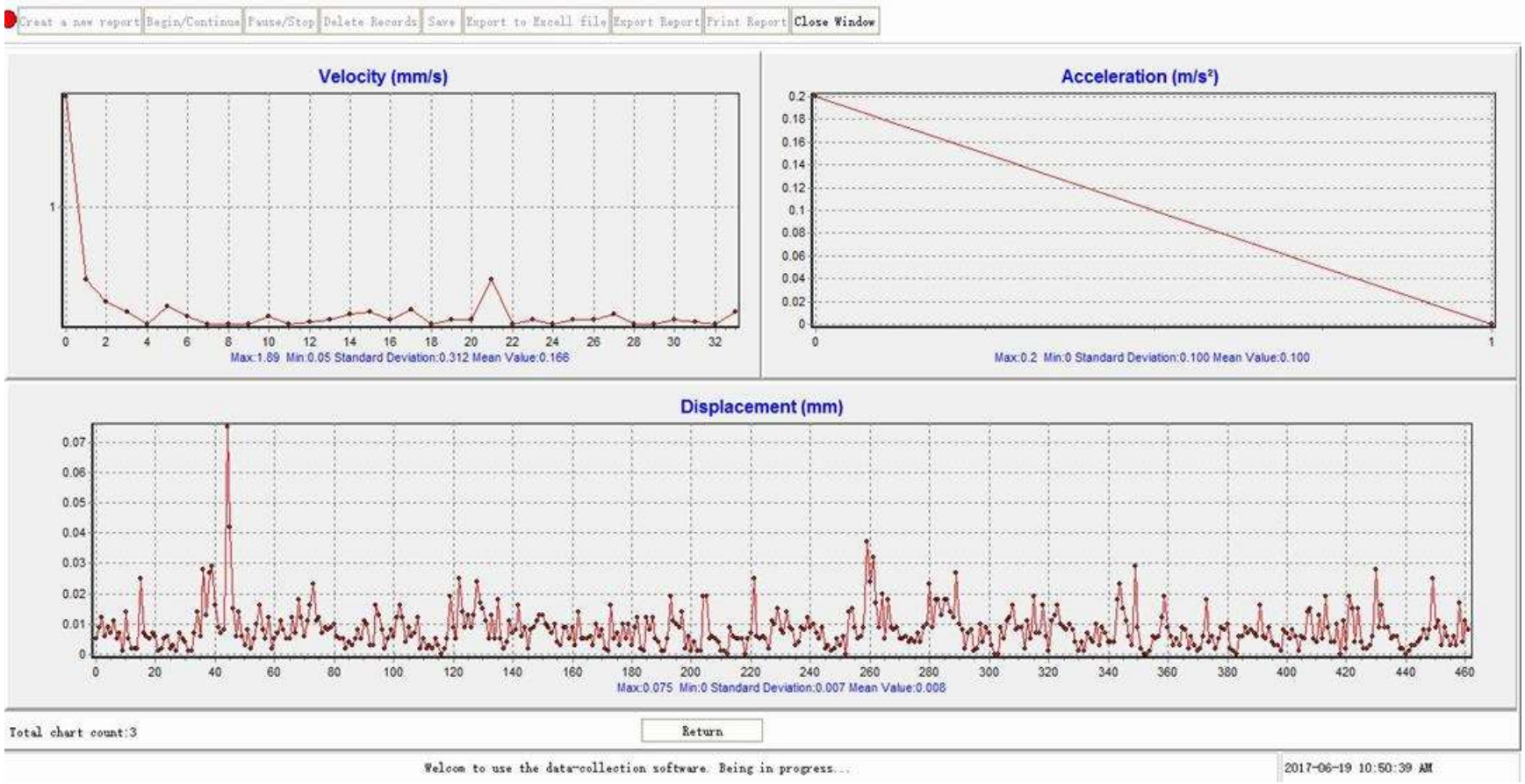
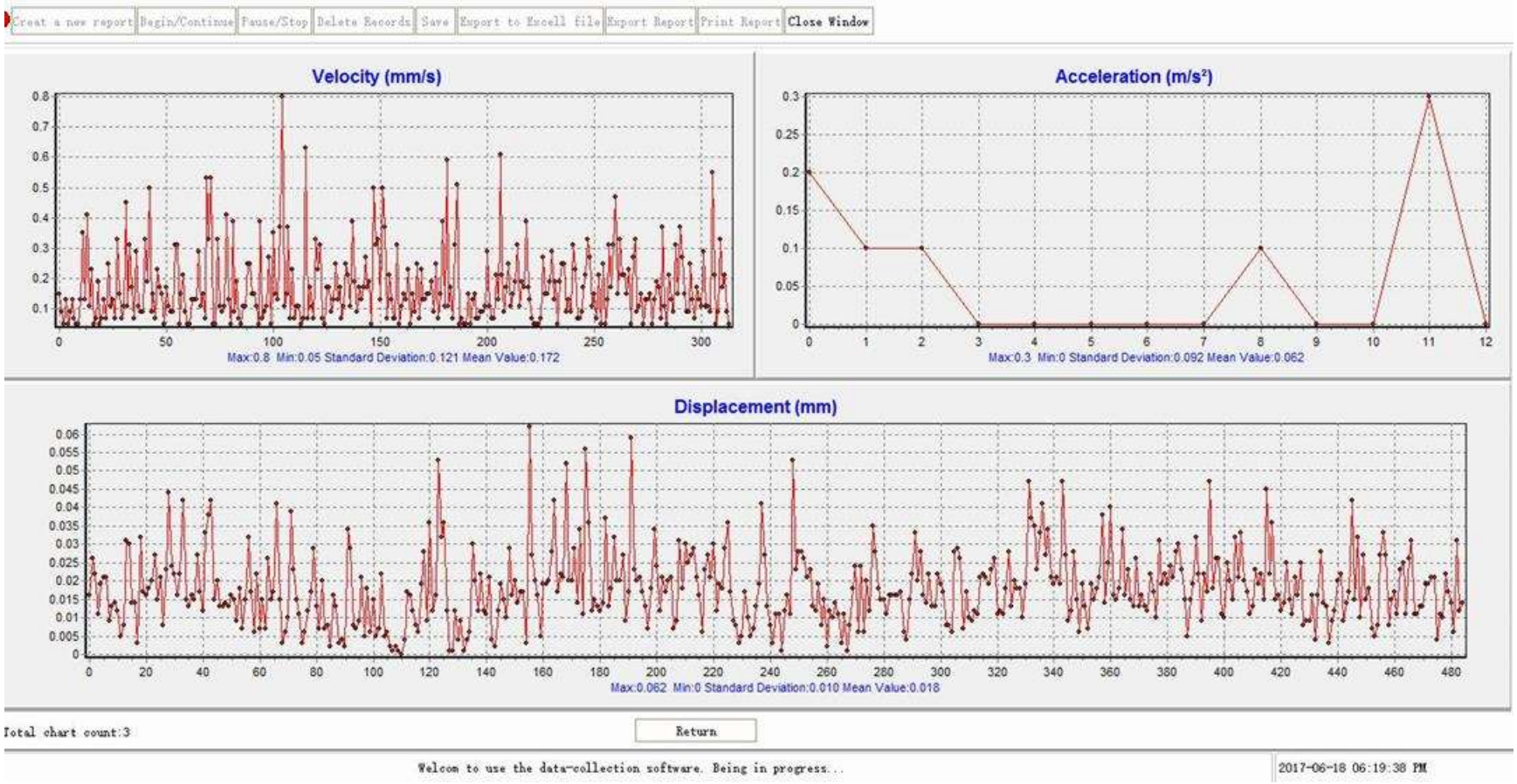
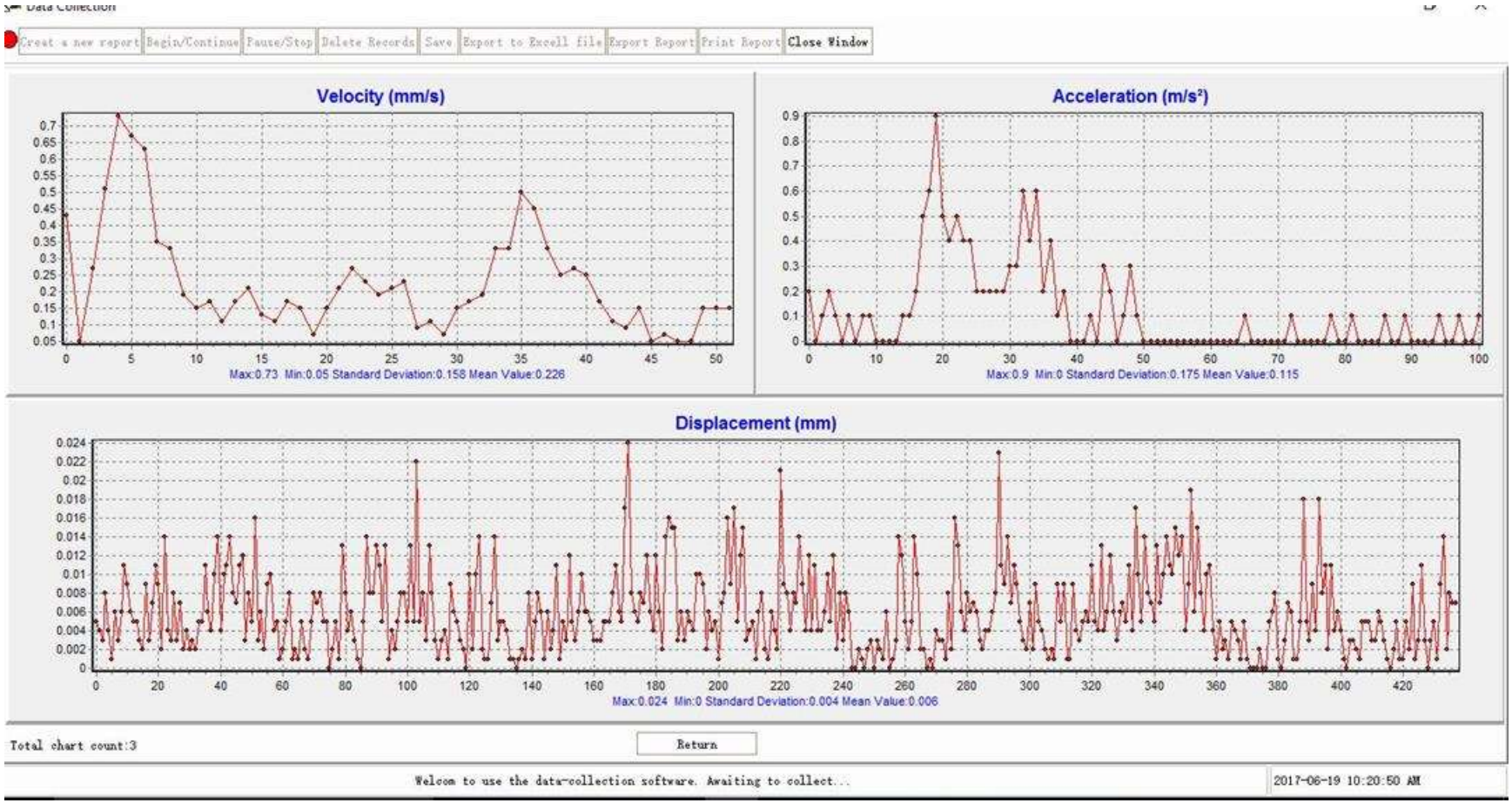
2017-06-17 02:46:56 PM


Creat a new report
Begin/Continue
Pause/Stop
Delete Records
Save
Export to Excell file
Export Report
Print Report
Close Window
Velocity (mm/s)
Max:29.15 Min:0.05 Standard Deviation:4.677 Mean Value:1.348
Acceleration (m/s²)
Max:0.9 Min:0 Standard Deviation:0.175 Mean Value:0.115
Displacement (mm)
Max:0.024 Min:0 Standard Deviation:0.004 Mean Value:0.006
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-19 10:19:50 AM


Creat a new report
Begin/Continue
Pause/Stop
Delete Records
Save
Export to Excell file
Export Report
Print Report
Close Window
Velocity (mm/s)
Max:1.89 Min:0.05 Standard Deviation:0.312 Mean Value:0.166
Acceleration (m/s²)
Max:0.2 Min:0 Standard Deviation:0.100 Mean Value:0.100
Displacement (mm)
Max:0.075 Min:0 Standard Deviation:0.007 Mean Value:0.008
Total chart count:3
Return
Welcom to use the data-collection software. Being in progress...
2017-06-19 10:50:39 AM


Creat a new report
Begin/Continue
Pause/Stop
Delete Records
Save
Export to Excell file
Export Report
Print Report
Close Window
Velocity (mm/s)
Max:0.8 Min:0.05 Standard Deviation:0.121 Mean Value:0.172
Acceleration (m/s²)
Max:0.3 Min:0 Standard Deviation:0.092 Mean Value:0.062
Displacement (mm)
Max:0.062 Min:0 Standard Deviation:0.010 Mean Value:0.018
Total chart count:3
Return
Welcom to use the data-collection software. Being in progress...
2017-06-18 06:19:38 PM


Creat a new report
Begin/Continue
Pause/Stop
Delete Records
Save
Export to Excell file
Export Report
Print Report
Close Window
Velocity (mm/s)
Max:0.73 Min:0.05 Standard Deviation:0.158 Mean Value:0.226
Acceleration (m/s²)
Max:0.9 Min:0 Standard Deviation:0.175 Mean Value:0.115
Displacement (mm)
Max:0.024 Min:0 Standard Deviation:0.004 Mean Value:0.006
Total chart count:3
Return
Welcom to use the data-collection software. Awaiting to collect...
2017-06-19 10:20:50 AM

Appendix-5: Surface Water Analysis

BUET/CE 0040944

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
DEPARTMENT OF CIVIL ENGINEERING
Mobile: 01619 557 964; PABX: 966 5650-60 Ext. 7226; www.buet.ac.bd/ce/
ENVIRONMENTAL ENGINEERING LABORATORY

BRTC No : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref No : Letter; Dt: 25/5/2017
Sent by : Development Solutions Consultant Ltd
Project : Bangladesh Rail Bridge Project
Company Address : House # 734 (5-6), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216
Sample Id : SW_PB_FS_500m_DS_EB Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water
Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	40	---	---	---	USEPA 9132, SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	10	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.44	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	1.6	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	82	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.25	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.855	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

Countersigned by:
Dr. Abu Siddique
Professor, Dept. of Civil Engg

fY2ZKdSTm

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Page 1

Test Performed by: 12/6/17
Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/

ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research Testing & Consultation

BRTC No. : **1101 36973/CE/16-17; Dt: 25/5/2017** Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd

Project : Bangladesh Rail Bridge Project

Company Address : House. # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_NS_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge Into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	20	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	Nil	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.38	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	70	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.17	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.777	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

BUETCE 003723

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg

14

CKCt9X7HX

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DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by : 12/6/17

Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/

ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_PB_NS_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	30	---	---	---	USEPA 9132, SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	20	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.32	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	1	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	2	150	500	200	USEPA 160.2, SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.22	---	---	---	USEPA 365.4, SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.621	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

15

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DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by 12/6/17

Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

Page 1

BUETCE 003235

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research, Testing & Consultation

BRTC No : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_PB_FS_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge Into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	40	---	---	---	USEPA 9132, SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	Nil	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.35	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	4	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	55	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.23	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.57	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

BUETCE 0037235

Countersigned by:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Test Performed by: 12/6/17

Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/

ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_PB_FS_500m_US_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	20	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	10	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.36	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	3	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	50	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.2	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.458	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

BUETCE 0037237

Countersigned by:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by: 12/6/17

Dr. Md. Mafizur Rahman
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DEPARTMENT OF CIVIL ENGINEERING

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_PB_FS_500m_US_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	20	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	Nil	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.42	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	97	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.23	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.417	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

BUETCE 0037238

Countersigned by:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Dr. Md. Mafizur Rahman
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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017
Sent by : Development Solutions Consultant Ltd.
Project : Bangladesh Rail Bridge Project
Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216
Sample Id : SW_PB_FS_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water
Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	10	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	Nil	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.35	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	95	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.21	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.443	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

Countersigned by:
Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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ENVIRONMENTAL ENGINEERING LABORATORY

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Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_PB_NS_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	30	---	---	---	USEPA 9132, SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	10	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.44	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	74	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.23	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.486	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

BUETCE 003740

Countersigned by :

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Professor, Dept. of Civil Engg.

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Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_NS_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge Into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	20	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	Nil	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.75	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2.2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	63	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.23	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.05
8	Total Organic Carbon (TOC)	mg/l	0.535	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.05

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

BUETCE 003241

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by 12/6/17

Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_FS_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	50	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	20	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.87	4.5-8	4.5-8	4.5-8	USEPA 360.3; 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	3	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	73	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.22	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.456	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

Countersigned by

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter, Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_FS_500m_US_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	20	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	10	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.5	4.5-8	4.5-8	4.5-8	USEPA 360.3; 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	78	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.23	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.554	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

BUETCE 003743

Countersigned by:

Dr. Abu Siddique
Professor, Dept. of Civil Engg

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Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC
Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter, Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_PB_FS_500m_DS_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	50	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	20	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.73	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2.2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	71	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.22	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.467	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

BUETCE 0037244

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_FS_500m_DS_WS Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	60	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	40	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.38	4.5-8	4.5-8	4.5-8	USEPA 360.3; 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	3	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B, SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	65	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.22	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.583	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg

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Dr. Md. Mafizur Rahman
Professor, Dept. of Civil Engineering

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DEPARTMENT OF CIVIL ENGINEERING

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC
Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_FS_500m_DS_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	50	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	30	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.93	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	2.2	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	77	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.19	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.568	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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BRTC

Bureau of Research, Testing & Consultation

BRTC No. : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No. : Letter; Dt: 25/5/2017

Sent by : Development Solutions Consultant Ltd.

Project : Bangladesh Rail Bridge Project

Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216

Sample Id : SW_EB_FS_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water

Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	30	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	Nil	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.9	4.5-8	4.5-8	4.5-8	USEPA 360.3; 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	3.1	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	56	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.23	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.472	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

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Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Professor, Dept. of Civil Engineering

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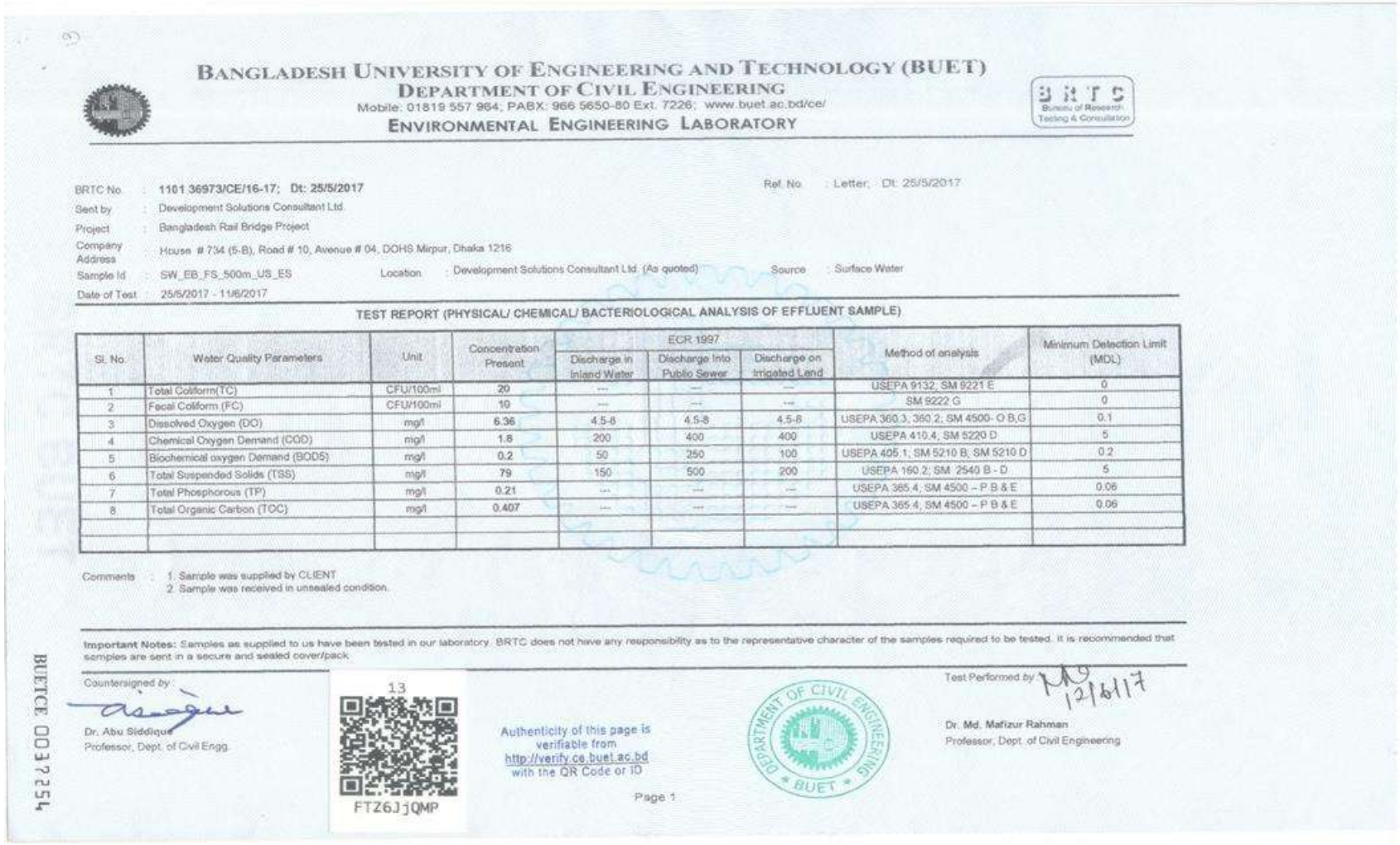

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BRTC No : 1101 36973/CE/16-17; Dt: 25/5/2017 Ref. No : Letter; Dt: 25/5/2017
Sent by : Development Solutions Consultant Ltd.
Project : Bangladesh Rail Bridge Project
Company Address : House # 734 (5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka 1216
Sample Id : SW_EB_FS_500m_US_ES Location : Development Solutions Consultant Ltd. (As quoted) Source : Surface Water
Date of Test : 25/5/2017 - 11/6/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF EFFLUENT SAMPLE)

Sl. No	Water Quality Parameters	Unit	Concentration Present	ECR 1997			Method of analysis	Minimum Detection Limit (MDL)
				Discharge in Inland Water	Discharge into Public Sewer	Discharge on Irrigated Land		
1	Total Coliform(TC)	CFU/100ml	20	---	---	---	USEPA 9132; SM 9221 E	0
2	Fecal Coliform (FC)	CFU/100ml	10	---	---	---	SM 9222 G	0
3	Dissolved Oxygen (DO)	mg/l	6.36	4.5-8	4.5-8	4.5-8	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
4	Chemical Oxygen Demand (COD)	mg/l	1.8	200	400	400	USEPA 410.4; SM 5220 D	5
5	Biochemical oxygen Demand (BOD5)	mg/l	0.2	50	250	100	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
6	Total Suspended Solids (TSS)	mg/l	79	150	500	200	USEPA 160.2; SM 2540 B - D	5
7	Total Phosphorous (TP)	mg/l	0.21	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06
8	Total Organic Carbon (TOC)	mg/l	0.407	---	---	---	USEPA 365.4; SM 4500 – P B & E	0.06

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

Countersigned by
Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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মৃত্তিকা, পানি ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
ঢাকা ১০০০

Department of Soil, Water and Environment
University of Dhaka
Dhaka 1000
Bangladesh

Date: 20. 06. 2017

Report of Analysis

Sample supplied by
Mrs. Tanzia Sharmin
Deputy Manager (Water & Environment)
Development Solutions Consultant Ltd.
House-734 (5-B), Road-10, Avenue-04
DOHS Mirpur, Dhaka-1216, Bangladesh

Project Name: Bangabandhu Railway Bridge Construction Project

Sample Title: Surface water quality test for oil and grease

Analytical Results:

Serial No.	Sample ID	Test Parameters	Test Method (APHA)
		Oil and Grease (mg/L)	
1	SW_EB_NS_ES	Less than 5.0	5520.B
2	SW_PB_NS_ES	Less than 5.0	5520.B
3	SW_PB_FS_ES	Less than 5.0	5520.B
4	SW_PB_FS_500m_US_ES	Less than 5.0	5520.B
5	SW_PB_FS_500m_US_WS	5.80	5520.B
6	SW_PB_FS_WS	Less than 5.0	5520.B
7	SW_PB_NS_WS	Less than 5.0	5520.B
8	SW_EB_NS_WS	24.60	5520.B
9	SW_EB_FS_WS	Less than 5.0	5520.B
10	SW_EB_FS_500m_US_WS	Less than 5.0	5520.B
11	SW_PB_FS_500m_DS_WS	Less than 5.0	5520.B
12	SW_EB_FS_500m_DS_WS	Less than 5.0	5520.B
13	SW_EB_FS_500m_DS_ES	Less than 5.0	5520.B
14	SW_PB_FS_500m_DS_ES	Less than 5.0	5520.B
15	SW_EB_FS_ES	Less than 5.0	5520.B
16	SW_EB_FS_500m_US_ES	6.40	5520.B

(Professor Dr. Sirajul Hoque)
Chairman

Dr. Sirajul Hoque
Professor & Chairman
Department of Soil, Water & Environment
University of Dhaka, Dhaka-1000

Telephone: 9661920-73/7470, Fax: (880-2) 8615583, e-mail: swed@du.ac.bd

Appendix-6 : Groundwater Quality Test Results

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

BRTC No. : 110136857 /16-17/CE; Dt: 24/5/2017 Ref. No. : letter; Dt: 24/5/2017
Sent by : Ms. Tanzia Sharmin, Deputy Manager (Water & Environment), Development Solutions Consultant Ltd.
Project : Bangabandhu Rail Bridge Project
Company Address : House # 734(5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka
Sample Id : Groundwater: GW_WS_100m_S Location : - Source : Groundwater
Date of Test : 24/5/2017 - 31/5/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF DRINKING WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline Values, 2004	Method of analysis	Minimum Detection Limit (MDL)
1	Chloride (Cl-)	mg/l	86	150-600	250	USEPA 325.6; SM 4500-Cl-	1
2	Arsenic (As)	mg/l	0.005	0.05	0.01	USEPA 206.2; SM 3113 B	0.001
3	Iron (Fe)	mg/l	0.02	0.3-1.0	0.3	USEPA 200.9 ; SM 3111 B	0.02
4	Manganese (Mn)	mg/l	0.678	0.1	0.4a, 0.1b	USEPA 200.9 ; SM 3111 B	0.08
5	Sulphate (SO4)	mg/l	41.3	400	250	USEPA 375.4; SM 4500-SO4	7
6	Total Coliform(TC)	CFU/100ml	2	0	0	USEPA 9132; SM 9221 E	0
7	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :
Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

BRTC No. : 110136857 /16-17/CE; Dt: 24/5/2017
Ref. No. : letter; Dt: 24/5/2017
Sent by : Ms. Tanzia Sharmin, Deputy Manager (Water & Environment), Development Solutions Consultant Ltd.
Project : Bangabandhu Rail Bridge Project
Company Address : House # 734(5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka
Sample Id : Groundwater: GW_ES_100m_N
Location : -
Source : Groundwater
Date of Test : 24/5/2017 - 31/5/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF DRINKING WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline Values, 2004	Method of analysis	Minimum Detection Limit (MDL)
1	Chloride (Cl-)	mg/l	47	150-600	250	USEPA 325.6; SM 4500-Cl-	1
2	Arsenic (As)	mg/l	0.012	0.05	0.01	USEPA 206.2; SM 3113 B	0.001
3	Iron (Fe)	mg/l	1.8	0.3-1.0	0.3	USEPA 200.9 ; SM 3111 B	0.02
4	Manganese (Mn)	mg/l	1.42	0.1	0.4a, 0.1b	USEPA 200.9 ; SM 3111 B	0.08
5	Sulphate (SO4)	mg/l	15.3	400	250	USEPA 375.4; SM 4500-SO4	7
6	Total Coliform(TC)	CFU/100ml	0	0	0	USEPA 9132; SM 9221 E	0
7	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :
Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Professor, Dept. of Civil Engineering

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BRTC
Bureau of Research, Testing & Consultation

BRTC No. : 110136857 /16-17/CE; Dt: 24/5/2017 Ref. No. : letter; Dt: 24/5/2017
Sent by : Ms. Tanzia Sharmin, Deputy Manager (Water & Environment), Development Solutions Consultant Ltd.
Project : Bangabandhu Rail Bridge Project
Company Address : House # 734(S-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka
Sample Id : Groundwater: GW_ES Location : - Source : Groundwater
Date of Test : 24/5/2017 - 31/5/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF DRINKING WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline Values, 2004	Method of analysis	Minimum Detection Limit (MDL)
1	Chloride (Cl-)	mg/l	32	150-600	250	USEPA 325.6; SM 4500-Cl-	1
2	Arsenic (As)	mg/l	0.084	0.05	0.01	USEPA 206.2; SM 3113 B	0.001
3	Iron (Fe)	mg/l	2.72	0.3-1.0	0.3	USEPA 200.9 ; SM 3111 B	0.02
4	Manganese (Mn)	mg/l	2.4	0.1	0.4a, 0.1b	USEPA 200.9 ; SM 3111 B	0.08
5	Sulphate (SO4)	mg/l	<MDL	400	250	USEPA 375.4; SM 4500-SO4	7
6	Total Coliform(TC)	CFU/100ml	0	0	0	USEPA 9132; SM 9221 E	0
7	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

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Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Professor, Dept. of Civil Engineering

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BRTC
Bureau of Research, Testing & Consultation

BRTC No. : 110136857 /16-17/CE; Dt: 24/5/2017
Ref. No. : letter; Dt: 24/5/2017
Sent by : Ms. Tanzia Sharmin, Deputy Manager (Water & Environment), Development Solutions Consultant Ltd.
Project : Bangabandhu Rail Bridge Project
Company Address : House # 734(S-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka
Sample Id : Groundwater: GW_WS
Location : -
Source : Groundwater
Date of Test : 24/5/2017 - 31/5/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF DRINKING WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline Values, 2004	Method of analysis	Minimum Detection Limit (MDL)
1	Chloride (Cl-)	mg/l	60	150-600	250	USEPA 325.6; SM 4500-Cl-	1
2	Arsenic (As)	mg/l	<MDL	0.05	0.01	USEPA 206.2; SM 3113 B	0.001
3	Iron (Fe)	mg/l	0.02	0.3-1.0	0.3	USEPA 200.9 ; SM 3111 B	0.02
4	Manganese (Mn)	mg/l	0.495	0.1	0.4a, 0.1b	USEPA 200.9 ; SM 3111 B	0.08
5	Sulphate (SO4)	mg/l	41.3	400	250	USEPA 375.4; SM 4500-SO4	7
6	Total Coliform(TC)	CFU/100ml	0	0	0	USEPA 9132; SM 9221 E	0
7	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:
Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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Professor, Dept. of Civil Engineering

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BRTC
Bureau of Research, Testing & Consultation

BRTC No. : 110136857 /16-17/CE; Dt: 24/5/2017
Ref. No. : letter; Dt: 24/5/2017
Sent by : Ms. Tanzia Sharmin, Deputy Manager (Water & Environment), Development Solutions Consultant Ltd.
Project : Bangabandhu Rail Bridge Project
Company Address : House # 734(5-B), Road # 10, Avenue # 04, DOHS Mirpur, Dhaka
Sample Id : Groundwater: GW_WS_100m_N
Location : -
Source : Groundwater
Date of Test : 24/5/2017 - 31/5/2017

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF DRINKING WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR'97)	WHO Guideline Values, 2004	Method of analysis	Minimum Detection Limit (MDL)
1	Chloride (Cl-)	mg/l	83	150-600	250	USEPA 325.6; SM 4500-Cl-	1
2	Arsenic (As)	mg/l	0.007	0.05	0.01	USEPA 206.2; SM 3113 B	0.001
3	Iron (Fe)	mg/l	0.02	0.3-1.0	0.3	USEPA 200.9 ; SM 3111 B	0.02
4	Manganese (Mn)	mg/l	0.667	0.1	0.4a, 0.1b	USEPA 200.9 ; SM 3111 B	0.08
5	Sulphate (SO4)	mg/l	40.8	400	250	USEPA 375.4; SM 4500-SO4	7
6	Total Coliform(TC)	CFU/100ml	4	0	0	USEPA 9132; SM 9221 E	0
7	Fecal Coliform (FC)	CFU/100ml	2	0	0	SM 9222 G	0
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack.

Countersigned by:
Dr. Abu Siddique
Professor, Dept. of Civil Engg.

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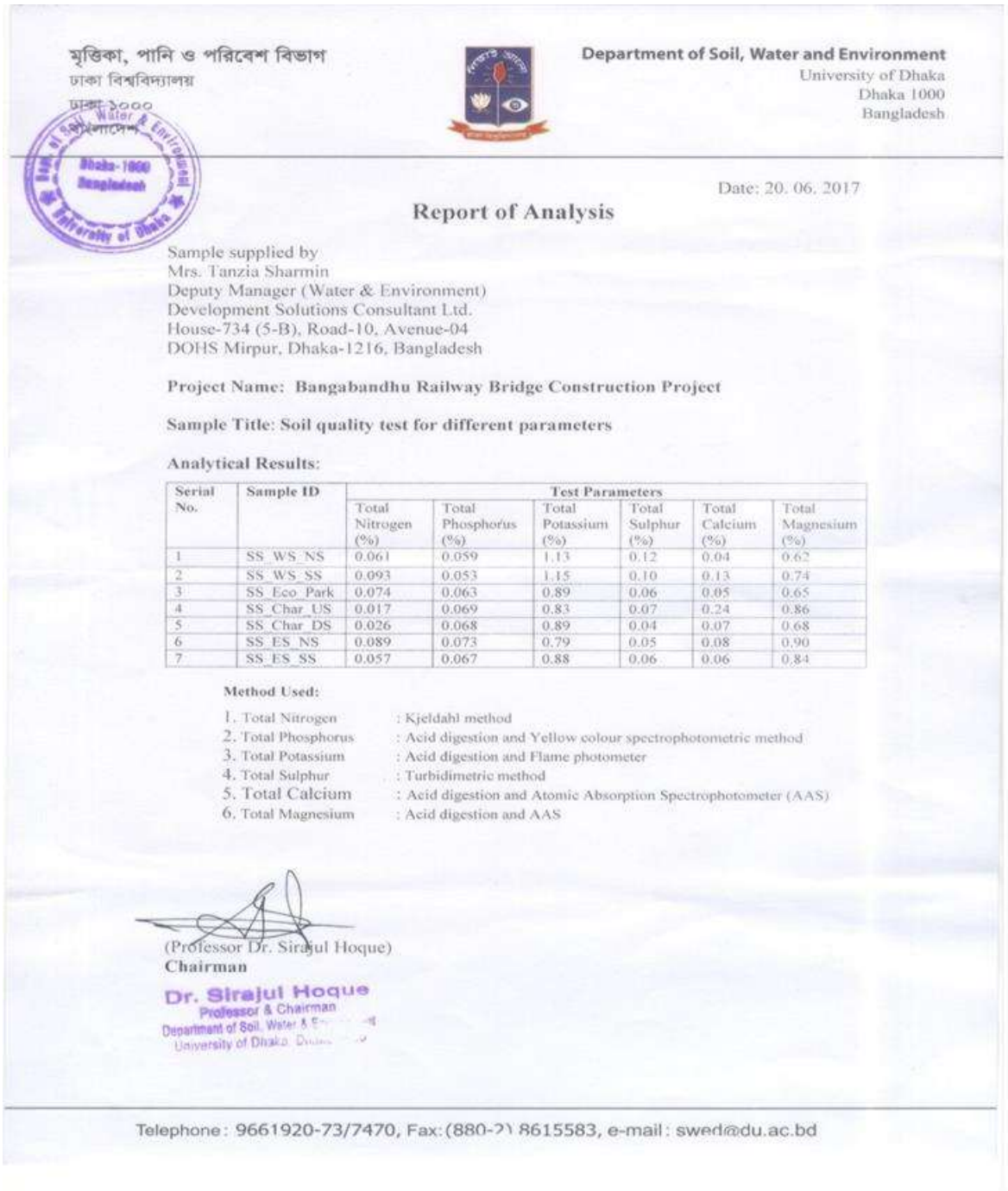
Appendix-7: Soil Quality Test Results



মৃত্তিকা, পানি ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
ঢাকা-১০০০
বাংলাদেশ

Department of Soil, Water and Environment
University of Dhaka
Dhaka 1000
Bangladesh

Date: 20. 06. 2017

Report of Analysis

Sample supplied by
Mrs. Tanzia Sharmin
Deputy Manager (Water & Environment)
Development Solutions Consultant Ltd.
House-734 (5-B), Road-10, Avenue-04
DOHS Mirpur, Dhaka-1216, Bangladesh

Project Name: Bangabandhu Railway Bridge Construction Project

Sample Title: Soil quality test for different parameters

Analytical Results:

Serial No.	Sample ID	Test Parameters					
		Total Nitrogen (%)	Total Phosphorus (%)	Total Potassium (%)	Total Sulphur (%)	Total Calcium (%)	Total Magnesium (%)
1	SS_WS_NS	0.061	0.059	1.13	0.12	0.04	0.62
2	SS_WS_SS	0.093	0.053	1.15	0.10	0.13	0.74
3	SS_Eco_Park	0.074	0.063	0.89	0.06	0.05	0.65
4	SS_Char_US	0.017	0.069	0.83	0.07	0.24	0.86
5	SS_Char_DS	0.026	0.068	0.89	0.04	0.07	0.68
6	SS_ES_NS	0.089	0.073	0.79	0.05	0.08	0.90
7	SS_ES_SS	0.057	0.067	0.88	0.06	0.06	0.84

Method Used:

1. Total Nitrogen : Kjeldahl method
2. Total Phosphorus : Acid digestion and Yellow colour spectrophotometric method
3. Total Potassium : Acid digestion and Flame photometer
4. Total Sulphur : Turbidimetric method
5. Total Calcium : Acid digestion and Atomic Absorption Spectrophotometer (AAS)
6. Total Magnesium : Acid digestion and AAS

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ঢাকা বিশ্ববিদ্যালয়
ঢাকা-১০০০

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DOHS Mirpur, Dhaka-1216, Bangladesh

Project Name: Bangabandhu Railway Bridge Construction Project

Sample Title: Soil quality test for different parameters

Analytical Results:

Serial No.	Sample ID	Test Parameters					
		Total Iron (Fe) (%)	Total Manganese (Mn) (ppm)	Total Copper (Cu) (ppm)	Total Zinc (Zn) (ppm)	Total Boron (B) (ppm)	Total Molybdenum (Mo) (ppm)
1	SS_WS_NS	3.10	627.7	97.5	128.7	0.725	22.9
2	SS_WS_SS	3.44	595.2	152.5	529.5	0.556	18.0
3	SS_Eco_Park	3.22	540.2	72.5	47.3	0.520	17.5
4	SS_Char_US	2.25	450.2	120.0	96.5	0.625	21.9
5	SS_Char_DS	2.01	437.7	30.2	16.9	0.338	17.2
6	SS_ES_NS	2.86	495.2	295.8	210.6	0.475	14.3
7	SS_ES_SS	3.45	622.7	50.0	77.4	0.488	17.0

Method Used:

1. Total Iron : Acid digestion and Atomic Absorption Spectrophotometer (AAS)
2. Total Manganese : Acid digestion and Atomic Absorption Spectrophotometer (AAS)
3. Total Copper : Acid digestion and Atomic Absorption Spectrophotometer (AAS)
4. Total Zinc : Acid digestion and Atomic Absorption Spectrophotometer (AAS)
5. Total Boron : Colorimetric method
6. Total Molybdenum : Acid digestion and Atomic Absorption Spectrophotometer (AAS)

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Appendix-8: Riverbed Sediment Quality Test Results

মৃত্তিকা, পানি ও পরিবেশ বিভাগ
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বাংলাদেশ

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Report of Analysis

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Project Name: Bangabandhu Railway Bridge Construction Project

Sample Title: Sediment quality test for different parameters

Analytical Results:

Serial No.	Sample ID	Test Parameters (ppm)				
		Arsenic (As)	Cadmium (Cd)	Calcium (Ca)	Cobalt (Co)	Chromium (Cr)
1	RBM_PB_ES_NS	2.574	0.251	2545.1	10.78	21.8
2	RBM_PB_500m_US	3.296	*BDL	3037.5	11.83	14.5
3	RBM_PB_FS_ES	1.081	BDL	1525.2	2.81	4.8
4	RBM_PB_WS_NS	1.949	BDL	1837.5	7.09	9.1
5	RBM_PB_FS_WS	1.094	BDL	816.3	3.58	5.5
6	RBM_PB_500m_DS	1.221	BDL	910.1	3.04	5.0

*BDL= below detection limit

Method Used:

1. Arsenic : Kjeldahl method
2. Cadmium : Acid digestion and Yellow colour spectrophotometric method
3. Calcium : Acid digestion and Flame photometer
4. Cobalt : Acid digestion and Atomic Absorption Spectrophotometer (AAS) method
5. Chromium : Turbidimetric method

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Appendix-9: Tree Inventories and Replacement Program

1. Introduction

The project is known as “Bangabandhu Railway Bridge Construction Project (BRBCP)”. As its name suggests, a separate railway bridge will be constructed beside the current Bangabandhu Multipurpose Bridge. Construction of the Bangabandhu Railway Bridge will improve better connectivity. During the construction of the bridge, it may raise concerns about certain environmental adverse impacts on the surrounding environment. By implementing the mitigation plan the adverse impacts can be effectively handled. The baseline environmental parameters need to be considered to assess the existing environmental conditions of the project area. Environmental surveys were conducted during the feasibility stage (2013-2014) for the project for all the environmental parameters. As there are rapid developments and industrialization taking place in the surrounding areas (Sirajganj) adjacent to the proposed project, with some of the power plants became already functional in the recent years and few more are under construction, will give increase in pollution loads. Considering the developmental activities, the existing baseline parameters should be monitored to assess the present status of environment.

2. Methodology

A general approach of tree counting for a typical infrastructure development project rather than a specific methodology was used in this survey. The survey was conducted for a period of 14 consecutive days from 23 July to 5 August, 2017 along the proposed Bangabandhu Railway Bridge Project Corridor. The first day was spent for reconnaissance survey, general identification of the abundance trees, formulation of the groups and assigning the responsibilities and the training on the duties to be performed during the survey as per the developed guideline / format for information collection. The next 13 days were used for main survey purposes. The survey area, as per requirement of the ToR, was a 120ft buffer (60ft in both sides) from the proposed centreline. Two survey teams surveyed the corridor both for the left side and right side from the centreline. The teams were composed both from the members from ACE Consultants Limited and the members from the Forest Department (FD). Considering the recommendation in the approval letter for tree counting from the Divisional Forest Officer, Social Forestry, Pabna; the ACE Consultants Limited included the personnel from the Bangabandhu Jamuna Eco Park during the tree counting survey work. Additionally, since the Forest Department will prepare an assessment report for the affected trees and the consultant

of BRBCP project under Bangladesh Railway will develop a similar type of assessment. So it was decided to work together to avoid errors in the numbers of affected trees in the reports from two different institutions. During survey, each counted tree was marked with 'red color' by a number for future identification as per the requirement of the TOR. The photographs in the below Figure 1 shows some snaps during the tree counting survey where surveyors from ACE Consultants Limited and the Forest Department (FD) are working together.

Figure 1 Some Photographs of Tree Counting Survey Team

3. Results and Discussion

3.1. Summary of the Results

The summary of the survey results is given in the below Table 1.

Table 1 Summary of trees counted for the Bangabandhu Railway Bridge (Source: JICA field Survey 2017)

Sl. No.	Issues		Results
1	Total trees counted for felling	Trees belongs to Forest Department	3530
		Trees belongs to BBA	15
		Trees belongs to Bangabandhu Cantonment	38
		Total	**3583**
2	Total fuel wood calculated	Trees belongs to Forest Department/West Side	153272 kg
		Trees in the East Side	3035 kg
		Total	**156307 kg**
3	Total Identified Species		**28**
4	Total number of timber trees		**998**
5	Total number of commercial trees		**23**
6	Total number of fuel trees		**949**
7	Total number of invasive trees		**102**
8	Total number of medicinal trees		**747**
9	Total number of fruit trees		**16**

3.1.1. Results of East Side

The total trees in the East side of the proposed railway bridge is very limited and counted as only 53 from 8 species. Among the total counted trees 15 trees are belong to Bangladesh

Bridge Authority (BBA) and the rest 38 trees are belonging to Bangabandhu Cantonment authority. The species of trees under the BBA land are Jhau (*Tamarix dioica*) and Koroi (*Albizia lebbeck*). All the counted Jhau (8 nos.) and 03 Koroi are belonging to BBA and the remaining species are belonging to Cantonment authority. The details of the counted trees in the east side are given in below Table 2.

Table 2 Number of trees counted for felling in the east side of the Bangabandhu Bridge (Source: Field Survey 2017)

Sl.No.	Vernacular name	Scientific Name	Count
1	Jhau	*Tamarix dioica*	8
2	Koroi	*Albizia lebbeck*	7
3	Akashmoni	*Acacia auriculiformis*	1
4	Arjun	*Terminalia arjuna*	2
5	Bokul	*Mimusops elengi*	7
6	Jiga	*Maerua crasifolia*	2
7	Mehagani	*Swietenia macrophylla*	4
8	Neem	*Azadirachta indica*	22
Total Species = 8			53

Total four types of trees have been identified in the east side along the proposed bridge alignment. The category of the types is given in below Table 3. Among the types of the trees; the medicinal categories are in the highest (24) and the fuel tress (2) is in the lowest.

Table 3 Type of trees identified in the east side of the Bangabandhu Bridge (Source: Field Survey 2017)

Sl.No.	Type	Vernacular name	Scientific Name	Count
1	Ornamental	Jhau	*Tamarix dioica*	16
		Akashmoni	*Acacia auriculiformis*	
		Bokul	*Mimusops elengi*	
2	Timber	Koroi	*Albizia lebbeck*	11
		Mehagani	*Swietenia macrophylla*	
4	Medicinal	Arjun	*Terminalia arjuna*	24
		Neem	*Azadirachta indica*	
5	Fuel	Jiga	*Maerua crasifolia*	2

The calculated total amount of fuel of the trees in the east side of the proposed bridge is 3035 Kg. the details of the calculation are given in the below Table 4. The amount of the fuel for Koroi (*Albizia lebbeck*) trees(900 kg) is the highest and the Jiga (*Maerua crasifolia*) is the lowest(70kg).

Table 4 Amount of fuel of trees counted in the east side of the Bangabandhu Bridge (Source: JICA field survey 2017)

Sl.No.	Vernacular name	Scientific Name	Fuel (Kg)
1	Jhau	*Tamarix dioica*	780
2	Koroi	*Albizia lebbeck*	900
3	Akashmoni	*Acacia auriculiformis*	75
4	Arjun	*Terminalia arjuna*	150
5	Bokul	*Mimusops elengi*	210
6	Jiga	*Maerua crasifolia*	70
7	Mehagani	*Swietenia macrophylla*	110
8	Neem	*Azadirachta indica*	740
Total Amount of Fuel			**3035**

3.1.2. Results of West Side

Almost all the counted trees for the total alignment are located in the west side of the proposed bridge and the percentage (%) of the total trees located in the west as 98.5%. Among the total 27 identified species; 26 species are found in the west side. All the counted trees in the west side are belonging to Divisional Forest Office (DFO) of Pabna of Forest Department (FD). The abundant species in the west side of the proposed bridge alignment are Akashmoni (*Acacia auriculiformis*), Jarul (*Lagerstroemia speciosa*), Shishu (*Dalbergia sissoo*) and Arjun (*Terminalia arjuna*) with the number 625, 703, 636, and 571 respectively. The least common species along the alignment are Bohera (*Terminalia belerica*), Kodom (*Neolamarckia cadamba*), and Sonalu (*Cassia fistula*) with only one number. The details of the counted trees in the west side of the proposed project are given in the below Table 5.

Table 5 Details of trees counted for felling in the west side of the Bangabandhu Bridge (Source: Field Survey 2017)

Sl.No.	Vernacular name	Scientific Name	Count
1	Akashmoni	*Acacia auriculiformis*	625
2	Arjun	*Terminalia arjuna*	571
3	Babla	*Vachellia nilotica*	3
4	Bohera	*Terminalia belerica*	1
5	Debdaru	*Polyalthia longifolia*	90
6	Dewa	*Phaleria macrocarpa*	2
7	Ipil ipil	*Leucaena leucocephala*	2
8	Eucalyptus	*Euclalyptus globulus*	90
9	Gamar	*Gmelina arborea*	26
10	Guava	*Psidium guajava*	3
11	Hijol	*Barringtonia acutangula*	96
12	Jarul	*Lagerstroemia speciosa*	703
13	Joytun	*Olea europaea*	11
14	Jhau	*Tamarix dioica*	74
15	Jiga	*Maerua crasifolia*	146
16	Kodom	*Neolamarckia cadamba*	1
17	Kanchan	*Bauhinia acuminata*	4

Sl.No.	Vernacular name	Scientific Name	Count
18	Karmacha	*Carissa carandas*	8
19	Khoyer	*Acacia Catechu*	10
20	Koroi	*Albizia lebbeck*	321
21	Mango	*Mangifera Indica*	5
22	Neem	*Azadirachta indica*	50
23	Polash	*Butea monosperma*	8
24	Shewra	*Streblus asper*	4
25	Shimul	*Bombax ceiba*	23
26	Shishu	*Dalbergia sissoo*	636
27	Sonalu	*Cassia fistula*	1
28	Undetected		16
Total species = 27			3530

Total nine types of trees have been identified in the west side along the proposed bridge alignment. The category of the types is given in below Table 6. Among the types of the trees; the timber categories were in the highest (987) and the flower tress is in the lowest (14).

Table 6 Details of trees counted for remove in the west side of the Bangabandhu Bridge (Source: JICA field survey 2017)

Sl.No.	Type	Vernacular name	Scientific Name	Count
1	Ornamental	Akashmoni	*Acacia auriculiformis*	699
		Jhau	*Tamarix dioica*	
2	Medicinal	Arjun	*Terminalia arjuna*	723
		Debdaru	*Polyalthia longifolia*	
		Neem	*Azadirachta indica*	
		Bohera	*Terminalia belerica*	
		Joytun	*Olea europaea*	
3	Invasive	Babla	*Vachellia nilotica*	95
		Ipil ipil	*Leucaena leucocephala*	
		Eucalyptus	*Euclalyptus globulus*	
4	Fuel	Dewa	*Phaleria macrocarpa*	947
		Hijol	*Barringtonia acutangula*	
		Jarul	*Lagerstroemia speciosa*	
		Jiga	*Maerua crasifolia*	
5	Timber	Gamar	*Gmelina arborea*	987
		Koroi	*Albizia lebbeck*	
		Shewra	*Streblus asper*	
		Shishu	*Dalbergia sissoo*	
6	Fruit	Guava	*Psidium guajava*	16
		Karmacha	*Carissa carandas*	
		Mango	*Mangifera Indica*	
7	Commercial	Shimul	*Bombax ceiba*	23
8	Flower	Kodom	*Neolamarckia cadamba*	14
		Kanchan	*Bauhinia acuminata*	
		Polash	*Butea monosperma*	
		Sonalu	*Cassia fistula*	
9	Other	Khoyer	*Acacia Catechu*	26
		Undetected		

The calculated total amount of fuel of the trees in the west side of the proposed bridge is 1,53,272 Kg. The details of the calculation are given in the below Table 7. The amount of the fuel for Akashmoni (*Acacia auriculiformis*) trees was the highest (42566 kg) and the Sonalu (*Cassia fistula*) is the lowest(50kg).

Table 7 Amount of fuel of trees counted in the west side of the Bangabandhu Bridge (Source: Field Survey 2017)

Sl.No.	Vernacular name	Scientific Name	Fuel (Kg)
1	Akashmoni	*Acacia auriculiformis*	42,566
2	Arjun	*Terminalia arjuna*	24,365
3	Babla	*Vachellia nilotica*	1,580
4	Bohera	*Terminalia belerica*	90
5	Debdaru	*Polyalthia longifolia*	1,460
6	Dewa	*Phaleria macrocarpa*	250
7	Ipil ipil	*Leucaena leucocephala*	160
8	Eucalyptus	*Euclalyptus globulus*	4,695
9	Gamar	*Gmelina arborea*	970
10	Guava	*Psidium guajava*	120
11	Hijol	*Barringtonia acutangula*	1,957
12	Jarul	*Lagerstroemia speciosa*	14,729
13	Joytun	*Olea europaea*	285
14	Jhau	*Tamarix dioica*	5,469
15	Jiga	*Maerua crasifolia*	5,647
16	Kodom	*Neolamarckia cadamba*	100
17	Kanchan	*Bauhinia acuminata*	135
18	Karmacha	*Carissa carandas*	3,565
19	Khoyer	*Acacia Catechu*	265
20	Koroi	*Albizia lebbeck*	10,042
21	Mango	*Mangifera Indica*	430
22	Neem	*Azadirachta indica*	1,750
23	Polash	*Butea monosperma*	210
24	Shewra	*Streblus asper*	155
25	Shimul	*Bombax ceiba*	545
26	Shishu	*Dalbergia sissoo*	32,876
27	Sonalu	*Cassia fistula*	50
28	Undetected		565
Total Amount of Fuel			**153,272**

3.4. **Space for afforestation:**

Approximately, 3600 trees will be removed for project. The proposed Tree Plantation and Replacement Program (TPRP) will replace these with least three times the number of the actual fallen trees. The following areas have been identified for development of plantation sites in the project areas:

1. Bangabandhu Setu west station to Molibari both side of road
2. Bangabandhu Setu east station
3. West side of Cantonment

3.5. Selection of Tree species

The species for the proposed tree replacement have been selected based on the statistics of the lost vegetation and suitability for the intended purpose. The main consideration for selection of species is to conserve biodiversity, provide habitat for biotic species, minimize visual impacts, improve aesthetics and ecological conservation as well as commercial benefits. Accordingly, the list of native tree species proposed to be planted is as follows**:**

Table 8 Selection of Tree Species

Type	Scientific name
Timber Trees	Garjan (Dipterocarpus turbinatus) Shal (Shorea robusta) Shilkoroi (Albzia procera) Kat badam (Terminalia calappa) Mehogani (Swietenia mahagoni) Epil–epil (Leucaena leucocephala) Raintree (Samania saman)
Fruit Trees	Date palm (Phonix syslvestries) Olive (Elaeocarpus floribundus) Palm tree (Borossus flabelliformis)
Medicinal Trees	Neem (Azarlira chlaindica) Arjun (Teominalia arjunna) Bohera (Terminalia belliricha) Horitoki (Terminalia spp.) Amloki(Terminialia sp.)
Fuel Trees	Epil–epil (Leucaena leucocephala) Raintree (Samania saman) Koroi(Albigia procera) Krishnochura (Delonix regia)
Medicinal Trees	Neem (Azarlira chlaindica) Bel (Aegle marmelos) Bohera (Terminalia belliricha)

All saplings shall be planted at least 2 m away from the new railway track.

3.6. Conclusion for Tree Inventory

Data analysis of inventoried trees and observed that most of the trees are native species and environment friendly. Total 3530 trees under 27 species will be removed during construction and triple number of saplings will be re-planted in another location. Native and ecologically sensitive species will be selected for afforestation. Fast growing variety, tall trees, perennial and evergreen with thick canopy cover, large leaf area index (LAI) and a high pollution attenuation factor (PAF) for effective dry deposition of particles and fibers will be selected for afforestation. Local species will be considered because of their high adaptive capability and birds will make nest easily.

3.7. Implementation Agreement

Department of Forest is generally responsible for plantation in public properties of Bangladesh. Usually, Department of Forest performs the task with the help or involvement of local communities especially proponent and PAPs, especially vulnerable poor and women, in the plant replacement programme. It was decided that BR will be responsible for the successful implementation of tree replacement programme with the help of Contractor and Consultant.

The tasks of the BR are as follows:

- Training of the local BR staff on tree maintenance;
- Preparation of the tree replacement programmes in accordance with this plan and get them approved by the Forest Department if necessary;
- Coordination of sapling procurement process of approved species prescribed above; and
- Supervision of nurseries for raising saplings.

Responsibility

It was decided that Contractor will be responsible for tree plantation in the areas designated by BR representative as prescribed above. The Contractor will be responsible for procure and raise saplings until they survive which will start from the 1st year of construction.

The Environmental Officer of BR/Engineer will be responsible for overall coordination with the FD, PAPs, and destitute women (if necessary), and supervision of the programme. It is recommended that BR should start dialogue with the Department of Forest if required for the tree replacement programme in the pre-construction stage, so that setting up of nurseries can be done in the early stages of the Project.

Budget and Payment Method

The budget for the proposed tree replacement programme is provided in Table 9. The budget also includes maintenance for first two years from the date of plantation to ensure that all planted saplings will survive and provision for an additional plantation. The budget also includes procurement and development of all facilities required to establish a nursery such as, collection of suitable soils, decomposing cow dung, procurement of fertilisers etc. The budget also includes measure required for maintenance of plantation, such as watering, weeding, fertiliser application, replacing of dead saplings (if any) etc. for first two years. Table 9 shows the total estimated budget for tree replacement cost that is USD 100,000.

Table 9 Cost Estimates for the Tree replacement Plan

Tree Replacement Area	Unit	Rate (USD)	Quantity	Amount (USD)
Slope of the embankment Stations area and Cultural/sensitive areas	No.	3.50	12,000	42,000
Labor Cost	LS			18,000
Miscellaneous	LS			20,000
Maintenance Cost	LS			20,000
Total				**100,000**

Contractor will be paid for the tree replacement programme after survival of each sapling at a rate mentioned in Table 9.

Appendix-10: Information Disclosure Meeting (IDM)

1. Introduction

While concerns about environmental protection have increasingly become high profile issue around the world, stakeholder demands for corporate environmental information disclosure are increasing in the recent years. This refers to disclose their information on activities relating to the natural environment, social environment, ecosystem, environmental protection and use of resource. The information disclosure has several roles:

(1) To assess social and environmental impacts of corporate activities

(2) To measure the effectiveness of corporate social and environmental programs

(3) To report corporate social and environmental responsibilities, and

(4) To allow external and internal information systems for comprehensive assessment of sustainability impacts for all corporate resources.

Governments around the world are beginning to embrace a new form of environmental regulations on mandatory disclosure of information. The Government of Bangladesh (GoB) has also adapted the policy of Information Disclosure before any large-scale project. The construction of Bangabandhu Railway Bridge implemented by Bangladesh Railway funded by JICA is one of the largest projects in Bangladesh that requires public Information disclosure, by both GoB and JICA policy.

The JICA Guidelines for Environmental and Social Considerations (2010) states: "Democratic decision-making is indispensable for environmental and social considerations. It is important to ensure stakeholder participation, information transparency, accountability, and efficiency, in addition to respect for human rights, in order to conduct an appropriate decision-making process. In this context, with respect to human rights and in view of the principles of democratic governance, the measures for environmental and social considerations are implemented by ensuring a wide range of "meaningful stakeholder" participation and transparency of decision-making, as well as by working for information disclosure and by ensuring efficiency. Governments bear the responsibility for accountability, but at the same time stakeholders are responsible for their comments."

2. Information Disclosure (JICA policy)

According to JICA (2010):

1. In principle, project proponents (here Bangladesh Railway, GoB) will disclose information about the environmental and social considerations of their projects. JICA assists project proponents etc. by implementing cooperation projects as needed.
2. JICA itself discloses important information about environmental and social considerations at the main stages of cooperation projects, in a manner in accordance with the guidelines.
3. JICA discusses frameworks with project proponents etc. in order to ensure information disclosure, and comes to an agreement in an early stage of cooperation projects.
4. The information to be disclosed includes that of environmental and social considerations and of the cooperation projects by themselves.
5. Besides the information to be disclosed publicly by JICA, JICA provides information about environmental and social considerations to third parties to the extent possible in response to requests.
6. JICA encourages project proponent (here Bangladesh Railway, GoB) to disclose and present information about environmental and social considerations to local stakeholders.
7. Project proponents etc. disclose information well in advance when they have meetings with local stakeholders in cooperation with JICA. On these occasions, JICA supports project proponents etc. in the preparation of documents in an official or widely used language and in a form understandable by local people.
8. JICA discloses information on its website in Japanese, English, and/or local languages, and provides related reports for public reading at its library and at related overseas offices.
9. JICA pays due consideration to the confidentiality of the commercial and other matters of Project proponents etc., taking into account their competitive relationships, and encourages them to exclude such confidential information from any documents on environmental considerations that they submit which may later be subject to public disclosure. JICA takes into account information control in Project proponents etc. and discloses their documents subject to their approval. Any information that is prohibited from public disclosure in the agreement between JICA and Project proponents etc. may be disclosed only through the agreement of Project proponents etc. or in accordance with legal requirements.

3. The meetings

Two Information Disclosure Meetings were organized on 17 August 2017 at Bhuapur Upazila, Tangail District and Sirajganj Sadar Upazila, Sirajganj District. The meetings were moderated by Dr. Ravi Shankar (International Environmental Specialist) and key note presentation was presented by Dr. Tajul Islam (Environmental Specialist). The advertisement for Information disclosure has been published by local newspaper (annexure 10).

4. Objectives

The specific objectives of this report to:

- Summarize public opinion to environmental survey information disclosed
- Inform local people and stakeholders about the project and its impact on environment

5. Overview of the meetings

5.1 Sirajganj Upazila Complex

The meeting started on 11:00 AM in the morning. Dr. Ravi Shankar opened the session with introductory speech. He introduced the project parts and components to the participants. Later Dr. Tajul Islam gave the presentation on environmental survey conducted earlier and informed about the possible environmental impacts of the project. Dr. Tajul was followed by the Upazila Engineer, Upazila Agricultural Officer, Upazila Fisheries officer, Upazila vice Chairman, Upazila chairman and the Upazila Nirbahi Officer (UNO). The meeting ended around 12:30 PM.

5.2 Bhuapur Upazila complex

The meeting started on 3:00 PM in the afternoon with Dr. Ravi Shankar addressing the participants. He gave an overview of the project to the participants. He also gave an overview of the construction process and related environmental mechanisms in the project site. Then Dr. Tajul Islam, Environmental Expert from DDC gave his presentation on the possible environmental impacts that are found from study in the area. He also discussed about what type of public opinion has been found over the environmental survey and the possible benefits of the railway construction project and history of the existing Bangabandhu Bridge Construction Project.

Dr. Tajul was followed by the Upazila Engineer, who gave an interesting analysis of the current flow pattern of the Jamuna River. He was followed by Upazila Agriculture Officer,

who was concerned about the incentives (if any) given to the local farmers. Upazila Fisheries officer discussed about the current trend of fisheries loss in river Jamuna. The Upazila Vice Chairman Mr. Banerjee followed by the UNO who emphasized on conducting information disclosure meeting at district level. The Upazila chairman was the last participant to share opinion and comments. He gave vote of thanks to all participants. Dr. Tajul Islam, around 4:25 PM started the closing presentation and ended around 4:45 PM giving a summary of what has been discussed in the meeting.

6. Questions and Discussions

The meetings were moderated by Dr. Tajul Islam. The following questions and discussions took place in the meeting:

6.1 Sirajganj Upazila Complex

Table 1 Questions and responses during Information Disclosure Meeting at Sirajganj Upazila Complex

SL	Name of the Person	Question/ Comment	Response
1	Dr. Ravi Shankar	• Introduction to the project • Brief discussions about project construction plans • Brief discussion about the local environment	
2	Dr. Tajul Islam	• Described the previous history behind construction of the existing bridge. • Necessity of Rail Bridge beside existing bridge. • Advantage of Railway Bridge in brief. • Briefing about pre-environmental impact assessment of bridge construction area within 5 km radius.	
3	Upazila Engineer	• Described present existing bridge from engineering point of view. • Described about two-layer flow of water in the Jamuna River. • Request to considering the pressure/load of transport during two Eids in constructing Railway Bridge. • Requested to conservation of Eco Park as bridge will go over Eco Park.	Dr. Tajul and Dr. Ravi Shankar responded that they will include this possibility as alternative option to current design in the EIA report
4	Upazila Agriculture Officer	• Query about giving incentive to the farmer of bridge construction area.	Dr. Tajul responded that they will raise this issue in the EIA report
5	Upazila Fisheries Officer	• Discussed about fisheries loss trends in Jamuna river	
6	Ashok Banerjee, Journalist, The Observer	• It is to be considered that the normal course of river will not change. • Sustainable construction and development suggested • The local people must be given privilege to	

SL	Name of the Person	Question/ Comment	Response
		appoint in the bridge construction work. • Meeting should be held with local journalists about the benefits and progression of construction work at any interval.	
7	Shamim Alam, Vice Chairman	• Described the effects of changing pathway of the Jamuna River. • Demanded for testing the effect of train movement over the bridge. • Demanded for conservation of environment during construction.	Dr. Islam responded that the recommendations of the EIA report will be considered during construction
8	Upazila Nirbahi Officer (UNO)	• Discussed that the pathway of the River Jamuna is very unpredictable. • Recommended to perform information disclosure meeting at district level • Demanded that cropping pattern must not change.	
9	Upazila Chairman	• Said that Jamuna Bridge is the result of Bangabandhu's dream and the widespread thought of the then minister of transportation	
10	Dr. Tajul Islam, DDC	• Concluding remarks • Summary of the public opinion	

6.2 Bhuapur Upazila Complex

Table 2 Questions and responses during Information Disclosure Meeting at Bhuapur Upazila Complex

SL	Name and Occupation	Comments	Response
1	Md. Saidul Islam Talukder, Chairman	• Suggested to provide signals in different points of railway line	
2	Abdul Matin Sarker, Chairman, Nikrail Union	• Wanted to know about incentives. • In Past Govt. decided to provide various facilities but it actually did not happen • Described problem associated with drainage system in Nikrail • Demanded to involve skilled and unskilled labor in Bangabandhu Rail Bridge Construction Project	
3	Moniruzzaman Monir, Chairman, 3 no. Gabsara Union	• Described the effect of changing pathways of river due to construction of the bridge. • Emphasized to keep in mind during construction that interrupted water due to pillar will create more problem • Demanded for more developmental work considering the condition of the upstream people. • Development of the fate of the people of Char region as well as demand for their rehabilitation	
4	Fishery Officer	• Comment to consider the changing pathways of the Jamuna river	
5	Ayob Ali Molla, Chairman, Anjuna Union	• Suggest to make guide dam • Demand for rule the river by dredging the river	
6	Jakir Hossain, Fishery Officer	• River dredging • Railway junction should be constructed • Suggest to establish Eco Park in both side of the bridge. • Use local Manpower	
7	UNO	• Describe advantages of Jamuna Bridge. • Railway Bridge should be constructed as early as possible as it is claim of time and people.	

SL	Name and Occupation	Comments	Response
		• Railway Bridge will change the whole economic pattern of this area.	
8	Vice- Chairman, Bhuapur Upazila	• Exclude the people who were appointed previously during the construction of Bangabandhu Bridge. He demanded to stop it.	
9	Upazila Fishery officer	• Advice to consider oil spill during construction project. • Advice to keep migratory road of Hilsha fish free from construction effect. • Worried about decrease the production of Hilsha fish. • Request to provide incentives to fisherman.	

Photographs for Information Disclosure Meeting at Sirajganj Upazila Complex

Photographs for Information Disclosure Meeting at Bhuapur Upazila Complex

Attendance List for Information Disclosure Meeting at Sirajganj Upazila Complex

Sirajganj

Bangabandhu Railway Bridge Construction Project

List of Participants for Information Disclosure Meeting

Address: Upazila Parishad Complex, Sirajganj Sadar, Sirajganj

Date: 17 August 2017 Time: 11.00 am

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
1	[redacted]				
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Personal Information is protected

Facilitated By: Moynul Hasan

Signature:

Organized by

Bangabandhu Railway Bridge Construction Project

List of Participants for Information Disclosure Meeting

Address Upazilla parishad Complex, Sirajganj Sadar, Sirajganj

Date 17 August 2017 Time 11.00 am

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
19	[redacted]				
20.					
21					
22					
23					
24					
25					

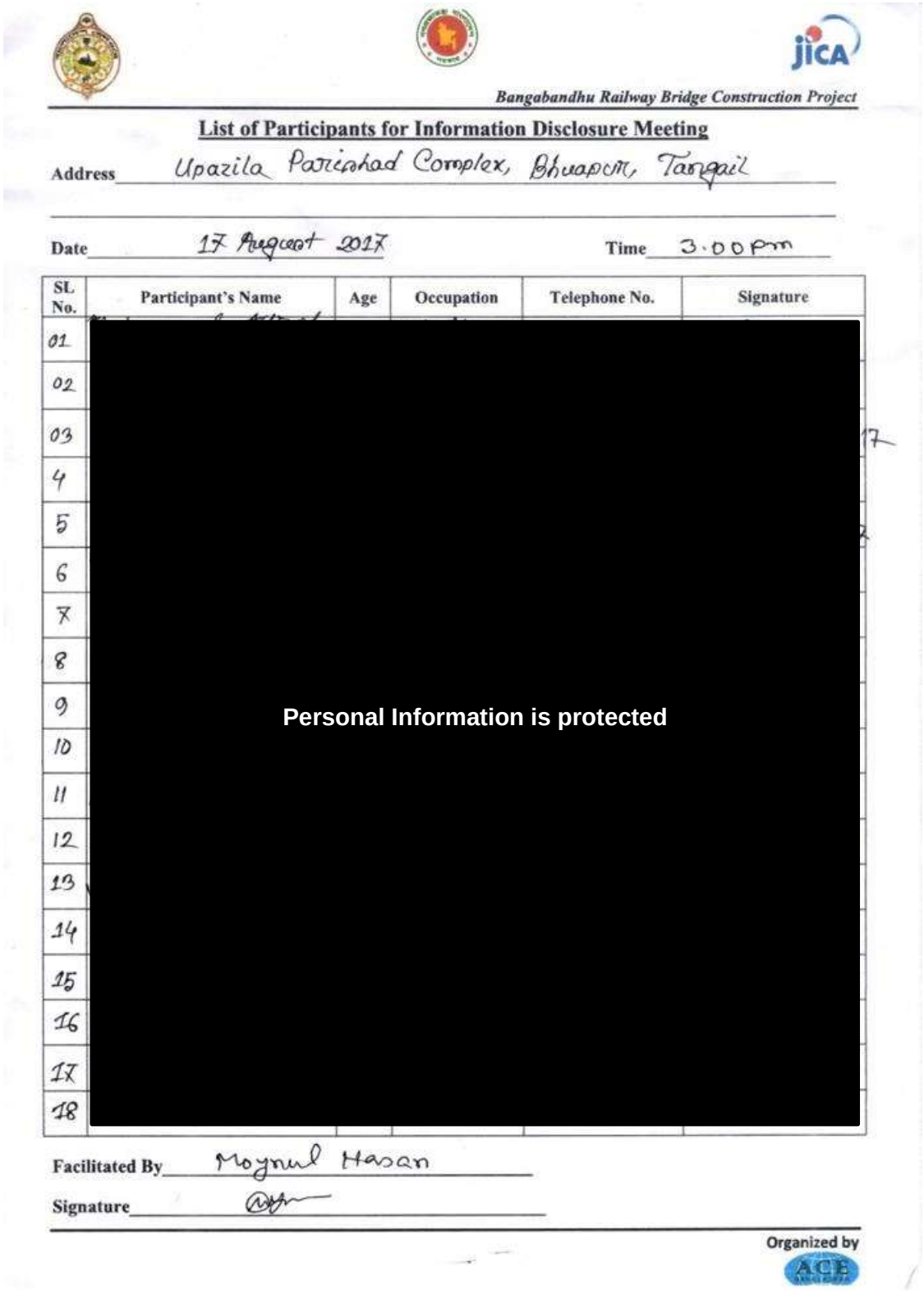
Personal Information is protected

Facilitated By Moynul Hasan

Signature

Organized by

Attendance List for Information Disclosure Meeting at Bhuapur Upazila Complex



Bangabandhu Railway Bridge Construction Project

List of Participants for Information Disclosure Meeting

Address: Upazila Parishad Complex, Bhuapur, Tangail

Date: 17 August 2017 Time: 3.00 pm

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
01	[redacted]				
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Personal Information is protected

Facilitated By: Moynul Hasan

Signature:

Organized by ACE

Bangabandhu Railway Bridge Construction Project

List of Participants for Information Disclosure Meeting

Address Upazilla parishad Complex, Bhuapur, Tangail

Date 17 August 2017 Time 3.00 pm

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
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Personal Information is protected

Facilitated By Moynul Hasan

Signature

Organized by

IDM program published in the local papers

দৈনিক যুগের কথা
চেতনায় দেশপ্রেম
www.dailyjugerkatha.com

বৃহস্পতিবার সিরাজগঞ্জ সদর উপজেলা পরিষদ হল রুমে বঙ্গবন্ধু রেলওয়ে সেতু নির্মান প্রকল্প বাস্তবায়নে পরিবেশের প্রভাব সমীক্ষার উপর তথ্য উন্মোচন সভা অনুষ্ঠিত হয়। ছবি: যুগের কথা

বঙ্গবন্ধু রেলওয়ে সেতু নির্মান প্রকল্প বাস্তবায়নে পরিবেশের প্রভাব সমীক্ষার উপর তথ্য উন্মোচন সভা অনুষ্ঠিত

যুগের কথা প্রতিবেদক : বঙ্গবন্ধু রেলওয়ে সেতু নির্মান প্রকল্প বাস্তবায়নে পরিবেশের প্রভাব সমীক্ষার উপর তথ্য উন্মোচন সভা বৃহস্পতিবার সিরাজগঞ্জ সদর উপজেলা পরিষদ হল রুমে অনুষ্ঠিত হয়। সিরাজগঞ্জ সদর উপজেলা নির্বাহী অফিসার সরকার মোহাম্মদ রায়হান'র সভাপতিত্বে সভায় সদর উপজেলা চেয়ারম্যান মো. রিয়াজ উদ্দিন, ভাইস চেয়ারম্যান মো. শামীম আলম, বঙ্গবন্ধু রেলওয়ে সেতু নির্মান প্রকল্প'র কনসালটেন্স ড. রবিশংকর, পরিবেশ বিশেষজ্ঞ ড. তাজুল ইসলাম ও রেজন আকতার ফিরোজ, সদর উপজেলা প্রকৌশলী মো. বদরুজ্জোহা, উপজেলা মৎস্য ও কৃষি কর্মকর্তা সহ সংশ্লিষ্টরা উপস্থিত ছিলেন। সভায় জানানো হয় বঙ্গবন্ধু সেতুর তিনশত মিটার উত্তরে বঙ্গবন্ধু রেলওয়ে সেতু নির্মান করা হবে। উন্নয়ন সহযোগী সংস্থা জাপানের জাইকা সহযোগীতা করবে। এছাড়া প্রকল্পের পরামর্শক (৩য় পাতায় ৬ষ্ঠ কলামে দেখুন)

বঙ্গবন্ধু রেলওয়ে সেতু প্রতিষ্ঠান হলো জাপানের অরিয়েন্টা গ্লোবাল কোম্পানী লিমিটেড ও চোডি কোম্পানী লিমিটেড এবং বাংলাদেশের ডেভেলপমেন্ট ডিজাইন কনসালটেন্স লিমিটেড ও অ্যাসোসিয়েশন (এসিই) কনসালটেন্স লিমিটেড। বঙ্গবন্ধু রেলওয়ে সেতু নির্মান প্রকল্প বাস্তবায়নে পরিবেশে, মাটি ও পানি পরীক্ষা সহ যাবতীয় পরীক্ষা ইতোমধ্যে শেষ করা হয়েছে। সংশ্লিষ্ট বিষয়ে দেশের বিশেষজ্ঞদের পরামর্শ নেয়া হয়েছে। বর্তমানে বঙ্গবন্ধু সেতুর উপর দিয়ে রেল ধীর গতিতে চালাতে হয় এতে করে সময় নষ্ট হয়। যার কারনে সরকার বঙ্গবন্ধু রেলসেতু নির্মানের পরিকল্পনা নিয়েছেন। এছাড়া সভায় আরো জানানো হয় ৬.২ কিলোমিটার রেলওয়ে এ্যপ্রোজ সহ মূল সেতু হবে ৪.৮কিলোমিটার দৈর্ঘের। সেতুটি নির্মান করতে ব্যয় ধরা হয়েছে নয় হাজার ৯৭৩ কোটি টাকা। ২০১৯ সালের পহেলা জানুয়ারী সেতু নির্মানের কাজ শুরু হবে এবং ২০২৩ সালের ৩১ ডিসেম্বর এর কাজ শেষ হবে। ডুয়েল গেজ সেতুটি নির্মান হলে উত্তরাঞ্চল সহ দেশের যোগাযোগ ব্যবস্থায় আমুল পরিবর্তন আসবে। কর্মসংস্থান সৃষ্টি সহ পাঁচকোটি মানুষ এর সুবিধা পাবে।

দৈনিক যমুনা প্রবাহ

পরিবেশের প্রভাব সমীক্ষার উপর তথ্য উন্মোচন সভা অনুষ্ঠিত

■ স্টাফ রিপোর্টার

বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প বাস্তবায়নে পরিবেশের প্রভাব সমীক্ষার উপর তথ্য উন্মোচন সভা বৃহস্পতিবার সিরাজগঞ্জ সদর উপজেলা পরিষদ হল রুমে অনুষ্ঠিত হয়।

সিরাজগঞ্জ সদর উপজেলা নির্বাহী অফিসার সরকার মোহাম্মদ রায়হানের সভাপতিত্বে সভায় সদর উপজেলা চেয়ারম্যান মো. রিয়াজ উদ্দিন, ভাইস চেয়ারম্যান মো. শামীম আলম, বঙ্গবন্ধু রেলওয়ে সেতু নির্মান প্রকল্পর কনসালটেন্স ড. রবি শংকর, পরিবেশ বিশেষজ্ঞ (২য় পাতায় দেখুন)

ড. তাজুল ইসলাম ও রেজন আকতার ফিরোজ, সদর উপজেলা প্রকৌশলী মো. বদরুজ্জোহা, উপজেলা মৎস্য ও কৃষি কর্মকর্তা সহ সংশ্লিষ্টরা উপস্থিত ছিলেন।

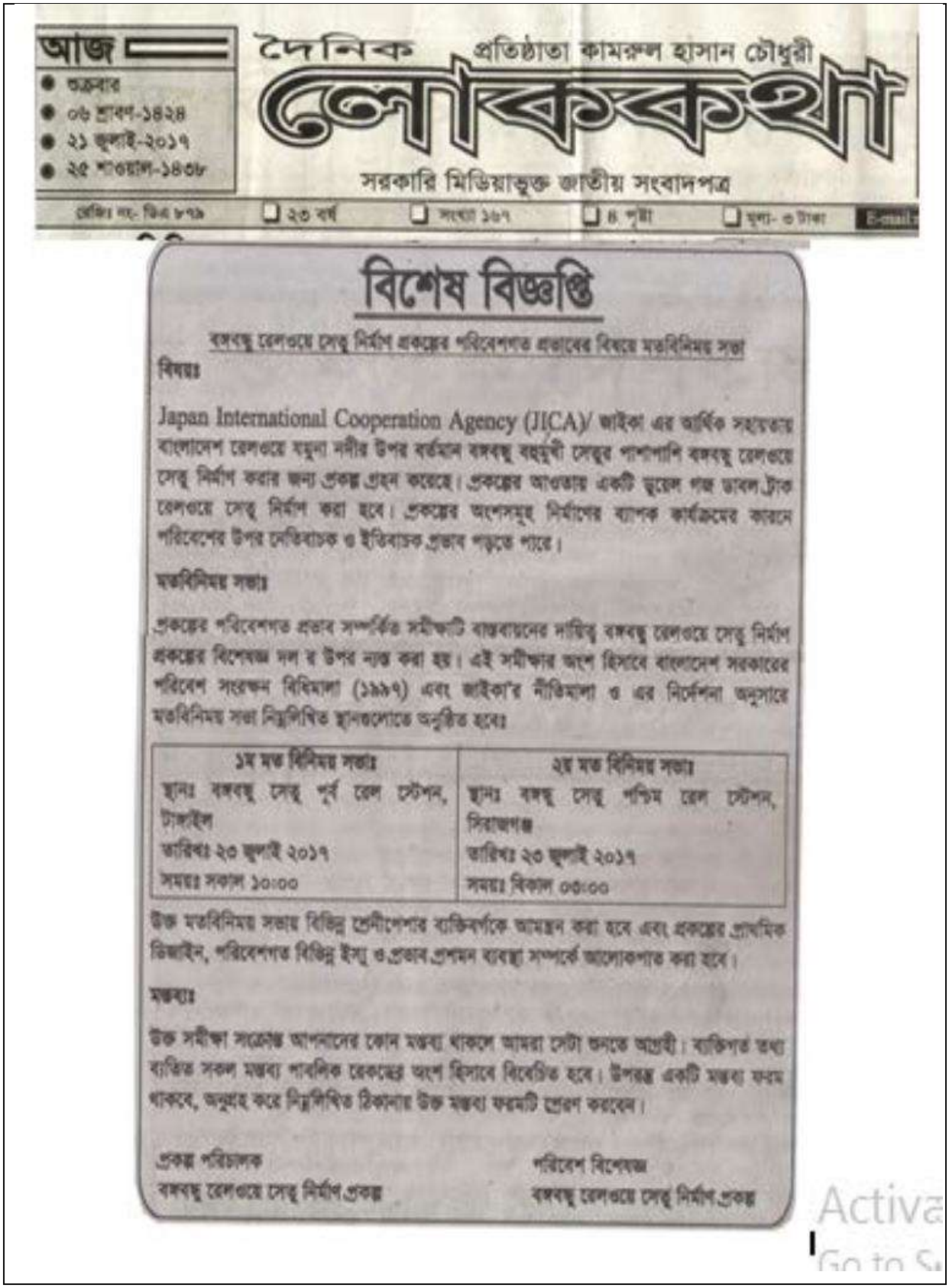
সভায় জানানো হয় বঙ্গবন্ধু সেতুর তিনশত মিটার উত্তরে বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ করা হবে। উন্নয়ন সহযোগি সংস্থা জাপানের জাইকা সহযোগীতা করবে। এছাড়া প্রকল্পের পরামর্শক প্রতিষ্ঠান হলো জাপানের অরিয়েন্টা গ্লোবাল কোম্পানী লিমিটেড ও চোডি কোম্পানী লিমিটেড এবং বাংলাদেশের ডেভেলপমেন্ট ডিজাইন কনসালটেন্স লিমিটেড ও অ্যাসোসিয়েশন (এসিই) কনসালটেন্স লিমিটেড।

বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প বাস্তবায়নে পরিবেশে, মাটি ও পানি পরীক্ষা সহ যাবতীয় পরীক্ষা ইতোমধ্যে শেষ করা হয়েছে। সংশ্লিষ্ট বিষয়ে দেশের বিশেষজ্ঞদের পরামর্শ নেয়া হয়েছে। বর্তমানে বঙ্গবন্ধু সেতুর উপর দিয়ে রেল ধীর গতিতে চালাতে হয় এতে করে সময় নষ্ট হয়। যার কারনে সরকার বঙ্গবন্ধু রেলসেতু নির্মানের পরিকল্পনা নিয়েছেন।

এছাড়া সভায় আরো জানানো হয় ৬.২ কিলোমিটার রেলওয়ে এ্যাপ্রোজ সহ মুল সেতু হবে ৪.৮কিলোমিটার দৈর্ঘের।

সেতুটি নির্মাণ করতে ব্যয় ধরা হয়েছে নয় হাজার ৯৭৩ কোটি টাকা। ২০১৯ সালের পহেলা জানুয়ারী সেতু নির্মানের কাজ শুরু হবে এবং ২০২৩ সালের ৩১ ডিসেম্বর এর কাজ শেষ হবে। ডুয়েল গেজ সেতুটি নির্মাণ হলে উত্তরাঞ্চল সহ দেশের যোগাযোগ ব্যবস্থায় আমুল পরিবর্তন আসবে। কর্মসংস্থান সৃষ্টি সহ পাঁচকোটি মানুষ এর সুবিধা পাবে।

Newspaper Advertisement at Tangail and Sirajganj district for Public Consultation



আজ
- শুক্রবার
- ০৬ শ্রাবণ-১৪২৪
- ২১ জুলাই-২০১৭
- ২৫ শাওয়াল-১৪৩৮

দৈনিক লোককথা

প্রতিষ্ঠাতা কামরুল হাসান চৌধুরী

সরকারি মিডিয়াভুক্ত জাতীয় সংবাদপত্র

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বিশেষ বিজ্ঞপ্তি

বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্পের পরিবেশগত প্রভাবের বিষয়ে মতবিনিময় সভা

বিষয়ঃ

Japan International Cooperation Agency (JICA)/ জাইকা এর আর্থিক সহায়তায় বাংলাদেশ রেলওয়ে যমুনা নদীর উপর বর্তমান বঙ্গবন্ধু বহুমুখী সেতুর পাশাপাশি বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ করার জন্য প্রকল্প গ্রহণ করেছে। প্রকল্পের আওতায় একটি ডুয়েল গজ ডাবল ট্রাক রেলওয়ে সেতু নির্মাণ করা হবে। প্রকল্পের অংশসমূহ নির্মাণের ব্যাপক কার্যক্রমের কারনে পরিবেশের উপর নেতিবাচক ও ইতিবাচক প্রভাব পড়তে পারে।

মতবিনিময় সভাঃ

প্রকল্পের পরিবেশগত প্রভাব সম্পর্কিত সমীক্ষাটি বাস্তবায়নের দায়িত্ব বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্পের বিশেষজ্ঞ দল ব উপর ন্যস্ত করা হয়। এই সমীক্ষার অংশ হিসাবে বাংলাদেশ সরকারের পরিবেশ সংরক্ষন বিধিমালা (১৯৯৭) এবং জাইকা'র নীতিমালা ও এর নির্দেশনা অনুসারে মতবিনিময় সভা নিম্নলিখিত স্থানগুলোতে অনুষ্ঠিত হবেঃ

১ম মত বিনিময় সভাঃ	২য় মত বিনিময় সভাঃ
স্থানঃ বঙ্গবন্ধু সেতু পূর্ব রেল স্টেশন, টাঙ্গাইল	স্থানঃ বঙ্গবন্ধু সেতু পশ্চিম রেল স্টেশন, সিরাজগঞ্জ
তারিখঃ ২৩ জুলাই ২০১৭	তারিখঃ ২৩ জুলাই ২০১৭
সময়ঃ সকাল ১০:০০	সময়ঃ বিকাল ০৩:০০

উক্ত মতবিনিময় সভায় বিভিন্ন শ্রেণীপেশার ব্যক্তিবর্গকে আমন্ত্রন করা হবে এবং প্রকল্পের প্রাথমিক ডিজাইন, পরিবেশগত বিভিন্ন ইস্যু ও প্রভাব প্রশমন ব্যবস্থা সম্পর্কে আলোকপাত করা হবে।

মন্তব্যঃ

উক্ত সমীক্ষা সংক্রান্ত আপনাদের কোন মন্তব্য থাকলে আমরা সেটা শুনতে আগ্রহী। ব্যক্তিগত তথ্য ব্যতিত সকল মন্তব্য পাবলিক রেকর্ডের অংশ হিসাবে বিবেচিত হবে। উপরন্তু একটি মন্তব্য ফরম থাকবে, অনুগ্রহ করে নিম্নলিখিত ঠিকানায় উক্ত মন্তব্য ফরমটি প্রেরণ করবেন।

প্রকল্প পরিচালক
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প

পরিবেশ বিশেষজ্ঞ
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প

দৈনিক

চেতনায় দেশপ্রেম

যুগের কথা

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বিশেষ বিজ্ঞপ্তি

বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্পের পরিবেশগত প্রভাবের বিষয়ে মতবিনিময় সভা

বিষয়ঃ

Japan International Cooperation Agency (JICA)/ জাইকা এর আর্থিক সহায়তায় বাংলাদেশ রেলওয়ে যমুনা নদীর উপর বর্তমান বঙ্গবন্ধু বহুমুখী সেতুর পাশাপাশি বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ করার জন্য প্রকল্প গ্রহণ করেছে। প্রকল্পের আওতায় একটি ডুয়েল গজ ডাবল ট্রাক রেলওয়ে সেতু নির্মাণ করা হবে। প্রকল্পের অংশসমূহ নির্মাণের ব্যাপক কার্যক্রমের কারণে পরিবেশের উপর নেতিবাচক ও ইতিবাচক প্রভাব পড়তে পারে।

মতবিনিময় সভাঃ

প্রকল্পের পরিবেশগত প্রভাব সম্পর্কিত সমীক্ষাটি বাস্তবায়নের দায়িত্ব বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্পের বিশেষজ্ঞ দল এর উপর ন্যস্ত করা হয়। এই সমীক্ষার অংশ হিসাবে বাংলাদেশ সরকারের পরিবেশ সংরক্ষণ বিধিমালা (১৯৯৭) এবং জাইকা'র গাইডলাইন ও এর নির্দেশনা অনুসারে মতবিনিময় সভা নিম্নলিখিত স্থানগুলোতে অনুষ্ঠিত হবেঃ

১ম মত বিনিময় সভাঃ	২য় মত বিনিময় সভাঃ
স্থানঃ বঙ্গবন্ধু সেতু পূর্ব রেল স্টেশন, টাঙ্গাইল	স্থানঃ বঙ্গবন্ধু সেতু পশ্চিম রেল স্টেশন, সিরাজগঞ্জ
তারিখঃ ২৩ জুলাই ২০১৭	তারিখঃ ২৩ জুলাই ২০১৭
সময়ঃ সকাল ১০:০০	সময়ঃ বিকাল ০৩:০০

উক্ত মতবিনিময় সভায় বিভিন্ন শ্রেণীপেশার ব্যক্তিবর্গকে আমন্ত্রণ করা হবে এবং প্রকল্পের প্রাথমিক ডিজাইন, পরিবেশগত বিভিন্ন ইস্যু ও প্রভাব প্রশমন ব্যবস্থা সম্পর্কে আলোকপাত করা হবে।

মন্তব্যঃ

উক্ত সমীক্ষা সংক্রান্ত আপনাদের কোন মন্তব্য থাকলে আমরা সেটা শুনতে আগ্রহী। ব্যক্তিগত তথ্য ব্যতিত সকল মন্তব্য পাবলিক রেকর্ডের অংশ হিসাবে বিবেচিত হবে। উপরন্তু একটি মন্তব্য ফরম থাকবে, অনুগ্রহ করে নিম্নলিখিত ঠিকানায় উক্ত মন্তব্য ফরমটি প্রেরণ করবেন।

প্রকল্প পরিচালক
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প

পরিবেশ বিশেষজ্ঞ
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প

Appendix-11: NOC from Local Authorities

S/N	Name of Institutes	Status
1	NOC From BBA (Bangladesh Bridge Authority)	Obtained
2	NOC from Bhuapur Upazila Nirbahai Officer	Obtained
3	NOC from Nikrail Union Parishad Chairman	Obtained
4	NOC from Soidabad Union Parishad Chairman	Obtained
5	NOC from Forest Department- by CCF	Obtained
6	NOC from Forest Department – by DFO Pabna	Obtained
7	NOC from BWDB (Bangladesh Water Development Board)	Obtained
8	NOC from BIWTA (Bangladesh Inland Water Transport Authority)	Obtained
9	NOC from Land Acquisition Officer under Sirajganj District	Obtained

1. NOC From BBA (Bangladesh Bridge Authority)

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সড়ক পরিবহণ ও সেতু মন্ত্রণালয়
সেতু বিভাগ
বাংলাদেশ সেতু কর্তৃপক্ষ
সেতু ভবন, নিউ এয়ারপোর্ট রোড
বনানী, ঢাকা-১২১২।

স্মারক নং: ৫০.০০.০০০০.১৪৬.০০.০৯০.১৪- ৬৭৪ তারিখ: ০১/০৮/২০১৭

প্রকল্প পরিচালক
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প
প্রকল্প পরিচালক এর কার্যালয়
বাংলাদেশ রেলওয়ে, রেলওয়ে ভবন, ঢাকা।

বিষয়: "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প" এর অবস্থাগত, কারিগরি ও পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্র প্রদান প্রসঙ্গে।

সূত্র- আপনার দপ্তরের পত্র নং- ৫৪.০১.০০০০.৬৩০.১৪.০২৫.১৭-২৩৮, তারিখ : ১৭/০৭/২০১৭।

উপর্যুক্ত বিষয় ও সূত্রোস্থ পত্রের প্রেক্ষিতে বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প নির্মাণের লক্ষ্যে বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ এবং পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ অনুসরণ পূর্বক প্রয়োজনীয় কার্যাদি সম্পন্নের জন্য বাংলাদেশ সেতু কর্তৃপক্ষের অনাপত্তি প্রদান করা হলো।

কেবির আহমেদ
প্রধান প্রকৌশলী
ফোন: ৫৫০৪০০১৩
Email: dir-tech@bba.gov.bd

অনুলিপি:

১। মহাপরিচালক, বাংলাদেশ রেলওয়ে, রেল ভবন, ঢাকা।
২। সচিব/নির্বাহী পরিচালক মহোদয়ের একান্ত সচিব, সেতু বিভাগ/বাসেক, ঢাকা।
৩। নির্বাহী প্রকৌশলী (সড়ক ও সেতু), বাসেক, ঢাকা।
৪। মোঃ ওয়াশিম আলী, সহকারী প্রকৌশলী (নদীশাসন), বাসেক সাইট অফিস, ভুয়াপুর, টাঙ্গাইল।

2. NOC from Bhuapur Upazila Nirbahai Officer

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
উপজেলা নির্বাহী অফিসারের কার্যালয়
ভূঞাপুর, টাঙ্গাইল।
www.bhuapur.tangail.gov.bd

স্মারক নং-০৫.৩০.৯৩১৯.০০০.৩৫১৪-২০১৬-৫৯৩ তারিখঃ ২২-০৮-২০১৭ খ্রিঃ।

"অনাপত্তিপত্র"

প্রত্যয়ক করা যাচ্ছে যে, "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প" কারিগরি ও পরিবেশ বিপর্যয় না ঘটিয়ে বাস্তবায়িত হলে স্থানীয় প্রশাসনের কোন আপত্তি নাই। রেল সেতু নির্মাণ হলে সমগ্র বাংলাদেশের সাথে দেশের উত্তরাঞ্চলের যোগাযোগ আরও সহজতর হবে। "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প" বাস্তবায়িত হলে তা বাংলাদেশের যোগাযোগ ব্যবস্থার ক্ষেত্রে এক ঐতিহাসিক মাইল ফলক স্থাপন করবে। আমি দ্রুত এর বাস্তবায়ন কামনা করছি।

22/8/17
(মুহাম্মদ আশরাফ হোসেন)
উপজেলা নির্বাহী অফিসার
ভূঞাপুর, টাঙ্গাইল।
email: unobhuapur@mopa.gov.bd
টেলিফোন-০৯২২৩৫৬১০১

প্রকল্প পরিচালক
বিআরবিসি প্রজেক্ট, বাংলাদেশ রেলওয়ে,
রেল ভবন, ১৬ আব্দুল গনি রোড,
ঢাকা-১০০০।

3. NOC from Nikrail Union Parishad Chairman

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

৬নং নিকরাইল ইউনিয়ন পরিষদ

স্থানীয় সরকার মন্ত্রণালয় মোবাইলঃ০১৭১২-৭২১৯৭৫

ডাকঘর-নিকরাইল, উপজেলা-ভূঞাপুর. জেলা- টাঙ্গাইল।

WEB:http://nikrailup.tangail.gov.bd Email: nikrail.tangail@yahoo.com

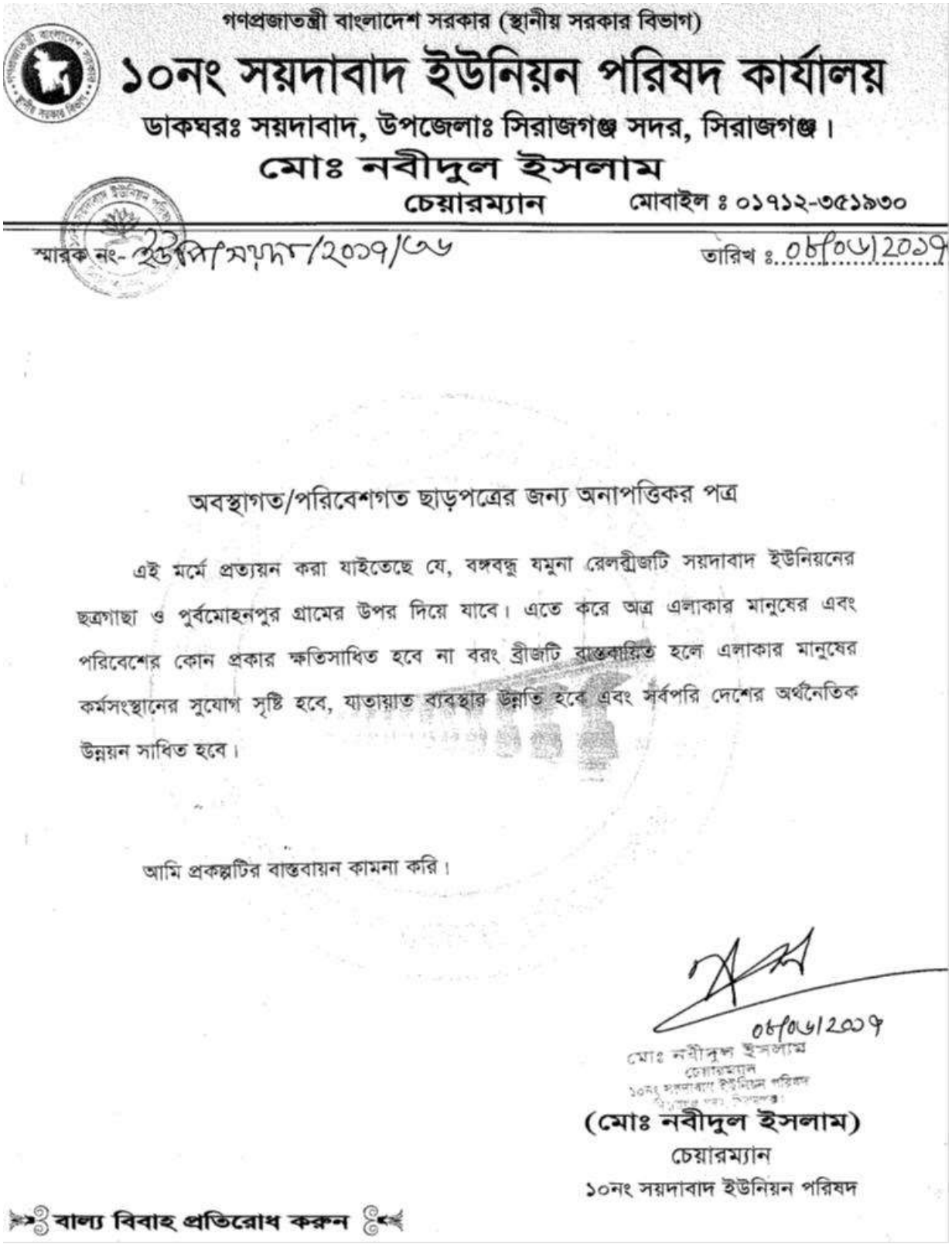
স্মারক নং তারিখঃ ০৮-০৬-২০১৭ ইং

অবস্থানগত /পরিবেশগত ছাড়পত্রের জন্য অনাপত্তি

এই মর্মে প্রত্যয়ন করা যাইতেছে যে, বঙ্গবন্ধু যমুনারেল ব্রিজটি নিকরাইল ইউনিয়নের সারপলশিয়া গ্রামের উপর দিয়ে যাবে। এতে করে অত্র এলাকার মানুষের এবং পরিবেশের কোন ক্ষতি সাধিত হবেনা। বরং ব্রিজটি বাস্তায়িত হলে এলাকার মানুষের কর্মসংস্থানের সুযোগ সৃষ্টি হবে, যাতায়াত ব্যবস্থার উন্নতি ঘটবে এবং দেশের অর্থনৈতিক উন্নয়ন সাধিত হবে ।

মুহাম্মদ আব্দুল মতিন সরকার
চেয়ারম্যান
৬নং নিকরাইল ইউনিয়ন পরিষদ
ভূঞাপুর, টাঙ্গাইল ।

4. NOC from Soidabad Union Parishad Chairman



গণপ্রজাতন্ত্রী বাংলাদেশ সরকার (স্থানীয় সরকার বিভাগ)

১০নং সয়দাবাদ ইউনিয়ন পরিষদ কার্যালয়

ডাকঘরঃ সয়দাবাদ, উপজেলাঃ সিরাজগঞ্জ সদর, সিরাজগঞ্জ।

মোঃ নবীদুল ইসলাম

চেয়ারম্যান মোবাইল ঃ ০১৭১২-৩৫১৯৩০

স্মারক নং- ইউপি/সয়দা/২০১৭/৩৬ তারিখ ঃ ০৮/০৬/২০১৭

অবস্থাগত/পরিবেশগত ছাড়পত্রের জন্য অনাপত্তিকর পত্র

এই মর্মে প্রত্যয়ন করা যাইতেছে যে, বঙ্গবন্ধু যমুনা রেলব্রীজটি সয়দাবাদ ইউনিয়নের ছত্রগাছা ও পুর্বমোহনপুর গ্রামের উপর দিয়ে যাবে। এতে করে অত্র এলাকার মানুষের এবং পরিবেশের কোন প্রকার ক্ষতিসাধিত হবে না বরং ব্রীজটি বাস্তবায়িত হলে এলাকার মানুষের কর্মসংস্থানের সুযোগ সৃষ্টি হবে, যাতায়াত ব্যবস্থার উন্নতি হবে এবং সর্বপরি দেশের অর্থনৈতিক উন্নয়ন সাধিত হবে।

আমি প্রকল্পটির বাস্তবায়ন কামনা করি।

০৮/০৬/২০১৭

মোঃ নবীদুল ইসলাম
চেয়ারম্যান
১০নং সয়দাবাদ ইউনিয়ন পরিষদ

(মোঃ নবীদুল ইসলাম)
চেয়ারম্যান
১০নং সয়দাবাদ ইউনিয়ন পরিষদ

বাল্য বিবাহ প্রতিরোধ করুন

5. OC from Forest Department by (CCF)

শেখ হাসিনার বাংলাদেশ
পরিচ্ছন্ন পরিবেশ।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
প্রধান বন সংরক্ষকের দপ্তর
বন অধিদপ্তর
বন ভবন, আগারগাঁও, শেরেবাংলানগর, ঢাকা-১২০৭।

পত্র নং-২২.০১.০০০০.০১১(প্রঃ).৪ডি-৯৬(পার্ট-২৭-৪).২০১৭. তারিখ- /০৮/২০১৭ইং

গ্রাপক ঃপ্রকল্প পরিচালক
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প
বাংলাদেশ রেলওয়ে,
রেলভবন, ঢাকা।

বিষয় ঃ 'বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প' এর অবস্থানগত, কারিগরি ও পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্র প্রদান প্রসংগে।

সূত্র ঃ আপনার পত্র নং-৫৪.০১.০০০০.৬৩০.১৪.০২৫.১৭.২৪০ তাং-১৭/০৭/২০১৭ইং।

উপর্যুক্ত বিষয় ও সূত্রোক্ত পত্রের প্রেক্ষিতে বিভাগীয় বন কর্মকর্তা, সামাজিক বন বিভাগ, পাবনা তার পত্র নং-২২.০১.০০০০.২৩৩.২৯.০৭৫.১৭.৮৮০ তাং-০১/০৮/২০১৭ইং মূলে পরিবেশ অধিদপ্তর হতে বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্পের অবস্থানগত, কারিগরি ও পরিবেশগত ছাড়পত্র গ্রহণের নিমিত্তে স্থানীয় কর্তৃপক্ষ হিসেবে অনাপত্তি প্রদান করেছেন (কপি সংযুক্ত)।

বিষয়টি আপনার অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য অবহিত করা হলো।

(মোহাম্মদ সফিউল আলম চৌধুরী)
প্রধান বন সংরক্ষক
বন অধিদপ্তর, বাংলাদেশ
ফোন ঃ ৮১৮১৭৩৭

পত্র নং-২২.০১.০০০০.০১১(প্রঃ).৪ডি-৯৬(পার্ট-২৭-৪).২০১৭. / ৫৫৪ তারিখ-২৮/০৮/২০১৭ইং

অনুলিপি জ্ঞাতার্থে ও কার্যার্থে ঃ-

১। বন সংরক্ষক, সামাজিক বন অঞ্চল, বগুড়া।
২। বিভাগীয় বন কর্মকর্তা, সামাজিক বন বিভাগ, পাবনা।

০/৫

(মোহাম্মদ সফিউল আলম চৌধুরী)
প্রধান বন সংরক্ষক
বন অধিদপ্তর, বাংলাদেশ।

D:\Saiful\Letter\March-2016.doc

৬৬৬

6. **NOC from Forest Department by (DFO Pabna)**

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
বন বিভাগীয় বন কর্মকর্তার কার্যালয়
সামাজিক বন বিভাগ
পাবনা।

পত্র নং-২২.০১.০০০০.২৩৩. ২৯.০৭৫.১৭/৮৮০ তারিখ:- ০১/০৮/২০১৭খ্রিঃ।

বিষয়: বঙ্গবন্ধু রেলওয়ে সেতু নির্মান শীর্ষক প্রকল্প এর অবস্থানগত কারিগরি ও পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্র প্রদান প্রসংগে ।

সূত্র : ১) আপনার পত্র নং ২২.০১.০০০০.০১১(প্রঃ).৪৬-২৮৬(পার্ট-১).২০১৭/৪৮৯ তারিখ ২৫/০৭/২০১৭খ্রিঃ।
২) প্রকল্প পরিচালক, বাংলাদেশ রেলওয়ে, রেলভবন,ঢাকার পত্র নং ৫৪.০১.০০০০.৬৩০.১৪.০২৫.১৭-২৪০ তারিখ ১৭/০৭/২০১৭ খ্রিঃ।

সম্মান সহকারে উপর্যুক্ত বিষয় ও সূত্রোক্ত পত্রের প্রেক্ষিতে জানানো যাচ্ছে যে, বঙ্গবন্ধু রেলওয়ে সেতু নির্মান শীর্ষক প্রকল্পের জন্য সম্ভাব্যতা,সমীক্ষা, বিস্তারিত জরীপ ও নকশা প্রনয়নসহ প্রকল্পের নির্মান কাজের জন্য সরকারী স্বার্থে প্রকল্পের অবস্থানগত, কারিগরি ও পরিবেশগত অনাপত্তির ছাড়পত্র দেয়া যেতে পারে। ইতোমধ্যে আপনার পত্র নং ২২.০১.০০০০.০১১.০১. ২৪৭.২০১৭/৩২৫ তারিখ ২৩/০৭/২০১৭ খ্রিঃ মূলে নির্দেশের প্রেক্ষিতে প্রকল্পের পরামর্শক প্রতিষ্ঠান প্রকল্প এলাকায় অবস্থিত ইকোপার্ক ও সামাজিক বন এলাকায় টপোগ্রাফিক এ্যালাইনমেন্ট সার্ভে, টেষ্ট বোরিং এবং প্রস্তাবিত সেতুর এপ্রোচ এ্যালাইনমেন্ট এর মধ্যে অবস্থিত গাছের তালিকা প্রনয়ন করার জন্য অনুমতি দেয়া হয়েছে (কপি সংযুক্ত)।

ইহা আপনার সদয় অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহনের জন্য জানানো হলো।

সংযুক্তি : বর্ণনামতে ০১ (এক) পাতা।

(মো: কবির হোসেন পাটোয়ারী)
বিভাগীয় বন কর্মকর্তা
সামাজিক বন বিভাগ,পাবনা।
ফোনঃ ০৭৩১-৬৫৬৭১ (অফিস)
ই- মেইল ঃ sfd.pabna@gmail.com

প্রাপক ঃ প্রধান বন সংরক্ষক
বাংলাদেশ ঢাকা।

দৃষ্টি আকর্ষন : সহকারী প্রধান বন সংরক্ষক, ব্যবস্থাপনা পরিকল্পনা ইউনিট
আগারগাঁও, ঢাকা।

পত্র নং-২২.০১.০০০০.২৩৩. ২৯.০৭৫.১৭- তারিখ:- ০১/০৮/২০১৭খ্রিঃ।

অনুলিপি সদয় অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহনের জন্য বন সংরক্ষক, সামাজিক বন অঞ্চল বগুড়ার নিকট প্রেরণ করা হলো।

(মো: কবির হোসেন পাটোয়ারী)
বিভাগীয় বন কর্মকর্তা
সামাজিক বন বিভাগ,পাবনা।

Hadi New Word Document 200

7.NOC from BWDB (Bangladesh Water Development Board)

বাংলাদেশ পানি উন্নয়ন বোর্ড

Bangladesh Water Development Board

প্রধান পরিকল্পনার দপ্তর
ওয়াপদা ভবন (৩য় তলা)
মতিঝিল বা/এ, ঢাকা ১০০০
ফোনঃ ৮৮-০২-৯৫৮৮৪৫৭
ফ্যাক্সঃ ৮৮-০২-৯৫৬৭২৮৯
ই-মেইলঃ cplanwdb@yahoo.com

Office of the Chief Planning
WAPDA Bhaban, (2nd Floor)
Motijheel C/A, Dhaka-1000
Phone: 88-02-9588457
Fax: 88-02-9567289
web: www.bwdb.gov.bd

স্মারক নং-চীফ প্ল্যানিং/ ৪০২

তারিখঃ ২২/০৬/২০১৭ খ্রিঃ।

প্রকল্প পরিচালক
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প
বাংলাদেশ রেলওয়ে
রেল ভবন, ঢাকা।

বিষয়: "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প"এর অবস্থানগত, কারিগরী ও পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তি প্রদান।

সূত্র: প্রকল্প পরিচালক এর পত্র সংখ্যা-৫৪.০১.০০০০.৬৩০.১৪.০২৫.১৭-২৬৯ তারিখ: ০৭-০৬-২০১৭ খ্রিঃ।

উপর্যুক্ত বিষয় ও সূত্র স্মারকের প্রেক্ষিতে পানি আইন ২০১৩ এর ধারা ২০ (সংযুক্তি-১), জাতীয় পানি নীতি ১৯৯৯ এর ৪.২ (ক)(২)ও (৩) (সংযুক্তি-২) এর শর্তাবলী এবং নিম্ন-বর্ণিত শর্ত-সাপেক্ষে "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প"এর অবস্থানগত, কারিগরী ও পরিবেশগত ছাড়পত্রের জন্য বাংলাদেশ পানি উন্নয়ন বোর্ড হতে অনাপত্তি প্রদান করা হলো।

- বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প বাস্তবায়নে নদীর প্রশস্ততা এমন পর্যায়ে পরিবর্তিত করা যাবেনা যাতে পানি/বন্যা প্রবাহ বাধাগ্রস্ত হয়, সেতুর উজান ও ভাটিতে নদীর মরফোলজি পরিবর্তিত হয়ে নদী তীরবর্তী বাপাউবো'র স্থাপনা যেমন বন্যা বাঁধ, নদী তীর সংরক্ষণমূলক কাজ ক্ষতিগ্রস্ত হয় এবং বন্যার সময় পানি সমতল বৃদ্ধির ফলে বাপাউবো কর্তৃক নির্মিত অবকাঠামো পুনর্বাসন করা প্রয়োজন হয়।

নির্দেশক্রমে,
(signature) 22-6-17
(এ. এম. আমিনুল হক)
প্রধান পরিকল্পনা (অঃদাঃ)
বাপাউবো, ঢাকা।

প্রকল্প পরিচালক/[illegible]	
• [illegible] • অতিঃ পিডি/প্রশাসন • অতিঃ পিএসসিই/[illegible] • ডিডি/সদর • ডিডি/রিসেটেলমেন্ট • পিই/ওয়ে এন্ড ওয়ার্কস • ডিডি/[illegible]	○ [illegible] ব্যবস্থা নিন ○ পরীক্ষা [illegible] করুন ○ [illegible] পত্র আবহিত করুন ○ [illegible] ব্যবস্থা নিন ○ [illegible] ○ আলোচনা করুন ○ নথিভুক্ত করুন
নম্বর : 226 তারিখ : 24/6/17 সময় :	স্বাক্ষর

(initials) 06-06-17

8. NOC from BIWTA (Bangladesh Inland Water Transport Authority)

Fax No. : 880-2-9551072
Grams : AUTHORITY
Phones : 9556151-55
9552039
9552027

বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষ
BANGLADESH INLAND WATER TRANSPORT AUTHORITY
প্রধান প্রকৌশলীর দপ্তর

বি.আই.ডব্লিউ.টি.এ ভবন
১৪১-১৪৩, মতিঝিল বাণিজ্যিক এলাকা
পোস্ট বক্স ৭৬, ঢাকা-১০০০
বাংলাদেশ

BIWTA BHABAN
141-143, MOTIJHEEL C/A,
POST BOX 76, DHAKA-1000
BANGLADESH

নথি নং-১৮.১১.০০.০০.২৬৭.৯৯.০১২.১৬/ ৯১৩ তারিখঃ ০১/০৭/২০১৭ খ্রীঃ।

প্রকল্প পরিচালক
বঙ্গবন্ধু রেলওয়ে ব্রীজ কনস্ট্রাকশান প্রজেক্ট
বাংলাদেশ রেলওয়ে, রেলভবন, ১৬ আব্দুল গণি রোড
ঢাকা-১০০০।

বিষয়ঃ Bangabandhu Railway Bridge Construction Project: confirmation of Horizontal and Vartical Clearance Requirement.

সূত্র ঃ বাংলাদেশ রেলওয়ের স্মারক নং-৫৪.০১.০০০০.৬৩০.১৯.০১৯.১৭-১৭৪, তারিখঃ ০৭/০৬/২০১৭খ্রিঃ।

উপর্যুক্ত বিষয় ও সূত্রস্থ স্মারকের প্রেক্ষিতে নির্দেশক্রমে জানানো যাচ্ছে যে, বিষয়ে বর্ণিত প্রস্তাবিত ব্রীজটির ক্ষেত্রে ভার্টিক্যাল ক্লিয়ারেন্স ষ্ট্যান্ডার্ড হাই-ওয়াটার লেভেল (SHWL) হতে ১২.২০ (বার দশমিক দুই শূন্য) মিটার এবং হরাইজন্টাল ক্লিয়ারেন্স ৭৬.২২ (ছিয়াত্তর দশমিক দুই দুই) মিটার রেখে ব্রীজটি নির্মাণে অত্র কর্তৃপক্ষের আপত্তি নাই। উল্লেখ্য যে, লেভেল নির্ধারণের সময় বিআইডব্লিউটিএ'র হাইড্রোগ্রাফি বিভাগের ১জন প্রতিনিধির উপস্থিতি নিশ্চিত করতে হবে।

ব্রীজটির কোন নির্দিষ্ট স্থানে সার্ভে অব বাংলাদেশ কর্তৃক স্থাপিত B.M হতে ল্যাভেলিং এর মাধ্যমে প্রাপ্ত মানসহ একটি বেঞ্চমার্ক স্থাপন এবং নৌ-যান চালকদের যাতে সহজে দৃষ্টিগোচর হয় এমন স্থানে ভার্টিক্যাল ক্লিয়ারেন্স লিখে রাখার ব্যবস্থা গ্রহণের জন্য অনুরোধ করা যাচ্ছে।

(আবু ছালেহ মোহাম্মদ এহছেশামুল পারভেজ)
সহকারী পরিচালক (প্রশাসন)

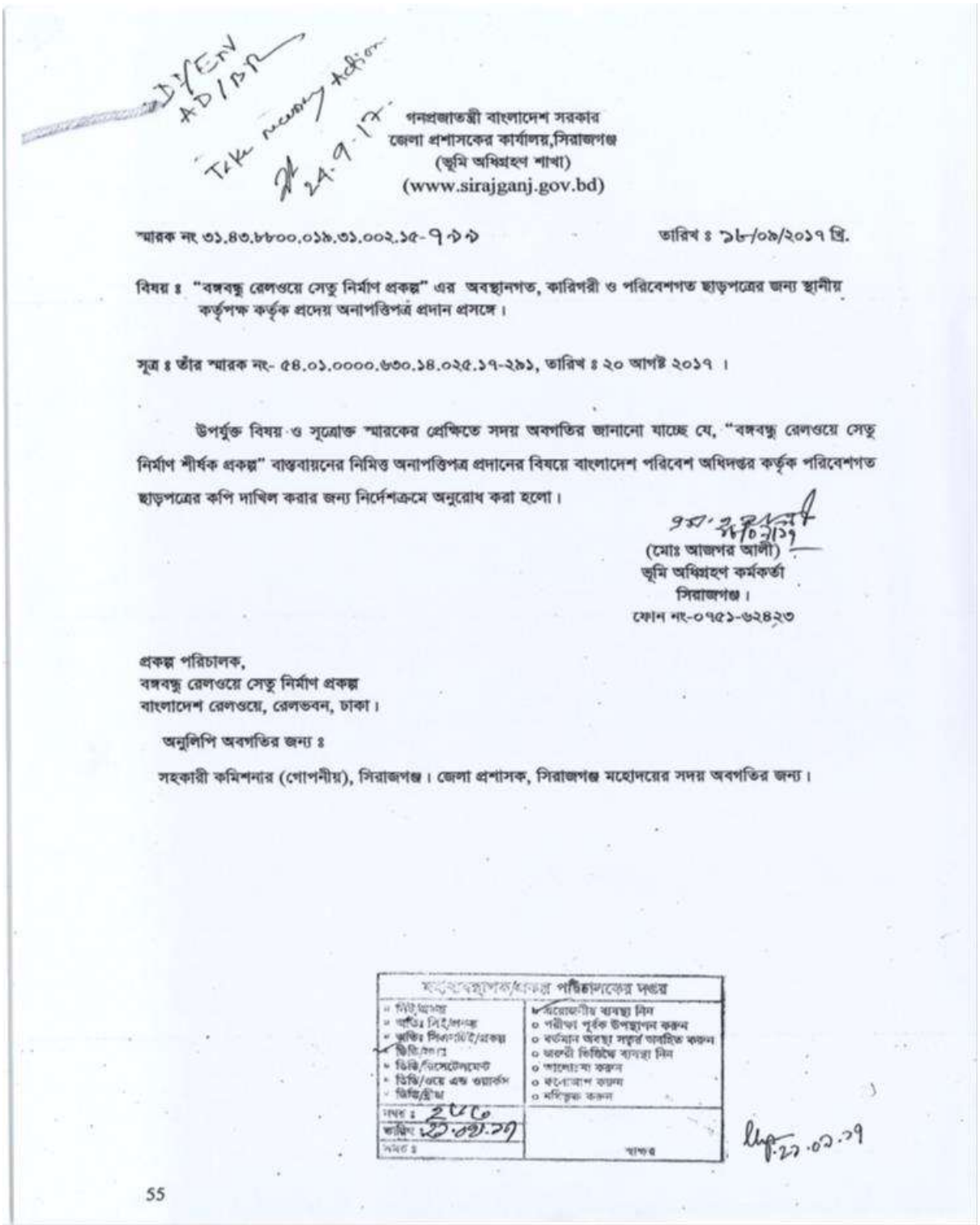
নথি নং-১৮.১১.০০.০০.২৬৭.৯৯.০১২.১৬/ তারিখঃ ...../০৭/২০১৭ খ্রীঃ।

অনুলিপিঃ
১। পরিচালক, নৌ-সংরক্ষণ ও পরিচালন বিভাগ, বাঅনৌপক, ঢাকা।
২। পরিচালক, হাইড্রোগ্রাফি বিভাগ, বাঅনৌপক, ঢাকা।
৩। প্রধান প্রকৌশলী, প্রকৌশল বিভাগ, বাঅনৌপক, ঢাকা।
৪। তত্ত্বাবধায়ক প্রকৌশলী, ঢাকা সার্কেল, বাঅনৌপক, ঢাকা।
৫। নির্বাহী প্রকৌশলী, সিরাজগঞ্জ ডিভিশন, বাঅনৌপক, সিরাজগঞ্জ।
৬। নথি।

মহাব্যবস্থাপক/প্রকল্প পরিচালকের দপ্তর	
• ডিই/প্রকল্প • অতিঃ ডিই/প্রকল্প • অতিঃ সিএসটিই/প্রকল্প • ডিডি/সদর • ডিডি/ডিসেন্টেলমেন্ট • ডিডি/ওয়ে এন্ড ওয়ার্কস • ডিডি/ব্রীজ	○ প্রয়োজনীয় ব্যবস্থা নিন ○ পরীক্ষা পূর্বক উপস্থাপন করুন ○ বর্তমান অবস্থা সচুর অবহিত করুন ○ আলাপী ভিত্তিতে ব্যবস্থা নিন ○ আলোচনা করুন ○ যোগাযোগ করুন ○ সংক্ষিপ্ত করুন
সদর ঃ তারিখ ঃ ০৯/৭/১৭ সময় ঃ	স্বাক্ষর

In favor the Consulta

9. NOC from Land Acquisition Officer under Sirajganj District



গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
জেলা প্রশাসকের কার্যালয়,সিরাজগঞ্জ
(ভূমি অধিগ্রহণ শাখা)
(www.sirajganj.gov.bd)

স্মারক নং ৩১.৪৩.৮৮০০.০১৯.৩১.০০২.১৫-৭৯৯ তারিখ ঃ ১৮/০৯/২০১৭ খ্রি.

বিষয় ঃ "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প" এর অবস্থানগত, কারিগরী ও পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্র প্রদান প্রসঙ্গে।

সূত্র ঃ তাঁর স্মারক নং- ৫৪.০১.০০০০.৬৩০.১৪.০২৫.১৭-২৯১, তারিখ ঃ ২০ আগষ্ট ২০১৭ ।

উপর্যুক্ত বিষয় ও সূত্রোক্ত স্মারকের প্রেক্ষিতে সদয় অবগতির জানানো যাচ্ছে যে, "বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ শীর্ষক প্রকল্প" বাস্তবায়নের নিমিত্ত অনাপত্তিপত্র প্রদানের বিষয়ে বাংলাদেশ পরিবেশ অধিদপ্তর কর্তৃক পরিবেশগত ছাড়পত্রের কপি দাখিল করার জন্য নির্দেশক্রমে অনুরোধ করা হলো।

(মোঃ আজগর আলী)
ভূমি অধিগ্রহণ কর্মকর্তা
সিরাজগঞ্জ।
ফোন নং-০৭৫১-৬২৪২৩

প্রকল্প পরিচালক,
বঙ্গবন্ধু রেলওয়ে সেতু নির্মাণ প্রকল্প
বাংলাদেশ রেলওয়ে, রেলভবন, ঢাকা।

অনুলিপি অবগতির জন্য ঃ

সহকারী কমিশনার (গোপনীয়), সিরাজগঞ্জ। জেলা প্রশাসক, সিরাজগঞ্জ মহোদয়ের সদয় অবগতির জন্য।

55

Appendix-12: Approved ToR of DoE

Annex 1: DoE Approval of Project EIA Terms of Reference

(320)

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/5209/2013/ 153-A Date: 08 July, 2013

Subject: Approval of Terms of Reference for Environmental Impact Assessment (EIA) in favour of Regional Cooperation and Integration Project : Rail Component.

Ref: Your application received on 06 May 2013.

With reference to your letter dated 06.05.2013 for the subject mentioned above, the Department of Environment hereby gives approval of TOR for Environmental Impact Assessment (EIA) in favour of Regional Cooperation and Integration Project (RCIP) : Rail Component subject to fulfilling the following terms and conditions.

i. Bangladesh Railway shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of each sub-component under RCIP-Rail Component of the said Project in accordance with the TOR submitted to the DOE and additional suggestions provided herein.

ii. 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 project.

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. Socio-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.

1/2

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 maid 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

iii. Without approval of EIA report by the Department of Environment, Bangladesh Railway shall not be able to open L/C in favor of importable machineries.

iv. Without obtaining Environmental Clearance, Bangladesh Railway shall not start operation of each sub-component under RCIP-Rail Component of this project.

v. Bangladesh Railway 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 sub-component under RCIP-Rail Component of this project to the Head office of DOE in Dhaka with a copy to the concerned Divisional offices of DOE.

08.07.2013

(Syed Nazmul Ahsan)
Deputy Director (Environmental Clearance)
and
Member Secretary
Environmental Clearance Committee
Phone # 8181778

Mr. S. K. Chakraborty
Project Director & General Manage
Bangladesh Railway
Regional Cooperation and Integration Project (RCIP) : Rail Component
Rail Bhaba, 16, Abdul Gani Road, Dhaka.

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Dhaka/Chittagong/Rajshahi/Khulna Divisional Office, Dhaka/Chittagong/Rajshahi/Khulna.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

2/2

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6. Environmental and Social Impact Assessment of 400 MW Combined Cycle Power Plant, Sirajganj, Environmental Resources Management, August 2016.
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