CONSULTANCY SERVICE FOR FEASIBILITY STUDY AND DETAILED DESIGN FOR INTRODUCTION OF ELECTRIC TRACTION (INCLUDING OVERHEAD CATENARY & SUB-STATION) IN BETWEEN NARAYANGANJ–DHAKA–CHATTOGRAM AND TONGIJOYDEVPUR SECTION OF THE BANGLADESH RAILWAY PROJECT

Feasibility Study – Final Feasibility Report

Annex-12: Environmental Impact Assessment (EIA)

June 2024

TÜMAŞ TURKISH ENGINEERING CONSULTING & CONTRACTING CO

innovate engineering & development

Executive Summary

The Environmental Impact Assessment (EIA) is prepared for introduction of electric traction (including overhead catenary & sub-station) of Narayanganj–Dhaka–Chattogram and Tongi Joydebpur Section of Bangladesh Railway (the Project). The Project includes construction sub-station and workshop. Bangladesh Railways (BR) has developed a strategy to switch from diesel-electric traction to an electric traction system, which provides an economical, environmentally friendly, and efficient transportation system. In this context, BR has started to work on the transition to the electric traction system. It is anticipated that; this Project will need to acquire very small amount of land as it will follow mostly the existing railway alignment. Bangladesh Railway (BR) under the Ministry of Railways is the executing agency (EA) of the Project. The Government of Bangladesh (GoB) finance the feasibility study of the Project.

Surveys have been done for the concept design for the EMU Workshop, Electrical Locomotive Workshop, and Loco Sheds. As a result, the privately owned area at km 376+100 on the railway line section between Joydebpur - Mouchak stations was decided as the EMU workshop location, the area owned by Bangladesh Railways at km 2+000 on the railway line section between Chattogram - Fouzderhat stations has been proposed as an electric locomotive workshop location. The area in the TT Para is proposed for the Loco Shed location in Dhaka. In addition, a place was reserved for an electric locomotive shed in the area proposed as the Electric Locomotive Workshop in Pahartali.

The surface water along the proposed alignment is dominated by the Kumira, Chinki Astana Laksam, Mandabag, Ashuganj, Pubail, Tongi, Fatulla, Joydebpur, Pahartoli, and Kamalapur. Surface water samples were collected on September, 2024 at eleven specific locations, with one 50 m upstream and one 50 m downstream of the crossing area, for a total of 11 samples along the corridor. However, the surface water quality test results showed that for the most part surface water quality, except dissolved oxygen, is within DoE standards. Therefore, during the construction period, the pollution of surface waters will need to be monitored and contractors will need to adhere to specifications defined in the Project's Environmental Management Plan (EMP).

Air quality and noise level measurements were carried out on October 2024 at eleven specific locations for a total of 11 samples covering day and night along the Project alignment. The baseline data for CO, SO_2, O_3, SPM, $PM_{2.5}$, and PM_{10} show that none of the test result at eleven sampling stations exceeded the DoE acceptable limit. The existing noise level within the study area varies from 51 dB to 61 dB during daytime and 58 dB to 73 dB during night time which is above the standard of mixed zone land use (DoE, 2023), also slightly above commercial zone land use, which is the legal designation for the railway corridor. Noise generated from the construction machinery, vehicle movements, sounds of construction/demolition of station buildings and associated facilities will have temporary intermittent impacts and for a limited period of time in any single location.

During the construction period, most of the impacts associated with the Project will occur due to a long and high (between 2-7 m) embankment, requiring millions of tons of fill material. Much of that will be dredged from nearby rivers and pumped as slurry to the work sites. As much ballast as possible will be hauled on rail and if needed by roads. 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 are also addressed in detail.

The EIA identified 11 mitigative actions needing to be addressed during the pre-construction period, another 11 during the construction period and 10 during the operating period of the upgraded rail line. None of these were considered serious but do need specific actions, principally during the construction season. The EMP was prepared and is included in this EIA as Chapter IX. To track the compliance and effectiveness of mitigation as defined in the EMP an air, noise and surface water quality monitoring programme will be undertaken quarterly during the construction period and carried into the operating period. Monitoring during the operating period will continue through the 1 to 2-year Defects Notification Period, when the contractor is responsible for ensuring that all work has been done and is functioning according to contract specifications.

Given that all work will be strictly confined to the railway's existing Right of Way, and with the careful adherence to the Project EMP, there is little chance that impacts of the Project construction and upgraded rail operation will extend much beyond the 100 m wide corridor of impact centred over the rail line. However, these distances were adjusted in relation to sensitive receptors where

excessive noise was predicted and at natural waterbody crossings and wetland areas by as much as 200 m. Careful implementation of the pre-construction mitigative measure, designed to prevent future negative impacts, will make the likelihood or scale of the construction period impacts less.

BR is moving forward with the establishment of an Environmental Unit (EU) at the Project level. BR concluded that the specialist(s) will be housed within the Project Implementation Unit (PIU) who will be responsible for implementation of all environmental requirements for the environmental and social measures of the Project. This expertise will be essential and will make the job of implementing environmental safeguards much more credible, since expertise will reside in BR, overseeing the entire EIA procedure, instead of it being only with outside consultants.

Social impacts, especially associated with land acquisition and the need to relocate people (although illegally occupying land within the Corridor of Impact (COI)) and use productive agricultural lands, will be significant and will affect thousands of people. The procedure for determining entitlement and compensation is defined in the Resettlement Plan (RP) documents, being prepared by the Joint Venture Consultant (JVC) on behalf of BR. The actions defined in this EIA and the RP shall be implemented by BR, the contractor and the Construction Supervision Consultant (CSC) engaged by BR for the duration of the construction and during the Defects Notification Period of the Project.

No 'red-flag' environmental safeguard issues have been identified to date and all likely impacts can be prevented or mitigated to an acceptable level through the application of mitigation measures as defined in the EMP.

BR will prepare semi-annual monitoring reports to document compliance with EMP to BR defined in the EIA. Should problems be noted with the data, BR will recommend immediate actions, and the semi-annual reporting will be used to adjust the mitigative actions to be taken. These activities will provide the appropriate level of environmental oversight and demonstrate to DOE that the natural environment is being protected while the rail line is built and the system become operational.

Three large bridges will need bored pilings in river beds, and the use of drilling muds such as bentonite. Bentonite is fine clay that once released to the water body will remain in suspension for a long time, affecting the turbidity and degrading fish habitat. To avoid this impact, a strict bentonite handling and recovery protocol involving both handling and recovery procedures and records will be defined by the contractor. The contractor will be encouraged to replace bentonite with muds available locally or substitutes available in the market. To address these issues a separate EMP, designed to deal with all possible effects that might endanger the river's aquatic environment, has been prepared, is included in this EIA and will be implemented.

Compensation measures for climate change will also be implemented, focusing on rail track elevations, and bridge freeboard and culvert sizing. This EIA report defines the proposed design parameter revisions necessary to protect the infrastructure from climate change- related damage.

The construction, reconstruction and upgrading of station buildings with application of the Universal Design Principles for the elderly and persons with disabilities at eleven stations – Kumira, Chinki Astana, Laksam, Mandabag, Ashuganj, Pubail, Tongi, Fatulla, Joydebpur (workshop), Connection rail line to EMU workshop and Pahartali railway stations of the Project. It will also involve the construction of other buildings and new facilities at the remaining 10 railway sub stations. This will be managed through a programme of maximum recycling of materials and management of all wastes (as specified in the EMP). Each station building and other buildings and new facilities at stations, have been designed to accommodate future passenger loads, in relation to sewage, waste, water, lighting and universal design features, and presented in a special station design report and completed by the JVC. The report findings and conclusions have been incorporated in this EIA but will also be verified as part of the pre-construction check by BR, it's PIU, and the CSC.

The stakeholders contributed to the EIA through two seasons of consultations in four communities along the alignment. A cross section of all affected people attended the sessions and the details have been provided in Annex 18. The views expressed were incorporated into the EIA, and helped to shape the planning and development of the Project. The EIA contains a description of the specific actions taken by BR in response to the comments.

In addition to bringing economic benefits, the Project will be environment-friendly since stations will be rebuilt with environment-friendly solar panel systems, rainwater harvesting systems, improved sanitation facilities and accessibility for physically challenged persons. Based on the economic and traffic forecasts, the Project will not lead to significant traffic diversion but permit people wanting to travel to Chattogram to use the train instead of driving.

An indicative estimate of the cost for the implementation of the EMP including all items, and all provisional sums (detailed budget in EIA) will be USD 1,107,400. These estimates are tentative and once more construction details are known, the EMP will need to be revised and associated costs adjusted.

A Grievance Redress Mechanism (GRM) has been designed and will be implemented by BR to receive, evaluate and facilitate the resolution of affected people's concerns, complaints, and grievances. The GRM aims to provide a time-bound and transparent mechanism for expressing and resolving social and environmental concerns linked to the Project.

To conclude, this EIA addresses all relevant likely impacts and defines a full set of time-bounded mitigative and monitoring actions, including assignment of responsibility, for all stages of Project's completion. BR will ensure that the work is carried out in an environmentally acceptable manner and that the monitoring and reporting is completed in a compliant and timely fashion, acceptable to DoE. This EIA, with its feasibility study and no objection certificates will be submitted to DoE for review, approval and issuance of the Environmental Clearance Certificate.

CONSULTANCY SERVICE FOR FEASIBILITY STUDY AND DETAILED DESIGN FOR INTRODUCTION OF ELECTRIC TRACTION (INCLUDING OVERHEAD CATENARY & SUB-STATION) IN BETWEEN NARAYANGANJ–DHAKA–CHATTOGRAM AND TONGI JOYDEBPUR SECTION OF BANGLADESH RAILWAY PROJECT

Table of Contents

List of Tables

List of Figures

List of Annexes

ABBREVIATIONS

As	Arsenic
AIDS	Acquired Immune Deficiency Syndrome
AP	Affected People
BADC	Bangladesh Agricultural Development Corporation
BBS	Bangladesh Bureau of Statistics
BD	Bangladesh
BDT	Bangladeshi Taka
BG	Broad gauge
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
BR	Bangladesh Railway
BWDB	Bangladesh Water Development Board
C2	Component 2 of the DCCRPPF Project
CFT	Cubic Feet
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPRs	Community Property Resources
CSC	Construction Supervision Consultant
DBH	Diameter at Breast Height
D/D	Detail Design
DC	Deputy Commissioner
DF	Department of Forest
DFC	Dedicated Freight Corridor
DG	dual gauge
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Fisheries
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQS	Environmental Quality Standards
EU	Environmental and Social Safeguards Unit
F/S	Feasibility Study
FC	Faecal Coliform
Fe	Iron
FGD	Focus Group Discussions
GHG	Greenhouse Gases
GoB	Government of Bangladesh

GRC	Grievance Redress Committees
GRM	Grievance Redress Mechanism
ha	hectare
HIV	Human Immunodeficiency Virus
IDM	Information Disclosure Meeting
ILO	International Labour Organization
IUCN	International Union for Conservation of Nature and Natural Resources
KII	Key Informant Interviews
km	kilometre
km/h	kilometres per hour
Leq	Average Sound Level
LGD	Local Government Division
LGED	Local Government Engineering Department
m	Metre
mm	milimetre
MG	metre gague
Mn	Manganese
MoEF	Ministry of Environment and Forest
NCS	National Conservation Strategy
NEMAP	National Environmental Management Action Plan
NEMP	National Environmental Management Plan
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NGO	Non-Government Organization
NM	Noise Measurement
NO	Nitric Oxide
NO_2	Nitrogen dioxide
NOC	No Objection Certificates
O_3	Ozone
OSHA	Occupational Safety and Health Administration
PAHs	polycyclic aromatic hydrocarbons
PAPs	Project Affected Persons
PC	Stakeholder Consultation
PD	Project Director
PIA	Project Influence Areas
PET	Potential Evapotranspiration
PM_{10}	Particulate Matter in air (less than or equal to 10 microns)
$PM_{2.5}$	Particulate Matter in air (less than or equal to 2.5 microns)
PPE	Personal protective equipment
PPV	Peak Particle Velocity
PRA	Participatory Rural Appraisals
RCC	Reinforced Cement Concrete
RHD	Roads and Highways Department
RoW	Right of Way
RTW	River Training Works
RUB	Road underbridge

SCC	Site Clearance Certificate
SCM	Stakeholder Consultation Meeting
SEMP	Sustainable Environmental Management Plan
SO_2	Sulphur dioxide
SPS	Safeguards Policy Statement
STD	Sexually Transmitted Diseases
STP	Sewage Treatment Plant
TC	Total Coliform
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
ToR	Terms of References
TP	Total Phosphorus
TSS	Total Suspended Solids
UNESCO	United Nations Educational Scientific and Cultural Organization
UNFCCC	UN Framework Convention on Climate Change
UNICEF	United Nations Children's Emergency Fund
UNO	Upazila Nirbahi Officer
UP	Union Parishad
USD	US Dollars
USEPA	US Environmental Protection Agency
VOC	Volatile Organic Compound
WQS	Water Quality Standards

CURRENCY EQUIVALENTS

(as of 01 Dec, 2024)

Bangladesh Taka (BDT) 1 =$0.0084

USD $1 = BDT 120.67

WEIGHTS AND MEASURES

1 ha	=	2.47 acre
1 ha	=	10,000 sq.m
1 Acre	=	100 Decimals

NOTE: In this report, "$" refers to US dollars

1. INTRODUCTION

1.1 Background

1. The Government of Bangladesh is undertaking extensive construction and development work in transport logistics. Priority is being given to the railway sector since it is considered to be the best land transport option for the country. It is a better human transport mode than long distance buses, and is more cost effective for transporting bulk freight, and has overall lower adverse environmental impacts than other modes of transport. It is considered to be the preferred transport option and will solve many of the country's land transport restrictions.
2. The railway sector in particular is receiving a greater priority and the GoB has already placed high priority on increasing the capacity of the electric traction (including overhead catenary & sub-station) of Narayanganj–Dhaka–Chattogram and Tongi Joydebpur Section of Bangladesh Railway (the Project). The Project includes construction sub-station and workshop. Bangladesh Railways (BR) has developed a strategy to switch from diesel-electric traction to an electric traction system, which provides an economical, environmentally friendly, and efficient transportation system. In this context, BR has started to work on the transition to the electric traction system. It is anticipated that; this Project will need to acquire very small amount of land as it will follow mostly the existing railway alignment. Bangladesh Railway (BR) under the Ministry of Railways is the executing agency (EA) of the Project. The Government of Bangladesh (GoB) finance the feasibility study of the Project.

1.2 Scope of the Study

3. The scope of this EIA is as follows.

- Identification of environmental features within the proposed the Project influence area (100 m each side of the proposed center line) and developing suitable maps;
- Identification of the terrestrial flora and fauna within 200 m (100 m each side) from the center line of the railway track;
- Identification of the aquatic flora and fauna within 200 m (100 m each side from the center line), particularly focusing on notable water bodies such as rivers, cannels;
- Identification of environmentally sensitive receptors within 200 m of the Project corridor, to include, wetlands, forest patches, breeding habitats;
- Description of impacts mitigation measures and monitoring actions to be implemented to prevent or mitigate degradation of the biophysical, ecological and social environment within the Project corridor, and preparation of an Environmental Management Plan;
- Conducting environmental quality assessment in select locations along the Project corridor;
- Organizing stakeholder consultations in regional and local levels through private meetings, public meetings, organized gatherings, questionnaires, focus groups;
- Developing Environmental Mitigation and Monitoring Plan that takes into account the existing terrestrial and aquatic ecosystems as well as the social scenario to formulate solutions that ensure the sustainability of the Project.

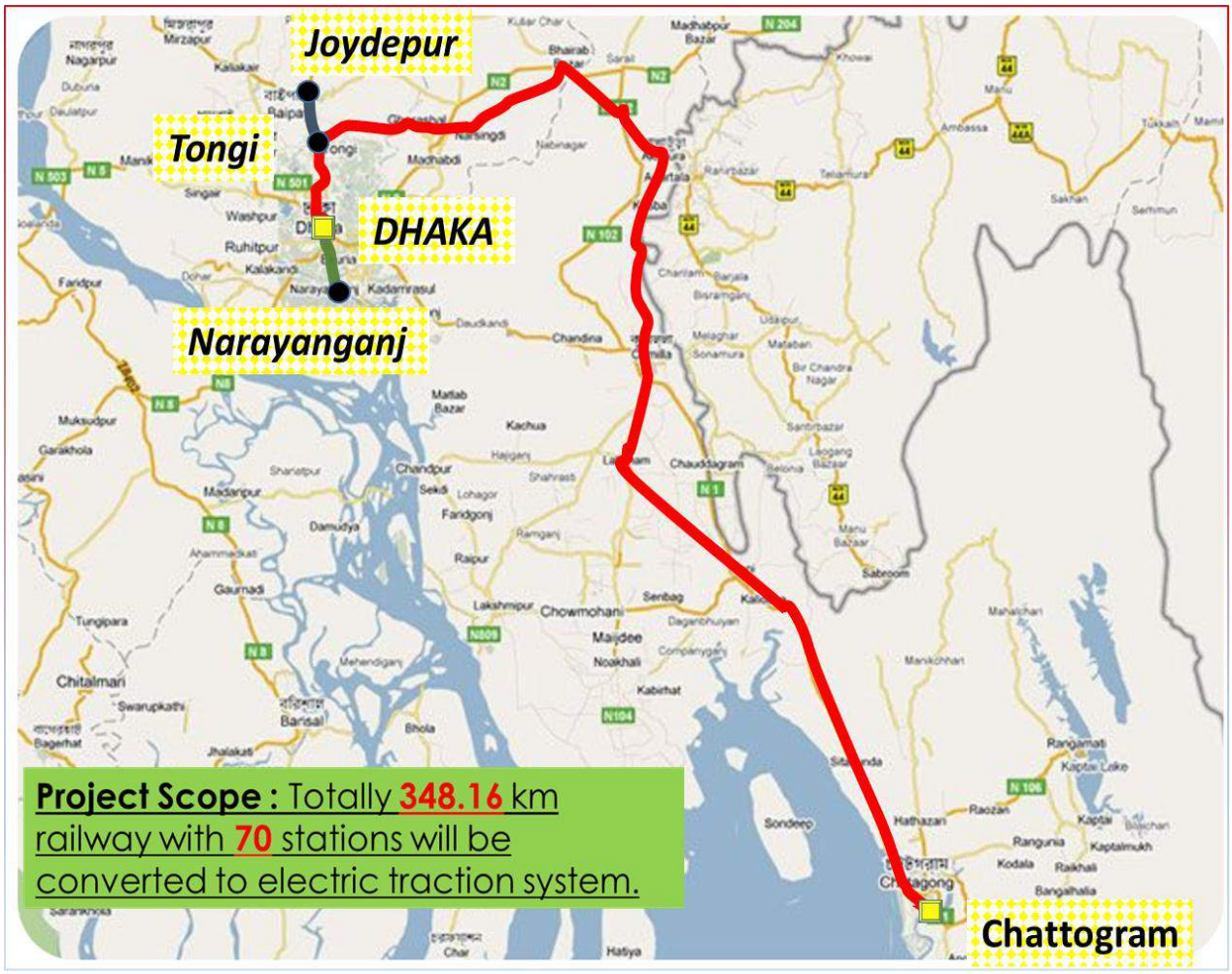


Figure 1: Location Map of all Component

1.3 Project Objectives and Benefits

4. The project to introduce electric traction on the Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur sections of Bangladesh Railway aims to modernize the rail network and improve efficiency. Key objectives include technically, economically, financially, environmentally, and socially viable solutions, increased freight traffic, reduced pressure on road transport, faster travel times, and compatibility with the Trans-Asian railway network.

5. The overall objective of this EIA is to ensure that 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; to quantify and where possible value these, providing BR with a set of actions it needs to implement in order to meet national and international environmental safeguard standards and hopefully prevent the impacts from actually materializing. Project Objectives:

   Technical, Economic, Financial, Environmental, and Social Viability:

6. The project seeks to determine the feasibility of electric traction across various aspects, ensuring its long-term sustainability.

   Increased Freight Traffic:

7. Electrification is expected to improve the capacity and efficiency of freight transport, potentially shifting cargo movement from road to rail.

Reduced Pressure on Road Transport:

8. By offering a more efficient and potentially faster mode of transportation, the project aims to alleviate congestion on roadways.

Improved Average Speed:

9. Electric trains are generally faster and more reliable than their diesel counterparts, leading to reduced travel times and improved overall speed.

Compatibility with the Trans-Asian Railway Network:

10. Electrification can facilitate seamless integration with the broader regional railway network, enhancing connectivity and trade opportunities.

Project Benefits:

Reduced Operational Costs:

11. Electrification can facilitate to trains do not require onboard fuel, leading to lower operational costs compared to diesel locomotives.

Reduced Maintenance Costs:

12. Electric traction systems generally have lower maintenance requirements than diesel systems.

Reduced Carbon Emissions:

13. Electric trains produce fewer emissions, contributing to a cleaner environment.

Reduced Travel Time:

14. Faster train speeds and improved efficiency can significantly reduce overall travel time for both passengers and freight.

Modernization of the Railway Network:

15. Electrification is a key step in modernizing Bangladesh Railway, aligning it with global standards and best practices.

Enhanced Passenger Amenities:

16. The introduction of electric trains can improve passenger experience through increased comfort and reliability.

1.4 Methodology

17. The collection of primary data was conducted during two sampling periods, between July and December 2024. The physical environment parameters surveyed were air quality, noise & vibration and surface water quality (upstream and downstream of a large crossing structure). The sampling stations were defined and data were collected, allowing a set of baseline or/ existing conditions to be recorded. This dataset was then used to predict the likely impacts and when the construction and operations take place, it will be applied to monitor change (usually negative) using the dataset as a baseline. The sampling was conducted primarily within 100 m of either side of the center line of the existing railway track at locations reflecting representative land use conditions and population densities.

18. The biophysical environment data collected in the Project corridor were from both primary and secondary sources. Primary data collection involved a comprehensive field survey programme. The outline of the environmental quality sampling programme of the Project is shown in (Table 1). Sample collection as well as air and noise testing were conducted by the Global Environment and water quality testing was undertaken by the Dhaka Water Supply and Sewerage Authority (WASA) and Department of Public Health Engineering (DPHE), which is an accredited lab.

19. Secondary data sources included the Bangladesh Water Development Board, Bangladesh Meteorological Department, Soil Resource Development Institute, and the International Union for Conservation of Nature (IUCN), Bangladesh.

Table 1: Outline of Sampling Programme

Analysis	Parameters to be Tested	Sample Per Station	No. of Sampling Station of the Project	Standard	Sampling Duration	Total Samples
Air	($PM_{2.5}$, PM_{10}, CO, SO_2, NO, NO_2, O_3, VOC, temperature, humidity, wind speed and wind direction	1 (Day time data)	11	USEPA/ EU Standard/ equivalent	1-hour with 10 mins interval	the Project=11
Noise	level (LAeq)	1 (Day time data)	11	USEPA/ EU Standard/ equivalent	1-hour with 10 mins interval	the Project=11
Surface Water	(Total Organic Content, total phosphate, Total Suspended Solids, Dissolved Oxygen, Oil and grease)	1	11	USEPA/EU /Ca/Aus/NZ/ equivalent	Not applicable	the Project=11
Ground Water	(Total Organic Content, total phosphate, Total Suspended Solids, Dissolved Oxygen, Oil and grease)	1	11	USEPA/EU /Ca/Aus/NZ/ equivalent	Not applicable	the Project=11

1) Air Quality

20. A total of 10 samples of air quality data were collected from 10 sample stations during one sampling periods, between July and December 2024, that were set up to be on or next to the railway Right of Way (RoW) along the Project area within the aforementioned range of within 100 m of the railway track. The parameters that were tested were $PM_{2.5}$, PM_{10}, CO, SO_2, NO, NO_2, O_3, VOC, air temperature, humidity, wind speed and wind direction. The data was collected using the Environmental Perimeter Air Sampler (EPAS) (model ECOTECH) of Environmental Devices Corporation (EDC), Australia.

21. The sampling process was conducted for one to five minutes repeatedly over a one-hour sample period (also selectable on the data logger), and samples were collected during daytime and night-time (**Figure 2**).

Figure 2: Noise and Air Sampling in the Project Alignment During Morning (kamalapur) and Evening (Joydebpur)

Conversion of Hourly to 24-hour Averages

Typically, the standard used is the 24-hour collection period for establishing air quality levels. The GoB's DoE also prefers using the 24-hour standard. However, with 11 stations in moderately remote locations, requiring over 200 hours of just data collection, the full 24-hour system was simply not practical. Many agencies (e.g., New York State Dept. of Environmental Conservation, California Office of Environmental Health Hazards Assessment, USEPA, Ontario Canada, Ministry of Environment) face the same problems and have had to adapt by applying a conversion process using Pasquill's (1961) air mass dispersion tables defining six air mass stability classes (**Table 2**) and a set of meteorological conditions (**Table 3**) and Schroeder and Jugloff's (2012) conversion steps. Using the simple power law principle4 Schroeder and Jugloff (2012), using Pasquill's air mass stability classes (**Table 2**) and meteorological classifications (**Table 3**), developed the steps for converting one-hour readings to 24-hour values 5. The stability classes (**Table 2**) are related to average wind speed, daytime solar radiation and night-time cloud cover and a second table (**Table 3)**, refining these relationships.

Table 2: 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 [1]

Table 3: 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 [1]

Note: Grey highlight indicates condition selected for the Project.

22. The average wind speed in all air quality survey locations is less than 2 m/s. Therefore, taking the simple average of these three values from

23. **Table** 2 and **Table 3**, the Project stability class was calculated as 0.39 (see below).

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

24. This suggests a somewhat unstable air mass, resulting in considerable dilution of a one-hour sample when spread out over a 24-hour period. In order to provide 24-hour averages for SO_2, PM2.5, and PM10 parameters, the following power-law equation, as defined in Schroeder and Jugloff was applied:

$$C_{24h}=C2_h(t_{short}/t_{long})^{0.39}$$

25. Where C14 is the measured 1-hour concentration and C_{24h} is the estimated average using the exponent 0.39., and "t" is time. Therefore:

$$C_{24h}= C_{2h}\ (1/24)^{0.39}$$
$$= C_{2h\ x}\ (0.0416)^{0.39}$$
$$= C_{2h\ x}\ 0.289 \ldots\ldots\ldots\ldots\ldots\ (1)$$

26. So, for example, for the one-hour measurement of PM_{10} of 80.72 µg/m^3 , the 24-hour average would be:

$$\text{24hr Avg. } PM_{10} = 80.72 \times 0.289$$
$$= 23.36\ \mu g/m^3$$

27. This generalized approach was applied to all data, and the 24-hour averages generated, in order to be able to compare the Project results to GoB standards. The Bangladesh University of Engineering and Technology laboratory (BUET) applied the same methodology for some of their Projects but used 'p' values specific to a given parameter, which ranged between 0.068 for SO_2 to 0.1267 for PM, suggesting extreme dispersion. The USEPA and Government of Ontario, Canada use an average 'p' value of 0.29. The Project has adopted a single p-value of 0.39.

2) Noise and Vibration

28. The noise level measurements were conducted at 11 sampling stations for total of 11 samples on the same location specified for air quality measurement those are mostly along the rail corridor during two sampling periods, between July and December 2024. Noise readings were recorded for one hour at two different times of the day. One sample was recorded between 0600-1900 hours and another sample was recorded between 1900-0600 hours. Measurements were taken using a Lutron's Sound Level Meter (SL-4033SD). Noise level was measured in terms of the A-weighted equivalent continuous sound pressure level (Leq). The noise measurements were taken at the known sensitive receptors important for their ecological and

social value as well as at the time operating trains passed the sampling location. This was done as it allowed emissions from passing trains to be pinpointed accurately by comparing readings with the noise spikes of the passing trains.

29. The measurement of vibration has been carried out according to the USEPA approved methods. The spot ground vibration measurements were also taken at these locations and at the same time that noise measurements were being recorded. Vibration was measured using a Lutron's spot Vibration Meter (VB-8206SD). The magnitude of vibration has been expressed as millimetre per second (mm/sec.)

3) Noise Modelling

30. A SoundPLAN Essential Version 4.0 computer noise model has been used for the prediction of future Project noise levels at sensitive receivers in construction and operation phases. Each section represents the most common land uses, namely one commercial area, one residential area and one agricultural field. Sensitive receptors within 100 m besides the train line were identified of that particular area. Three scenarios during operating year 2024, 2030, and 2040 and baseline for the year 2024 were assess to determine the railway noise and its impact to nearby sensitive receptors. The potential noise level in Leq (dBA) was predicted with and without locomotive movements for each of the areas. These scenario assessments were again analyzed for three-land use pattern including level crossing, agricultural land and railway station area.

31. The resultant noise level was compared with the national and international standard. Finally, noise level contour maps for each 1 km section were prepared showing noise levels at varying distances from the future operating rail line.

4) Surface Water

Sampling stations for surface water were selected to capture any possible runoff pollution from bridge worksites into the rivers crossed by the Project corridor. After analysing the map, 11 river and/or canal points were selected throughout corridor, at bridges within the Project. Notable water bodies include the. At each sampling point, 1 sample –one 50 m downstream – for a total of 11 samples have been collected. The samples were collected on 19 September 2024 -01 October 2024 by the environmental survey team (Figure 3). All samples were collected in plastic and amber sampling bottles and stored according to standard methods and analyzed within 24 hours of being collected at an ISO 14000-certified laboratory. The parameters measured were total organic carbon (TOC), pH, total phosphate, total suspended solids (TSS), dissolved oxygen, and oil and grease.

Figure 3: Collection of Surface water from Ashugonj and Pahartoli

5) Ecology

32. An ecological survey was conducted during 19 September to October 12, 2024 in the Project area to determine the extent, species composition and the condition of existing vegetation, wildlife, threatened and protected flora and fauna, and important habitat for local migratory species. For the sampling, 11 points were visited along the transect line of 365.90 km Laksam-ChinkiAstana-Pahartoli-kumira-Chattogram-Mangabag-Fotullha-Asuganj-Pubail- Kamalapur - Joydebpur-Tongi Railway alignment. Random Meander method was applied in the sampling sites. Observation made 100 metres apart from right side and 100 metre apart from the left side of the central line. The following activities were undertaken during the terrestrial and aquatic field surveys:

Direct Observation

33. Direct observation on the occurrence and abundance of flora and fauna was made while travelling within water bodies, along road edges, across the agricultural fields and within village groves. As well as direct sightings, identification of animal presence was also based on identification of tracks, foot prints, feeding signs and animal/bird calls. Appropriate field guides and data proformas were used for this activity so that information was accurately recorded.

Interviews with Local Residents

34. 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.

Inspection of Fishermen's Catches and Fish Market Survey

35. Whenever available, the catches of local fishermen were examined to assess species composition and abundances. The local fishermen were also interviewed to collect information on the occurrence and abundance of species, seasonality, etc. As with the terrestrial data collected during interviews with local residents, the data collected from these activities did not comprise the core information of the aquatic assessment, nonetheless, provided a useful supplement. The major fish markets, including the local fish landing centres, were also surveyed to record the local fish species caught as well as other aquatic animals which were collected along with the fish catch (e.g., insect larva collected in cast nets). Sources of the fish

were ascertained prior to making any observations to verify that they were from within the local study area.

6) Stakeholder Consultation

36. Stakeholder consultation is the process relevant stakeholders about the Project and its impacts as well as addressing their concerns. In order to obtain opinion from direct and indirect stakeholders, the stakeholder consultation broadly divided into regional and community level.

37. During the study period, public consultations were set up in four separate locations spread out throughout the Project corridor. These locations were selected due to their importance as major urban areas with highly dense communities located on areas notably close to the Project's corridor. In fact, there were heavy levels of encroachment and squatting taking place in and around various points of the corridor. The primary function of the public consultation was twofold – to inform the stakeholders that are most likely to be directly impacted by the Project, and to gather opinions on the Project's perceptions, the wants and needs of the communities in order to develop a fine-tuned Environment Management Plan that will eventually ensure their wants and needs. The location of the consultations was Upazila of Laksam, Feni, Kamalpur and Sitakund. These sessions were conducted on October, 2024 for the Project disclosure meeting.

Picture: Project disclosure meeting at Kamalapur

7) GIS Mapping

38. Geographical Information Systems (GIS) was used as a specialized analysis and presentation tool. Before commencing field investigations, spatial analysis of satellite imagery was used to identify present administrative areas and other boundaries/constraints to be considered for both the environmental and social assessments. For example, the administrative boundaries of Local Government areas were defined, and alignment, settlement areas and drainage networks were identified. It also supports more detailed on-ground survey, particularly spatial features that may be directly or indirectly influenced by Project activities.

39. Detailed on-ground validation of spatial information – particularly land use – was undertaken using a hand-held, non-differential GPS. The spatial data acquisition team undertook detailed transect walks through the Project area in order to identify various land use types and confirm the findings of the satellite imagery analysis. The extensive ground-truthing exercise both validated the land use mapping and identified additional sensitive areas to include within the environmental fieldwork for sampling. The collected information is demonstrated by means of the numerous GIS mapping figures found throughout this report.

8) Environmental Classification of the Project

40. In accordance with the requirements of the Department of Environment (DoE), Ministry of Environment and Forests of the Government of Bangladesh, the Project is classified as red category and requires a full Environmental Impact Assessment (EIA).

41. In accordance to the Department of Environment (DoE) Environmental Screening Checklist and Environmental Conservation Act (ECA) of 1995, the Project is classified as Environment Category A (**Annex 2**), due to the fact that there will be 1117 affected people and despite the fact that no environmentally sensitive sites are within the Project corridor, and all work is within the existing BR RoW.

1.5 The EIA Team

42. **Table 4** shows the full EIA team members with their designations.

Table 4: The EIA Team for this Project

Name	Designation/Office	Email Address	Contact Number
Syed Nazmul Husain	Team Leader (EIA) & Environmental Specialist	nazmulhusain6@gmail.com	01711131242
Mohd Nur E Alam Siddique	Environmental Specialist	m.siddique@gmail.com	01817013234

1.6 Structure of the EIA Report

43. An Environmental Impact Assessment (EIA) report typically follows a structured format to comprehensively assess a project's potential environmental impacts. A common structure includes an introduction, project description, environmental description, impact assessment, mitigation measures, and more. Here's a breakdown of the structure:

1. Introduction:
    - Provides an overview of the project, the purpose of the EIA, and the scope of the report.
    - Include the project's objectives, legislative and policy context, and the EIA methodology.
2. Project Description:
    - Details the proposed project, including its location, activities, technologies, and implementation phases.
    - Covers aspects like infrastructure, resource use (water, energy), waste generation, and potential accidents.
3. Description of the Environment:
    - Describes the existing environmental conditions of the project area, covering physical, biological, and socio-economic aspects.
    - Includes baseline data on air quality, water resources, soil conditions, flora, fauna, and human populations.
4. Anticipated Environmental Impacts and Mitigation Measures:
    - Identifies and analyzes both positive and negative potential impacts of the project on the environment.
    - Proposes mitigation measures to minimize or eliminate adverse impacts and enhance positive ones.
5. Analysis of Alternatives:
    - Examines alternative project options, including the "no-action" alternative, to assess their environmental consequences.
    - Provides a rationale for choosing the preferred alternative based on environmental and other relevant factors.

6. Environmental Monitoring Program:
    - Outlines a plan for monitoring the project's environmental performance during construction, operation, and decommissioning.
    - Specifies parameters to be monitored, frequency of monitoring, and reporting procedures.
7. Additional Studies:
    - Includes any specialized studies needed to assess specific environmental impacts, such as ecological assessments or risk assessments.
8. Project Benefits:
    - Details the positive social and economic benefits of the project, including job creation and economic growth.
9. Environmental Cost-Benefit Analysis:
    - Evaluates the economic costs and benefits of the project, considering both environmental and socio-economic factors.
10. Environmental Management Plan (EMP):
    - Outlines the procedures and responsibilities for managing environmental impacts during the project lifecycle.
    - Includes pollution control measures, waste management strategies, and emergency response plans.
11. Summary and Conclusion:
    - Summarizes the key findings of the EIA report and draws conclusions about the project's environmental acceptability.
    - May include recommendations for environmental management and monitoring.
12. Disclosure of Consultants:
    - Lists the consultants who prepared the EIA report and their qualifications.

1.7 Study Limitations

44. EIA reports, while valuable, have limitations including: short-term focus, quality issues, and challenges in addressing cumulative and indirect impacts. These reports may also suffer from lack of transparency, inadequate stakeholder engagement, and reliance on outdated or insufficient data. EIA studies often focus on the immediate and medium-term environmental impacts of a project, potentially overlooking long-term consequences. EIA reports may struggle to fully assess the cumulative effects of multiple projects or the indirect impacts of a single project. Lack of transparency in the scoping process and insufficient stakeholder engagement can lead to conflicts and undermine the effectiveness of the EIA. The time and financial resources required to conduct a thorough EIA can be significant, potentially leading to compromises in the scope or quality of the assessment. Inconsistent regulations, lack of enforcement, and potential loopholes in the EIA process can hinder its effectiveness.

45. EIA involves complex scientific and technical assessments, which can be challenging to interpret and apply effectively. Mitigation measures proposed in EIA reports may not always be well-justified, transparent, or based on reliable evidence of their effectiveness. In essence, while EIA is a crucial tool for environmental management, it is important to acknowledge its limitations and work to address them through improved methodologies, increased transparency, and stronger enforcement mechanisms.

2. Regulatory and Policy Consideration

2.1 Introduction

46. 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 growth is improving 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, climate change impacts may lead to devastating flooding, impacting the environment and people.

47. Bangladesh's constitution is the supreme law of the country, and Article 18 A ensures environmental protection and pursuit of sustainable development. The Article 18 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.

48. 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 initiatives.

49. The Ministry of Environment and Forest is 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 dealing with the environmental issues in Bangladesh. It is the final arbitrator 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. It has a jurisdiction over the activities of the following technical/implementing agencies under it: DoE, Department of Forests, Bangladesh Forest Industries Development Corporation, and Bangladesh Forest Research Institute.

2.2 Environmental Legislative Framework

50. The Environmental Conservation Act's (ECA) Rule (ECR) provides a basic framework for environmental evaluation of the Project, 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 construction can begin.

51. Rule 7 of the ECR provides a list classifying many types of projects into the following four categories based on the site conditions and the environmental impacts recorded for past and similar projects. The categories 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 all existing and proposed industrial units and projects falling in the green category are exempted from EIA. However, Category Orange A and B and for Red Projects require location clearances referred to No Objection Certificate, followed by issuing of ECC upon the satisfactory submission of the required documents to DoE.

52. For getting location and environmental clearances, BR must submit to DoE Form-3 as per the rules given in the ECR (

53.

54. Figure 4 and **Figure 5**). The form must be accompanied with the following documents:

- Application through prescribed form-3 under ECR 1997
- Fee under the schedule of ECR 1997 (Amended in 2002)
- Feasibility Study for the Project
- EMP for the Project (included as part of the EIA)
- No Objection Certificates (NOC) from the Local Authorities.
- Emergency plan relating adverse environmental impact and plan for mitigation of the effect of pollution
- Outline of Relocation and rehabilitation plan (from RP document)
- Other necessary information (based on the type of the project)

55. The ECC is valid for one year and will be sought for seven of the eight components of 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 5.**

56. The document is the detailed EIA and includes the EMP, as defined above.

2.3 Relevant Bangladesh Legislation

57. In addition to the ECA 1995 and ECR 1997, there are a number of other policies, plans, and strategies, which need to be considered in the Project. A summary of relevant national legislation is provided in **Table 5.**

Table 5: Summary of Project-Relevant National Legislation

Policy/Act/Plan	Year	Description
National Environmental Policy	1992	The National Environmental Policy was drawn up with the aim of providing protection and sustainable management of the environment. The National environment policy has introduced a number of salient environment principles like precautionary approach and EIA.
National Environmental Management Action Plan	1995	The National Environmental Management Plan (NEMP) was developed as the framework of programs and interventions aimed at implementing NEP. • 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.
Sustainable Environmental Management Plan (SEMP)	1998	A segment of NEMAP, cantered on green initiates. 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.

Policy/Act/Plan	Year	Description
Environmental Conservation Act	1995	The Bangladesh ECA is the most important legislative document for pollution aspects. 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.
Environmental Conservation Act	Amendment 2000	Ascertaining responsibility for compensation in cases of damage to ecosystem. Increased provision of punitive measures for both fines and imprisonment. Fixing authority on cognizance of offence.
	Amendment 2002	• 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
	Amendment 2010	• Demarcation of wetlands and water bodies • Hazardous waste import, transportation, storage etc. • Cutting of hills, mountains • Ecologically critical areas
Environmental Conservation Rules (ECR)	1997 (Amended 2002, 2003)	• 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,

Policy/Act/Plan	Year	Description
		• 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.
Environmental Court Act	2000	• 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.
Ecologically Critical Areas	1995	• Declaring an Ecologically Critical Area (under Section-5 of ECA and Rule-3). Human habitat, ancient monument, archaeological site, forest sanctuary, national park, game reserve, wild animal's habitat, wetland, mangrove, forest area, Biodiversity of the relevant area etc.; • Among the ECA`s four rivers MoEF made restriction on: hunting, fishing, all activities that could result in the destruction of floral or faunal habitats, activities that could destroy natural characteristics of water and soil, activities detrimental to fishery, installation of polluting industrial units, and discharge of domestic/ industrial liquid waste.
National Environmental Management Action Plan (NEMAP)	1995-2005	• 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.
National Water Policy	1999	• 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
Water Act	2013	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.

Policy/Act/Plan	Year	Description
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.
National Conservation Strategy	1992	• 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.
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.
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.
National Forest Policy	1994 (Amended 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 programme, and increase the reserve forestland by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.
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.
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.
National Conservation Strategy	1992 (updated 2013)	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

Policy/Act/Plan	Year	Description
		disaster management, environmental awareness and education, gender issues, and environment and international obligations.
National Biodiversity Strategy & Action Plan (NBSAP)	2007	• 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.
Bangladesh Wildlife (Conservation & Security) Act	2012	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.
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.
Labour Laws	2006	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.

2.4 Environmental Requirements for the project

58. Environmental requirements for a project encompass the conditions and parameters related to the surrounding environment that the project must adhere to or consider. These can include physical, biological, and social factors that may be impacted by or impact the project's execution and outcomes. Essentially, environmental requirements ensure that the project is planned and implemented in a way that minimizes negative impacts and maximizes positive contributions to the environment.

59. The introduction of electric traction on the Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur sections of Bangladesh Railway will require environmental considerations, particularly regarding the construction of overhead catenary systems and substations. Key environmental requirements will likely involve assessing potential impacts on air and noise pollution, land use, and biodiversity, as well as implementing mitigation measures to minimize negative effects.

2.5 Environmental Standards

60. Under the ECR1997, once the EIA has been filed, DoE has 60 days to respond with its review comment, and approval. Submission of any further materials would be carried out, as per requirement of DoE in order to obtain the ECC. Steps to be followed for obtaining the ECC for this railway Project are shown in

61.

62. **Figure** 4**.** Additionally, a flow diagram detailing the steps for obtaining an ECC is shown in **Figure 5**.

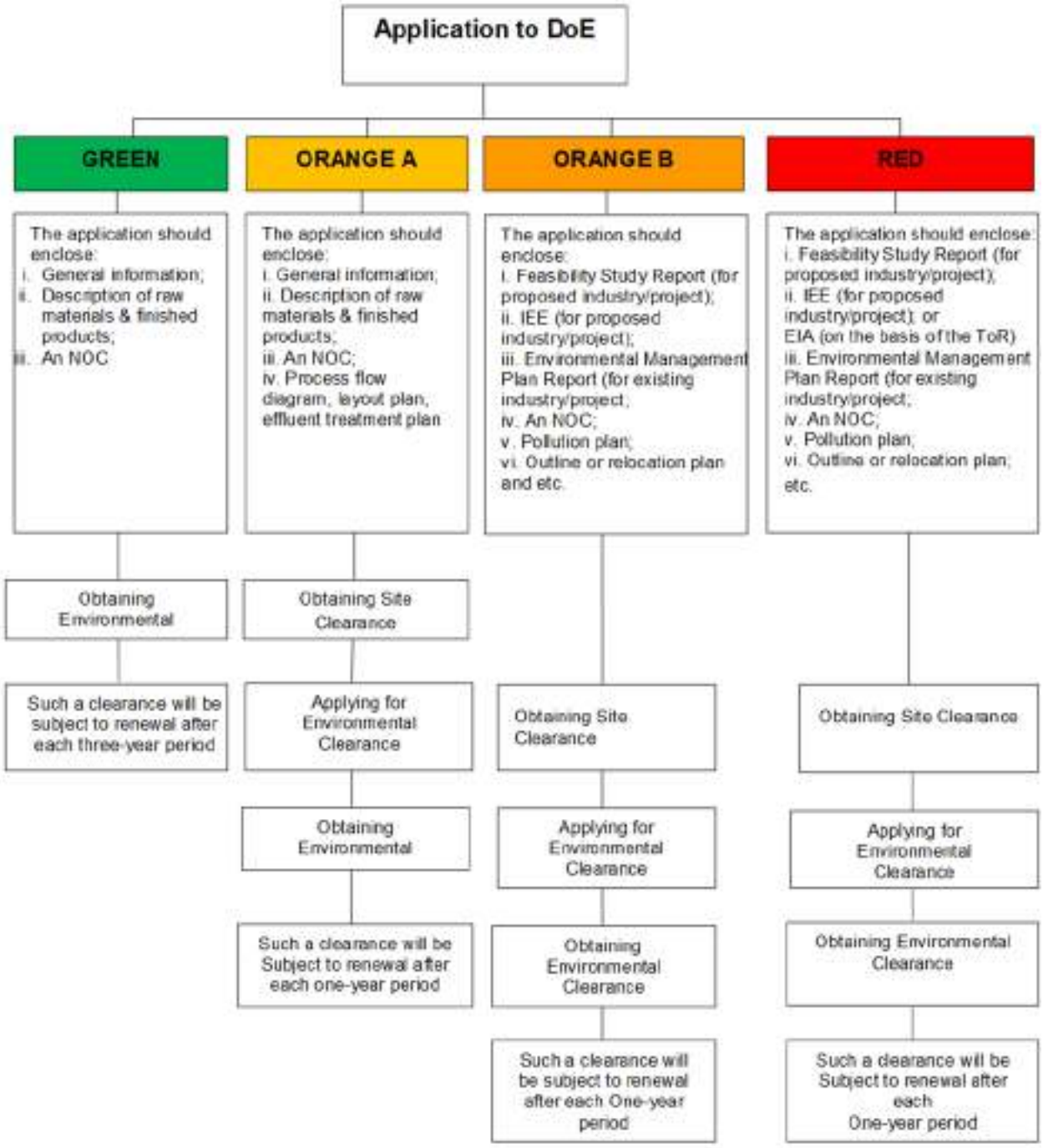


Figure 4: Government of Bangladesh Environmental Assessment Process

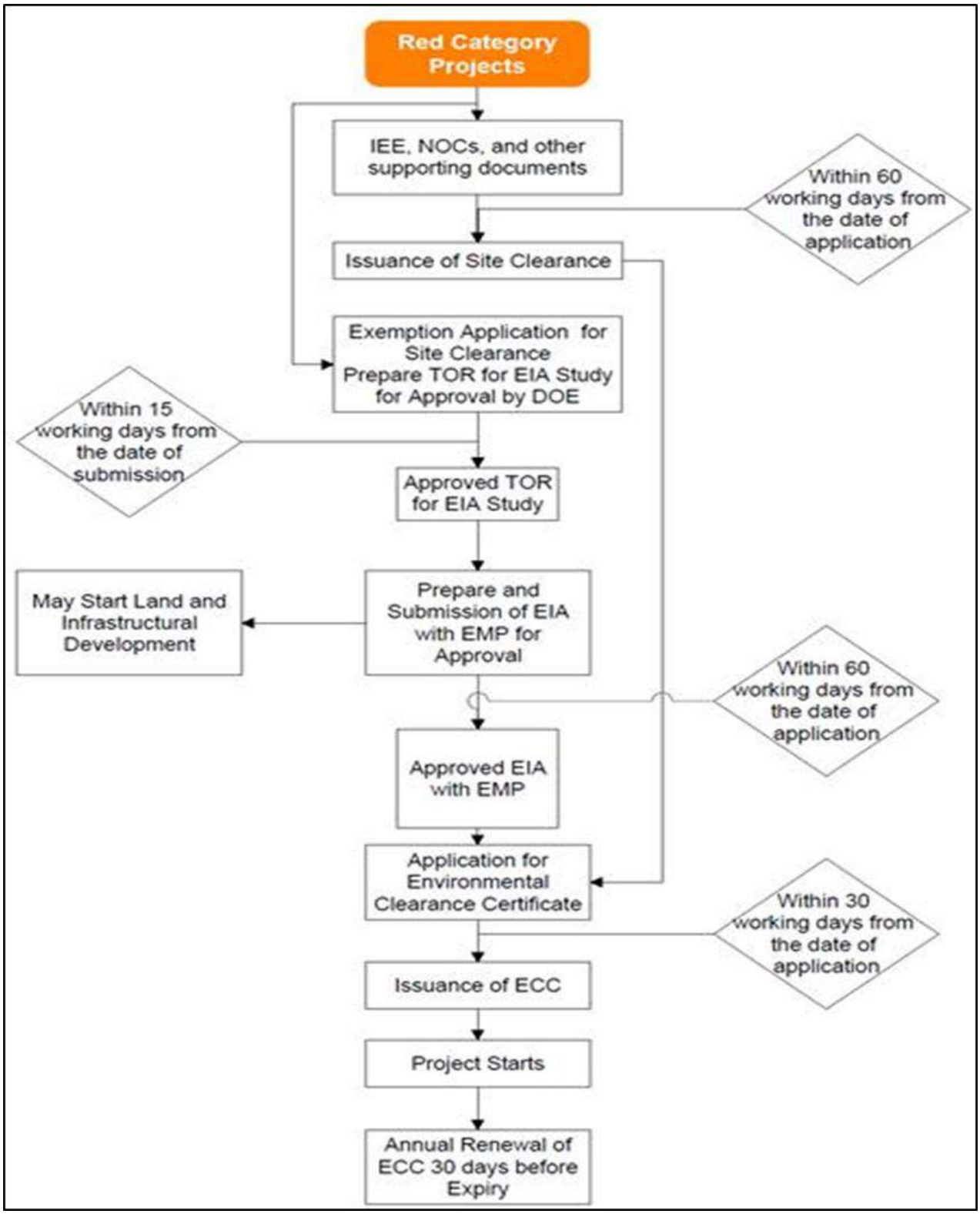


Figure 5: Process for Obtaining an Environmental Clearance Certificate of Red Category Project

2.6 International Agreements and Obligations

63. Most development Projects implemented in Bangladesh have been facilitated by the financial help and technical guidance by international lending agencies. These agencies have their own environmental and social safeguard policies, design codes, standards and guidelines which must be adhered to and which this EIA comply with.

64. Bangladesh is a party to a large number of international conventions, treaties, and protocols related to the environmental protection and are committed to ensuring that these protocols are complied with during all development works. The applicable international conventions, treaties, and protocols (**Table 6**) are the Rio Declaration (environment and development) 1992, Convention on Biological Diversity (Rio de Janeiro) 1992, UNESCO World Heritage Convention 2011, International Plant Protection Convention 1951, Plant Protection Agreement for the South East Asia and Pacific Region 1956, Convention on Biological Diversity 1992, UN Framework Convention on Climate Change 1992, Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) 1971, Convention on Persistent Organic Pollutants (Stockholm) 2001.

Table 6: Applicable International Laws

International Policy	Year	Description
Convention of Biological Diversity	1993	• 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).
UNESCO World Heritage Convention	1975	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.
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).
International Plant Protection Convention	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.
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.
Ramsar Convention (Convention on Wetlands of International	1971	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

International Policy	Year	Description
Importance especially as Waterfowl Habitat)		national actions and international cooperation. The Convention includes marine wetlands (wetlands up to a depth of six metres at low tide), islands, lakes and rivers.
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.
Paris Climate Conference Cop 21	2015	• Commits to a long -term goal of limiting warming to well below 2oC and to pursue efforts to limit temperature increase to 1.5oC. This is one of the most significant elements of the agreement; • Establishes global goals for mitigation and adaptation, which ensure balance between mitigation and adaptation in the agreement; • Sets out a framework for country commitments (nationally determined contributions) that will be submitted, implemented and strengthened in 5 -year cycles starting in 2020; • Includes strong recognition of the value of reducing emissions through forest protection, sustainable management and restoration, and the need to scale-up finance for these measures through, inter alia, international trading of credits; • Reflects a commitment towards scaled up climate finance; and • Acknowledges the need to address irreversible and extreme climate change impacts. In addition to the Agreement, in the margins of the COP: • Significant pledges to support action on climate change before the new agreement takes effect were made, including a new pledge of up to US$5 billion for REDD+; and • The Consumer Goods Forum co-chairs, Unilever and Marks & Spencer, unveiled their "Produce and Protect" commitment, a new kind of public- private partnership in addition to and supportive of current commitments to net zero deforestation.
Kyoto Proto col and Copenhagen Accord	1997 and 2009	• To achieve stabilization 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 timeframe 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.

Source: Ministry of Environment and Forests [2]

Major Institutions Involved in Environmental Planning and Implementation

65. Bangladesh has more than 200 laws and by-laws exist to tackle these challenges related to environmental issues, implemented by a number of agencies, which are shown in **Table 7**.

Table 7: Major Institutions involved in Environmental Permitting, as Part of EIA completion

Government Department	Relevant Planning and Enforcement Duties
Forest Department (FD)	No Objection Certificate will be required from FD as Project will require the cutting of trees in public area.
Department of Environment (DoE)	Environmental Clearance Certificate will be required for implementation of the Project.

Government Department	Relevant Planning and Enforcement Duties
Department of Fisheries (DoF)	No Objection Certificate will be required due to piling of piers in river.
Bangladesh Water Development Board	No Objection Certificate will be required due to river training works
Bangladesh Inland Water Transport Authority (BIWTA)	No Objection Certificate will be required due to construction of rail bridges over the water crossing.

3. Project Description

3.1 Project Justification

66. The project to introduce electric traction on the Narayanganj-Dhaka-Chattogram and Tongi-Joydebpur railway sections in Bangladesh aims to modernize the existing railway network, improve efficiency, and reduce operational costs. This involves implementing an overhead catenary system and establishing substations to power electric locomotives. The project is justified by the potential for increased train speeds, reduced travel time, lower operating expenses, and decreased environmental impact.

3.2 Project Description

67. The Government of Bangladesh Railways (BR) has developed a strategy to switch from diesel-electric traction to an electric traction system, which provides an economical, environmentally friendly and efficient transportation system. In this context, BR has started to work on the transition to the electric traction system, and started the study, project and feasibility studies in Between Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur Section, in line with the Strategic plan. It is expected that this Project will bring efficiency in railway operation and enhance the line capacity significantly. Further, the upgrading under the Project, particularly the existing loops will also permit the operation of longer trains, making better utilization of the available train slots.

68. The Project alignment between Narayanganj-Dhaka-Tongi-Joydebpur, Tongi-Pubail and Chattogram-Fouzderhat line sections, double stack train operations between Chattogram Port Station-Pubail Station-Dhirashram ICD. Also, it decided that Double-stack trains would consist of well-type wagons and two standard ISO (2.6m) containers. Regarding this decision: the contact wire minimum height will be 4.89m for single stack and 5.98m for double stack load gauge. So, when a structure is checked against electrical clearance this structure height should be a minimum of 5.39m for single stack and 6.48m for double stack. After that, these values will be used to check a structure's electrical clearance for a 25kV AC catenary system. Location is shown in Figure 1. Bangladesh Railway (BR) under the Ministry of Railways (MoR) is the Executing Agency (EA) of this Project. A component-wise breakdown of the work needed is as follows:

- Component 1: System operation modelling and load-flow simulation to identify the required number of substations, and switching stations for the preferred technology
- Component 2: Identification of preliminary locations of the traction power substations, and the switching stations.
- Component 3: Determination of the required number and rating of power transformers in each facility.
- Component 4: Establishment of conductor sizes and materials for the overhead catenary system and the feeder system.
- Component 5: Calculation of substation power demands and energy consumption.

Table 8: Total Length of the project

From	To	Approximate Distance (km)
Chattogram	Narayanganj	336.80
Chattogram Port	Fouzderhat	10
Tongi	Joydevpur	12
Pubail	Dhirisham	7.1
TOTAL		**365.90**

69. For these main purposes “Feasibility Study and Detailed Design for Introduction of Electric Traction (including Overhead Catenary & Sub-Station) in Between Narayanganj-Dhaka-Chattogram and Tongi-Joydebpur Section of Bangladesh Railway Project” initiated and after tendering stage completed, contract signed between Bangladesh Railways and TÜMAŞ(Consultant) at 16 July, 2023.

3.3 Project Location

70. Bangladesh Railways (BR) has developed a strategy to switch from diesel-electric traction to an electric traction system, which provides an economical, environmentally friendly, and efficient transportation system. In this context, BR has started to work on the transition to the electric traction system, and started the study, project and feasibility studies in Between Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur Section, in line with the Strategic plan. Main objective implementation of Electric Traction in Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur existing rail section to achieve below results.

- Reduce Running Cost.
- Increase revenue.
- Improve average Speed.
- Reduce locomotive maintenance cost.
- Reduce environmental pollution.
- To achieve Compatibility with Trans-Asian Railway Network

The alignment of the Project is presented in Figure 6

71. The impact assessment was confined to BR’s general legal right of way, which is between 50 and 100 m centered over the existing track and station sections respectively. However, these distances were adjusted in relation to sensitive receptors where excessive noise was predicted, and at river crossings where work in and over rivers was defined and wetland areas. For these areas the boundary widened to include variable distances, defined as needed.

72. Details on land elevation, settlements both rural and urban, road crossings of all types of roads, river and power line crossings, visible gas and pipe line crossings on and around the alignment were collected during the topographic survey.

73. Ground elevations at 25 m intervals and at places where there is marked difference in levels along the alignment and block levels up to 50 m on either side of the alignment were taken.

Block levels for a distance of 100 m on either side were taken at proposed station yard locations.

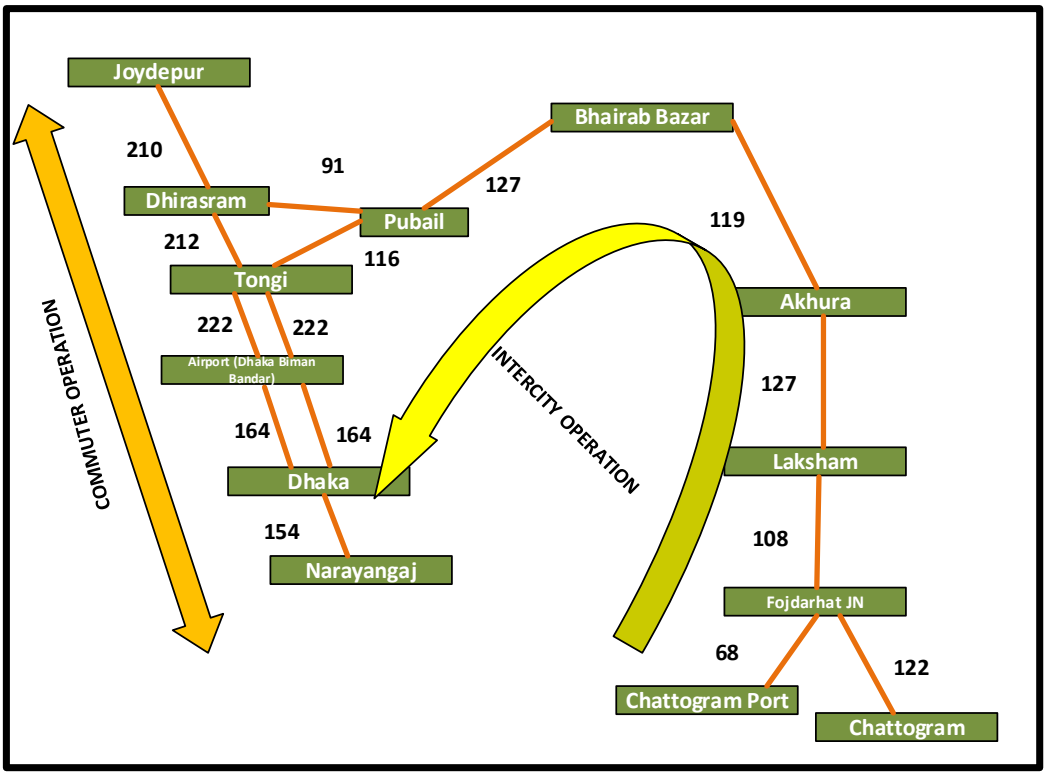


Figure 6: Location Map of the Project along with Existing Railway Stations

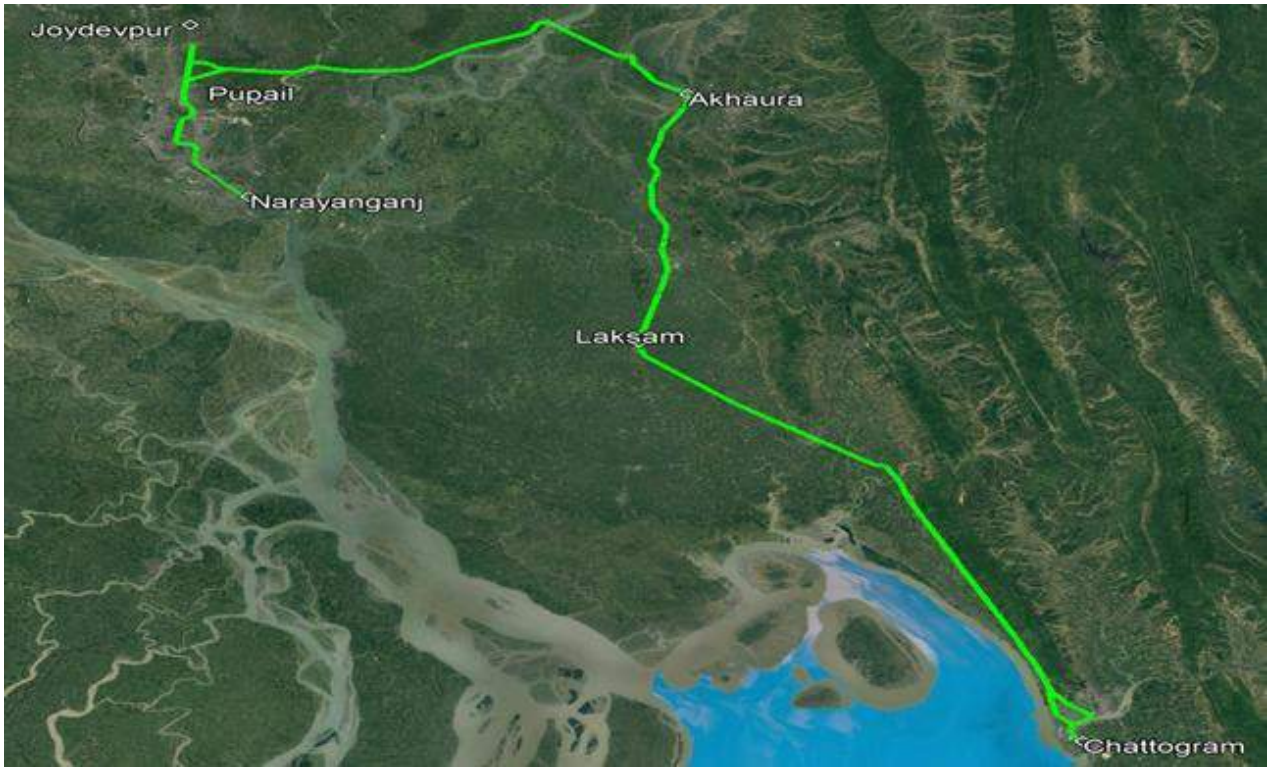


Figure 7: Main Line Scheme for Conceptual train operational Plan

Table 9:Sub-Station Construction area with Coordinates

SS & Workshop Name	Land Area	Point 1	Point 2	Point 3	Point 4
SS_1 Kumira	80x55 m	22°28'33.82"N 91°43'46.42"E	22°28'33.23"N 91°43'43.69"E	22°28'34.72"N 91°43'42.97"E	22°28'35.46"N 91°43'45.66"E
SS_2 Chinki Astana	80x55 m	22°53'17.41"N 91°32'16.71"E	22°53'17.80"N 91°32'18.59"E	22°53'15.33"N 91°32'19.50"E	22°53'14.95"N 91°32'17.62"E
SS_3 Laksam	80x55 m	23°12'31.26"N 91° 9'0.09"E	23°12'32.45"N 91° 8'58.66"E	23°12'34.08"N 91° 9'0.89"E	23°12'33.02"N 91° 9'2.16"E
SS_4 Mandabag	80x55 m	23°43'18.54"N 91° 8'59.58"E	23°43'19.00"N 91° 8'56.79"E	23°43'20.74"N 91° 8'57.24"E	23°43'20.28"N 91° 9'0.02"E
SS_5 Ashuganj	80x55 m	24° 2'15.86"N 91° 0'1.58"E	24° 2'17.36"N 90°59'59.28"E	24° 2'18.80"N 91° 0'0.44"E	24° 2'17.29"N 91° 0'2.75"E
SS_6 Pubail	80x55 m	23°56'0.48"N 90°29'54.57"E	23°56'0.57"N 90°29'52.63"E	23°56'3.17"N 90°29'52.76"E	23°56'3.08"N 90°29'54.71"E
SS_7 Tongi	75x50 m	23°54'41.18"N 23°54'41.18"N	23°54'38.59"N 90°24'35.75"E	23°54'38.41"N 90°24'37.69"E	23°54'41.00"N 90°24'38.00"E
SS_8 Fatulla	75x50 m	23°39'20.22"N 90°28'9.68"E	23°39'19.15"N 90°28'8.35"E	23°39'17.26"N 90°28'10.12"E	23°39'18.38"N 90°28'11.40"E
EMU Workshop (Joydebpur)	100x500 m	24° 0'48.30"N 90°24'38.11"E	24° 0'57.57"N 90°24'23.5	24° 0'55.07"N 90°24'21.28"E	24° 0'47.93"N 90°24'32.08"E
Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)		22°20'27.64"N 91°48'50.85"E	22°20'30.58"N 91°48'52.28"E	22°20'35.20"N 91°48'45.91"E	22°20'38.43"N 91°48'47.09"E
Dhaka Electric Loco Shed (Kamalapur)	30x40 m	23°43'28.05"N 90°25'38.15"E	23°43'27.64"N 90°25'39.11"E	23°43'26.37"N 90°25'39.18"E	23°43'26.75"N 90°25'38.20"E

Figure 8: Electric Loco Shed- Kamlapur

Figure 9: Electric Loco Workshop- Pahartali

Figure 10: EMU Workshop- Joydebpur

Figure 11: Substation- Kumira

Figure 12: Substation - Chinki Astana

Figure 13: Substation - Laksam

Figure 14: Substation - Mandabag

Figure 15: Substation - Ashuganj

Figure 16: Substation - Fatulla

Figure 17: Substation - Pubail

3.4 Amount of land: Amount of land required, land ownership, land acquisition

74. The alignment has been designed on the basis of the information collected from the currently available topographic, hydrological and geotechnical surveys and the design criteria stated earlier, while keeping in mind the objective of minimizing land acquisition. In describing the alignment, the terms “left” and “right” are used as viewed proceeding to Joydebpur from Chattogram.

Table 10: Amount of land required, land ownership, land acquisition

SI. No	Plot No.	Khatian No.	**land required of Plot (sqm)**	Total Arean of Plot (Acre)	Type of Land (As Per Record)	Area to be Acquired (sqm)	**Area to be Acquired (Acre)**	Full/Partial Plot to be acquired (%)	Type of Land (As per Physical Features)	**Owing Status (BR/Private)**	Owner Name	Area to be Acuired (Hqr)
Land Acquisition Schedule (Kumira)												
Thana/Upazila: Sitakunda, District: Chattogram												
Mouza Name: Bashbaria, J. I. No: 41, Sheet No:												
1	892	291	2225.773	0.55	Viti	1795	0.443554	81%	Viti	Jute Ministry	Torof Dowlot	0.1795
2	893	291	1821.087	0.45	Viti	1550	0.383013	85%	Viti	Jute Ministry	Torof Dowlot	0.155
3	894	291	3237.488	0.8	Viti	225	0.055599	7%	Viti	Jute Ministry	Torof Dowlot	0.0225
Land Acquisition Schedule (Laksam)												
Thana/Upazila: Laksam, District: Comilla												
Mouza Name: Paotoli, J. I. No: 332, Sheet No: 01												
4	371	Not given by the Local Authority	1133.121	0.28	Nal	950	0.23475	84%	Nal	Private	Rofikul Alom	0.095
5	358	Not given by the	809.372	0.2	Nal	275	0.067954	34%	Nal	Private	Munshi Monirul İslam	0.0275

		Local Authority										
6	359	Not given by the Local Authority	930.7778	0.23	Nal	900	0.222395	97%	Nal	Private		0.09
7	360	Not given by the Local Authority	283.2802	0.07	Nal	200	0.049421	71%	Nal	Private	Oliullah	0.02
8	372	Not given by the Local Authority	687.9662	0.17	Nal	450	0.111197	65%	Nal	Private	Ajijur Rahman, Arob Ali	0.045
Land Acquisition Schedule (Laksam)												
Thana/Upazila: Laksam, District: Comilla												
Mouza Name: Komodda, J. I. No: 286, Sheet No:												
9	140	22	1821.087	0.45	Nal	800	0.197684	44%	Nal	Private	Golam Rahman and Others	0.08
10	139	22	1942.493	0.48	Nal	425	0.10502	22%	Nal	Private	Bozlur Rahman	0.0425
Land Acquisition Schedule (Mandabag)												
Thana/Upazila: Kasba, District: Brahmanbaria												
Mouza Name: Jajishar, J. I. No: 117, Sheet No:												
11	1519	57	1294.995	0.32	Nal	260	0.064247	20%	Nal	Private	Al Mahmud, Abu Siddik	0.026
12	1520	1431	1013.334	0.2504	Nal	700	0.172974	69%	Nal	Private	Abu Taher	0.07

13	1523	204	566.5604	0.14	Nal	215	0.053128	38%	Nal	Private	Abdul Goni	0.0215
14	1524	204	971.2464	0.24	Nal	900	0.222395	93%	Nal	Private	Abdul Goni	0.09
15	1530	362	1214.058	0.3	Nal	1200	0.296526	99%	Nal	Private	Golan Samdani	0.12
16	1531	850	2225.773	0.55	Nal	725	0.179151	33%	Nal	Private	Humayun Kobir	0.0725
Land Acquisition Schedule (Pubail)												
Thana/Upazila: Gazipur Sadar, District: Gazipur												
Mouza Name: Pipuliya, Shimuliya, J. I. No: 03, 01, Sheet No: 01												
17	117	99	890.3092	0.22	Duba	200	0.049421	22%	Duba	Private	Abdul Latif	0.02
18	119		1011.715	0.25	Duba	200	0.049421	20%	Duba	Private		0.02
Land Acquisition Schedule (Tongi)												
Thana/Upazila: Tongi, District: Gazipur												
Mouza Name: Duttapara, J. I. No: 42, Sheet No: 02												
19	2910	490	930.78	0.23	Chala	105.057	0.0260	11%	Chala	Private	Neyazuddin	0.011
20	2911	311, 414	6758.26	1.67	Khama	1354.221	0.3346	20%	Khama	Private	Joynuddin & Kamaluddin	0.135
21	2912	573	2347.18	0.58	Khama	2347.180	0.58	100%	Khama	Private	Mominuddin	0.235
22	2913	221	2347.18	0.58	Khama	517.508	0.1279	22%	Khama	Private	Ankanonnesa	0.052
23	2940	94, 237, 648, 725	6191.70	1.53	Khama	530.419	0.1311	9%	Khama	Private	Abdul Gafur & Others	0.053
Land Acquisition Schedule (Joydebpur)												
Thana/Upazila: Gazipur Sadar, District: Gazipur												
Mouza Name: Deshipara, J. I. No: 29, Sheet No:												

24	305	8	404.69	0.1	Sail	151.57	0.0375	37%	Sail	Private	Aftabuddin & Others	0.015
25	306	113	156.61	0.0387	Chala	156.44	0.0387	100%	Chala	Private	Hasinuddin	0.016
26	324	8	607.03	0.15	Bari	392.99	0.0971	65%	Bari	Private	Aftabuddin & Others	0.039
27	328	8	571.82	0.1413	Bari	572.02	0.1413	100%	Bari	Private	Aftabuddin & Others	0.057
28	329	50, 97	6879.66	1.7	Bari	1520.95	0.3758	22%	Bari	Private	Alauddin, Sofor Ali Sikdar	0.152
29	330	8	11203.73	2.7685	Chala	11203.89	2.7685	100%	Chala	Private	Aftabuddin & Others	1.120
30	331	9	2630.46	0.65	Sail	2525.36	0.6240	96%	Sail	Private	Aftabuddin & Others	0.253
31	323	8	8822.15	2.18	Chala	5203.58	1.2858	59%	Chala	Private	Aftabuddin & Others	0.520
32	341	51	1618.744	0.4	Sail	248.34	0.0614	15%	Sail	Private	Hafizuddin	0.025
33	342	109	1659.213	0.41	Sail	522.45	0.1291	31%	Sail	Private	Hafizuddin & others	0.052
34	343	109	2446.732	0.6046	Amon	2446.59	0.6046	100%	Amon	Private	Hafizuddin & others	0.245
35	344	10	2751.865	0.68	Amon	2798.94	0.6916	102%	Amon	Private	Aftabuddin & Others	0.280
36	345	66	647.4976	0.16	Chala	94.58	0.0234	15%	Chala	Private	Sekandar Ali	0.009
37	346	27	607.029	0.15	Sail	563.73	0.1393	93%	Sail	Private	Abdul Wadud	0.056
38	347	88	647.4976	0.16	Sail	484.58	0.1197	75%	Sail	Private	Mises Jahanara	0.048

39	348	89	445.1546	0.11	Sail	426.27	0.1053	96%	Sail	Private	MD Anowar Hossain	0.043
40	349	10	4651.056	1.1493	Amon	4651.05	1.1493	100%	Amon	Private	Aftabuddin & Others	0.465
41	350	34	998.3604	0.2467	Sail	998.46	0.2467	100%	Sail	Private	Enayatullah Munshi	0.100
42	358	35	2792.333	0.69	Amon	142.50	0.0352	5%	Amon	Private	Enayatullah Munshi	0.014
43	359	109	728.4348	0.18	Sail	443.27	0.1095	61%	Sail	Private	Hafizuddin & others	0.044
44	360	51	1416.401	0.35	Amon	744.92	0.1841	53%	Amon	Private	Chinta Horon	0.074
45	363	50	1052.184	0.26	Sail	63.88	0.0158	6%	Sail	Private	Chinta Horon	0.006
46	371	6	4006.391	0.99	Pukur	761.51	0.1882	19%	Pukur	Private	Ayesha Khatun	0.076
47	374	65	7082.005	1.75	Chala	2246.43	0.5551	32%	Chala	Private	Mohammad Jomseduddin	0.225
48	375	108	1416.401	0.35	Chala	252.69	0.0624	18%	Chala	Private	Halima Khatun	0.025
49	376	87	2144.836	0.53	Chala	2125.18	0.5251	99%	Chala	Private	Mises Lotifa Begum	0.213
50	377	89	1319.681	0.3261	Chala	1319.80	0.3261	100%	Chala	Private	MD Anowar Hossain	0.132
51	378	88	768.9034	0.19	Chala	563.12	0.1391	73%	Chala	Private	Mises Jahanara	0.056
52	379	27	1537.807	0.38	Chala	124.91	0.0309	8%	Chala	Private	Abdul Wadud	0.012
Land Acquisition Schedule (Joydevpur)												
Thana/Upazila: Gazipur Sadar, District: Gazipur												

Mouza Name: Joydebpur, J. I. No: 58, Sheet No: 01												
53	623	7	13395.11	3.31	Mixed	200	0.0494	1%	Mixed	BR		0.020
54	647	125	283.2802	0.07	Bari	65	0.0161	23%	Bari	Private	Amina Khatun	0.007
55	643	1	263045.9	65	Mixed	180	0.0445	0%	Mixed	BR		0.018
56	745	1	263045.9	65	Mixed	45	0.0111	0%	Mixed	BR		0.005
57	744	1	263045.9	65	Mixed	65	0.0161	0%	Mixed	BR		0.007
58	749	689	1335.464	0.33	Dukan	75	0.0185	6%	Dukan	Private	Kupomoyi Kalimata	0.008
59	735	1	263045.9	65	Mixed	650	0.1606	0%	Mixed	BR		0.065
60	752	3	25292.88	6.25	Mixed	110	0.0272	0%	Mixed	BR		0.011
61	753	3	25292.88	6.25	Mixed	94	0.0232	0%	Mixed	BR		0.009

3.5 Project Activities and Implementation Schedule.

75. The project implementation phases and investment plan below for economic and financial analysis. This project will be implemented in different phases:

- Phase 1 Commuter Train Operation
    - Phase 1A: Gendaria - Dhaka- Joydebpur Electric Traction and Other Related Infrastructure (Including Maintenance Workshop) Construction Investment
    - Phase 1B: Narayanganj - Gendaria Electric Traction and Other Related Infrastructure Construction Investment
- Phase 2 Tongi-Chattogram Electric Traction and Other Related Infrastructure (Including Maintenance Workshop and Loco Shed) Construction Investment
- Phase 3 Rolling Stock
    - Phase 3A first lot rolling stock tendering for phase 1 (EMUs)
    - Phase 3B first lot rolling stock tendering for phase 2 (Electric Loco)
    - Phase 3C will continue to invest in rolling stock, considering future needs and rolling stock procurement plan for electric traction.

The investment plan is given below:

- BR will finalize tendering works for phase 1 in 2026 and will start operating with electric traction in 2028.
- BR will finalize tendering works for phase 2 in 2030 and will start operating with electric traction in 2033.
- BR will finalize Phase 3A tendering works in 2026 and add new rolling stock to inventory in 2028.
- BR will finalize Phase 3B tendering works for 2026 and add new rolling stock to inventory in 2033.
- BR will finalize Phase 3C tendering works for 2038 and add new rolling stock to inventory until 2047.

3.6 Process flow diagram (Material, Water, and Energy Balance)

76. The introduction of electric traction on the Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur sections of Bangladesh Railway involves a complex process with various material, water, and energy flows. A process flow diagram would visually represent these flows, illustrating how materials are acquired, processed, and utilized, and how water and energy are consumed and managed throughout the system. This diagram would be crucial for understanding the overall operational efficiency and environmental impact of the electric traction system.

77. A process flow diagram (PFD) visually represents the material, water, and energy balance of a process. It shows the flow of materials, water, and energy through various unit operations, including inputs, outputs, and recycle streams. The PFD helps in understanding the overall process, identifying potential bottlenecks, and optimizing resource utilization.

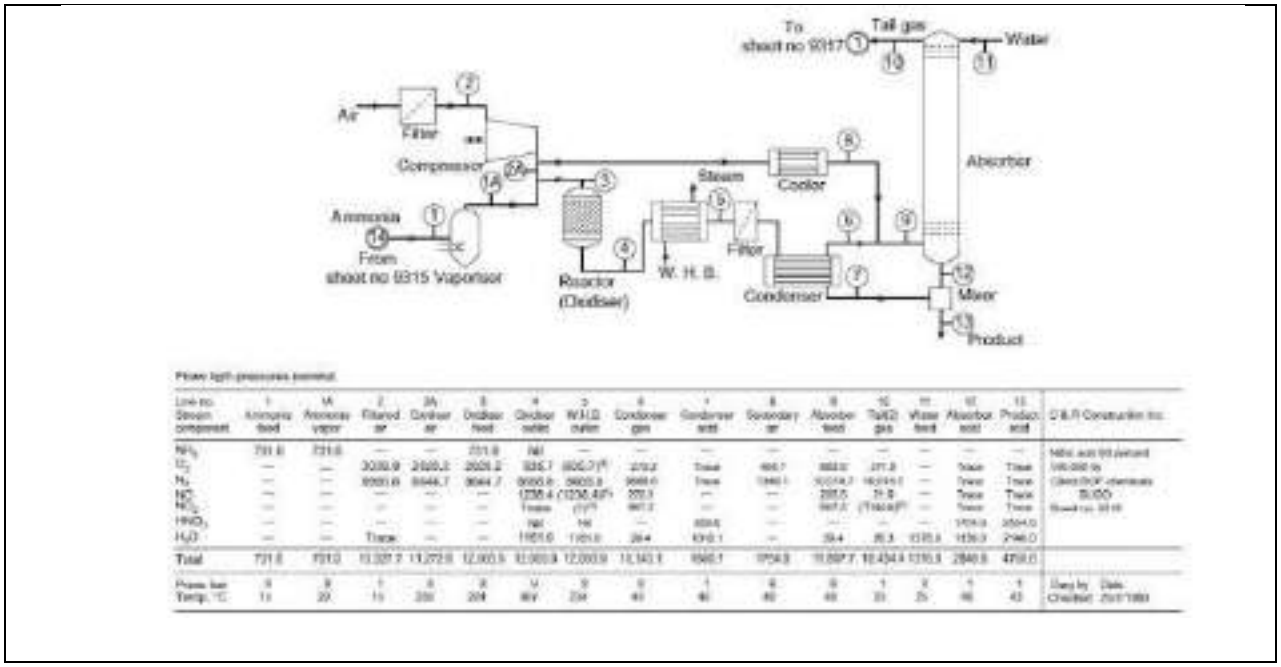


Figure 18: Process flow diagram (Material, Water, and Energy Balance)

3.7 Chemical Storage and Hazard Management

78. The "Chemical Storage and Hazard Management" aspect, mentioned in the context of the Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur electric traction project, likely refers to the safe storage and handling of chemicals used in the project, particularly those associated with the electric traction system's components like substations and overhead catenary systems. This includes chemicals used for cleaning, maintenance, and potentially even for fire suppression in critical areas. Key Considerations for Chemical Storage and Hazard Management:

- **Types of Chemicals:**

The project will likely involve various chemicals, including:

  - **Insulating oils:** Used in transformers and other electrical equipment in substations.
  - **Cleaning solvents:** For maintaining the overhead catenary and other electrical components.
  - **Fire retardants:** For fire suppression systems in critical areas.
  - **Lubricants:** For moving parts in electrical equipment.
  - **Corrosion inhibitors:** To protect metal components from rust and degradation.

- **Storage Requirements:**
  - **Segregation:** Chemicals should be stored separately based on their compatibility (e.g., flammable liquids should be kept away from oxidizing agents).
  - **Containment:** Storage areas should be designed to prevent leaks and spills, with appropriate containment systems in place (e.g., bunds for liquid storage).
  - **Ventilation:** Adequate ventilation is crucial for storing volatile chemicals to prevent the buildup of hazardous vapors.
  - **Temperature Control:** Some chemicals require specific temperature ranges for storage.
  - **Security:** Access to chemical storage areas should be restricted to authorized personnel.

- **Hazard Management:**

- **Risk Assessment:** A thorough risk assessment should be conducted to identify potential hazards associated with each chemical and develop appropriate control measures.
- **Personal Protective Equipment (PPE):** Workers handling chemicals should be provided with appropriate PPE, such as gloves, respirators, and eye protection.
- **Emergency Response Plan:** An emergency response plan should be in place to deal with spills, leaks, or fires involving chemicals. This plan should include procedures for containment, cleanup, and first aid.
- **Training:** Workers should be trained on the proper handling, storage, and disposal of chemicals. They should also be trained on the emergency response plan.
- **Waste Disposal:** Chemical waste should be disposed of properly according to local regulations.

- **Specific to Railway Operations:**
  - **Substation Safety:** Substations, where high voltages and hazardous chemicals are present, require special attention to safety.
  - **Catenary System Safety:** Working with the overhead catenary system can be hazardous due to the high voltages involved. Proper procedures and training are essential.
- **Environmental Considerations:**
  - **Minimizing Environmental Impact:** The project should aim to minimize the environmental impact of chemical storage and handling.
  - **Proper Disposal:** Chemical waste should be disposed of in an environmentally responsible manner.

79. By implementing robust chemical storage and hazard management procedures, the project can ensure the safety of workers, the public, and the environment. This is particularly important given the potential hazards associated with electrical traction systems and the chemicals used in their operation.

3.8 Wastewater Generation

80. While the primary focus of the project is electric traction, wastewater generation is a relevant environmental consideration. Potential sources of wastewater could include:
    - **Construction Activities:** Washing of equipment, site runoff, and potential sewage from construction workers.
    - **Substation Operations:** Small amounts of wastewater from cleaning and maintenance of substation equipment.
    - **Workshops:** Maintenance and cleaning of trains could generate wastewater.
81. The project's environmental impact assessment addresses these potential sources of wastewater and implements appropriate mitigation measures, such as:
    - **Proper drainage and containment:** Ensuring wastewater is properly managed and does not contaminate surrounding areas.
    - **Wastewater treatment:** Implementing treatment systems for wastewater generated from workshops and substations.
    - **Minimizing water usage:** Promoting water conservation practices during construction and operation.

3.9 Use of Hazardous Materials

82. The introduction of electric traction on the Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur sections of Bangladesh Railway will involve the use of various hazardous materials during construction and operation. These materials include, but are not limited to, oils,

lubricants, and cleaning agents for the locomotives and other equipment, as well as various chemicals used in the construction and maintenance of the overhead catenary and substations. A detailed waste management plan will be developed to ensure the proper disposal of hazardous waste generated during construction and operation.

3.10 Demand for resources and utility services

83. For this project Railway will require significant resources and utility services, including the construction of an overhead catenary system, substations, and potentially workshops. This project will necessitate substantial investment, particularly for the main line, and will involve tendering processes for various phases of the project. The project also aims to improve travel times, reduce operational costs, and enhance passenger amenities.
84. Electricity is the primary utility service will be a reliable and consistent power supply from the national grid, requiring coordination with the Bangladesh Power Development Board (BPDB).
85. Water will be needed for various purposes, including construction and maintenance activities.
86. A robust communication system will be essential for train control, signaling, and passenger information.
87. Efficient transportation of materials and equipment will be necessary during the construction and operation phases.

3.11 Potential for contamination

88. The introduction of electric traction on the Narayanganj-Dhaka-Chattogram and Tongi-Joydevpur sections of Bangladesh Railway, including overhead catenary and substations, presents both opportunities and potential contamination challenges. The project aims to enhance train speed, reduce operational costs, and minimize environmental impact by transitioning from diesel to electric locomotives. However, the construction and operation of the electric traction system could lead to localized contamination issues. Potential Contamination Sources:

- **Construction Phase:**
    - **Catenary Pole Installation:** Digging foundations for catenary poles can generate dust and potentially disturb soil, leading to localized contamination if not managed properly.
    - **Material Transport:** Transportation of construction materials like steel, concrete, and other equipment can cause dust and minor spills, contributing to air and soil contamination.
    - **Waste Generation:** Construction activities generate various types of waste, including construction debris and packaging materials, which need to be managed to prevent environmental pollution.
- **Operational Phase:**
    - **Substation Operations:** Substation equipment may contain hazardous materials like insulating oil, which could leak or spill in case of accidents or improper maintenance, contaminating soil and water.
    - **Overhead Catenary Maintenance:** Maintenance activities, such as replacing damaged wires or insulators, could generate waste materials that need to be disposed of responsibly.
    - **Electric Traction System:** The electric traction system itself, including the catenary and substations, could be a source of electromagnetic radiation, which may have potential health and environmental impacts if not properly managed.

89. While the introduction of electric traction in Bangladesh Railway offers numerous benefits, it's crucial to proactively address potential contamination issues through careful planning, implementation, and monitoring. By implementing appropriate mitigation measures, the project

can minimize its environmental impact and contribute to a more sustainable transportation system.

4. Description of the Environment

4.1. Introduction

90. The proposed introduction of electric traction, including overhead catenary and substations, on the Narayanganj-Dhaka-Chattogram and Tongi-Joydebpur sections of Bangladesh Railway aims to modernize the existing railway system. This project is expected to bring significant benefits, including reduced travel time, lower operational costs, and decreased reliance on road transport. The environmental impact during construction is anticipated to be minimal, with potential benefits like reduced fuel consumption and a greener transportation system.

4.1.1 Site Overview

91. The centre line of alignment represents the centre line of BG track. The track will be reconstructed as a three-rail configuration with one of the outer rails as a common track, thus accommodating both MG and BG traffic. The outer rail on the right side of the track will be the 'common' rail for the Project. The Proposed boundaries of the work are as follows in (**11)**.

Table 11: Environmental Impact Assessment Site overview of the Project

Component	Definition	Boundary
General Right of Way	Legal RoW of the BR rail line (centred over track) Non station sections:	50 m
Legal RoW of the BR rail line (centred over track) station sections:	100 m	
Legal RoW of the BR rail line (centred over track) large bridges:	100 m	
Air Quality	50 m distance other than at stations centred over existing track. At Stations: 100 m	
Noise: the boundaries for noise measurements will be variable since noise is relevant when it impacts a sensitive receptor and there are rural track sections and sections through urban areas and stations	a) the nearest sensitive receptor (record distance); b) + 25 m reading from source c) +50 m reading from source d) At stations 10,25 and 50 m distance readings	
Surface Water Quality	Upstream at river crossing and at least 5 m from shore	25 m U/S and D/S of crossing centreline and at 1 m below
Groundwater	Tube wells within General RoW of 100 m	Identify tube well and measures distance from work area
Terrestrial Ecosystem	Generally visual survey including 50 m in either side of the alignment for its entire length	
Aquatic Ecosystem	Survey to be completed at major river crossing only	
Sensitive, protected components of the environment	Wetlands, special habitat, large river crossings. Survey as needed and depending on existing habitat in the Project corridor of impact	1 km on either side of track centreline

Table 12: List of Rivers and Major Canals on the Project Alignment

Sl No	Bridge No	KM	River/Canal	Lengh of Bridge (m)
1	50	23+699	Kumira Sarat	18.3
2	53	25+031	Chota Kumira	18.3
3	155	061+043	Mahamaya	12.2
4	181	72+599	Feni River	230.85
5	185	77+400	Muhuri River	138.6
6	190A	84+091	Kalidash Pahari River	46.6
7	207	105+964	Dakatia River	117
8	Fouzderhat to CGPY		Canal Connecting Bay of Bengal	4 Major & 11 Minor bridges
9	Fouzderhat to CGPY		Canal Connecting Karnafuli River	1 Major & 5 Minor Bridges
10	Fouzderhat to CGPY		Mahesh Khal	1 Major bridge
11	231	138+158-140+333	Dakatia River	48.76
12	232	138+158-140+333	Goniajoori Khal	36.57
13	234	142+393-147+763	Goniajoori Khal	36.57
14	243	153+546-160+616	Gumti	115.85
15	246	153+546-160+616	Gumti Spill	61
16	259	174+714-178+728	Salda	18.3
17	261	174+714-178+728	Bajna	41.77
18	272	188+500-190+402	Sinai	18.3
19	276	197+090-199+434	Howrah	18.3
20	1	202+843	Titas	218.7
21	1A	203+912	Titas Spill	42.972
22	12	215+397	Kurulia	80.2
23	26	232+064	Meghna	982.2
24	34	236+499	Brahmaputra	198.4
25	63	261+226	Arial khan	136.85
26	65	262+789	Haridhoa	80.2
27	79	275+204	Sitalakhya	367.65
28	89	288+551	Balu	80.2
29	Dhaka- Tongi		Tongi Khal	100
30	Tongi Joydebpur		Hydrabad Khal	60

92. Therefore, once details are known, BR will update the EIA's; EMP and address the noise and dust issues associated with crushing and transportation operations taking place in Bangladesh

Infrastructure in Support of the Project

Level Crossing

93. There are authorized and unauthorized level crossings along this corridor. The authorized level crossings having been approved by BR, and are owned, operated and maintained by BR. All the authorized gates fall in the categories as mentioned in Table 13. The unauthorized level crossings are those over which passage of traffic has not been permitted by BR. These unauthorized level crossings are not maintained by BR and consequently pose a constant threat to public safety. There are 51 authorized level crossings and 108 unauthorized level crossings along the Project Corridor (Table 14). These are of different categories and classifications (Special, A, B and C) according to Bangladesh Railway (BR) regulations. The

level-crossing gates will require signalling and approach warning systems designed to accommodate the number of train-vehicle units (TVUs) passing over level-crossing gates well into the future. The Consultant recommends closure of 67 unauthorized level crossings and authorization of the remaining 92 (including the 49 existing authorized gates) into different classes (**Table 13**); i.e., 45 new authorized gates.

Table 13: Criteria for Classification of Level Crossings

Class	Criteria
Special Class	TVUs greater than 50,000
A Class	TVUs between 50,000 & 30,000 Or Line capacity utilization 80% (on single line) and number of road vehicles greater than 1,000.
B Class	TVUs between 30,000 and 20,000 and number of road vehicles greater than 750
C Class	All other level crossings for road not covered in above classes
D Class	For cattle crossings
Where, TVU= Train Vehicle Unit (No. of trains per day X No. of road vehicle units per day) ❖ TVUs unit of measurement (i) Train, Motor vehicle, bullock carts & Tanga – 1 unit (ii) Cycle rickshaw & Auto-rickshaw. - ½ unit	

Hydrology and River Training Works

94. The surface water along the proposed alignment is dominated by the three major rivers and their tributaries and so also the hydrology and drainage system.

95. Effective drainage of rainwater in the monsoon season is very important to safeguard the embankments must be protected against failure. The flow of water should not be allowed along the track as it not only contaminates the ballast but also erodes the formation. Ponding of water at the base of the embankment is not desirable and has been addressed by installing longitudinal drainage pipes under the toe of the embankments to drain to the nearest watercourses. A transverse cross-drainage pipe will discharge water from the sump to the longitudinal drain at the toe of the embankments.

96. **Navigation Clearance** – Bridges crossing navigable perennial rivers in Bangladesh must provide minimum clearances as defined by the Bangladesh Inland Water Transport Authority (BIWTA). BIWTA has specified the horizontal and vertical clearance for various classes of navigation channels (**Table 14**) and which the Project designers are adhering to.

Table 14: Navigational Clearance for Proposed Railway Bridge

Name of Route	Draught	Length of Route and Percentage	Vertical Clearance	Horizontal Clearance
Class- I	3.65 m	683 km (11%)	18.30 m	76.22 m
Class- II	2.13 m	1,000 km (17%)	12.20 m	76.22 m
Class -III	1.52 m	1,885 km (32%)	7.62 m	30.48 m
Class -IV	1.52 m	2,400 km (40%)	5.00 m	20.00 m
Total		**5,968 km (100%)**		

97. The datum for measuring the vertical clearance is the Standard High-water Level (SHL). None of the rivers in the Project corridor are legally designated as navigable waters under any of the above four categories. However, local boats are used for crossing the rivers at many locations during floods, and therefore minimum clearance for small boat traffic, say Class IV, will be maintained.

Social and Resettlement Considerations

98. Despite the limited trackside acquisition, the number of affected households and shop/businesses is quite significant. This is because most affected households and businesses are in clusters and located close to railways stations, bazars and railway crossings, effectively inside the BR RoW. In the rural section of the railway track, the newly acquired lands are typically agricultural.

99. All technical efforts have been undertaken to minimise the impact by using the existing railway track, which is on average 30 m wide. The width of new acquisition is 10 m, taken from only one side of the track as a measure to minimise potential adverse impacts.

100. The scope of social safeguard works for the Project includes:

(i) consultation with affected communities and stakeholders;

(ii) social surveys and census of all effected households and structures (residential, commercial, community structures),

(iii) property valuation survey (land, structures, trees) for replacement value;

(iv) preparation and disclosure of RP, including the Project entitlement policy and matrix; and

(v) income and livelihood restoration of the affected households as well as vulnerable groups. This work was completed by the Consultant's social sector team.

4.2 Physical Environment

4.2.1 Topography

101. **Annex 4, Figure 4** presents a digital elevation model (DEM) of Bangladesh based on a 300 m grid. From the DEM, topography of the Project area slightly undulating, with elevation changes from 0 metre to 23 metres above mean sea level.

102. The Project area comprises the following physiographic units. The Project corridor lies within the subzone of Meghna Flood plain (45%), Chattogram CHT (30%) and coastal plains (25%) zone.

103. Chattogram coastal plain comprises gently sloping piedmont plains near the hills, river floodplains alongside the Feni, Karnafuli, Halda and other rivers, tidal floodplains along the lower courses of these rivers, a small area of a young estuarine floodplain in the north, adjoining sub-regional young Meghna estuarine floodplain, and sandy beach ridges adjoining the coast in the south. Sediments near the hills are mainly silty, locally sandy, with clays more extensive in floodplain basins. The whole of the mainland area is subjected to flash floods.

104. The terrain along these key railway sections in Bangladesh is predominantly low-lying and flat, shaped by the deltaic landscape of the Ganges–Brahmaputra–Meghna River system. Here's a breakdown of the topographical features relevant to the electrification project:

Table 15: Environmental Impact Assessment Boundaries for the Project

Section	Average Elevation	Terrain Type	Notable Features
Narayanganj–Dhaka	6–7 meters	Urban floodplain	Dense urbanization, river crossings
Dhaka–Chattogram	5–20 meters	Alluvial lowlands	Rivers, wetlands, rolling hills near Comilla
Tongi–Joydevpur	10–16 meters	Slightly elevated	Suburban sprawl, light industrial zones

105. Key Topographical Considerations

- **Flood Risk**: Much of the corridor lies in flood-prone zones, especially near Narayanganj and Dhaka, requiring elevated or flood-resilient infrastructure.
- **Soil Conditions**: Predominantly **alluvial and clayey**, which may affect foundation design for masts and substations.
- **River Crossings**: Multiple bridges span rivers like the **Buriganga**, **Shitalakshya**, and **Meghna**, necessitating specialized catenary support structures.
- **Urban Density**: In Dhaka and Narayanganj, limited space and dense construction pose challenges for substation placement and overhead line installation.

106. This topography demands a resilient and adaptive electrification design, balancing technical feasibility with environmental and urban constraints

4.2.2 Climate

107. Despite the general predictability of the seasons in Bangladesh, local conditions vary widely across the country. As such, Bangladesh can be divided into seven climactic sub-zones based on differences in a range of factors including rainfall, temperature, evapotranspiration and local seasonality.Source*: Rashid, Haroun Er*

108. Figure 19 shows that the Project area is located within the South-Eastern region and is characterized by heavy rainfall, often in excess of 2,500 mm/year, as well as somewhat mild summers and cloudy, cool winters. Mean daily maximum temperature reaches 31°C – generally in the month of April, and mean daily minimum temperature may at times fall below 10°C – usually in January. Average humidity is relatively high, often exceeding 80%, and most rainfall occurs during the monsoon season. Fog is very common in winter, and the north-eastern region is considered to be the cloudiest part of the country.

109. Twenty years average climatic data (2004-2024) collected from Dhaka, Cumilla, Feni, Sitakund and Chattogram weather stations (Bangladesh Meteorological Department, Dhaka) reflect the weather pattern of the Project Corridor as outlined in **Table 16.**

Table 16: Weather Pattern of the Project Corridor

Description	Dhaka	Cumilla	Feni	Sitakund	Chattogram
Average Annual Maximum Temperature (2004-2024)	32..5(°C)	33.7(°C)	34.0 (°C)	34.4(°C)	33.4(°C)
Average Annual Minimum Temperature (2004-2024)	18.7 (°C)	18.3 (°C)	18.2 (°C)	17.6(°C)	19.4(°C)
Average Annual Rainfall (2004-2024)	2467 mm	2157 mm	3132 mm	3398 mm	3132 mm

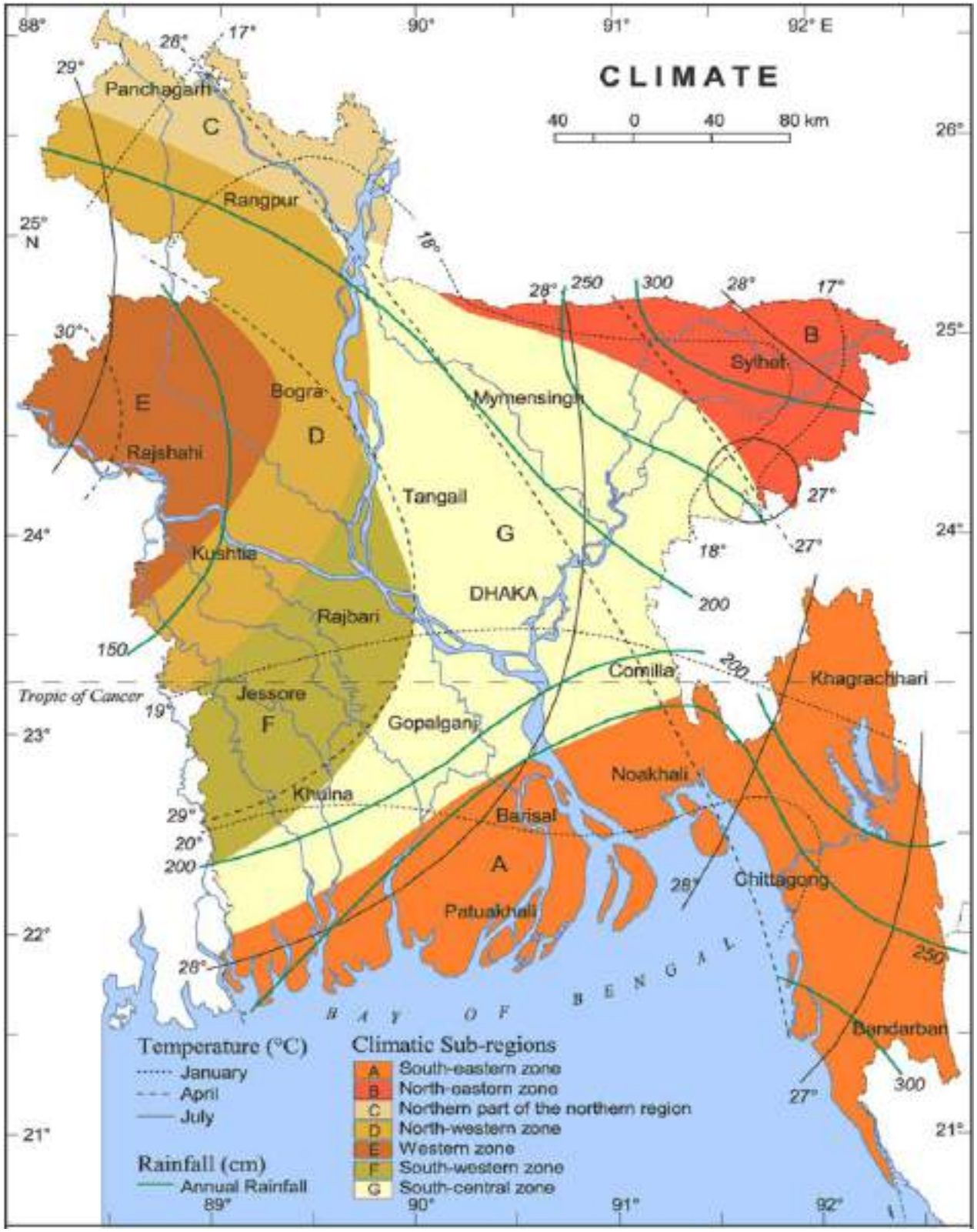
Description	Dhaka	Cumilla	Feni	Sitakund	Chattogram
Average Annual Relative Humidity (2004-2024)	81%	80%	80%	81%	78%

Rainfall and Air Temperature

110. Within the Project corridor rainfall varies considerably from year to year and month to month. The average annual rainfall from 2004 to 2024 of the study area approximately 2,955 mm (**Figure 20**), with about 88% of the mean annual rainfall occurring during the period from May to October, and 36% during June – July .

111. The driest month is January, with 1.2 mm of rainfall and the greatest amount of precipitation occurs in July, with an average of 708 mm. During, July 2015, the highest precipitation recorded at Chattogram station, which is 1,466 mm. The precipitation varies by 458 mm between the driest month and the wettest month.

112. Figure 21, Figure 22 and Figure 23 show the mean maximum and minimum air temperature (during 2004-2024) of the Dhaka, Cumilla, Feni and Sitakund meteorological substation respectively. May is the warmest month with average temperature 37.1 and 37.5 °C respectably at these locations. As recorded, January is the coolest month in Dhaka and Cumilla with temperature averaging 10 °C and 8.7 °C respectively.



Source: Rashid, Haroun Er

Figure 19: Climatic Map of Bangladesh

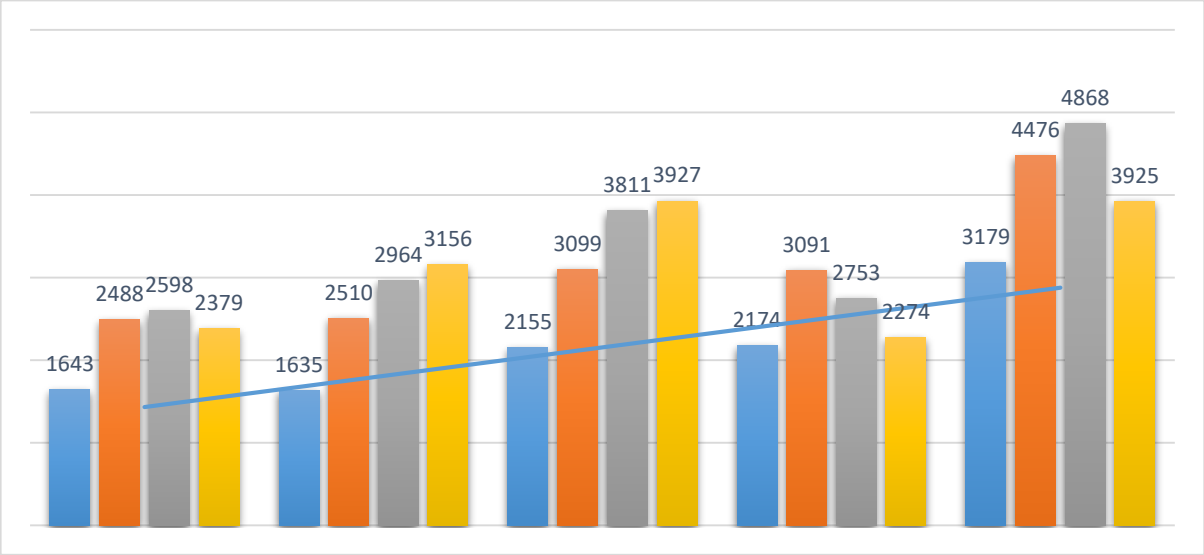
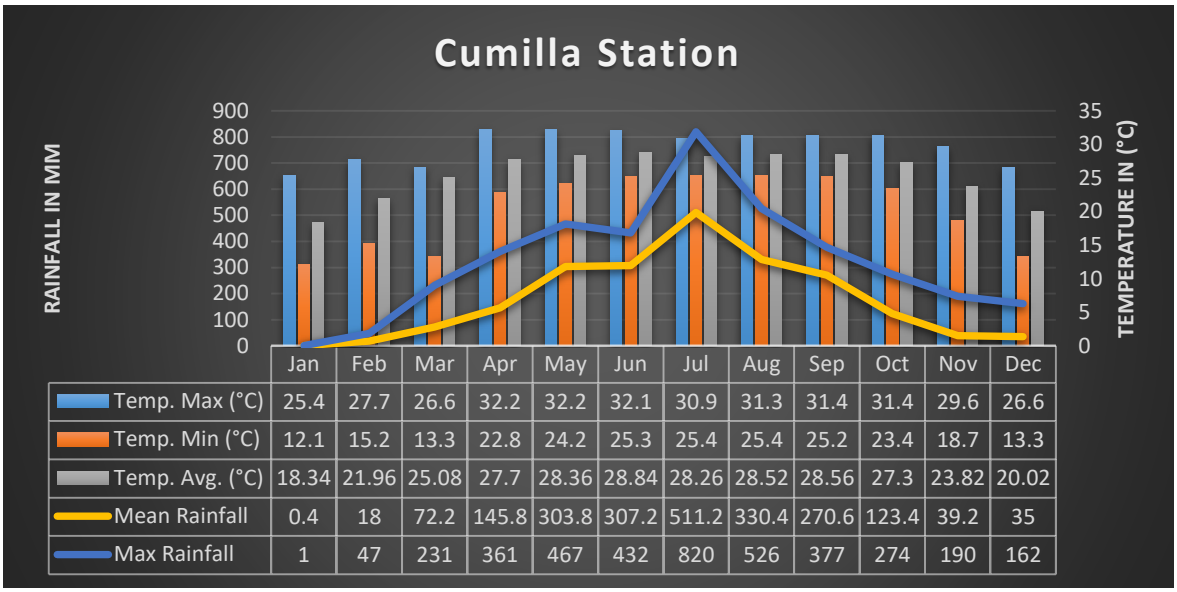


Figure 20: Annual Rainfall in Weather Station of the Project

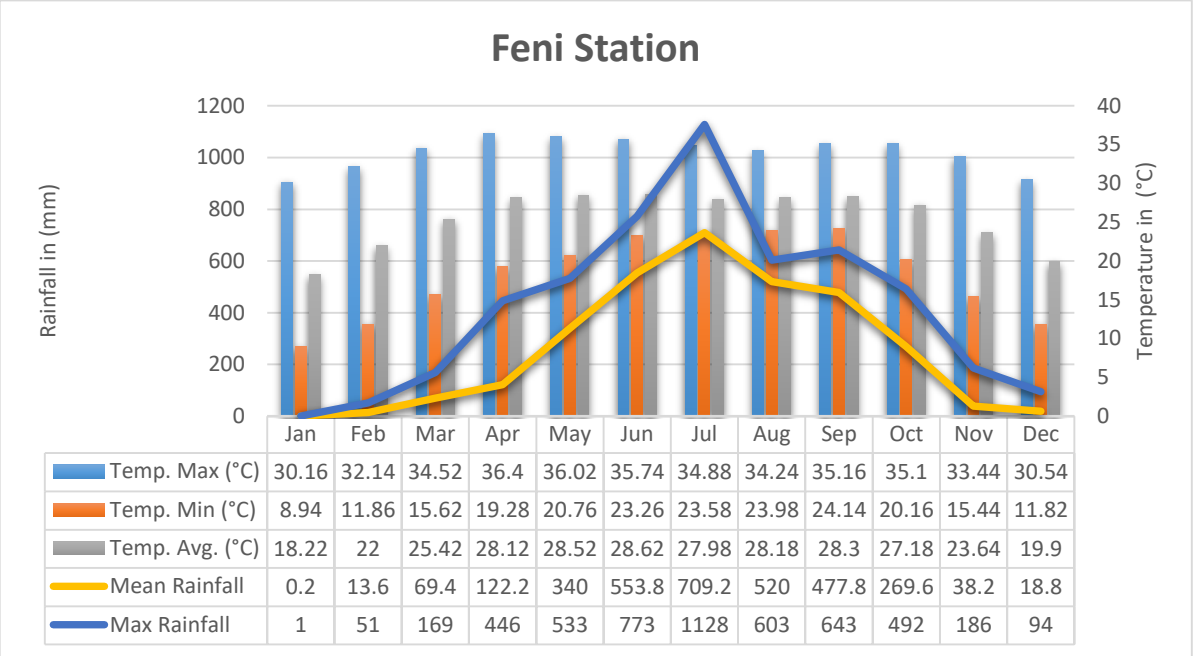
Source: Bangladesh Meteorological Department



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. Max (°C)	25.4	27.7	26.6	32.2	32.2	32.1	30.9	31.3	31.4	31.4	29.6	26.6
Temp. Min (°C)	12.1	15.2	13.3	22.8	24.2	25.3	25.4	25.4	25.2	23.4	18.7	13.3
Temp. Avg. (°C)	18.34	21.96	25.08	27.7	28.36	28.84	28.26	28.52	28.56	27.3	23.82	20.02
Mean Rainfall	0.4	18	72.2	145.8	303.8	307.2	511.2	330.4	270.6	123.4	39.2	35
Max Rainfall	1	47	231	361	467	432	820	526	377	274	190	162

Source: Bangladesh Meteorological Department, BMD

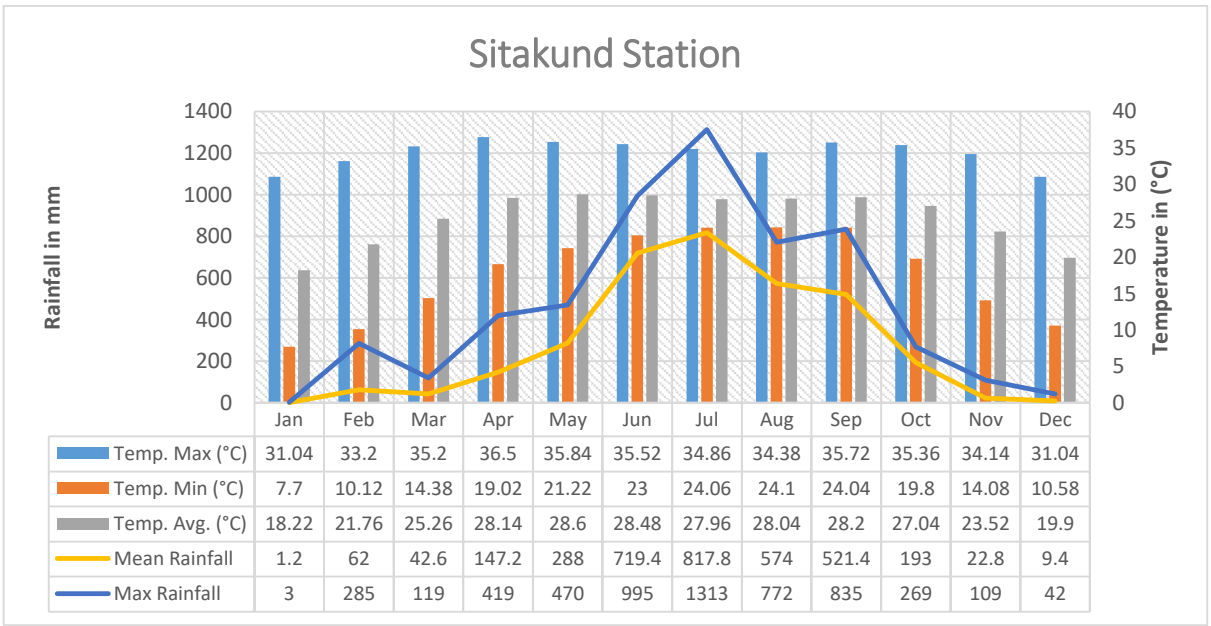
Figure 21: Mean Monthly Maximum, Minimum & Average Temperature and Total Rainfall in Cumilla Station (2004- 2024)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. Max (°C)	30.16	32.14	34.52	36.4	36.02	35.74	34.88	34.24	35.16	35.1	33.44	30.54
Temp. Min (°C)	8.94	11.86	15.62	19.28	20.76	23.26	23.58	23.98	24.14	20.16	15.44	11.82
Temp. Avg. (°C)	18.22	22	25.42	28.12	28.52	28.62	27.98	28.18	28.3	27.18	23.64	19.9
Mean Rainfall	0.2	13.6	69.4	122.2	340	553.8	709.2	520	477.8	269.6	38.2	18.8
Max Rainfall	1	51	169	446	533	773	1128	603	643	492	186	94

Figure 22: Mean Monthly Maximum, Minimum & Average Temperature and Total Rainfall in Feni Station (2004-2024)

Source: Bangladesh Meteorological Department, BMD



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. Max (°C)	31.04	33.2	35.2	36.5	35.84	35.52	34.86	34.38	35.72	35.36	34.14	31.04
Temp. Min (°C)	7.7	10.12	14.38	19.02	21.22	23	24.06	24.1	24.04	19.8	14.08	10.58
Temp. Avg. (°C)	18.22	21.76	25.26	28.14	28.6	28.48	27.96	28.04	28.2	27.04	23.52	19.9
Mean Rainfall	1.2	62	42.6	147.2	288	719.4	817.8	574	521.4	193	22.8	9.4
Max Rainfall	3	285	119	419	470	995	1313	772	835	269	109	42

Figure 23: Mean Monthly Air Temperature and Total Rainfall in Sitakundo Station (2004- 2024)

(Source: Bangladesh Meteorological Department, BMD)

Relative Humidity

113. In the Project area the relative humidity is the lowest (62% - 68%) during December to March, and from April there is a steady increase till September. The highest humidity recoded at Feni station (90%) and Sitakund (89%) during July 2015 and the lowest at Chattogram (62%) during March 2024.

Wind

114. Monthly prevailing wind data (wind speed and wind directions) were collected from Cumilla, Feni, and Sitakund and Chattogram substations for twenty years (2004-2024) and analyse to determine the distribution of wind force within the study area. The average wind speed recorded in Cumilla, Feni and Chattogram Stations are 2.43, 2.37 and 6.26 knots respectively.

The highest wind speed recorded at Chattogram in the month of March, 2024, which was 7.2 knot (3.70 m/s)[1].

4.2.3 Natural Hazards

115. The proposed electrification route traverses regions that are highly vulnerable to natural hazards, shaped by Bangladesh's deltaic geography and monsoonal climate. These risks must be carefully integrated into the design and implementation of railway infrastructure.

Table 17: Key Natural Hazards

Hazard Type	Description	Affected Areas
Flooding	Seasonal monsoon floods and river overflows due to low elevation	Narayanganj, Dhaka, Brahmanbaria, Comilla
Cyclones & Storm Surges	Tropical cyclones from the Bay of Bengal causing wind damage and coastal flooding	Chattogram region
Riverbank Erosion	Gradual loss of land along major rivers like the Meghna and Shitalakshya	Narayanganj, parts of Comilla
Waterlogging	Poor drainage in urban areas during heavy rainfall	Dhaka, Narayanganj
Earthquakes	Moderate seismic risk due to proximity to tectonic boundaries	Entire corridor, especially Chattogram
Heatwaves	Increasing frequency due to climate change	Urban centers like Dhaka and Narayanganj

Flood Risks

116. Floods usually occur between July and August, and severe floods seem to reoccur every 7 years, and catastrophic floods every 33-50 years. Every year, nearly 26,000 km^2 or around 18% of the country is flooded. But railway embankments in the Project area are mostly above prevailing flood levels.

117. According to Flood Map (**Figure 2**) it's recorded that 50% of the Project corridor falls on moderate river flooding and 40%o of the Project corridor falls on not flood prone. Only 10% of the Project corridor cover flash flooding and river flash flooding region.

Cyclones and Storm Surges

118. In Bangladesh, due to its unique geographic location, suffers from devastating tropical cyclones frequently. The funnel-shaped northern portion of the Bay of Bengal causes tidal when cyclones make landfall due to which thousands of people living in the coastal areas are affected. Some of the most devastating natural disasters in recorded history with high casualties were tropical cyclones that hit the region now forming Bangladesh **(Annex 4, Figure 3)** shows that 83 % of the Project area is mostly lies in no risk and low risk zone area except last 22 km at Chattogram side which is close to Bay of Bengal. This 22 km stretch which covers 17% of the Project corridor falls under high-risk cyclone zone.

4.2.4 Physiography

[1] 1 knot =0.5444 m/s.

119. The physiographic setting of this railway corridor is shaped by Bangladesh's dynamic deltaic landscape, which plays a crucial role in planning and implementing electric traction infrastructure. Here's a breakdown of the key physiographic zones the route traverses:

Table 18: Major Physiographic Divisions

Section	Physiographic Unit	Characteristics
Narayanganj–Dhaka	**Madhupur Tract (fringe) & Floodplains**	Low-lying floodplains with some elevated terraces; dense urban development
Dhaka–Comilla	**Old Meghna Estuarine Floodplain**	Flat alluvial plains with seasonal flooding and silt deposits
Comilla–Chattogram	**Chittagong Hill Tracts (foothills)**	Undulating terrain with rolling hills and narrow valleys
Tongi–Joydevpur	**Madhupur Tract (northern edge)**	Slightly elevated red clay terraces with better drainage

4.2.5 Agro-ecological Zone

120. The railway corridor spans multiple Agro-Ecological Zones (AEZs), each defined by unique combinations of soil type, physiography, hydrology, cropping patterns, and seasonal flooding. These zones are critical for understanding land use, soil stability, and environmental impacts of electrification infrastructure.

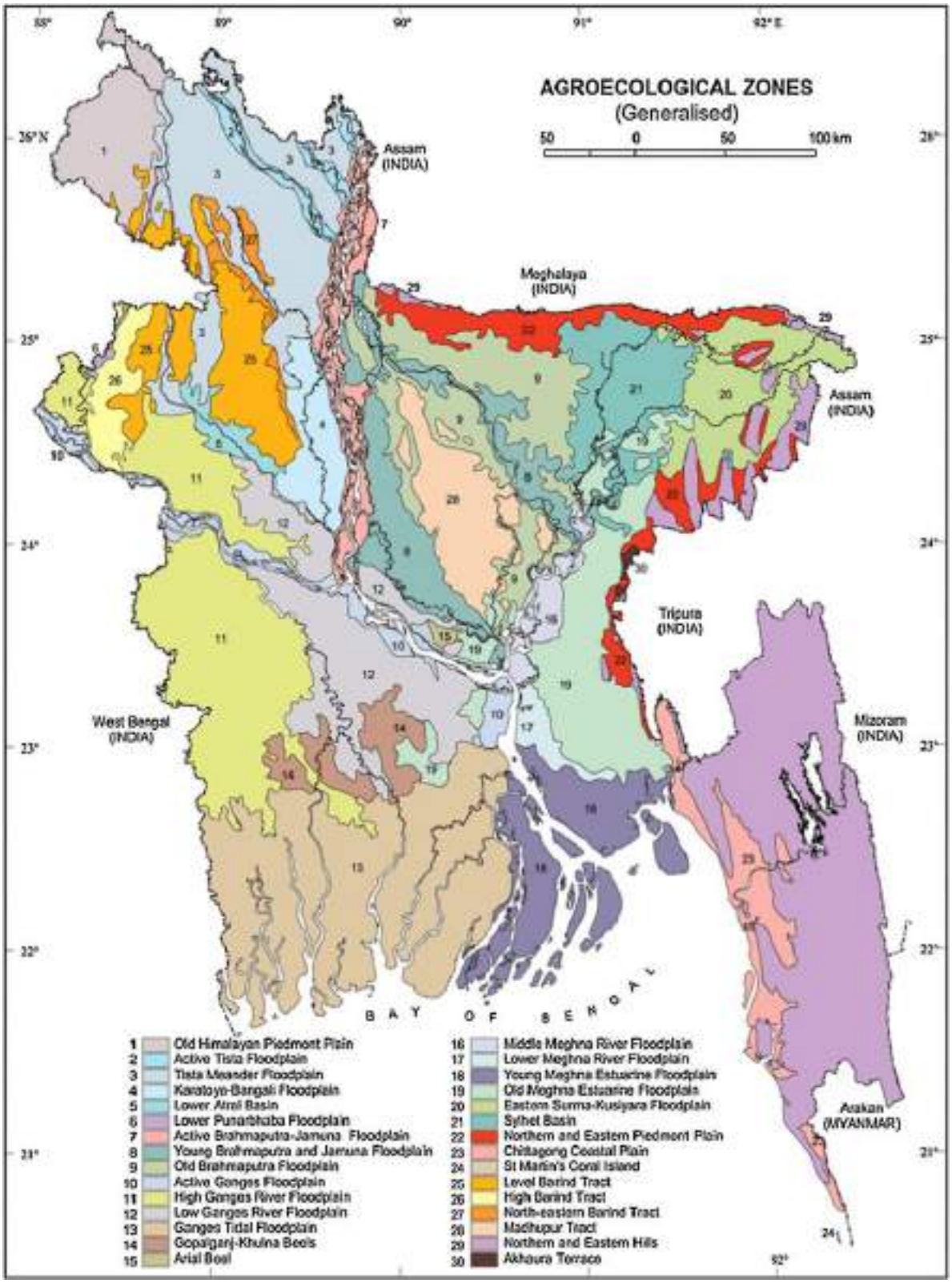


Figure 24: Map of AEZs Traversed by the Corridor

4.2.6 Geology and Soil

121. The geology of Bangladesh can be divided in 15 categories and out of which three of them fall within the Project corridor. The alignment passes through active and nearly level alluvium and dune sand zone. The geological map (**Figure 5**) shows these geological units are Chandina alluvium (30%), valley alluvium (40%) and beach and dune sand (30%) in the Project area. All of these geological settings impact on need to concern about embankment and piling preparation.

122. The soils type of the Project area consists mainly in three categories, which are non-calcareous dark Grey floodplain soils (40%), Non-Calcareous Grey floodplain soils (40%) and Brown Hill soils (20%). From Laksam to upper part of Feni falls within the Grey floodplain soils & non-calcareous dark Grey floodplain soils, from upper part of Feni to upper part of Chattogram falls within Calcareous alluvium, and Chattogram region fall within Grey piedmont soils **(Annex 4, Figure 6).**

123. Given its very flat topography the Project area is not prone to erosion hazards. Historically, the area has seen little erosion. Along the alignment, due care has been taken to ensure that the effects of climate change do not adversely impact the railway.

4.2.7 Hydrology

124. The railway track traverses two distinct hydrographic systems; namely SE (South East) Hydrologic Regions of Bangladesh and after crossing Little Feni River the railway track passes across the EH (Eastern Hill) regions till it ends at Chattogram railway station. The surface water along the proposed Project alignment is dominated by the Dakatia, Little Feni, Muhuri and Feni Rivers (Error! Reference source not found.). However, during field visit and literature review, n o protected wetlands were found in the Project alignment.

4.2.8 Drainage

125. The ground water table varies across the corridor between Laksam and Chattogram but is typically shallow at around 5–9 m below the ground surface with a small seasonal variation during dry season. 100% of local communities along the Project corridor relies on groundwater for potable supplies that is also an important source for irrigation and industrial uses. Ground water is also used for washing, bathing, and irrigation purposes in the Project area.

4.2.9 Seismicity

126. According to BDPC (2010), Bangladesh is classified into four seismic zones (Annex 4, Figure 1). The Project area lies in Zone II (40%) and Zone III (60%), i.e., within an active seismic zone and is mostly classified as medium risk to low risk zone. No major earthquake has been reported in the Project area in recent years or recent past. It is understood that seismic risk at the Project area is of medium intensity.

4.2.10 Ecologically Critical Area (ECA)

127. In Bangladesh, Ecologically Critical Areas (ECAs) are designated under the Bangladesh Environment Conservation Act (1995) to protect regions where ecosystems are under threat due to environmental degradation. These zones are legally protected and any development—like railway electrification—must undergo strict environmental scrutiny.

Table 19: ECAs Relevant to the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur Corridor

ECA Name	Location	Ecosystem Type	Relevance to Railway Corridor
Buriganga River	Dhaka	Urban river	Crossed by Dhaka–Narayanganj section
Shitalakshya River	Narayanganj	Riverine ecosystem	Adjacent to Narayanganj station
Turag River	Dhaka outskirts	River with urban encroachment	Near Tongi–Dhaka section
Balu River	Eastern Dhaka	Floodplain river	Close to Dhaka–Comilla alignment

128. These rivers and water bodies were declared ECAs in 2009 and 2001 due to pollution, encroachment, and loss of biodiversity. Infrastructure must maintain a safe distance from ECA boundaries to prevent ecological disruption. Activities like dredging, piling, or substation installation near ECAs are tightly regulated.

4.2.11 Environmental Quality Test (Water, Air, Noise, and EMF)

Surface Water Quality

129. Surface water samples were collected for laboratory analysis from five locations, with one 50 m upstream and one 50 m downstream of the crossing area, a total of 11 sampling points along the corridor during 19 November-01 October, 2024. The samples were submitted to Dhaka Water Supply and Sewerage Authority and DPHE Laboratory and analysed for the presence of total organic content, total suspended solids, dissolved oxygen, total phosphate and oil & grease. These analysed results were used to develop Error! Reference source not f ound. and compared with the Schedule-3(A) of (Standards for Inland Surface Water) Environmental Conservation Rules, 1997. The concentration levels of all the parameters for surface water were within the acceptable limit set by the DoE, GoB. The water quality results indicate that water quality condition is suitable for irrigation and agricultural use. All water quality test reports have been provided in **Annex 5**

Table 20: Surface Water Quality in Project Influence Area (October, 2024)

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	80x55 m	SS_1 Kumira	22°28'33.82"N 91°43'46.42"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	80x55 m	SS_1 Kumira	22°28'33.82"N 91°43'46.42"E	27	150-600	Water Quality parameter is below from National Standard level
pH	80x55 m	SS_1 Kumira	22°28'33.82"N 91°43'46.42"E	6.2	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS_1 Kumira	22°28'33.82"N 91°43'46.42"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS_1 Kumira	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS_1 Kumira	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	80x55 m	SS_2 Chinki Astana	22°53'17.41"N 91°32'16.71"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	80x55 m	SS_2 Chinki Astana	22°53'17.41"N 91°32'16.71"E	25	150-600	Water Quality parameter is below from National Standard level
pH	80x55 m	SS_2 Chinki Astana	22°53'17.41"N 91°32'16.71"E	6.7	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS_2 Chinki Astana	22°53'17.41"N 91°32'16.71"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS_2 Chinki Astana	22°53'17.41"N 91°32'16.71"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS_2 Chinki Astana	22°53'17.41"N 91°32'16.71"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	80x55 m	SS_3 Laksam	23°12'31.26"N 91° 9'0.09"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	80x55 m	SS_3 Laksam	23°12'31.26"N 91° 9'0.09"E	29	150-600	Water Quality parameter is below from National Standard level
pH	80x55 m	SS_3 Laksam	23°12'31.26"N 91° 9'0.09"E	6.1	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS_3 Laksam	23°12'31.26"N 91° 9'0.09"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS_3 Laksam	23°12'31.26"N 91° 9'0.09"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS_3 Laksam	23°12'31.26"N 91° 9'0.09"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	80x55 m	SS_4 Mandabag	22°28'33.82"N 91°43'46.42"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	80x55 m	SS_4 Mandabag	22°28'33.82"N 91°43'46.42"E	32	150-600	Water Quality parameter is below from National Standard level
pH	80x55 m	SS_4 Mandabag	22°28'33.82"N 91°43'46.42"E	6.0	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS_4 Mandabag	22°28'33.82"N 91°43'46.42"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS_4 Mandabag	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS_4 Mandabag	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	80x55 m	SS_5 Ashuganj	24° 2'15.86"N 91° 0'1.58"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	80x55 m	SS_5 Ashuganj	24° 2'15.86"N 91° 0'1.58"E	26	150-600	Water Quality parameter is below from National Standard level
pH	80x55 m	SS_5 Ashuganj	24° 2'15.86"N 91° 0'1.58"E	6.8	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS_5 Ashuganj	24° 2'15.86"N 91° 0'1.58"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS_5 Ashuganj	24° 2'15.86"N 91° 0'1.58"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS_5 Ashuganj	24° 2'15.86"N 91° 0'1.58"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	80x55 m	SS_6 Pubail	23°56'0.48"N 90°29'54.57"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	80x55 m	SS_6 Pubail	23°56'0.48"N 90°29'54.57"E	34	150-600	Water Quality parameter is below from National Standard level
pH	80x55 m	SS_6 Pubail	23°56'0.48"N 90°29'54.57"E	6.9	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS_6 Pubail	23°56'0.48"N 90°29'54.57"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS_6 Pubail	23°56'0.48"N 90°29'54.57"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS_6 Pubail	23°56'0.48"N 90°29'54.57"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	75x50 m	SS_7 Tongi	23°54'41.18"N 23°54'41.18"N	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	75x50 m	SS_7 Tongi	23°54'41.18"N 23°54'41.18"N	25	150-600	Water Quality parameter is below from National Standard level
pH	75x50 m	SS_7 Tongi	23°54'41.18"N 23°54'41.18"N	6.7	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	75x50 m	SS_7 Tongi	23°54'41.18"N 23°54'41.18"N	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	75x50 m	SS_7 Tongi	23°54'41.18"N 23°54'41.18"N	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	75x50 m	SS_7 Tongi	23°54'41.18"N 23°54'41.18"N	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	75x50 m	SS_8 Fatulla	23°39'20.22"N 90°28'9.68"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	75x50 m	SS_8 Fatulla	23°39'20.22"N 90°28'9.68"E	29	150-600	Water Quality parameter is below from National Standard level
pH	75x50 m	SS_8 Fatulla	23°39'20.22"N 90°28'9.68"E	6.1	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	75x50 m	SS_8 Fatulla	23°39'20.22"N 90°28'9.68"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	75x50 m	SS_8 Fatulla	23°39'20.22"N 90°28'9.68"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	75x50 m	SS_8 Fatulla	23°39'20.22"N 90°28'9.68"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	25	150-600	Water Quality parameter is below from National Standard level
pH	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	6.7	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water					
Arsenic (As)	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'27.64"N 91°48'50.85"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'27.64"N 91°48'50.85"E	28	150-600	Water Quality parameter is below from National Standard level
pH	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'27.64"N 91°48'50.85"E	6.3	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'27.64"N 91°48'50.85"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'27.64"N 91°48'50.85"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'27.64"N 91°48'50.85"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Location		GPS Coordinate	Monitoring Result	National Standard	Remarks
Surface water Water						
Arsenic (As)	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	31	150-600	Water Quality parameter is below from National Standard level
pH	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	6.8	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0	0	Water Quality parameter is within National Standard level

Data Source: Field Sample based laboratory test reports 2024

130. **Dissolved Oxygen (DO)** -The dissolved oxygen values ranged from 1.5mg/L to 6.0 mg/L. The DO level in good fishing waters generally averages about 9.0 mg/L. Decrease in DO values below the critical level of 3 mg/L causes death of most fish and other aerobic aquatic organisms. Many scientific studies suggest that 4-6 mg/L of DO is the minimum amount that will support a large, diverse fish population. The lowest value was recorded at Kamalapur. Such low value does not support the survival of aquatic life.

131. Low dissolved oxygen (DO) levels would suggest that nutrient pollution is a serious issue at the stations sampled. This reduction in value is due to huge municipal or industrial wastes that the water receives.

132. **Total Organic Carbon (TOC)** - The concentration of TOC ranges from 26.4 mg/L to 62.4 mg/L. In Fotulla recorded the highest value. In surface waters, TOC concentrations are generally less than 10 mg/L unless the water receives municipal or industrial wastes.

133. **Total Phosphates -** The concentration of total phosphates is recorded less than o.5 mg/L except Feni River and Dhamair khal.

134. **Total Suspended Solids (TSS) -** The concentration of total suspended solids ranges from 3.6 mg/L to 90.8 mg/L. The water sample collected from Fotulla recorded the highest value of suspended solids.

135. During the dry season when water flows are low and nutrients accumulate in the rivers, a few stations showed low DO levels. This is a common occurrence when water levels drop, water temperatures rise and the natural nutrient processing, requiring oxygen, uses what little there is in the water column.

Table 21: Ground Water Quality in Project Influence Area (October, 2024)

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Ground Water						
Arsenic (As)	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0.001	0.05	Water Quality parameter is below from National Standard level
Chloride (Cl)	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	25	150-600	Water Quality parameter is below from National Standard level
pH	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	6.7	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23°43'28.05"N 90°25'38.15"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-6, Pubail, Gazipur	23°56'0.48"N 90°29'54.57"E	0.001	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-6, Pubail, Gazipur	23°56'0.48"N 90°29'54.57"E	15	150-600	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
pH	80x55 m	SS-6, Pubail, Gazipur	23°56'0.48"N 90°29'54.57"E	7.3	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-6, Pubail, Gazipur	23°56'0.48"N 90°29'54.57"E	0.07	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-6, Pubail, Gazipur	23°56'0.48"N 90°29'54.57"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS-6, Pubail, Gazipur	23°56'0.48"N 90°29'54.57"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-8,Fatulla, Narazanganj	23°39'20.22"N 90°28'9.68"E	0.001	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-8,Fatulla, Narazanganj	23°39'20.22"N 90°28'9.68"E	20	150-600	Water Quality parameter is within National Standard level
pH	80x55 m	SS-8,Fatulla, Narazanganj	23°39'20.22"N 90°28'9.68"E	7.0	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-8,Fatulla, Narazanganj	23°39'20.22"N 90°28'9.68"E	0.06	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-8,Fatulla, Narazanganj	23°39'20.22"N 90°28'9.68"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Fecal Coliform	80x55 m	SS-8,Fatulla, Narazanganj	23°39'20.22"N 90°28'9.68"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	Pahartoli, Chattogram	22°20'27.64"N 91°48'50.85"E	0.001	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	Pahartoli, Chattogram	22°20'27.64"N 91°48'50.85"E	80	150-600	Water Quality parameter is within National Standard level
pH	80x55 m	Pahartoli, Chattogram	22°20'27.64"N 91°48'50.85"E	6.9	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	Pahartoli, Chattogram	22°20'27.64"N 91°48'50.85"E	0.09	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	Pahartoli, Chattogram	22°20'27.64"N 91°48'50.85"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	Pahartoli, Chattogram	22°20'27.64"N 91°48'50.85"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0.001	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	20	150-600	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
pH	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	7.2	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0.10	--	Water Quality parameter is within National Standard level
Total Coliforms	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	100x500 m	EMU Workshop (Joydebpur)	24° 0'48.30"N 90°24'38.11"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-1, Kumira, Cumilla	22°28'33.82"N 91°43'46.42"E	<LOQ	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-1, Kumira, Cumilla	22°28'33.82"N 91°43'46.42"E	100	250	Water Quality parameter is within National Standard level
pH	80x55 m	SS-1, Kumira, Cumilla	22°28'33.82"N 91°43'46.42"E	7.55	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-1, Kumira, Cumilla	22°28'33.82"N 91°43'46.42"E	0.20	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-1, Kumira, Cumilla	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Fecal Coliform	80x55 m	SS-1, Kumira, Cumilla	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-2, Chinki Astana	22°53'17.41"N 91°32'16.71"E	<LOQ	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-2, Chinki Astana	22°53'17.41"N 91°32'16.71"E	70	250	Water Quality parameter is within National Standard level
pH	80x55 m	SS-2, Chinki Astana	22°53'17.41"N 91°32'16.71"E	7.62	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-2, Chinki Astana	22°53'17.41"N 91°32'16.71"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-2, Chinki Astana	22°53'17.41"N 91°32'16.71"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS-2, Chinki Astana	22°53'17.41"N 91°32'16.71"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-3, Laksham	23°12'31.26"N91° 9'0.09"E	0.375	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-3, Laksham	23°12'31.26"N91° 9'0.09"E	790	250	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
pH	80x55 m	SS-3, Laksham	23°12'31.26"N91° 9'0.09"E	7.64	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-3, Laksham	23°12'31.26"N91° 9'0.09"E	0.06	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-3, Laksham	23°12'31.26"N91° 9'0.09"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS-3, Laksham	23°12'31.26"N91° 9'0.09"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-4, Mandabag,Cumilla	22°28'33.82"N 91°43'46.42"E	0.020	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-4, Mandabag,Cumilla	22°28'33.82"N 91°43'46.42"E	40	250	Water Quality parameter is within National Standard level
pH	80x55 m	SS-4, Mandabag,Cumilla	22°28'33.82"N 91°43'46.42"E	7.28	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-4, Mandabag,Cumilla	22°28'33.82"N 91°43'46.42"E	0.02	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-4, Mandabag,Cumilla	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
Fecal Coliform	80x55 m	SS-4, Mandabag,Cumilla	22°28'33.82"N 91°43'46.42"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	80x55 m	SS-5, Ashuganj, Brahmanbaria	24° 2'15.86"N91° 0'1.58"E	0.006	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	80x55 m	SS-5, Ashuganj, Brahmanbaria	24° 2'15.86"N91° 0'1.58"E	90	150-600	Water Quality parameter is within National Standard level
pH	80x55 m	SS-5, Ashuganj, Brahmanbaria	24° 2'15.86"N91° 0'1.58"E	7.36	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	80x55 m	SS-5, Ashuganj, Brahmanbaria	24° 2'15.86"N91° 0'1.58"E	0.03	--	Water Quality parameter is within National Standard level
Total Coliforms	80x55 m	SS-5, Ashuganj, Brahmanbaria	24° 2'15.86"N91° 0'1.58"E	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	80x55 m	SS-5, Ashuganj, Brahmanbaria	24° 2'15.86"N91° 0'1.58"E	0	0	Water Quality parameter is within National Standard level
Arsenic (As)	75x50 m	SS-7,Tongi,Gazipur	23°54'41.18"N 23°54'41.18"N	0.001	0.05	Water Quality parameter is within National Standard level
Chloride (Cl)	75x50 m	SS-7,Tongi,Gazipur	23°54'41.18"N 23°54'41.18"N	15	150-600	Water Quality parameter is within National Standard level

Monitoring Parameter	Land Area	Location	GPS Coordinate	Monitoring Result	National Standard	Remarks
pH	75x50 m	SS-7,Tongi,Gazipur	23°54'41.18"N 23°54'41.18"N	6.6	6.5-8.5	Water Quality parameter is within National Standard level
Total Clorine	75x50 m	SS-7,Tongi,Gazipur	23°54'41.18"N 23°54'41.18"N	0.15	--	Water Quality parameter is within National Standard level
Total Coliforms	75x50 m	SS-7,Tongi,Gazipur	23°54'41.18"N 23°54'41.18"N	0	0	Water Quality parameter is within National Standard level
Fecal Coliform	75x50 m	SS-7,Tongi,Gazipur	23°54'41.18"N 23°54'41.18"N	0	0	Water Quality parameter is within National Standard level

Data Source: Field Sample based laboratory test reports

Air Quality

136. Ambient air quality measurements were carried out during 07 October-18 October, 2024 at 11 specific locations of the Project alignment for 8 hours. The key air quality parameters (PM_{10}, $PM2_{2.5}$, CO, SO_2, NO, NO_2, temperature, humidity, wind speed and wind direction) were monitored. Following the methodology described in Section 1.4.1, the one-hour air quality data were converted to 24 hours' average. These data were used to develop **Table 22** and compared with Bangladesh national standards for ambient air quality. The test results (**Table 22**) show that the local ambient air quality condition meets the national standard, according to the Bangladesh National Ambient Air Quality Standards defined in the Environmental Conservation Rules amendment 19 July 2005 vide S.R.O. No. 220-Law/2005. None of the test results for any of the parameters exceed Bangladesh standard. All air quality test reports have been provided in **Annex 2.**

Table 22: Ambient Air Quality Measurements in Project Influence Area (October, 2024)

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
Air Quality						
SPM	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	110	200	Ambient air quality is below the National Standard Level
PM10	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	67	150	Ambient air quality is below the National Standard Level
PM25	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	32	65	Ambient air quality is below the National Standard Level
NOX	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	29	100	Ambient air quality is below the National Standard Level
SO2	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	19	365	Ambient air quality is below the National Standard Level
CO	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	457	9 ppm	Ambient air quality is below the National Standard Level
NH3	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	36	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	8	15	157	Ambient air quality is within the National Standard Level
Pb	Aligang, Fatullah, Narayangonj	23˚39'19.3"N 90˚28'07.9"E	24	0.03	0.5	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
SPM	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	121	200	Ambient air quality is within the National Standard Level
PM10	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	75	150	Ambient air quality is within the National Standard Level
PM25	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	36	65	Ambient air quality is within the National Standard Level
NOX	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	33	100	Ambient air quality is within the National Standard Level
SO2	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	22	365	Ambient air quality is within the National Standard Level
CO	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	532	9 ppm	Ambient air quality is within the National Standard Level
NH3	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	45	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	8	13	157	Ambient air quality is within the National Standard Level
Pb	Electric Loco Shed, Kamalapur	23˚43'28.2"N 90˚25'39.4"E	24	0.04	0.5	Ambient air quality is within the National Standard Level
SPM	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	111	200	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
PM10	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	69	150	Ambient air quality is within the National Standard Level
PM25	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	30	65	Ambient air quality is within the National Standard Level
NOX	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	27	100	Ambient air quality is within the National Standard Level
SO2	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	18	365	Ambient air quality is within the National Standard Level
CO	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	432	9 ppm	Ambient air quality is within the National Standard Level
NH3	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	25	50.96 ppb	Ambient air quality is within the National Standard Level
O3	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	8	15	157	Ambient air quality is within the National Standard Level
Pb	SS07-Tongi	23°54'40.0"N 90°24'35.9"E	24	0.02	0.5	Ambient air quality is within the National Standard Level
SPM	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	75	200	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
PM10	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	51	150	Ambient air quality is within the National Standard Level
PM25	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	27	65	Ambient air quality is within the National Standard Level
NOX	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	21	100	Ambient air quality is within the National Standard Level
SO2	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	13	365	Ambient air quality is within the National Standard Level
CO	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	321	9 ppm	Ambient air quality is within the National Standard Level
NH3	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	21	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	8	18	157	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
Pb	Deshipara, Jaydebpur, Gazipur	24°00'57.9"N 90°24'23.5"E	24	0.02	0.5	Ambient air quality is within the National Standard Level
SPM	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	123	200	Ambient air quality is within the National Standard Level
PM10	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	87	150	Ambient air quality is within the National Standard Level
PM25	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	41	65	Ambient air quality is within the National Standard Level
NOX	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	22	100	Ambient air quality is within the National Standard Level
SO2	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	17	365	Ambient air quality is within the National Standard Level
CO	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	347	9 ppm	Ambient air quality is within the National Standard Level
NH3	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	23	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	8	13	157	Ambient air quality is within the National Standard Level
Pb	Ashuganj Silo Road, B.Baria	24°02'17.2"N 90°59'59.9"E	24	0.03	0.5	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
SPM	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	64	200	Ambient air quality is within the National Standard Level
PM10	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	42	150	Ambient air quality is within the National Standard Level
PM25	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	21	65	Ambient air quality is within the National Standard Level
NOX	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	9	100	Ambient air quality is within the National Standard Level
SO2	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	4	365	Ambient air quality is within the National Standard Level
CO	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	231	9 ppm	Ambient air quality is within the National Standard Level
NH3	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	13	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	8	17	157	Ambient air quality is within the National Standard Level
Pb	Mandabag, Brahmanbaria	23°43'17.9"N 91°08'59.0"E	24	0.01	0.5	Ambient air quality is within the National Standard Level
SPM	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	74	200	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
PM10	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	45	150	Ambient air quality is within the National Standard Level
PM25	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	20	65	Ambient air quality is within the National Standard Level
NOX	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	10	100	Ambient air quality is within the National Standard Level
SO2	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	7	365	Ambient air quality is within the National Standard Level
CO	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	210	9 ppm	Ambient air quality is within the National Standard Level
NH3	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	16	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	8	11	157	Ambient air quality is within the National Standard Level
Pb	Ajghora, Laksham, Cumilla	23°12'32.1"N 91°08'59.2"E	24	0.01	0.5	Ambient air quality is within the National Standard Level
SPM	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	101	200	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
PM10	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	82	150	Ambient air quality is within the National Standard Level
PM25	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	42	65	Ambient air quality is within the National Standard Level
NOX	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	27	100	Ambient air quality is within the National Standard Level
SO2	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	21	365	Ambient air quality is within the National Standard Level
CO	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	426	9 ppm	Ambient air quality is within the National Standard Level
NH3	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	35	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	8	12	157	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
Pb	Chinki Astana Railway Station, Baroyerhat	22°53'17.3"N 91°32'16.5"E	24	0.04	0.5	Ambient air quality is within the National Standard Level
SPM	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	83	200	Ambient air quality is within the National Standard Level
PM10	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	54	150	Ambient air quality is within the National Standard Level
PM25	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	24	65	Ambient air quality is within the National Standard Level
NOX	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	16	100	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
SO2	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	11	365	Ambient air quality is within the National Standard Level
CO	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	234	9 ppm	Ambient air quality is within the National Standard Level
NH3	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	13	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	8	16	157	Ambient air quality is within the National Standard Level
Pb	Dakkhin Saonaichori, Sitakundo, (Kumira) Chattogram	22°28'34.1"N 91°43'46.3"E	24	0.02	0.5	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
SPM	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	93	200	Ambient air quality is within the National Standard Level
PM10	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	74	150	Ambient air quality is within the National Standard Level
PM25	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	35	65	Ambient air quality is within the National Standard Level
NOX	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	21	100	Ambient air quality is within the National Standard Level
SO2	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	14	365	Ambient air quality is within the National Standard Level
CO	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	424	9 ppm	Ambient air quality is within the National Standard Level
NH3	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	19	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	8	13	157	Ambient air quality is within the National Standard Level
Pb	Pahartoli, Chattogram	22°20'33.8" N 91°48'43.0"E	24	0.03	0.5	Ambient air quality is within the National Standard Level
SPM	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	60	200	Ambient air quality is within the National Standard Level

Monitoring Parameter	Location	GPS Coordinate	Frequency Of Monitoring	Monitoring Result (µg/m3)	National Standard	Remarks
PM10	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	54	150	Ambient air quality is within the National Standard Level
PM25	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	27	65	Ambient air quality is within the National Standard Level
NOX	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	16	100	Ambient air quality is within the National Standard Level
SO2	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	10	365	Ambient air quality is within the National Standard Level
CO	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	239	9 ppm	Ambient air quality is within the National Standard Level
NH3	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	14	50.96 ppb	Ambient air quality is within the National Standard Level
O3	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	8	15	157	Ambient air quality is within the National Standard Level
Pb	Pubail Rail Crossing	23°56'00.8"N 90°29'53.0"E	24	0.02	0.5	Ambient air quality is within the National Standard Level

Data Source: Field Sample based laboratory test reports 2024

137. **Carbon monoxide (CO)**: The test results for CO were all within GoB standard of ambient air quality. Carbon monoxide ranged from 0.01 to 1.51 µg/$m^{3.}$ The highest value of 0.3 µg/ is obtained at Fazilpur (AAQ_04).

138. **Nitric oxide (NO) and Nitrogen dioxide (NO_2)**: Ambient NO and NO_2 concentrations in all the sampling points showed compliance with DoE annual average standards. Measured concentrations for NO and NO_2 ranged from 1 to 19.29 µg/m^3 and 2 to 56.03 µg/m^3, respectively.

139. **Sulphur dioxide (SO_2)**: Measured concentrations ranged from 6.89 to 380.49 µg/m^3. The concentration of SO_2 at Hasanpur (AAQ_02) during daytime slightly exceeded the DoE guideline value of 365 µg/m^3. The reason for these high values is that during the sampling three express trains & one mail train passed the stations. Closely located stationary & tea stall using fossil fuels had crowd's drining tea and smoking cigarettes, also contributed to these levels.

140. **Ozone (O_3):** Measured concentrations ranged from 3.11 to 37.88 µg/m^3. All tested values satisfied the DoE guideline.

141. **PM_{10} and $PM_{2.5}$**: Particulate matters PM_{10} and $PM_{2.5}$ concentrations at all the sampling points were in compliance with DoE annual average standard. Measured concentrations for PM_{10} and $PM_{2.5}$ varied from 6.07 to 35.88 µg/m^3 and 3.19 to 44.56 µg/m^3, respectively.

142. **VOC:** The table shows that, the values of VOC for all the locations were within the DoE standards. Measured concentrations are ranges from 0 to 24.02 µg/m^3.

143. The measurement results showed achievement of all air quality standards. Based on the ambient air quality standard of DoE, air quality in the Project area can be stated as in good condition.

Noise Level

144. Noise level measurements were carried out during 07-18, October, 2024 at same 11 specific locations of the Project alignment for 8 hours. These data were used to develop Error! R eference source not found.**8** and compared with the amended Schedule 4, 2006, of (Noise Level Measurement Standard) Environmental Conservation Rules, 1997, DoE. The laboratory test results have been provided in **Annex 4**

Table 23: Noise Level Measurement in Project Corridor (October, 2024)

Monitoring Parameter	Land Area	Location	GPS Coordinate	Frequency of Monitoring (Day/Night)	Monitoring Result (Noise in dB)	National Standard (Zone)	Remarks
Noise Level							
Average Noise Level (Day Time)	80x55 m	SS_1 Kumira	24.83˚N 89.93˚E	8 Hours	65.2	Silent Area-50 & Working Zone 75dB	Noise Level is below the National Standard Level
Average Noise Level (Day Time)	80x55 m	SS_2 Chinki Astana	24.59˚N 89.83˚E	8 Hours	57.4	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	80x55 m	SS_3 Laksam	23°12'32.1"N 91°08'59.2"E	8 Hours	57.4	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	80x55 m	SS_4 Mandabag	23°43'17.9"N 91°08'59.0"E	8 Hours	50.4	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	80x55 m	SS_5 Ashuganj	24°02'17.2"N 90°59'59.9"E	8 Hours	65.3	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level

Table 23: Noise Level Measurement in Project Corridor (October, 2024)

Average Noise Level (Day Time)	80x55 m	SS_6 Pubail	23°56'00.8"N 90°29'53.0"E	8 Hours	48.2	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	75x50 m	SS_7 Tongi	23°54'40.0"N 90°24'35.9"E	8 Hours	44.4	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	75x50 m	SS_8 Fatulla	23˚39'19.3"N 90˚28'07.9"E	8 Hours	54.3	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	100x500 m	EMU Workshop (Joydebpur)	24°00'57.9"N 90°24'23.5"E	8 Hours	54.3	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	100x500 m	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'33.8" N 91°48'43.0"E	8 Hours	63.2	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level
Average Noise Level (Day Time)	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23˚43'28.2"N 90˚25'39.4"E	8 Hours	67.6	Silent Area-50 & Working Zone 75dB	Noise Level is within the National Standard Level

Data Source: Field Sample based laboratory test reports 2024

145. The existing noise level within the study area varies from 51.4 dB to 61.2 dB during day time which is slightly above the standard of mixed zone land use (DoE, 1997), but not the commercial zone, which is the legal designation for the railway corridor. The existing noise level within the study area varies from 58.6 dB to 73.1 dB during night time, which is above the standard of mixed zone land use (DoE, 1997), also for the commercial zone land use, which is the designation for the railway corridor. This may due to the movement of train during the testing along with heavy vehicular traffic movement. The description of the sampling sites is recorded in the noise sampling report **(Annex 4)**

146. The result of the noise measurements for October 2024 showed a marginally higher or bit higher few areas noise. This may be due to air temperature and relative humidity and the marginal attenuation effect of these two parameters on noise. Other areas noise is within the standard.

Electromagnetic field (EMF)

147. A substation emits an electromagnetic field (EMF). An EMF is a combination of an electric field and a magnetic field. Substations emit low-frequency EMF, which is thought to be responsible for health risks. Electricity substations don't produce a significant external electric field but they do produce a magnetic field. This is measured in microtesla (µT). The field levels at the boundary of a substation are typically around one to two microtesla (µT) and this decreases very quickly as you move away. At one or two metres from the substation, the magnetic field will usually be lower than the field found inside your home.

148. The result of the electromagnetic field (EMF) for October 2024 showed a marginally lower EMF. Substations emit a low-frequency electromagnetic radiation (EMR) which creates an electromagnetic field (EMF). This EMF has two components, an electric field and a magnetic field. Don't worry too much about the electric field. It lacks power to penetrate the substation walls. In this project the EMF is very low which is not harm to the human body. The description of the sampling sites is recorded in the noise sampling report **(Annex-3)**

Table 24: Eelectromagnetic field (EMF) Level Measurement in Project Corridor (October, 2024)

Monitoring Parameter	Land Area	Location	GPS Coordinate	Frequency of Monitoring (Day/Night)	Monitoring Result (Noise in dB)	Standard (Zone)	Remarks
Noise Level							
Average EMF Level (Day Time)	80x55 m	SS_1 Kumira	24.83˚N 89.93˚E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	80x55 m	SS_2 Chinki Astana	24.59˚N 89.83˚E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	80x55 m	SS_3 Laksam	23°12'32.1"N 91°08'59.2"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	80x55 m	SS_4 Mandabag	23°43'17.9"N 91°08'59.0"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	80x55 m	SS_5 Ashuganj	24°02'17.2"N 90°59'59.9"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	80x55 m	SS_6 Pubail	23°56'00.8"N 90°29'53.0"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level

Table 24: Eelectromagnetic field (EMF) Level Measurement in Project Corridor (October, 2024)							
Average EMF Level (Day Time)	75x50 m	SS_7 Tongi	23°54'40.0"N 90°24'35.9"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	75x50 m	SS_8 Fatulla	23˚39'19.3"N 90˚28'07.9"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	100x500 m	EMU Workshop (Joydebpur)	24°00'57.9"N 90°24'23.5"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	100x500 m	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	22°20'33.8" N 91°48'43.0"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level
Average EMF Level (Day Time)	30x40 m	Dhaka Electric Loco Shed (Kamalapur)	23˚43'28.2"N 90˚25'39.4"E	8 Hours	0.01-0.02 mG	0.1 to 4 mG	EMF Level is within the National Standard Level

Data Source: Field Sample based laboratory test reports 2024

4.2.12 Land Use

149. The land use pattern along this railway corridor reflects Bangladesh's rapid urbanization, industrial expansion, and agricultural transformation. These dynamics are crucial for planning electrification infrastructure, especially for substation placement, right-of-way acquisition, and environmental safeguards.

4.2.13 Existing sources of pollution

150. The Narayanganj–Dhaka–Chattogram and Tongi–Joydebpur railway corridor passes through some of the most pollution-prone zones in Bangladesh. These areas face a complex mix of air, water, and soil pollution, driven by rapid urbanization, industrialization, and poor environmental regulation.

Table 25: Major Pollution Sources by Type

Pollution Type	Primary Sources	Affected Areas
Air Pollution	Brick kilns, vehicle emissions, construction dust, diesel locomotives	Dhaka, Narayanganj, Tongi, Chattogram
Water Pollution	Industrial effluents, untreated sewage, river encroachment	Buriganga, Shitalakshya, Karnaphuli rivers
Soil Contamination	Heavy metals from tanneries, solid waste dumping, agrochemical runoff	Narayanganj, outskirts of Dhaka and Comilla
Noise Pollution	Traffic congestion, rail horns, construction machinery	Urban segments like Dhaka and Joydevpur

151. Dhaka's air pollution in 2024 was the highest in 9 years, with PM2.5 levels averaging 171 µg/m³, far exceeding safe limits. In Narayanganj, industrial zones recorded PM2.5 concentrations 3.37 times higher than national standards. Diesel-powered vehicles and locomotives contribute significantly to NOx and black carbon emissions, especially in rail-adjacent areas. Brick kilns remain a dominant source of fine particulate matter, especially during the dry season.

4.2.14 Disaster Risk Assessment

152. This corridor lies in one of the most disaster-prone regions in the world. Bangladesh's geography, climate, and urbanization patterns expose it to a range of natural and anthropogenic hazards. A comprehensive Disaster Risk Assessment (DRA) is essential for ensuring the resilience of the electrification infrastructure.

Table 26: Key Hazards Identified

Hazard Type	Risk Level	Description
Flooding	Very High	Seasonal monsoon floods, river overflows, and urban waterlogging
Cyclones & Storm Surges	High	Especially in Chattogram region due to proximity to Bay of Bengal
Earthquakes	Moderate	Seismic risk due to tectonic activity near the Dauki Fault and Tripura Fold Belt
Riverbank Erosion	High	Along Meghna, Shitalakshya, and Buriganga rivers
Heatwaves	Moderate	Intensifying due to climate change, especially in urban zones
Landslides	Localized	In hilly terrain near Chattogram

153. High population density in Dhaka and Narayanganj increases exposure. Aging infrastructure and informal settlements near the tracks. Encroachment on floodplains and wetlands reduces natural buffers. Critical assets like substations and bridges are often in hazard-prone zones.

4.2.15 Assessment of Disaster of the Project

154. The electrification of the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor involves significant exposure to natural hazards. A formal Disaster Risk Assessment (DRA) is a critical component of the project's Environmental and Social Impact Assessment (ESIA) and is guided by national frameworks and international best practices.

4.2.16 Sensitive Receivers

155. Sensitive receivers refer to locations or populations that are particularly vulnerable to disturbances such as noise, vibration, air pollution, or visual intrusion during construction and operation. Along the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor, several categories of sensitive receivers have been identified:

Table 27: Key Types of Sensitive Receivers

Type	Examples Along the Corridor	Sensitivity Factors
Educational Institutions	Schools, colleges, and universities in Dhaka, Narayanganj, Comilla	Noise, vibration, air quality
Healthcare Facilities	Hospitals and clinics near Tongi, Joydevpur, Chattogram	Noise, air pollution, emergency access disruption
Religious Sites	Mosques, temples, churches along urban and rural segments	Noise, visual intrusion
Residential Areas	Densely populated neighborhoods in Dhaka, Narayanganj, Feni	Noise, vibration, land acquisition impacts
Cultural Heritage Sites	Historical buildings and monuments (e.g., in Old Dhaka)	Vibration, visual impact, structural sensitivity
Wetlands & ECAs	Rivers and lakes (e.g., Buriganga, Shitalakshya, Karnaphuli)	Ecological disturbance, water pollution

4.3 Biological Environment

156. The survey of the ecological environment included terrestrial and aquatic flora and fauna, using field surveys, review of literature, and information documented by other agencies. The Project area consists of several ecological subsystems, e.g., open agricultural land, homesteads, railway crossing rivers, canal, water bodies and railway side vegetation.

157. The Project area (Laksam-Chinki Astana-Chattogram Railway) passes through three bio-ecological zones, namely Zone 8a (Coastal plains), Zone 9a (Chattogram Hills and CHTs), Zone 4e, the Meghna River flood plain. The Project corridor is highly disturbed due to huge traffic movement, industrial set up, commercial activities and anthropogenic pressure.

4.3.1 Flora

1) Terrestrial Flora

158. Terrestrial flora of the Project area mainly consisted of plantation trees, natural growing trees, herbs, shrubs, climbers, epiphytes and parasites. Plantation has been done mainly in the rail line side and homestead areas using both exotic and native tree species.

		
Coccinia grandis (Telakucha) cultivated land. Hasanpur station. Date: 19 oct 2024.	Xanthium strumanium (Ghagra), Naoti station premise. Date: 20 Sep. 2024	*Diplazium esculentum* (dheki shak), Langalkot station, Date: 22 Sep. 2024

Figure 25: Different Types of Flora in the Project Surrounding Areas

159. A total of 317 plant species were recorded from the Project alignment area. For each, its scientific name, local name, family, habit, habitat, status, and uses were provided **(Annex 10, Table 1)**. Herbs were the most common followed by trees, shrubs and climbers. Most abundant tree species in the road sides of the Project are *Samanea saman* (Rain tree), *Acacia auriculiformis* (Akashmoni), *Acacia mangium* (Belgium), *Phoenix sylvestris* (Date palm), *Musa paradisiacal* (Banana plantation), *Artocarpus heterophyllus* (Jack fruit), *Dalbergia sissoo* (Sissu), *Switenia Mahagoni (*Mahogoni), and *Eucalyptus camaldulensis (*Eucalyptus). Local people used such tree species as sources of fruits, timber, fire wood, medicines and other household purposes. **Table 28** shows summary of different types of affected trees due to commence of Project.

Table 28: Summary of Affected Trees in Project Alignment

Categories of Trees	Large	Medium	Small	Sapling	Total	%
Fruit bearing	1,346	6,064	5,891	3,565	16,866	12.29
Timber & fruit	983	5,100	5,709	2,588	14,380	10.48
Timber	1,618	23,019	11,656	5,359	41,652	30.35
Firewood	143	4,042	10,933	331	15,449	11.26
Medicinal	53	1,191	355	174	1,773	1.29
Banana	11,086	12,182	6,600	4,595	34,463	25.11
Bamboo	1,643	2,011	1,972	751	6,377	4.65
Cane Bush	1,325	1,657	2,050	0	5,032	3.67
Papaya	296	346	397	191	1,230	0.90
Grand Total	**18,493**	**55,612**	**45,563**	**17,554**	**137,222**	**100.00**

Source: Social survey, 2024

160. Cultivated land in the Project area mainly dominated by rice cultivation. Apart from rice, many other seasonal crops including banana, jute fiber, mustard, sugarcane, and vegetables of different species are also cultivated in this zone. Most common species are the members of Poaceae, Cyperaceae, Acanthaceae, Asteraceae, Amaranthaceae, Euphorbiaceae, Rubiaceae, and Araceae.

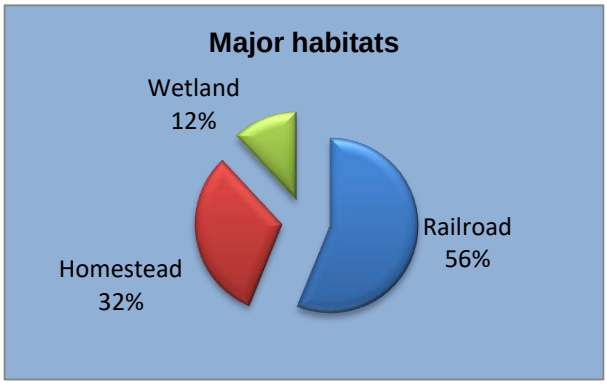


Figure 26: Distribution Plant Species in Major Habitats

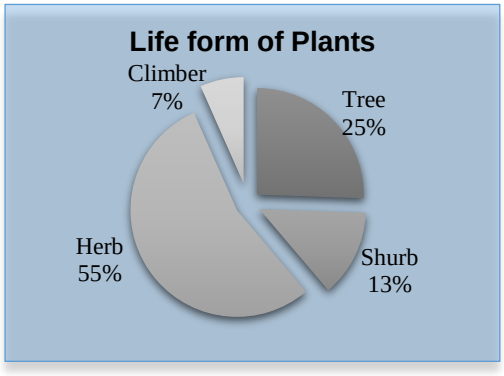


Figure 27: Different life forms of Plant Species

161. Maximum diversity was found beside the railway followed by homestead, cultivated land and wetland (**Figure 26**). Life form data analysis shows that the dominant life form is herbs followed by trees, shrubs and climbers (**Figure 27**). The research team also collected the data on uses of plant species. Eleven categories of uses of plants were determined in the Project area. Among the uses categories medicinal plants scored highest followed by cow fodder, timber plants, vegetables, fruits, ornaments, weed, fuel, manure, fish fodder and oil plants.(**Figure 28**). In case of distribution of species in the habitats variations were obsequaed. Based on observation and local information the plant species status was determined. Among the recorded 60% were common, 12% fairly common, 8% least common and rest 20% locally rare in the Project area (**Figure 29**).

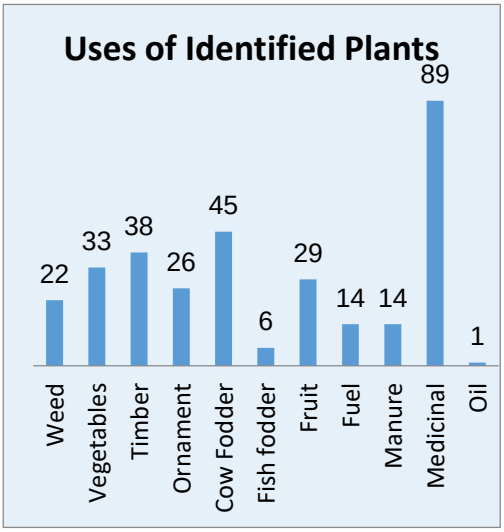


Figure 28: Uses of Identified Plants

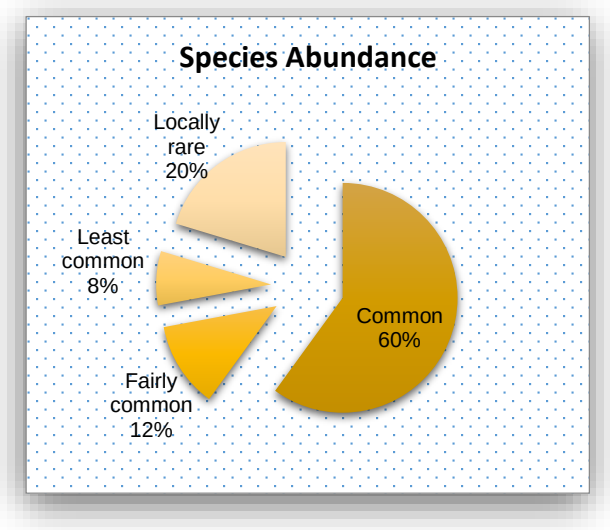


Figure 29: Species Abundance in the Project Area

4.3.2 Fauna

2) Terrestrial Fauna

162. Four categories of wildlife's are amphibians, reptiles, mammals and birds study in the Project area through discussion with local people, stakeholders, visual observation and sharing the photograph with different stakeholders. A total of 178 species of wildlife have been identified and recorded. Among them 6 species of amphibians, 13 species of reptiles, 33 species of mammals, and 126 species of birds. The assessment is based on frequency of occurrence of fauna and public consultation shows that critically endangered, endangered and vulnerable faunal species were also present as summarised in **Table 29**.

Table 29: Summary of Terrestrial Fauna Findings in the Study Area

Group	Total No.	Threatened Status					No=Not Threatened
		Critically Endangered	Endangered	Vulnerable	Least Concern	Lower Risk	
Amphibians	6					6	
Reptiles	13					9	4
Mammals	33	1	6	6	9	10	1
Birds	126				8	27	91
Total	**178**	**1**	**6**	**6**	**17**	**52**	**96**

Source:l survey, 2024

Mammals Species

163. Most of the mammal's habitats are the hilly area which is located from Chinki Astana rail station to Botanical Garden and eco-park of Sitakund. The hilly area is close located to the rail corridor. Based on field survey, focus group discussion and public consultations in total 16 species of mammals listed. There were no critically endangered, endangered, or vulnerable reptile species, but eight species are lower risk, 8 species were not threatened based on IUCN provided category.

Amphibians Species

164. In total six species of amphibian identified through field survey, focus group discussion and public consultations. Frogs and toads are ecologically diverse, inhabiting aquatic and terrestrial niches with great success. They are sensitive to environmental factors including noise and other disturbance that influence their behavior, and are represented in the study area by terrestrial, arboreal and aquatic species. Among them no amphibian's species are critically endangered, endangered but less concern.

Reptile Species

165. According to field survey, focus group discussion and public consultations in total 13 species of reptile identified. There were no critically endangered, endangered, and vulnerable reptile species, but nine species are lower risk, four species were not threatened based on IUCN category **Figure 30** shows some common bird and reptile species around the Project area.

Alauda Gulgula (Skylark), Gunaboti Station.

Date: June 29, 2024.

Varanus Bengalensis (Bengal monitor), Kalidah Station. Date: 19 Oct. 2024.

Figure 30: Common Bird and Reptiles Species around the Project Areas

Bird Species

166. During the field visit the above mentioned birds (**Figure 30)** issue seen along the rail line corridor. In this respect, local people were interviewed and recorded their findings. Recorded bird species were 126 among them eight species were least concern and 27 species were lower risk. 91 species of bird recorded are not threatened. No critical endangered, endangered, vulnerable species were not recorded in the study area.

3) Aquatic Flora

167. Aquatic ecosystem comprises the ponds, rivers, canals, ditches etc. are the habitat of the various floral and faunal species. The river systems within the Project area are used as local transport routes and are also important for fishing and fish farming. The freshwater watercourses also provide an important nursery ground for native fish. In addition, a number of fish ponds and freshwater wetlands cross within the Project area. These areas provide diverse habitats for many aquatic flora and fauna.

168. The aquatic ecosystem is sub-divided according to perennial and seasonal water bodies. All wetlands contain free floating, submerged, and emergent plants, creating an important habitat for a number of water birds and other wildlife during the whole monsoon period. Along the proposed rail line alignment crosses on the aquatic habitat Feni, Muhuri, Dakatia and Selonia River.

169. Some of the plants such as Blue water lily (Nymphaea stellata) and Kash (Saccharum spontaneum), once were in plenty, have now become rare. Other aquatic plant within the Project site include Alternanthera philoxeroides (Helencha), Eichhornia crassipes (Kachuripana), Lemna minor (Lemna), Ludwigia adscendens (Ledwiga), Monochoria hastate (Kochuripana), Utricularia exoleta (Jaji), reeds/sedges, etc., within and along the banks of ponds, rivers, channels and floodplain lands **Figure 31.**

Lemna Minor (Lemna), Joydebpur Station Premise, Date: 22 Sep. 2024.

Echinochloa Crassipes (Dalghas), near Dhakatia River Area, Date: 22 Sep 2024.

Eichhornia Crassipes (Kachuripana), Kalidah Station Premise, Date: 22 Sep. 2024

Figure 31: Aquatic Flora Species around Project Areas

4) Aquatic Fauna

170. Through discussion with community people and their opinions it was establised that four river crosses the alignment. The river Dolphin (Delphinus delphis) was not observed and Gharials (Gavialis gangeticus) was absent in the Project area. Other faunal species present in the aquatic ecosystems are the common kingfisher (Alcedo atthis), openbill stork (Anastomus oscitans), small egret (Egretta garzetta), fish eagle (Ichthyophaga ichthyaetus), snipe (Gallinago stenura), kite (Haliastur indus), water snake (Enhydris enhydris), common toad (Bufo melanostictus), skipper frog (Rana cyanophyctis), etc.

5) Fish Species

171. There are five main types of fishing are practiced around the Project areas which is capture of fish in river, ponds and channels; capture of carp spawn in river, particularly the Karnaphuli River; subsistence capture of fish in the floodplain during the flood season; and fish culture in ponds. In total 37 species of fish were recorded within the Project corridor and tabulated, out of which five endangered viz. Channa marulius (Gajar), Chitala chitala (Chital), Ompok pabda (Pabda), Pangasius pangasius (Pangas), Clupisoma garua (Gagra); 4 vulnerable viz Sperata aor (Ayre), Sperata seenghala (Guji), Pethia ticto (Tit punti), Notopterus notopterus (Foli); 25 least concern and 3 species were recorded as not threatened.

172. The following Figure 32, Figure 33 and Figure 34 shows the survey of fish species within the Project corridor.

Figure 32: Mixed Natural Fish, Laksam Market Survey. Date: 19 Oct. 2024

Figure 33: Mixed Natural Fish, Feni Junction Nearest Bazar

Figure 34: Market Fish Survey, Sithakanda Bazar Date: 20 Oct. 2024

6) Conservation Significance

173. The Project area does not contain special specific habitat for any particular species of flora and fauna noted. The four rivers crossed are sensitive to pollution and care will be taken as work near or over these waters proceeds. These rivers have already been badly polluted and BR will not allow any contamination to occur due to the Project.

4.3.3 Bio-ecological Zones

174. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor traverses several of Bangladesh's officially recognized 25 Bio-Ecological Zones (BEZs), each defined by its unique combination of flora, fauna, topography, and climate. These zones are critical for biodiversity conservation and must be considered in the planning and implementation of infrastructure projects like railway electrification.

Table 30: Key Bio-Ecological Zones Intersected

Corridor Segment	Bio-Ecological Zone	Ecosystem Type	Key Features
Narayanganj–Dhaka	Central Floodplain	Wetland & Urban River Ecosystem	Buriganga & Shitalakshya rivers, urban biodiversity pockets
Dhaka–Comilla	Eastern Floodplain	Agro-wetland Mosaic	Seasonal wetlands, migratory bird habitats
Comilla–Chattogram	Northern & Eastern Hills	Hill Forest & Upland Ecosystem	Semi-evergreen forests, endangered species (e.g., hoolock gibbon)
Tongi–Joydevpur	Madhupur Tract	Dry Deciduous Forest	Red clay terraces, sal forests, fragmented wildlife corridors

4.3.4 Wetlands

175. The railway corridor intersects several critical wetland ecosystems, which play a vital role in flood control, biodiversity conservation, and local livelihoods. These wetlands are part of the Ganges–Brahmaputra–Meghna delta system, making them ecologically sensitive and hydrologically dynamic.

Table 31: Major Wetlands Intersected

Wetland Name	Location	Type	Ecological Importance
Buriganga River Wetland	Dhaka	Urban riverine	Flood buffer, fish habitat, under severe pollution stress
Shitalakshya River Wetland	Narayanganj	Riverine & industrial	Supports fisheries, threatened by industrial discharge
Balu River Floodplain	Eastern Dhaka	Seasonal floodplain	Agricultural irrigation, migratory bird habitat
Meghna River Wetland	Near Comilla	Major river system	High biodiversity, erosion-prone banks
Karnaphuli River Estuary	Chattogram	Coastal wetland	Mangrove patches, estuarine fisheries, cyclone buffer

4.3.5 Protected Areas and Endangered Species

176. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor intersects or lies near several protected areas and habitats of endangered species, making biodiversity conservation a key consideration in the electrification project. According to the Forest Department of Bangladesh protected areas, the following are notable:

Table 32: Protected Areas Near the Corridor

Protected Area	Location	Type	Relevance to Corridor
Bhawal National Park	Gazipur (near Joydevpur)	National Park (IUCN Cat IV)	Close to Tongi–Joydevpur section
Baroiyadhala National Park	Chattogram District	National Park (IUCN Cat II)	Near Chattogram rail terminus
Sheikh Rasel Aviary & Eco Park	Chattogram	Eco Park	Adjacent to urban rail alignment
Shitalakshya River ECA	Narayanganj	Ecologically Critical Area	Crossed by Narayanganj–Dhaka section

177. Based on the WorldAtlas and Earth's Endangered Creatures database, several IUCN-listed endangered species inhabit or migrate through this corridor:

Table 33: Endangered Species in the Region

Species Name	Type	Status	Habitat Zone Along Corridor
Asian Elephant	Mammal	Endangered	Hill forests near Chattogram
Hoolock Gibbon	Mammal	Endangered	Eastern hill tracts
Assam Roofed Turtle	Reptile	Critically Endangered	Wetlands near Comilla and Dhaka
Asian Small-Clawed Otter	Mammal	Vulnerable	Rivers and wetlands (e.g., Buriganga, Meghna)
Greater Adjutant Stork	Bird	Endangered	Seasonal wetlands and floodplains

4.3.6 Nearest protected area

178. Bhawal National Park: A dry deciduous forest with sal trees and wildlife like monkeys, deer, and birds—important for ecological balance near Joydevpur. Baroiyadhala National Park: Located in the Chattogram hill tracts, home to semi-evergreen forests and endangered species like the hoolock gibbon. Shitalakshya River ECA: A riverine ecosystem under pressure from industrial pollution, yet vital for aquatic biodiversity and flood regulation. These areas are protected under the Wildlife (Conservation and Security) Act, 2012, and any nearby infrastructure development must comply with environmental clearance protocols.

4.3.7 Sensitive or threatened habitats

179. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor intersects several ecologically sensitive and threatened habitats, many of which are under pressure from urbanization, deforestation, and infrastructure development. These habitats are vital for biodiversity, ecosystem services, and climate resilience.

180. Elephant ranges in Bangladesh are shrinking rapidly due to forest degradation, unplanned development, and encroachment. Corridors have disappeared, isolating populations and increasing human-elephant conflict. The Chattogram Hill Tracts are among the last strongholds for wild elephants, but even here, habitat fragmentation is accelerating.

4.3.8 Threatened and Rare Species

181. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor intersects habitats that support a number of threatened and rare species, many of which are listed in the IUCN Red List of Bangladesh. These species face risks from habitat loss, pollution, and infrastructure development, making their protection a key concern for the electrification project.

Table 34: Notable Threatened and Rare Species

Species Name	Type	IUCN Status	Habitat Zone Along Corridor
Asian Elephant	Mammal	Endangered	Hill forests near Chattogram
Hoolock Gibbon	Mammal	Endangered	Eastern hill tracts
Batagur baska *(Northern River Terrapin)*	Reptile	Critically Endangered	Wetlands near Meghna and coastal rivers
Baer's Pochard	Bird	Critically Endangered	Seasonal wetlands and floodplains
Assam Roofed Turtle	Reptile	Critically Endangered	Wetlands near Comilla and Dhaka
Greater Adjutant Stork	Bird	Endangered	Floodplains and garbage dumps
Asian Small-Clawed Otter	Mammal	Vulnerable	Rivers and wetlands (e.g., Buriganga, Meghna)
Fox Tail Orchid *(Rhynchostylis retusa)*	Plant	Rare (locally threatened)	Northeastern floodplain forests

4.4 Social Environment

4.4.1 Introduction / Scope of investigation

182. This section provides a profile and analysis of the socio-economic characteristics that currently exist within the Project corridor. The data analysed in this section have been collected from a number of primary and secondary sources as detailed in the methodology section, and include:

- Interviews with government officials from several districts and Upazilas;
- Field assessments for community property resources outside of proposed width of the expressway, historical, cultural and archaeological sites;
- Published Government documents, especially those of the Bangladesh Bureau of Statistics (BBS), including census data on agriculture; and
- Reports by international organizations such as the United Nations and World Bank.

4.4.2 Population and Demographics

183. Total number of affected household is 757. There are 72 households (excluding CPR/PCR, and large-scale business enterprises) with a total population of 757. The male population is higher than that of female. There are 53.13% males and 47.49% females as found in the household census conducted in June-July 2024 with the proximity of the Project site to Dhaka, male members remain away from home as temporary migrant workers to earn a living.

184. It is observed that highest percentage of population belongs to the age group of 16-25 (21.2%) followed by the age group 6-15 (20.7%) and 26-35 (16.0%). It seems that percentage of working group of people is higher in this area than that of children and old age population.

4.4.3 Religion

185. It is found that Islam is the predominant religion in the Project area (96%). The percentage of Hinduism and Buddhism are minimal (4% and 0.01% respectively). According to the Bangladesh Population and demographic indicator -2024, 88% are Muslim and the remaining are of other religions in the country.

4.4.4 Housing Characteristics

186. According to the census and IoL survey, total 1,27 HH primary structure will be affected by the project for the component 62 owned by residential HHs, shops, CPRs and Bangladesh railway. Out of that, 56% Pucca, 14% Semi-pucca, 26% tin made, 2% katcha and rest of the thatched structures. Table 34 describes the quantity of affected primary structures by different categories.

Table 35: Summary of Quantity of Affected Primary Structures

Sl. No.	Name of the Station	Type of Structures	Quantity	Comments
1	Joydevpur	Pucca	8	
		Semi-pucca	12	
		Tin-made	10	
2	Kamalapur	Semi-pucca	85	Railway Quarter area,
		Tin-made	10	Railway Quarter area,
3	Pahartoli	Pucca	24 (Multi Storied)	BR Staff Quarter area
		Tin-made	27	BR Staff Quarter area
4	Kumira	Semi Pucca	5	
		Tin-made	3	
5	Fatulla	Semi Pucca	4	
		Tin-made	4	
6	Chinki Astana			MAX Contractor Project Workshop
7	Mandabag	N/A		
8	Laksham	N/A		
9	Ashuganj	N/A		
10	Tongi	N/A		
11	Pubail	N/A		

Source: Census and IoL survey, July 2024

4.4.5 Economic activities

187. The livelihoods of people living along the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor are shaped by a rich mix of urban, peri-urban, and rural economies. These activities range from traditional agriculture to modern industry and services, reflecting the corridor's role as a national economic artery. Street vendors, rickshaw pullers, and home-based workers are widespread in urban areas. Women's participation is high in garment factories, tailoring, and food vending. Youth employment is growing in e-commerce delivery, mobile repair, and ride-sharing services.

4.4.6 Water supply

188. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur corridor passes through regions with diverse water supply systems, ranging from deep tube wells to piped municipal networks. However, rapid urbanization, industrial expansion, and infrastructure development—including railway projects—have placed increasing pressure on these systems.

189. Substation siting must avoid areas with fragile water infrastructure or known waterlogging zones. Construction runoff must be managed to prevent contamination of local water bodies. Coordination with WASAs and city corporations is essential to protect and integrate water supply systems during and after construction.

4.4.7 Sanitation

190. Sanitation infrastructure along the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur corridor varies widely, reflecting the urban-rural divide and rapid population growth. While major cities have formal sanitation systems, many peri-urban and informal settlements still rely on on-site sanitation or unregulated waste disposal, posing challenges for public health and infrastructure development.

191. Open defecation persists in some rural pockets and informal settlements. Drainage congestion during monsoon leads to waterlogging and sewage overflow. Industrial effluents often mix with domestic waste, especially in Narayanganj and Chattogram. Lack of treatment plants: Most fecal sludge is dumped untreated into water bodies.

192. Construction runoff must be managed to avoid contaminating open drains and canals. Substation siting should avoid low-lying, poorly drained areas prone to sewage overflow. Coordination with WASAs and city corporations is essential to prevent disruption of existing sanitation lines.

4.4.8 Traffic and transport

193. Currently 52 numbers of trains both ways are operated on the Project corridor. After implementation of the Project, the sectional capacity on this portion will be 80 trains per day each way, i.e., 160 train movements both ways each day on Dhaka-Chattogram portion of the corridor including provision for a track maintenance window. If slower local trains are also assumed to run, then the sectional capacity would come down to 65 trains each way i.e., 130 train's movements each day (Bangladesh Railway, 2024).

4.4.9 Public health

194. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur corridor spans densely populated urban centers and rapidly growing peri-urban zones, where public health conditions are shaped by a mix of infrastructure gaps, environmental stressors, and socioeconomic disparities. Health Impact Assessments (HIAs) should be integrated into the Environmental and Social Impact Assessment (ESIA). Construction phase must include dust suppression, noise control, and worker health and safety protocols. Railway hospitals (e.g., in Chattogram) may require modernization to serve both staff and local communities. Community health outreach can mitigate risks from displacement, pollution, and construction-related stress.

4.4.10 Positive impact

195. This project is a cornerstone of Bangladesh's Green Railway Master Plan. The electrification of the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor

is more than just a transport upgrade—it's a catalyst for environmental, economic, and social transformation. Reduced Emissions- Electric trains will cut greenhouse gas emissions by replacing diesel locomotives, helping Bangladesh meet its climate goals. Cleaner Air- Lower levels of PM2.5 and NOx will improve air quality in urban centers like Dhaka and Narayanganj. Energy Efficiency- Electric traction is 20–30% more energy-efficient than diesel, reducing fossil fuel dependency.

196. Faster Commutes-Trains will run at speeds up to 120 km/h, reducing travel time and easing congestion on roads. Increased Capacity-Electrification allows for more frequent and longer trains, improving both passenger and freight services. Modernization-Upgraded stations, workshops, and signaling systems will enhance safety and reliability.

197. Community safety is a significant concern for BR. At present during any 24-hour period almost 52 trains per day both ways move between Laksam and Chattogram section. Safety features consist of manually operated gates. There are 51 Authorized Level Crossings and 108 Unauthorized Level Crossings along the Project Corridor. These level crossings pose a potential danger to public safety. BR is preparing a strategy to provide adequate crossings for local communities, while minimizing train service disruption and keeping vehicular traffic moving, with minimum delays.

198. Cultural Property refers to any local, regional and/or national cultural heritage features, e.g., ancient mosque, historic buildings, works of art, archaeological sites, libraries and museums potentially impacted by the Project work. Common Property Resources (CPR) mean the property usually used by the local communities, e.g., educational institutes, religious institutes, Eidgah, Crematory, etc. These properties require to be protected as they contribute to local culture. There are no declared (by the authority concerned) archaeological or paleontological sites or structures within the Project alignment.

5. Analyses of Alternatives

5.1 Introduction

199. As part of the feasibility study for the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway electrification, several alternatives were evaluated to determine the most viable, cost-effective, and environmentally sustainable solution. Continue operating diesel-powered trains on existing infrastructure. No capital investment required; avoids construction disruption. Reduces emissions by 20–30%, lowers operating costs by 35%, improves speed and reliability. Selected as the most sustainable and cost-effective long-term solution.

5.2 Design Alternatives

200. The electrification of the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor underwent a structured evaluation of design alternatives during the feasibility and detailed design phase, led by Bangladesh Railway and Turkish engineering firm TUMAS. Installation of 25kV AC overhead lines with masts, gantries, and substations to proven global standard for high-speed and heavy-haul rail, Compatible with existing track geometry, Easier to maintain than third-rail systems. alternatives were assessed based on cost, safety, environmental impact, operational efficiency, and climate resilience. The selected design reflects a balance between global best practices and local constraints.

5.3 Layout Alternatives

201. During the feasibility and design phase of the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway electrification project, several layout alternatives were explored to optimize land use, minimize disruption, and ensure resilience. These alternatives were assessed based on technical feasibility, environmental impact, cost, and operational efficiency.

5.4 Do nothing

202. In project planning, the “Do Nothing” scenario is a baseline used to assess what would happen if no action is taken—in this case, if the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway electrification project is not implemented.

Table 36: Consequences of Doing Nothing

Impact Area	Consequences
Transport Efficiency	Continued reliance on slow, diesel-powered trains; limited capacity and reliability
Environmental Impact	Ongoing emissions from diesel locomotives; worsening air quality in urban areas
Economic Growth	Missed opportunity to reduce logistics costs and boost trade via Chattogram Port
Public Health	Persistent exposure to noise and air pollution, especially in dense cities like Dhaka
Urban Congestion	Increased pressure on roads and highways due to lack of efficient rail alternatives
Climate Commitments	Failure to align with Bangladesh's NDC targets and green transport goals

203. The “Do Nothing” option is not neutral—it leads to increasing costs, environmental degradation, and lost economic potential. That’s why the electrification project was selected as the most viable alternative after evaluating multiple options, including hybrid and phased approaches.

6. Potential Environmental & Social Impacts Identification, Prediction and Evaluation

6.1 Introduction

204. This section of the EIA report describes the probable environmental impacts caused by the activities taking place during the pre-construction, construction and operating periods of the Project and defines mitigation measures to be implemented to prevent or minimize any serious negative effects.

205. The Contractor will be required to address all potential construction related effects specified in the EIA's Environmental Management Plan (EMP) and prepare a Construction Environmental Management Workplan (CEMWP), based on the EMP provided in this EIA. The CEMWP must provide a work plan for the implementation of the mitigation and monitoring tasks required and environmental supervision responsibilities during the construction and a minimum one-year defect operating year of the Project (**See Chapter 10**).

6.1.1 Identification of impacts

A. -Construction Period: Project Location and Design

206. Pre-construction work is not so much about mitigation of impacts, but much more about rethinking/redesigning specific aspects of the construction plan that could eliminate possible future negative impacts. It is a preventative, as opposed to remedial mitigation planning period, and 11 activities will be undertaken by BR, its CSC and the contractor were specified.

1) Trees and Landscape

207. Major impact will be from the Project activities of rail alignment, land acquisition, associated facilities, and demolition of some existing buildings and reconstruction of station buildings.

208. More than 137,000 trees will need to be removed from the 365.90 km long Project corridor. These will include timber trees, fruit trees, trees used in the production of medicines, banana plants, and bamboo thickets, each of them has their own economic, biological, eco-functional and aesthetic significance. The tree cutting will be based on a plan, prepared as part of this EIA and finalized during the preconstruction period by BR. The objective of the tree plantation and replacement programme is to compensate local people for the loss of tree, to protect the affected cultural/sensitive areas (within 100 m from the RoW boundary) and to enhance the health of the existing ecosystem. The formula agreed to with the Forest Department is to replace every mature tree cut with three trees of the same species, either within the proposed Project area or any suitable location in Bangladesh designated by the Forest Department and DoE**.**

2) Land Acquisition

209. Despite the limited and linear acquisition, 1117 households will be impacted. Most of the households and shops affected are in cluster and located close to railway stations and railway crossings, and on BR land.

210. To mitigate this impact, land acquisition has been minimized as much as possible, through careful design described in the Project RP and a compensation package of both relocation and rehabilitation is defined in detail in that report. BR will, strictly enforce this plan

211. BR is minimizing the loss through careful realignments past and around sensitive sites throughout the corridor and these mitigation measures will be fully in place prior to construction. The Project work will generate more than 1,000 skilled and unskilled temporary jobs, and many permanent ones as well. (Bangladesh Railway, 2024) Assuming that these workers spend their earnings locally, benefits will accrue to the community impacted by the Project construction.

3) Heritage and Culture

212. No known or recorded Archaeological, Historical or Architectural structures or sites are affected by the development of this Project. A total of 91 Community Property Resources (CPRs)

have been identified by the social assessment team those might be relocated and reconstructed by BR according to local wishes.

213. Compensation will be provided according to the guidelines specified in the Resettlement Plan. All communities losing CPRs (total 91) will be given cash compensation for the land, structure and additional transfer grants for relocation of each structure[2]. According to the entitlement policy defined in the RP, for dismantling and reconstruction, cash assistance will be provided as per assessed value. In this way CPRs will be rebuilt at BR's expense, in consultation with the APs and the affected communities. Affected graveyards will be dealt with sensitively, and in consultation with the concerned families as some graveyards are not registered with local Government, but rather are on private and mostly homestead lands. The concerned DC will pay compensation as homestead land and will not recognize the "graves" as they are not on record. The Implementation Non-Government Organization (INGO) will assist the families to exhume the bodies for reburial provided the concerned families wish relocation of graves. Further details are provided in the RP [10].

6.1.2 Environment Impacts associated with construction

4) Infrastructure and Utility Relocation

214. A number of overhead power lines cross the rail corridor; several of them need to be relocated. BR will request the concerned authorities and other relevant agencies to undertake this work and will cover all costs. Further details of these lines are described in Ancillary Work of the Feasibility Report of the Project.

5) Safety and Level Crossings

215. Level crossings pose a significant safety concern, and a majority of the fatal accidents that took place at level crossings were mainly attributable to negligence, incompetence or incapacity of road vehicle drivers.

216. Due to the Project, the number of trains per day will increase dramatically very significantly increasing the risk of accident and even fatalities. Unless crossing points are better managed, the dangers of at grade crossing incidents and a sharp rise on traffic congestion is very likely,

217. The level crossing issue will be carefully examined by BR and designs to incorporate safety features to protect the public as well as include a rapid crossing clearing system, will be implemented. Further, warning signs and closure notices will be placed at 34 crossings and the other 129 retained as authorised and properly controlled crossings. BR is coordinating with the relevant road authorities to construct several road flyovers to minimize conflicts between road and railway at high traffic volume intersections.

6) Transportation of Construction Materials

218. Having massive earthwork with millions of m^3 of construction materials to be transported and deposited on site, there is the potential for serious local negative local air quality, noise and traffic problems. This will degrade haul routes, due to excessive dust, traffic congestion and increase safety concerns.

219. Prior to the start of construction, a plan for the transportation of materials will be prepared in consultation with the contractor (as part of the CEMWP preparation) and the police prior to the start of construction. BR, in consultation with Contractor and local police, will prepare a checklist and guideline for handling of all construction materials and the designation of roads, not suited for hauling materials. BR will work with the local police enforce these conditions.

6.1.3 Construction waste management: Construction Period and Stations

220. Inadequate provision of sewage, sanitation and garbage management at construction sites may lead to chronic problems. To address this issue the contractor will need to prepare a waste management plan and schedule and submit that to the CSC for approval before construction begins.

[2] All of these structures will need to be removed from the CROW and relocated at BR's expense

221. Secondly, the designs of 11 sub stations were completed, sized each station's waste management facilities, in compliance with the Bangladesh National Building Code (BNBC). The designs included sewage management systems, the use of solar energy and rainwater harvesting, as well as natural ventilation, intended to reduce the energy requirement of each station.

7) Labour Standard

222. BR will instruct contractors to comply with ILO (**International Labour Organization)** and WHO (**World Health Organization**) standards on labour practices which the GoB is a signatory to and bound to enforce. These standards include, child labour, minimum wage, forced labour, unsanitary working conditions and unsafe water supplies. Contractors, applying poor labour standards, jeopardizing the smooth functioning of the work schedules will be fined and have potential work stoppages if corrective actions are not immediate and effective.

8) Technical Capacity to Undertake Environmental Work

223. Based on past experience it is likely that the contractor will be poorly equipped to implement the EIA and its EMP, resulting in a breakdown of the safeguards implementation process. To prevent this, the contractor will need to hire a qualified environmental safeguards officer full time during construction period to implement and supervise mitigation and monitoring tasks. Also. This person will be mobilized as soon as the contract is awarded and will work with BR's environment unit (EU) specialist(s) to fully and credibly implement the EMP and the CEMWP prepared by the contractor.

9) Environmental Clauses in Contract

224. BR and its CSC do not have the tools or specific environmental clauses in the standard FIDIC–style contracts to force the contractors to comply with requirements defined in the EIA and its EMP

225. To address this gap, BR has inserted environmental clauses into the construction contracts. These clauses underscore the requirements for environmentally responsible construction and specify the need for the contractor to apply the mitigation and monitoring measures defined in the EMP. Further, BR has prepared a section of the contract Bill of Quantities dedicated to environmental safeguards. This addition will help to link specific payments to the implementation of mitigation and monitoring actions as defined in the contract specifications.

10) Safeguard Documents, Training in EA and EMP for Contractors and Engineer

226. The contractor(s) will be given an electronic and hard copy of the EIA report at the time of mobilizing so that mandatory environmental safeguard measures can be reviewed, the CEMWP prepared, and the full range of measures credibly implemented.

227. Accordingly, BR will confirm that the EIA documentation is distributed to the contractors, Upazilas and the CSC for use during the construction period and beyond. In addition, before construction mobilization, BR will organize a briefing session for the contractor, to review the EMP and its implementation, provide guidance on CEMWP preparation and define reporting requirements. The CSC will train the representatives of BR, the contractor(s) and other relevant staff of the Project on EIA, EMP, environmental specifications, and legal aspects of DoE so that EMP implementation takes place properly and in a timely manner (**Table 48**).

1.1 Construction Period Impacts and Proposed Mitigation

228. **The Construction Environmental Management Work Plan (CEMWP)-** The Construction Supervision Consultant (CSC) retained by BR will assist the contractor with the preparation of the CEMWP. The purpose of the CEMWP exercise is to require the contractor to become familiar with the EMP and provide a plan on how mitigation and monitoring actions are to be implemented during the construction period. The CEMWP also allows BR, lending agencies and CSC, to follow the progress of the implementation of the EMP.

6.2 Environmental Impact Evaluation

6.2.1 Impact on Air Quality

229. Air quality measurements were carried out on July and December 2024 at eleven specific locations for a total 11 sample covering day and night along the Project alignment. The key air quality parameters (particulate matter-PM_{10} and $PM_{2.5}$, Oxides of Sulphur - SO_x, Carbon monoxide- CO, Oxides of Nitrogen – NO, NO_x, Ground Ozone O_3, VOC, Air Temperature, Relative Humidity, Wind Speed, Wind Direction) were analysed from samples collected over a 1 hour continuous sampling period at each sampling site (Chapter IV). These baseline data for CO, SO_2, O_3, VOC, $PM_{2.5}$, and PM_{10} show that none of the test result at 11 sampling stations exceeded the DoE acceptable limit.

230. All earthworks construction, site clearing, dry materials stockpiling, station and small structure demolition, reconstruction of station building, operation of batch plants, and hauling of materials will generate dust and affect the local air shed. Air pollution from trucks generating emissions and dust from the thousands of truck trips needed to place the material and excavation work will be the most significant direct potential impact on the local community. NO_2, SO_2 and Particulate Matter levels will increase by as much as 15% each day during the construction hours, but should not exceed GoB standards and should drop back down to ambient levels, as shown in **Table 19** and **Table 20** during the night. The materials must be trucked and placed on site in order to build the new line, however the following mitigative measures to minimise the impacts as much as possible will be implemented by the contractor and enforced by BR and its CSC. These measures will be as follows:

- trucks transporting fine materials, soils and wastes to and from the Project site will be covered to reduce the release of dust;
- the truck fleet used to haul materials must provide vehicle maintenance records to the Engineer, confirming that the fleet is in working order and that all engines are tuned so as to minimise emissions, especially particulate matter and black smoke. Uncertified trucks will not be permitted on any worksite;
- generators, compressors, equipment must be shut down when not in use;
- air emission monitoring programme must be undertaken quarterly by the contractor, according to the design used during the EMP and the contract specifications and included as a minimum testing for NO_2, SO_2, $PM_{2.5}$, and PM_{10};
- all construction and other disturbed areas must to be stabilized, e.g., with crushed concrete/brick or regularly wet down along heavily used haul roads to reduce dust generation in populated areas;
- truck speed limits will be restricted to ≤60 km/h, and no trucks will be permitted to keep their engines on when idling for longer than three minutes (unless they are being loaded); and,
- All aggregate processing, concrete and asphalt batch plants will be located at least 500 m from the nearest residence (or separated by a hill) and will be required have dust suppression equipment installed and in operation throughout the construction period. The contractor(s) will be required to provide BR with the specifications for this equipment.
- haul road will be cleaned of spilled earth and fines and watered daily to reduce dust. And finally, rapid vegetation including grass seeding will be planted.

6.2.2 Impact on Soil Quality

231. The electrification of the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor will inevitably interact with diverse soil types—ranging from floodplain alluvium to red clay terraces—each with varying sensitivity to disturbance. The most of work is on the existing trac, so there is no possibility to disturbance the soil either sub-station construction. For any kind of civil works which is associates with the soil take proper measures such as-Topsoil Preservation: Strip and store topsoil separately for reuse in landscaping and restoration. Erosion Control: Use silt fences, mulching, and terracing in sloped areas. Spill Management: Designated fueling zones and spill containment protocols. Soil Testing: Pre- and post-construction soil

quality monitoring (pH, organic matter, heavy metals). Green Buffer Zones: Replanting native vegetation to stabilize soil and restore fertility. According to the Soil Fertility Atlas of Bangladesh (2020), the region's soils are already under pressure from acidification, nutrient depletion, and urban encroachment. Without proper safeguards, construction could exacerbate these trends.

6.2.3 Impact due to Noise and Vibration

232. Noise and vibration measurements were carried out in July and December 2024 at 11 specific locations for a total 11 sample covering day and night along the Project alignment. The existing general noise level within the study area varies from 51 dBA to 61 dBA during day time and 58 dBA to 73 dBA during night time which is above the standard of mixed zone land use (DoE, 1997), also slightly above commercial zone land use, which is the designation for the railway corridor.

233. The severity of potential noise and vibration impacts is linked to the typical background noise and vibration environment, e.g., a noisy urban area versus a quiet rural setting as well as the mix of construction equipment operating at the same time. Key Project-related noise sources will be generators, heavy vehicles, construction machinery/equipment, aggregate crushing plants, concrete and asphalt batch plants and compaction equipment, station reconstruction and construction workforce presence.

234. Discussion with the design engineers identified the following activities that have potential to generate significant noise:

- Construction of new bridges
- Demolition and construction of new railway stations
- Plant operations
- Construction machinery

235. **Construction of New Stations** - The construction of new stations and other buildings will introduce new noise sources from the use of powered mechanical equipment and the carrying out of the construction activities (e.g., erection or dismantling of formwork and hammering) in addition to slowing of trains passing by as the approach the construction area. Based in the table for standard noise level associated with construction equipment, a steady 65–70 dBA can be expected during working hours up to a distance of 20 m from the work sites. As the proposed construction corridor is 50m wide and clear of structures, there will be negligible noise impact to the nearby receptors, as they are located outside the construction corridor on an average more than 70 m away from the tracks.

236. **Plant Operating Noise**- The operation of batch plants and aggregate crushing plants[3] will generate noise exceeding 80 dBA up to 15 m from the source. To mitigate this noise, facilities will be located at least 500 m from the nearest residence and generators will be either far away from noise sensitive sites or housed in a noise attenuating shroud. Where work is required within close vicinity of settlements, it will be undertaken only during the daytime (0600-1800). In some cases, work will have to take place during the night period in order to reduce disruption to local traffic, in which cases extremely loud equipment such as large vibrators, pile driving equipment and jack hammers will not be used and temporary baffles constructed as needed.

237. **Construction Machinery Noise (Embankment)**- Noise generated from the construction machinery, such as backhoes, bulldozers and compactors, jackhammers and pile driving/boring machines, vehicle movement and unloading of waste materials from trucks building the new embankment, will have temporary impacts for a limited period of time in any single location. Based on the previous studies for different construction equipment, average noise level at source at was around 80 dBA (measured at 15 m from the source), and decreased by 6 dBA, with every doubling of the distance from the source reading. Also, when, for example, four pieces of equipment are operating at the same site the noise at the source will be about 84-85 dBA, (an increase of 1-2 dBA above the equipment generating the highest noise). However, since the

[3] Although not finalized roch crushing will take place at the Jaflong crushing in Sylhet District, Bangladesh, with the finished materials transported to the construction sites.

background noise level was measured **(Table 37)** to be between 50 and 70dBA the construction equipment noise will reflect construction period conditions. Adding distance to the formula, a noise level of 85 dBA (at 15 m distance) would be attenuated to 79 dBA at 30 m from the source and to around 60-64 dBA at the BR RoW boundary. List of Equipment with noise level is provided in **Table 37**.

Table 37: List of Equipment with Noise level with 15 m from the Source

Equipment	Noise Level (dBA) with 15 m from the Source	Equipment	Noise Level (dBA) with 15 m from the Source
Air Compressor	81 (78)	Generator	81 (73)
Backhoe	80 (78)	Impact Wrench	85
Ballast Equalizer	82	Jack Hammer	88 (89)
Ballast Tamper	83	Loader	85 (78)
Compactor	82 (83)	Pile Driver (impact)	101 (101)
Concrete Mixer	85 (79)	Pile Driver (Sonic)	96 (82)
Concrete Pump	82 (81)	Pump	76 (81)
Concrete Vibrator	76 (80)	Rail Saw	90 (90)
Crane Derrick	88 (79)	Shovel	82 (78)
Crane Mobile	83 (81)	Truck	88 (76)
Dozer	85 (82)		

Source: Railroad construction equipment (9.4.3) taken during the northeast corridor Improvement Project and other measured data of Federal Highway Administration, USA 2017. No, in ( ) is taken from FDA dataset 2017 from 30 to >400 measurements.

238. By erecting temporary baffles and the use of low noise emitting equipment, noise pollution could be kept at or below the 60 dBA daytime and 50 dBA nighttime limits for mixed use land use (Bangladesh Standard 2006) at mosques, school[4], populated area and other sensitive sites. If noise levels, based on field measures, indicate exceedances of existing permissible levels, during the evening and night, work hour restrictions will be enforced.

239. **Noise Mitigation Measures** Implementation of the following appropriate mitigative measures by the contractor will reduce the impact on sensitive receptors throughout the Project corridor:

- Investigate any noise-related complaint, record its location and file a single-sheet report with the CSC. The CSC will take measurements using the hand-held sound level meter and if complaints are confirmed, i.e., the noise levels measured exceed GoB standards for the land use designation in the area, the contractor must take action to reduce noise, such as posting reduced speed and quite zone signs, diverting haul routes to less densely population roads, erecting temporary baffles to reduce construction noise.
- Where work is in or close to settlements, undertake noisy (known to exceed standards, such as pile driving or vibration intensive) works during the daytime.
- Less noisy equipment: One of the most effective methods of diminishing equipment noise is to use less noisy machinery. By specifying and/or using less noisy equipment (e.g. pile boring instead of pile hammer machines), 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.

- 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. BR will instruct the contractor to apply these noise attenuation measures
- 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.
- Enclosures: Enclosures for stationary work may be constructed of wood or any other suitable material and temporarily surround the specific operation areas and equipment. BR will discuss specific approaches with the contractor and recommend noise barrier materials and design, with a focus on ease of erection and dismantling.
- 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. Noise proof sheet shall be installed during the pile driving work in order to reduce the noise level. The proposed railway alignment will cross through the residential areas as well as sensitive areas. These areas have potential chances to expose high noise level during the pile driving while working near to shore if no mitigation measures have been taken. Therefore, it is suggested to install Noise Proof Cover on Piling Machine as shown in **Figure 35**. Beside this, following mitigation measures are also suggested during construction period those will reduce the noise level further.

Figure 35: Example of Noise Proofing for Pile Driving Machine

240. **Vibration Mitigation -** During the construction phase, vibration may be generated by some machines, i.e., mainly hammer machines, rammers. This equipment operating on clay may generate a vibration of Peak Particle Velocity (PPV) 7.0 mm/s or rammers with 30 kJ energy may generate a PPV of 4.3 mm/s at a distance of 10 metres, etc. However, these machines will be located at least 30m far away from the nearby structures. At this distance the vibration levels will be within the PPV 2.5 mm/sec level defined as the threshold for cosmetic damage to buildings.

241. The major sources of construction period noise are from construction of bridges, railway stations, pile construction, concrete plant operations, and machinery operations. The noise generated from these sources will be manageable through implementation of noise mitigation measures. Further, to establish the effects on sensitive receptors, contractor will discuss attenuation measures with local communities affected and take necessary action if required. A

quarterly field noise monitoring programme, at the sensitive sites sampled during this EIA will be undertaken throughout the Construction Period, lasting 4 years

Topography and Landscape Changes

242. Large piles of embankment materials and ballast and excavation work along the edge of the alignment leaving large unsafe trackside quarries are an unfortunately common site along railway construction corridors. These areas pose not only safety concerns but present serious visual barriers to local people. Once construction is completed in an area, site restoration and filling of the borrow pits (unless special agreement for farm ponds is organized by BR) must be undertaken and the area restored to pre-construction contours and revegetated. Embankment site to be planted trees to promote natural vegetation; as well as fast growing grasses such as Vetiver/Napitar.

Erosion

243. Due to very flat topography, the Project area is not prone to erosion hazards, and actually receives a few centimetres of sediment during each flood season. Historically, the area has seen little erosion.

Climate Change

244. Along the alignment, due care has been taken to ensure that the effects of climate change do not adversely impact the railway. Embankment heights have been designed for a minimum return period of 20 years. Careful attention will also be given in the detailed design to ensure that all waterway crossings have been provided with sufficient openings to ensure that there are no adverse impacts upstream or downstream of the water crossings. The design heights of the embankments are above the highest flood level for which the waterway openings have been designed, including an additional average freeboard on 0.6m as required by law.

245. According to flood zone map, around 30% of the Project area is flash flood prone. Flash flood impact is a regular and common phenomenon in the Project side. Contractors, BR and other agencies involved need to take precautionary measurement for construction preparation period and during construction management. The dry periods (September to April) is a peak period for flash flooding as the land is dry and periodic heavy rains cannot be retained by the soil and flash flooding results. Contractors need to be aware of this plan work around drainage channels and rivers with such events in mind.

6.2.4 Impact on Water Quality

246. **Hydrology**- In Bangladesh, rainfall and trans-boundary river flows are the main sources of surface water. The surface water along the proposed alignment is dominated by the Feni, Muhuri, Silonia and Dakatia Rivers (see Chapter IV).

247. **Surface Water Quality**- To establish existing water quality in the corridor, baseline surface water samples were collected for laboratory analysis from five locations, with one 50m upstream and one 50 m downstream of the crossing area, a total of 20 sampling points along the corridor during June and November, 2018. However, the existing surface water quality test results showed that for the most part of surface water quality is within DoE standards except dissolved oxygen. During the construction period, surface water quality needs to be well protected from contamination due to construction activities.

248. Earthwork activities during construction of embankment may result in drainage congestion. Surface water at Project sites may become contaminated due to faucal runoff from camp toilet facilities, erosion from poorly secured construction sites, spilled lubricants and fuels and other contamination from work camps and the construction operations. To prevent sewage pollution, contractors will be required to install proper construction camp toilet facilities, either via septic tanks, engineered pit privies or other toilet facilities that do not result in area sewage pollution.

249. Reduction of natural surface water drainage and degradation of surface water quality is common at construction sites, and since the Project corridor cuts across a mostly wet area with many rivers, creeks and canals, the likelihood of a negative effect is high. Surface water at

Project sites may be polluted due to faecal runoff, erosion, spilled lubricants and fuels and other contamination from work camps and the construction operations.

250. The contractor will be required to carefully control all wastes and manage the use of petroleum products and implement EMP mitigative actions 2.6, in accordance with GoB standards. A water quality monitoring programme will be undertaken quarterly during the construction years, with semiannual reports to ADB, tracking water quality conditions in relation to the background data collected during this EIA.

Groundwater

251. Groundwater will be required for the Project's batch plant operations for the production of the concrete needed for the structural elements of the bridges and culverts, as well as the foundations of the new stations. Also, a large volume of water will be required for thousands of workers to be housed in the work camps. Sets of pit privies will be constructed for workers and these have the potential for leaching pollutants, mostly nutrients, bacteria and viruses into nearby tube wells contaminating the aquifers. The potential exists for drinking water sources, whether existing or newly construction, to be contaminated by the seepage of wastes from workers' camps. To prevent such contamination, the placement of toilets and wells, must be designed in relation to groundwater protection parameters as provided by the government agency responsible.

252. If groundwater wells are needed, they must be permitted and drilled to a depth of >100 m, properly sealed to prevent leakage. Designing and constructing all latrines at construction camps and any contractor facility must be done with extra care. To minimize the risk of sewage contaminating the groundwater aquifer, licensed professionals must complete well lining and sealing of ring slabs. Workforce camps will be located at least 500 m from any water source, i.e., a well or water body.

6.2.5 Impact due to solid/hazardous waste

253. To prevent the wastewater and solid wastes from entering well and groundwater recharge areas, all practical measures such as provision of septic tanks, garbage bags, and other sanitation facilities will be implemented at the construction camps.

254. All solid wastes within construction sites should be contained at designated location. Construction machinery and vehicles should be serviced only at designated maintenance workshops where waste oils and lubricants can be collected and recycled. The monthly monitoring report will provide compliance update.

Land Use and Vegetation Cleaning Clearing

255. The most significant potential impacts on land use in the study area will be the loss of agricultural land (primarily rice paddy), and the relocation of 1,759 residential households, affecting 9,792 people. The other potential impacts are likely to be trimming of roadside vegetation and temporary relocation of fences, neither of which would be expected to constitute a significant and permanent impact to land use.

256. Mitigation measures may be taken in the manner that acquisition of land, and compensation for all losses should be made in accordance with the laws and as defined in the Project RP. Severe penalties will bd applied for unnecessary or careless clearing by the contractor and especially in areas where clearing is not permitted. Equipment operators will be trained and informed on where clearing is permitted and how this is to be done.

Health Safety and Contractors' Camp

257. Environmental health issues and disease contamination are common in labor camps. This would cause from poor work camp conditions, inadequate and unsanitary toilet facilities, lack of potable water and sanitary washing areas.

258. The following mitigation measures will be applied.

- Weekly compliance cheeks by BR (PIU) and the CSC.

- The contractor will be required to post a cleaning schedule at each toilet and washing facility, which CSC will inspect weekly.
- The contractor will be required to provide potable water (based on WQ tests), sanitary toilet and hygienic accommodation for workers at all construction camps, at all times and ensure that these facilities are cleaned and disinfected regularly.
- Provide a garbage disposal service such that no garbage or food waste is dumped in the contractor's yard or work camp at any time. There should be no litter or food scraps dumped anywhere other than in bins that are collected and cleaned at least weekly.
- The contractor will be required to prove that PSEs and First-Aid facility operate at each work camp.

Vector Borne Diseases and Health

- Construction activities create depressions in the ground that allow stagnant puddles to form which are ideal breeding areas for malaria and dengue carrying mosquitoes. Breeding areas include any stagnant water and puddles, as well as stored construction materials, tyres and empty storage drums. These will be inspected every three days to prevent mosquito eggs from hatching, and will be undertaken during the entire rainy season and within three days of every major rainfall.

259. **Worksite Safety Management -** Management of the worksites and poor safety oversight by the contractor leads to accidents and unsafe working conditions. Fences will be erected to keep the public from construction sites and to work closely with BR's dispatch staff in order to manage train movements while work is ongoing.

260. Contractors must at all times, ensure the local people who need to move from one side of the construction area to another can do so without undue delay.

261. **HIV Awareness -** Due to influx of workers in the Project area, AIDS/HIV may spread in local community for uncontrolled social gathering induced by being away from family. Workers health training programme will be organized during construction period to aware the health and hygienic issues. Training to be provided by health specialist such as a local NGO, and, if needed, an INGO.

Occupational Health and Safety

262. Accidents occur in work sites when Contractor does not provide adequate Personal Protective Equipment (PPE) or properly enforces its use.

263. Lack of safety training by contractor can lead to accidents and lost productivity. Construction workers will be trained in general health and safety matters and on specific hazards of their work.

264. Poorly prepared labour standards, lead to infractions regarding child labour, minimum wage, forced labour, and unsanitary working conditions and unsafe water supplies. Labour standards ignored or not complied with leading to infractions of basic labour standards as defined by ILO conventions.

265. The PIU will ensure that the contractors and any subcontractors implement the following measures to mitigate the occupational health and safety issues:

- Construction workers will be trained in general health and safety matters and hazards of their work;
- Workers will be provided with appropriate personal protective equipment, such as safety boots, helmets, gloves, and protective clothing, goggles and ear protection and;
- Safe drinking water will be provided to all workers.

The Construction Period Environmental Completion Reporting

266. The failure of the contractor to prepare a summary report defining the mitigation and monitoring actions completed during the construction period and fails to identify what must be

continued during the operating period, will result in a weakened and possibly short-circuited environmental safeguards programme. A completion report is to be prepared and should be delivered to the CSC sometime during the contractor's defect period year.

6.2.6 Impact on Ecosystem

1) Terrestrial and Aquatic Flora and Fauna

267. The clearing of more than 137,000 trees and associated understory vegetation and widening of the existing 129 km long and 2-5 m high embankment will reduce the habitat for mostly birdlife, given that the aquatic and terrestrial faunal is limited to common and pest species. Small patches of wetland will be filled in by the additional embankment.

268. A rapid revegetation / tree replanting programme will permit the rail-side habitat to recover quickly. The rapid reestablishment of pre-construction surface draining will help to bring wet areas, somewhat reduced (marginally) by the new embankment, back to pre-construction conditions**.**

Fisheries

269. The bridge construction activities, particularly the in-river pile driving operations, could temporarily impact the capture fisheries at the bridge site. The environmental monitoring during 2013 and 2014 of the Tongi Bhairab Double Tracking Project, which included intensive in-river pile driving at a number of bridges, showed no significant change in water quality and no change in the diversity of and quantity of fish taken by fishers upstream and downstream of the four bridge construction sites. Therefore, since the work proposed is similar to the Tongi-Bhairab Project, the impact on fish will be marginal. However, the contractor must not dump construction debris and sewage into the river that could potentially damage the quality of the surface water resulting degradation of fish species in bridge construction area.

6.2.7 Socio-economic Impact

1) Heritage and Culture

270. There will be some impact on the existing regionally and locally important structures and monuments such as mosques and graveyards. A social survey has identified 91 structures, of which few of them are physically and culturally important. A number of 91 CPRs will be affected by the rail line construction

271. Replacement and relocation to a suitable location will be carried out with the help and consent of the affected local community. Local community and religious leaders will be consulted to determine what modifications may be applied to the works scheduling and methodology to limit these potential impacts. Measures of mitigation to be applied will be based on the joint decision by PIU and the local community involved.

Resettlement

272. The RP and other social safeguard documents for the Project are guided by the National Laws – for example, the Acquisition and Requisition of Immovable Poverty Act, 2017 and the Asian Development Bank (ADB) Social Policy Statement (SPS) 2009/ Involuntary Resettlement (IR) Policy and other related guidelines. Thus, the approaches and policy framework being used in Resettlement Plan covers all affected persons, irrespective of titles, which are identified by the social surveys and household census, including the affected shops and businesses in compliance to duly prepared planning and survey activities for the RP.

273. Apart from direct impacts such as permanent land acquisition, the Project work may also entail some indirect impacts such as loss of access to land by tenants and informal occupants and loss of employment and workdays. Such indirectly affected persons will be included in the Resettlement Plan. In view of the extent and severity of losses, the Resettlement Plan will keep adequate provisions for alternative income generation and other enabling strategies whereby APs can either continue their previous occupation, initiate new venture or undertake an alternative occupation. The basic objective behind the livelihood restoration activities and

schemes will be to improve or at least restore the pre-Project standards the APs enjoyed, which also complies with ADB SPS (2009) requirements.

Livelihood

274. Average poverty rate (at or below the national poverty line) of this area is about 13%. Compensatory measures will be provided to all affected people and will follow the specifications as listed in the entitlement matrix of the RP. These are:

- Affected households/persons will receive replacement value of the land and other assets before relocation. Likewise, loss of standing crops and trees will be compensated at market price.
- Owners of residential/commercial structures, including structures on railway lands, will be compensated at replacement costs.
- Informal settlers on railway lands, renters/leaseholders affected by loss of living quarters or commercial premises will receive compensation and resettlement benefit due to loss of dwellings, fixed assets and income.
- Affected community structures or physical cultural resources will be re-built by the Project in consultation with the community.
- All affected people will receive assistance to re-establish lost assets or livelihood.
- The needs of women and vulnerable groups will be identified and provisions made for social and economic development support, employment, and means of subsistence to improve their status/livelihoods.
- Owners of affected structures will receive additional assistance for relocation and reconstruction of the structures at their own initiatives and places of choices.
- BR will guide, supervise, and monitor the land acquisition, compensation payment, and resettlement of the APs, including grievance redress and resolution of disputed claims for compensation/resettlement benefits.
- Grievance Redress Committees (GRCs) will be formed to ensure participation, and speedy and out of court settlement of as many disputes as possible.
- Independent third-party monitoring by external expert/agency will be provisioned for monitoring resettlement operations and outcomes.
- All affected households/businesses, as per the above policy guidelines, will be eligible for compensation and resettlement assistance from the Project. The RP will contain a detailed entitlement matrix explaining the various elements, including institutional arrangements for resettlement management.
- During the construction period, residential structures, commercial structures and entities may be affected. Proper compensation and relocation of the affected entities may stand suffice towards mitigation process.

Vulnerable People/Communities (Special Consideration)

275. Vulnerable or “at-risk” groups include people who, by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage or social status may be more severely affected by displacement than others and who may be limited in their ability to claim or take advantage of resettlement assistance and related development benefits. Vulnerable groups also include people living below the poverty line, the landless, the elderly, women- and children-headed households, indigenous peoples, ethnic minorities, natural resource dependent communities or other displaced persons who may not be protected through national land compensation or land titling legislation.

276. These groups have been identified through the social baseline studies component of the RP work undertaken by the social sector consultants retained by BR.

277. In some cases, special efforts must be made to ensure that vulnerable members have access to consultation events or discussion forums. Examples of this include provision of transportation and visits to individual households. Persons identified as vulnerable should be assisted to fully understand their options for resettlement and compensation, and encouraged to choose the option with the lowest risk and solid benefits.

Railway Station Construction Impact: Mitigation and Monitoring

278. Construction of rail stations and their access roads and other ancillaries will be carried over 2021-2025 and put into operation for services in 2026 between Laksam-Chinki Astana-Chattogram.

279. Therefore, the completion of the track work will finish ahead of the station rehabilitation, extending the work by several years. The mitigation of impacts associated with station building and upgrading will need to be included in the contractor's environmental reporting, and defined in a special EMP devoted to the construction of 7 stations. This will need to be completed, through a collaborative effort of the CSC the PIU and the Contractor, before the station construction begins. The Project EMP addresses all aspects of waste materials management, demolition, access road construction, etc.

Operating Period Biophysical Environment

1) Construction Period Environmental Monitoring Completion Report

280. During the lengthy construction period, Contractor, working under the supervision of a Construction Supervision Consultant and PIU, will have to complete a large number of mitigation and monitoring activities. The contractors will be required to submit an environmental mitigation completion report, a compliance monitoring checklist (**Annex 13**) Defining all the mitigative actions taken, the dates work was done and on-going actions needed to maintain what was started. This would include comments on the decommissioning of the work camps, the waste facilities, the rehabilitation of the embankments, and stabilization of cut areas and clean-up of all temporary storage areas.

281. If mitigation measures seem to be failing, an environmental expert will be assigned by BR to obtain, examine and take necessary actions to rectify these problems.

2) Construction Period Decommissioning

282. Before the final payment is made to the contractor BR, working jointly with the contractor, will conduct an environmental audit. At that time all non-compliant work will need to be brought into compliance, and payment will be released only after BR is satisfied with the contractor's clean-up is finished. Clean up will include restoration of all areas used as work camps, batch plants and contractor site office(s).

3) Air Quality and Dust

283. The main atmospheric pollution during the operating period will come from the added locomotive using the tracks, resulting in added emissions and dust from the train traffic, and possible exceedances of National Air Quality Standards.

284. The added train service should help to divert vehicular traffic to rail traffic. The combination of better equipment, more pollution control devices on the locomotives as the fleet is renewed and cleaner fuel will help to further reduce any air pollution effect due to additional train operations.

4) Surface and Ground Water Quality

285. Surface water pollution during the operating period comes primarily from untreated sewage effluent discharged by passing trains, which then washes into local surface waters. There is also some risk of spillage of fuel and other chemicals from freight trains; however, this latter pollution has not been an issue. There is of course the issue of accidental spillage of oil and other noxious chemicals, after a train accident, and the leakage of materials into rail side ponds and canals.

286. The contamination from train operations would be mostly bacteria, viruses and nutrients from the sewage-laden track runoff leaking into the well. BR may investigate retrofitting existing cars with holding tanks in order to collect sewage and dispose of it at treatment facilities, and also will inspect that all wells established during construction are secure.

5) Noise Model

287. A SoundPLAN Essential Version 4.0 computer noise model was used for the prediction of project noise levels at sensitive receivers during the construction and operation phases. Noise modelling was conducted for three approximately one-km long and 125 m wide stretches of the alignment, representing the land uses commonly found along the Project. These areas were at railway stations, busy at-grade crossings, and agriculture areas. In order to credibly model the noise, land use pattern data within 500 m of the track were added to the model dataset.

288. Using rail traffic forecasts (**Table 34**) for operating years 2022, 2030, and 2040, and the 2018 baseline, railway noise levels were predicted and noise contour plots generated (**Figure 36**). The plots indicated the likely noise environment at sensitive receptors.

Table 38: Train Traffic Forecast from 2018 to 2040 (Trains per day both ways)

Component	Type of train	Time	Existing	Future Forecast (Operational Period)		
			2018	2022	2030	2040
1	Passenger + Freight Train	In 24hrs	28	76	104	160

289. **Table 39** shows that the predicted noise levels in 2022, 2030, and 2040 in day and night time in the three 1 km sections of the alignment.

290. **Agricultural Area:** Four sensitive locations (Settlements, Local Market, NGO Office, and Mosque) within the 200 m agriculture lands section were identified. Their existing noise levels are 48.4 dBA to 64.6 dBA during day time and 39.7 dBA to 51.7 dBA during night time, which satisfy the residential criteria of Bangladesh Sound Pollution (Control) Rules, 2006 except few cases. However, the predicted noise levels in these sensitive receptor areas, during day-time noise will be between 48.6 and 64.6 dBA in 2022, between 48.7 and 64.6 dBA in 2030, and between 48.8 and 64.6 dBA in 2040. The predicted noise levels in these sensitive receptors during night-time will be between 40.6 and 51.9 dBA in 2022, between 41.1 and 52 dBA in 2030, and between 41.5 and 52.1 dBA in 2040. In all cases, the predicted results do not exceed the Bangladesh Noise Rules 2006. By 2040, about 0.4 dBA noise will be the contribution of the railway operation to the background noise at the closest sensitive receptors located 91 m to 120 m away from the railway track. Therefore, the railway noise will not increase the noise levels at the sensitive receptors (please see para. 294).

291. **Railway Station Area:** Five sensitive receptors (**Table 39**) within the 100 m wide corridor in Railway Station Land use areas were identified. Their existing noise levels were between 52.7 dBA to 66.5 dBA during day and 42.2 dBA to 59.6 dBA during the night; which mostly satisfies the residential and commercial criteria of Sound Pollution (Control) Rules, 2006, Bangladesh. The model data showed that noise levels at these sensitive receptor areas, in 2022 during day-time noise will be between 52.9 and 66.5 dBA, between 53 and 66.5 dBA in 2030, and between 53.1 and 66.6 dBA in 2040. The predicted noise levels at these receptors during night-time will be between 43.4 and 59.6 dBA in 2022, between 44.1 and 59.7 dBA in 2030, and between 44.5 and 59.7 dBA in 2040.The predicted results in few cases marginally exceeded the national standards of residential and commercial zone criteria of the Noise Rules 2006, Bangladesh (**Table 39**). These exceedances will be mainly due to high background noise at the receptor. The model indicated that by 2014, noise attributable to railway operations would at 0.4 dBA in day-time and 2.3 dBA in night-time, in this railway station area. These receptors are located 2 m to 106 m away from the railway track, and any structures within the Construction RoW defined by BR will be demolished, and fully compensated by BR.

292. **Level Crossing Area:** Five sensitive locations within 100 m corridor were identified in road level crossing land use area. These are Settlements, Nearest Settlements, Households near bypass, Mosque, Road side Market, and residences near highways. Their existing noise level are 54 to 85.5 dBA at day and 51.3 to 74.0 dBA at night, which are higher than the residential and commercial criteria of Bangladesh standards. However, the predicted noise levels in these sensitive receptor areas, during day-time noise will be between 55.1 and 80.2 dBA in 2022, between 55.7 and 80.2 dBA in 2030, and between 56.2 and 80.2 dBA in 2040. The predicted noise levels at these sensitive receptors during night-time will be between 52.7 and 74 dBA in 2022, between 53.6 and 74.0 dBA in 2030, and between 54.0 and 74.0 dBA in 2040. In most cases, the predicted results exceeded the applicable residential and commercial criteria of the Noise Rules 2006, Bangladesh, which is mainly due to high background noise. For this area the model indicated that 2.2 dBA in day-time and 2.7 dBA in night-time noise will be added to the noise environment at these receptors by 2040. These receptors are located 7.5 m to 75 m away from the railway track, and will be minimally impacted by the railway operations (background noise will be the major contributor). As the construction right of way of the proposed Project will be 50 m wide, any structure within this corridor will be demolished, and communities will be provided compensation as specified in RP.

.

Table 39: Prediction of Noise Level from 2024 to 2040

Sl. No.	Name & Location of Sensitive Receptor			Distance between Railway & Receptor	Measured Noise Level in 2018, LAeq (dBA)		Predicted Noise Level in 2022, LAeq (dBA)		Predicted Noise Level in 2030, LAeq (dBA)		Predicted Noise Level in 2040, LAeq (dBA)		Standard ECR, 2006 LAeq (dBA)		
	Name / Number												Classified	Day	Night
		Latitude (N)	Longitude (E)		Day	Night	Day	Night	Day	Night	Day	Night			
	No. of Train Passing	NA	NA	NA	21	7	57	19	78	26	120	40	NA	NA	NA
Component -2.1: Agricultural Area															
1	Settlements	23°12'41.85"N	91° 8'53.78"E	120	48.4	39.7	48.6	40.6	48.7	41.1	48.8	41.5	Residential.	55	45
2	Local Market	23°12'45.75"N	91° 8'35.18"E	130	64.6	51.7	64.6	51.9	64.6	52	64.6	52.1	Commercial	70	60
3	NGO Office	23°12'48.11"N	91° 8'44.05"E	80	63.4	47.6	63.4	47.9	63.4	48.2	63.4	48.3	Commercial.	70	60
4	Mosque	23°12'47.19"N	91° 8'45.72"E	91	56.4	49.1	56.4	49.2	56.5	49.4	56.5	49.4	Residential	55	45
Component -2.2: Rail Station															
1	Settlements	23° 0' 47.41"	91° 24' 6.59"	106	52.7	42.2	52.9	43.4	53.0	44.1	53.1	44.5	Residential.	55	45
2	Mosque	23° 0' 48.38"	91° 24' 9.79"	27	66.5	49.2	66.5	50.1	66.5	50.7	66.6	51.0	Residential.	55	45
3	Rail Station	23° 0' 47.81"	91° 24' 12.71"	5	55.2	44.2	55.6	48.7	55.8	49.5	56.0	49.9	Commercial	70	60
4	Settlement	23° 0'48.91"N	91°24'5.98"E	70	62.7	59.6	62.7	59.6	62.8	59.7	62.8	59.7	Residential.	55	45
5	Rail Station Office	23° 0' 47.2" N	91° 24' 13.21"E	2	65.4	56.9	65.4	57.1	65.5	57.3	65.5	57.4	Commercial	70	60
Component -2.3: Level Crossing (Residential Area)															
1	Nearest Settlements	22°24'29.38"N	91°45'22.68"E	7.5	75.1	60.1	75.1	60.5	75.1	60.9	75.1	61.0	Residential.	55	45
2	Households near bypass	22°24'28.96"N	91°45'24.80"E	20	54	51.3	55.1	52.7	55.7	53.6	56.2	54.0	Residential.	55	45
3	Mosque	22°24'34.60"N	91°45'20.41"E	25	74.2	57.9	74.2	58.1	74.2	58.3	74.2	58.4	Residential.	55	45
4	Road side Market	22°24'32.34"N	91°45'20.82"E	33.5	80.2	68.2	80.2	68.2	80.2	68.2	80.2	68.2	Commercial	70	60
5	Highway side office	22°24'37.75"N	91°45'17.48"E	75	75.5	74.0	75.5	74.0	75.5	74.0	75.5	74.0	Commercial	70	60

Coordinates based on WGS-84

293. **Figure 36** is an enlargement of the legend for the noise contour plots, which are divided into 12 categories with an incremental value of 5 dBA. Deep green colour represents lowest noise level (<20 dBA), yellow colour represents silent zone (40-50 dBA), mustered colour represents residential zone (45-55 dBA), orange colour represents mixed zone (50-60 dBA), light red colour represents commercial zone (60-70 dBA), deep red colour represents industrial zone (>70 dBA) noise level. Error! Reference source not found. shows the noise contour level a t 20 m, 50 m and 100m from the railway track and name and location of the sensitive receptors. In noise model area, noise level is higher during daytime, as the number of trains is higher compare to night-time noise level. Night-time noise reaching the acceptable limit will be mostly constrained within 50–70 m of trackside. The detailed noise modelling report is attached.

Noise from Train Pass-by

294. Train noise along this corridor has been a fact of life for generations, and so it was not raised as a significant issue during the Stakeholder Consultations. At 100 m from trackside, the existing noise levels along the line average 60.4 dB during the day, and 51.63 dBA at night (due almost entirely to background noise). However, when a train passes the noise spikes, lasting up to 18 seconds, were recorded from 78 to 82 dBA. The frequency of these noise spikes will likely increase noticeably once the upgraded line is in operation, i.e., the doubling of train movements in the first five operating years. Noise spikes due to train passing aside. The average noise level will change by less than 3 dBA for the years between 2018-2040, but the heavy vehicle traffic intersection, this resulting mostly from increasing vehicular traffic.

295. **Noise Contour Plots**- The operating period noise contour plots for the three representative land use area predicted for 2022, 2030 and 2040 are presented in in Annex 13, but a sample showing the 2018 (existing) and 2040 conditions (worst-case scenario) in **Figure 37**. When viewed in combination with **Table 39** these graphs suggest the for most of the sensitive sites/features noise levels will not exceed GoB 2006 Noise Standard (more or less the same as IFC's Noise standards) of 55 dBA for the day and 45 dBA for the night, assuming residential and institutional land uses and 70 dBA for industrial commercial land uses. In addition, the BR Right of Way (RoW) of this project varies between 50 m and 150 m on either side of the track. During the pre-construction period, all structures and trees will be removed from the RoW and will leave the area vacant for future railway development. As there will be no structures within the RoW, the noise impact on sensitive receptors will only occur for receptors beyond a minimum 50 m distance when for all but extreme situations levels will be within the standard. Further, BR has designated the railway corridor as an industrial-commercial zone and as such noise levels were predicted to exceed these standards only at heavy vehicular traffic locations, and during the noise spikes when trains pass.

296. The plots (**Figure 37**) suggest that noise level attenuation within 20 m of the tracks, including when a train passes (84 dBA) for an approximately 18 second period, will be reduced by 6 dBA with every doubling of the distance from the source, or by around 30 dBA resulting in 54 dBA at the receptor. By 2040, the estimated train passes will have quadrupled causing noise spikes every 8 minutes. Undoubtedly this will be annoying.

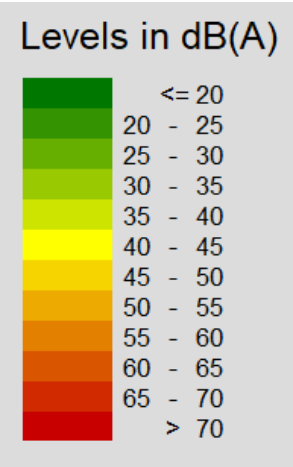
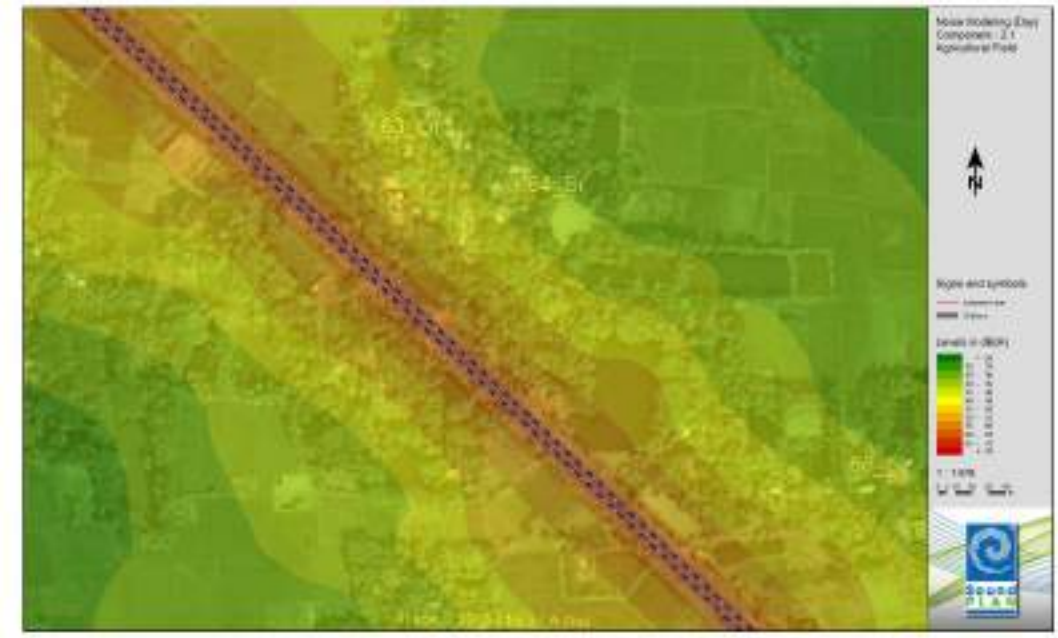
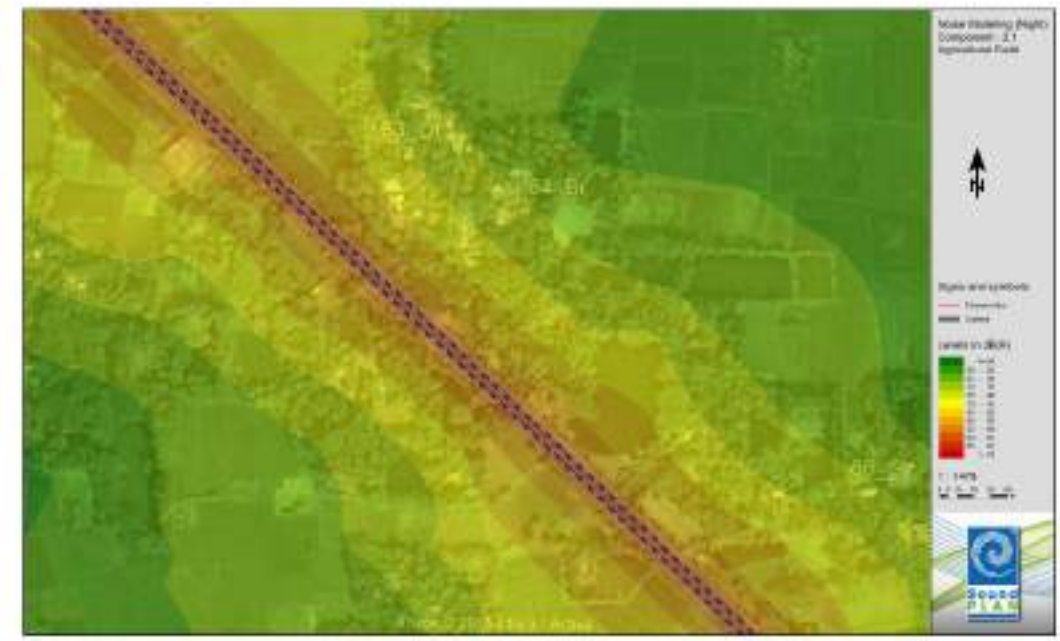


Figure 36: Legend of Noise Level

Component 2.1: Railway Station

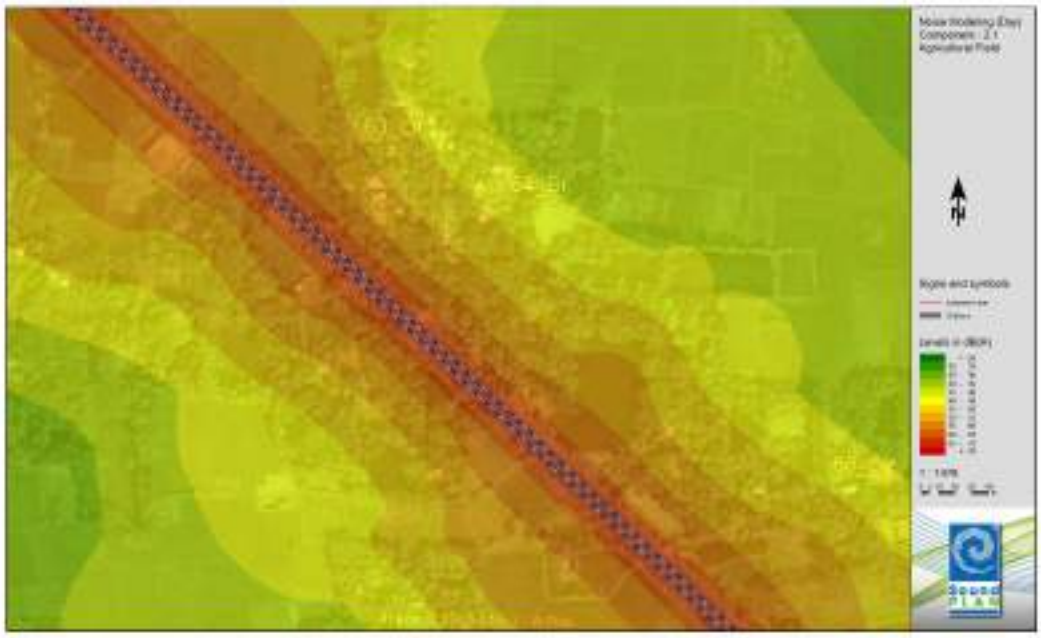


Component 2.1: Scenario 2024 (Day)

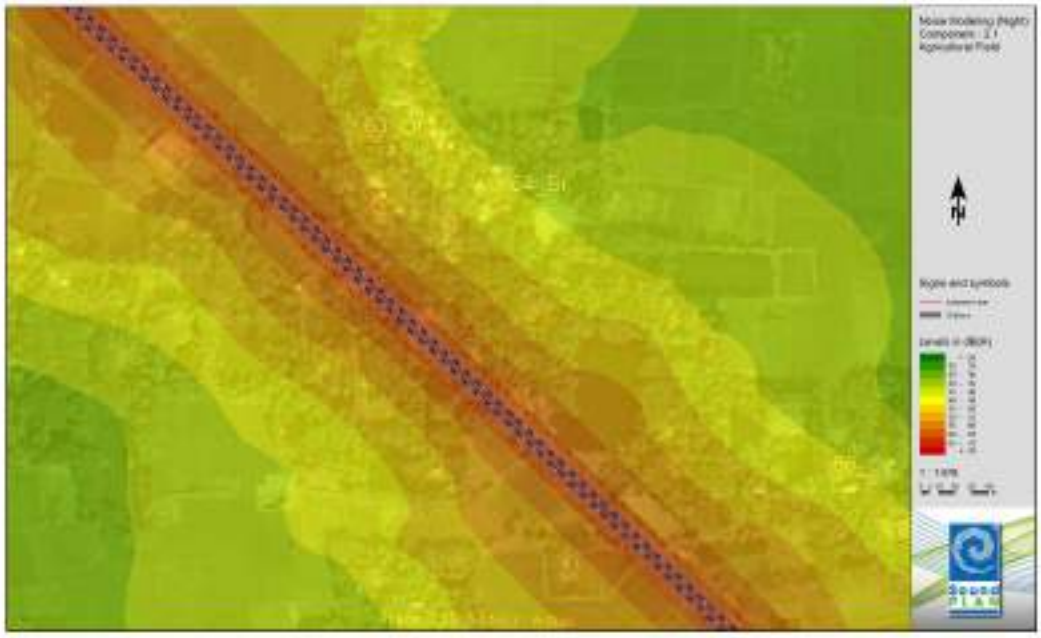


Component 2.1: Scenario 2024 (Night)

Component 2.1: Railway Station

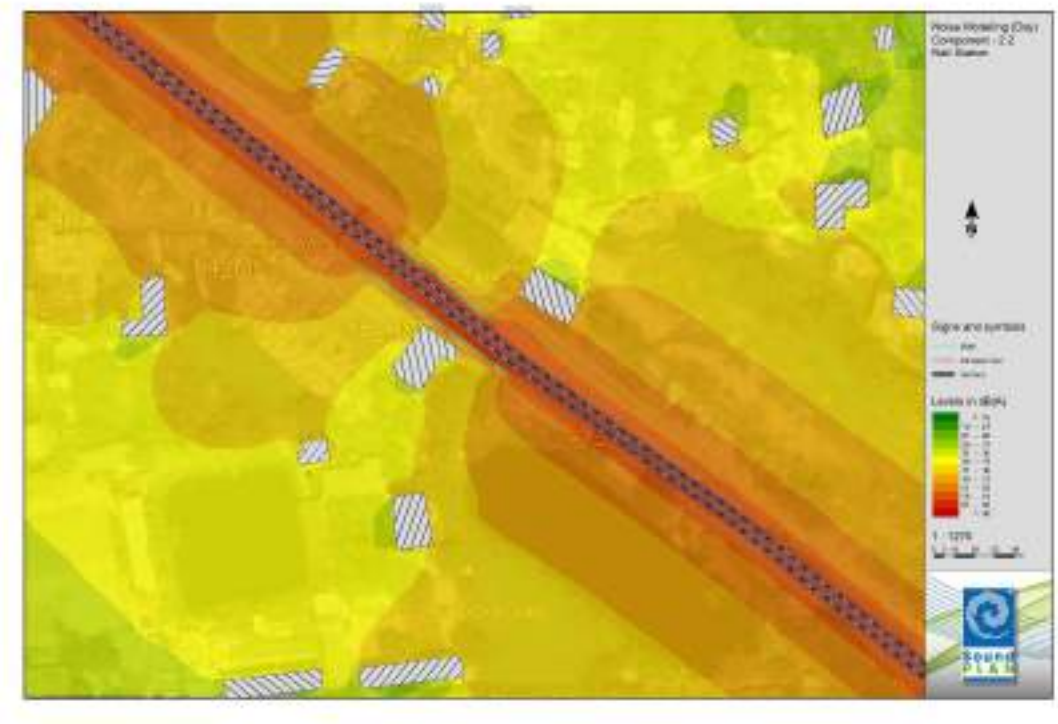


Component 2.1: Scenario 2040 (Day)

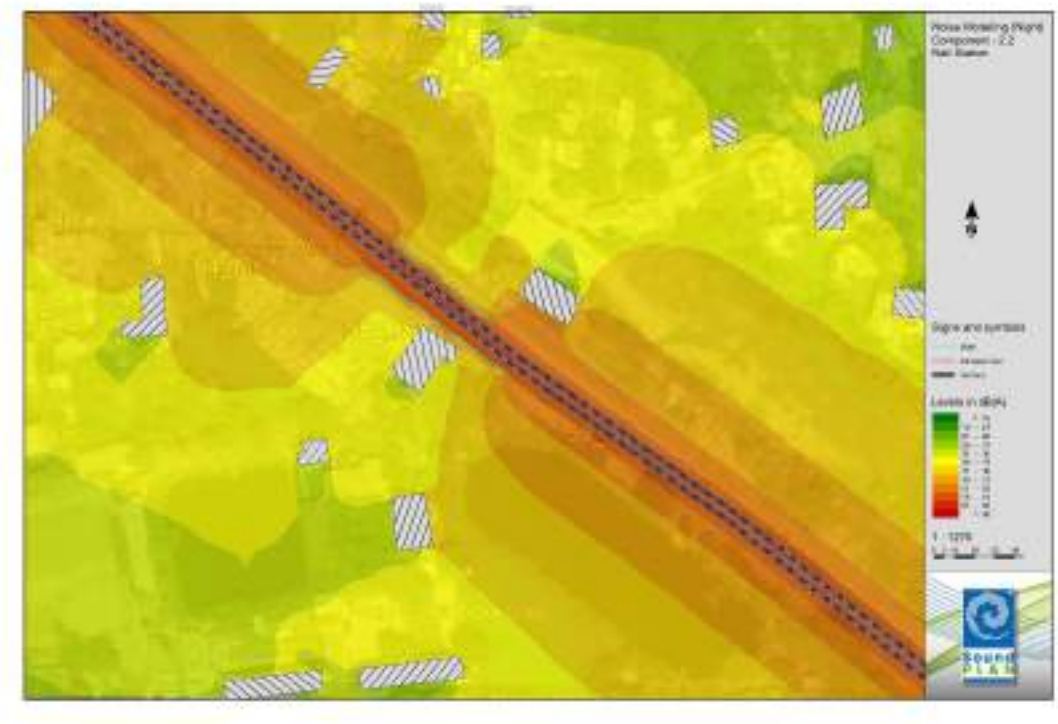


Component 2.1: Scenario 2040 (Night)

Component 2.2: Agricultural Area

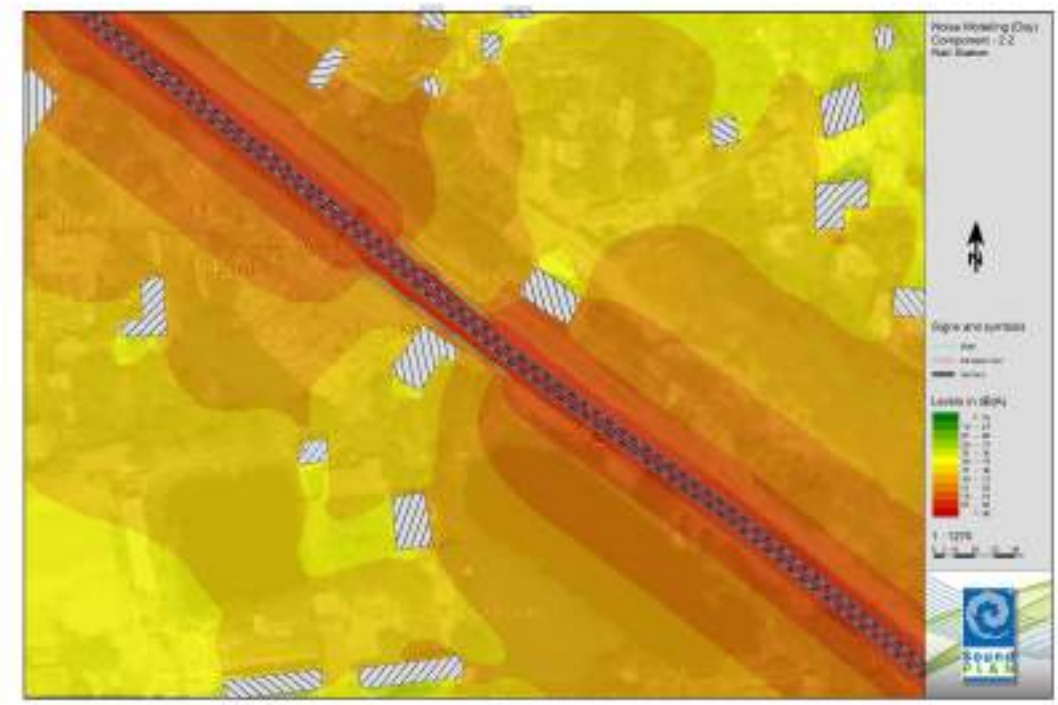


Component 2.2: Scenario 2024 (Day)

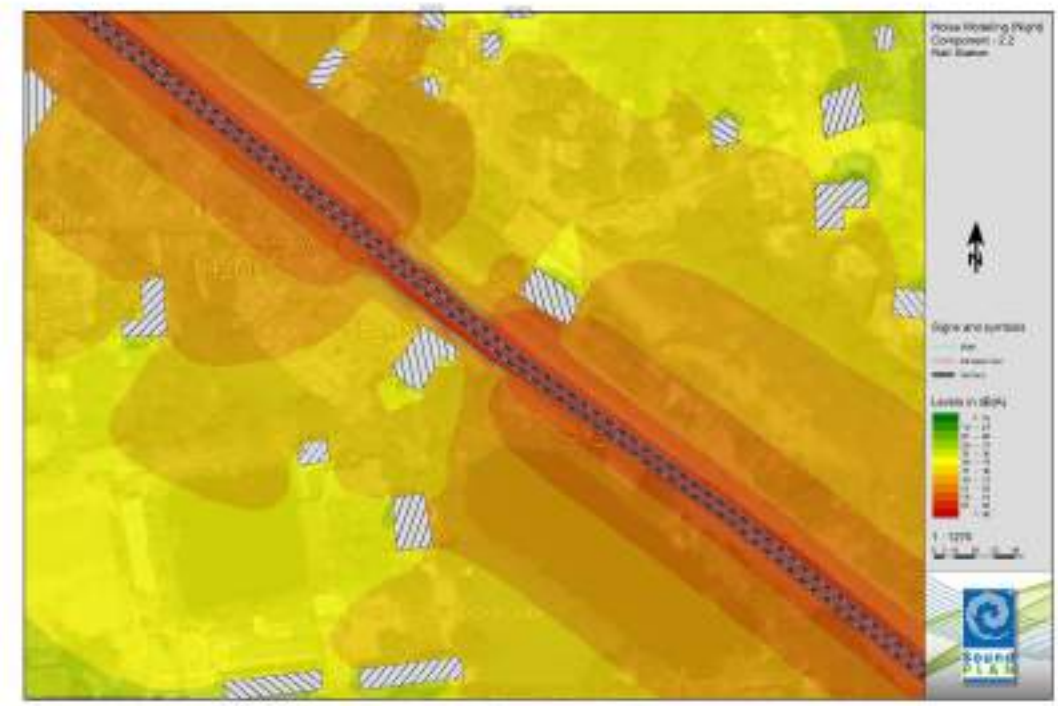


Component 2.2: Scenario 2024 (Night)

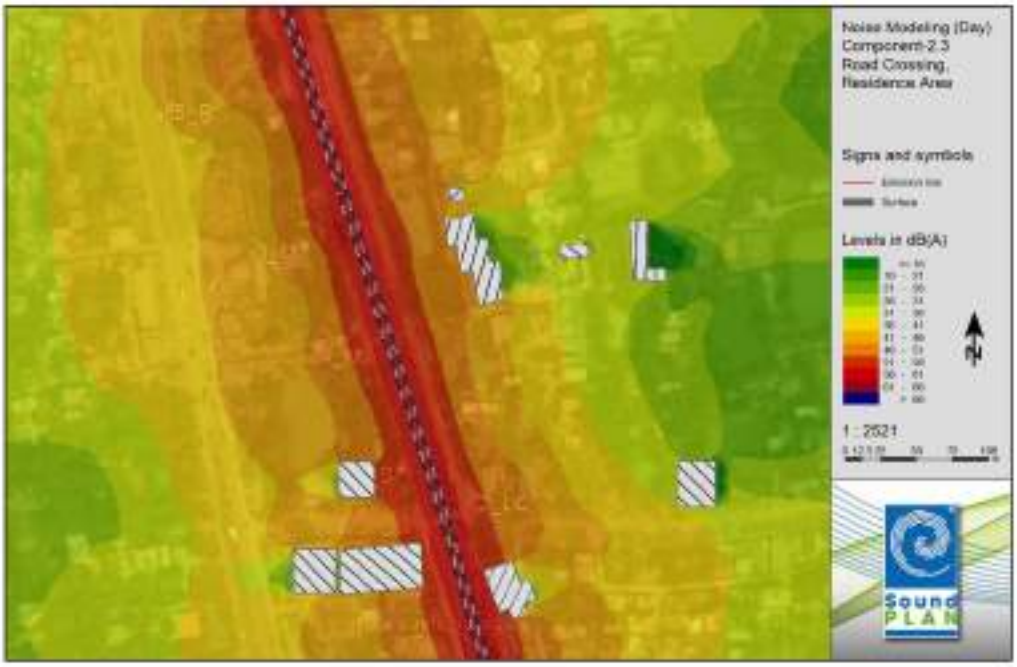
Component 2.2: Agricultural Area



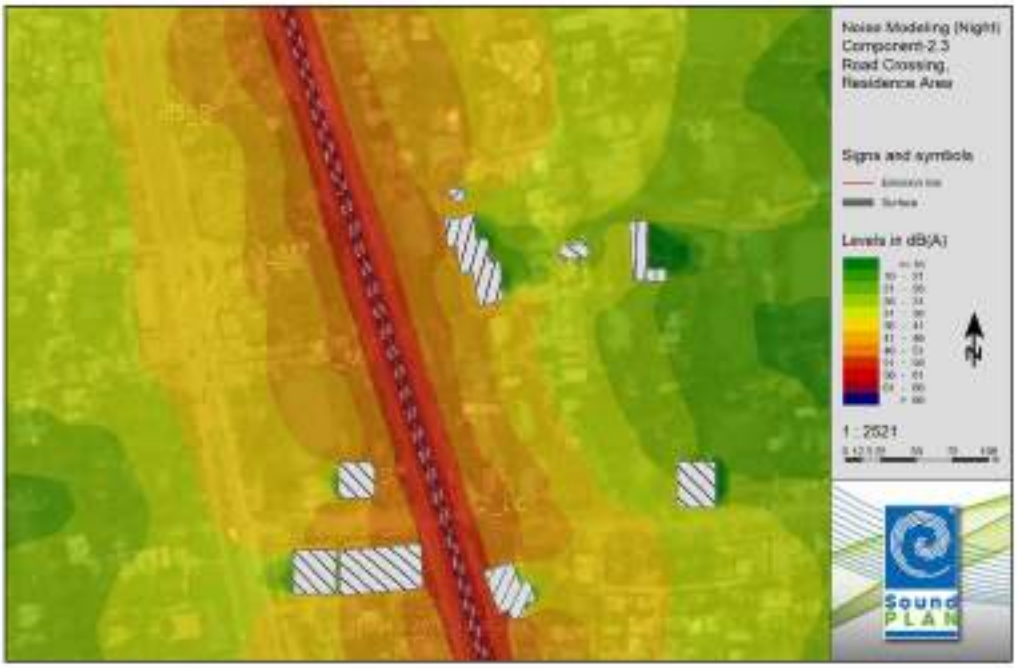
Component 2.2: Scenario 2040 (Day)



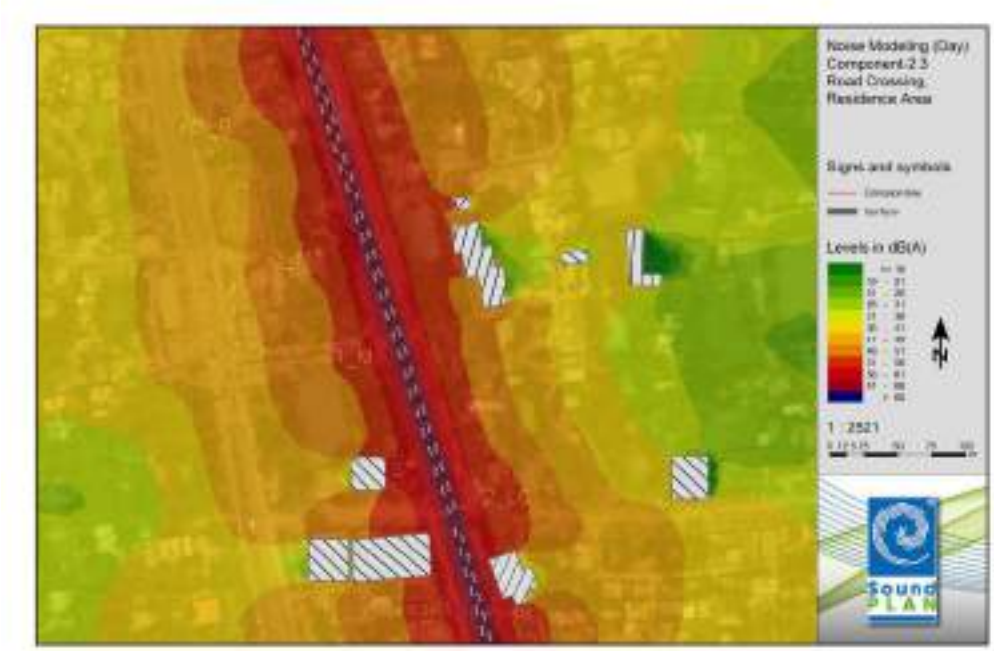
Component 2.2: Scenario 2040 (Night)



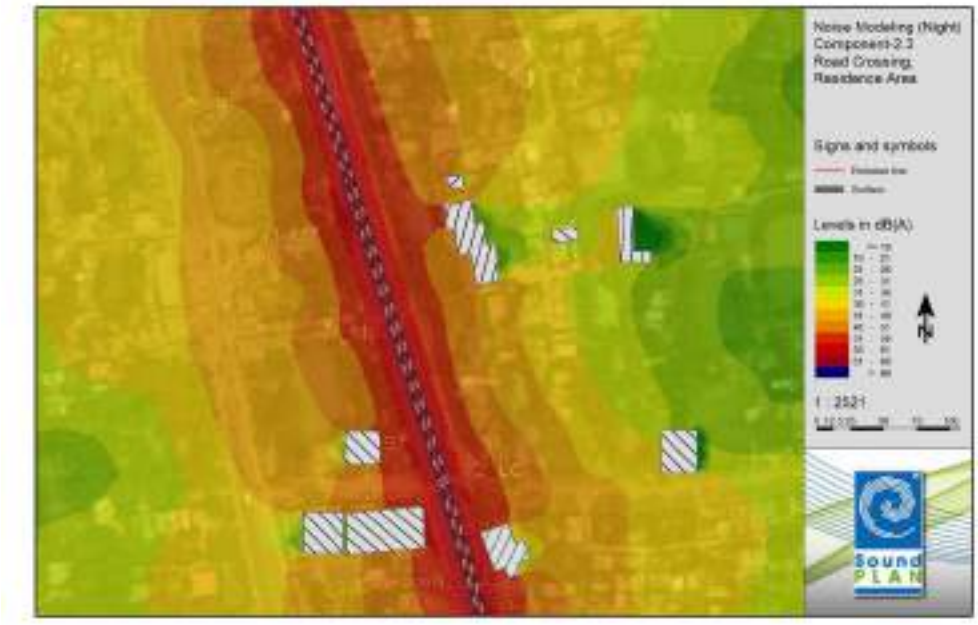
Component 2.3: Scenario 2024 (Day)



Component 2.3: Scenario 2024 (Night)



Component 2.3: Scenario 2040 (Day)



Component 2.3: Scenario 2040 (Night)

Figure 37: Day and Night Noise Level Estimated; 2018 and 2040 Railway Station, Agricultural Area and Urban High Traffic Area

297. Excessive train operating noise will be mitigated through the use of rubber padding under track sleepers, replacement of brake shoes with disc braking systems, minimal use of train whistle particularly at night, and maintenance of a smooth rail through regular grinding and the use of welded continuous track. Based in well- documented noise attenuation characteristics of these measures, train noise will be attenuated by 8-9 dBA. The replacement of old locomotives with quieter more efficient ones will also, over time, reduce noise by up to 10 dBA, for total noise attenuation via equipment and operating modifications of up to 19 dBA at source.

Another general mitigate measure will be an aggressive replanting programme, including not only trees but understory vegetation to a height of 5 m adjacent to all sensitive spots. However, such estimated reductions will need to be monitored by BR and for that noise monitoring will continue throughout the 1.5 to 2.0 year Defects Notification Period, at all sensitive receptors monitored during this EIA.

298. Finally, BR is implementing an aggressive lands zoning effort to restrict new and slowly eliminate all existing residential and related structure to outside the Right of Way. Outside this distance, the model indicates acceptable noise levels (see **Figure 37**).

6) Employment, Livelihood & Ribbon Settlement

299. Due to upgrading of the railway tracks and increase in passengers, goods and services, the area along the rail line will attract settlements and undesired structures including commercial facilities particularly near the railway stations.

300. Since this is very difficult to control, BR will as a minimum post the area as private property and permit only agricultural activities, no structures. Growing crops on the railroad embankment slopes actually helps to destabilize the slope, and therefore will not be permitted. BR will mount RoW patrols to enforce these conditions and may install fencing around the property surrounding stations.

7) Level Crossings

301. Due to the conversion and construction MG into DG railway track, movement of passengers, goods and so also number of trains would increase significantly. As such, many more trains will pass at all crossings each hour and the risk of accidents will also increase. Beyond better signage, BR is developing a strategy for level crossing management, to avert accidents.

302. Vehicle-train and train people and livestock accidents will be addressed through implementing sufficient awareness programme and providing signage, modern internationally approved crossing structures/signalling and gate systems. The training of crossing gate keepers will be enhanced. More pedestrian foot overbridges at stations will be built and increased as the need develops.

8) Waste Management at Stations

303. Garbage is thrown and sewage discharged onto the tracks from trains leads to chronic contamination of the corridor and nearby watercourses.

304. Adequate waste bins and waste biodegradable waste bags on trains are to be provided. BR will enforce strict fines for garbage throwing, and will initiate a programme of retrofitting trains with toilets which eliminate the direct discharge of sewage on to tracks.

9) Station Operation

305. New or upgraded stations will attract more passengers and require more waste to be managed. Poor waste management will lead to polluted conditions. Designs will have properly sized facilities for sewage, solid waste and utility services, and checked against the actual versus estimated throughput of people.

6.2.8 Impact on Biological

10) Terrestrial Flora and Fauna

306. The implementation of the Project will result in the loss of tree and understory vegetation within the BR RoW. The aggressive replanting programme will, over several years, restore this habitat and attract birds and insects.

Socio-cultural Environment

11) Heritage and Culture

307. Loss of some ancestral property, graveyards and mosques may stress the communities affected. Proper protection, restoration and rehabilitation of the religious and cultural monuments and structures, based on focused discussion with local authorities, should minimize the impact of these losses.

Disaster Management

308. Any of BR's Projects are vulnerable to a range of natural and human induced disaster events. These disasters have the potentials to disrupt normal functioning of the rail operations and likely to cause loss of BR assets, human casualties and also lead to environmental degradation.

309. In order to face any accident or disaster, the basics of a Disaster Management Plan (DMP) has been prepared by BR. The primary objective of the plan is to avoid any losses or keep the loss of life, material, machinery/equipment damage and environmental impacts to a minimum. The DMP for the proposed Project has been developed listing various actions commonly defined in the "disaster cycle", e.g. identification, preparedness, response, prevention, mitigation and recovery phases. The development of the Disaster Management Plan was based on the hazard identification and associated risk assessment, the latter beyond the mandate of this exercise.

1) Potential Natural Hazards at the Project Site

310. A hazard map has been prepared to identify potential natural hazards within the Project corridor (**Figure 38**).

311. **Earthquake**: According to ADPC (2010), Bangladesh is classified into four seismic zones and the Project alignment lies in Zone II (40% of the Project corridor) and Zone III (60% of the Project corridor) i.e. within an active seismic zone classified as medium to low risk. No major earthquake has been reported in the Project area in recent years or recent past. It is understood that seismic risk at the Project area is of medium intensity.

312. **Cyclones and Storm Surge:** The Project (83 % of the Project area) has an almost zero risk of a cyclone due to its geographical location, except last 22 km at Chattogram side which is close to Bay of Bengal. This 22 km stretch which covers 17% of the Project corridor falls under high risk cyclone zone. Seasonal storms, popularly known as 'norwesters' (Kalbaishakhi) occur in the Project area. Tornadoes can be associated with severe norwesters. Norwesters are most frequent in April and in late afternoons.

313. **Floods:** 50% of the Project corridor falls on Moderate river flooding and 40% of the Project corridor falls on not flood prone. Only 10% of the Project corridor covers flash flooding and river flash flooding region.

2) Anthropogenic Hazards

The potential hazards due to human activity are as follows:

- **Accidents** –Train Derailment and Collisions, Workplace Accidents, Structural Failure/Collapse, Mechanical Breakdown of Machinery
- **Social and Political Conflict**- Labor Strike, Demonstrations, Sabotage, Workplace Violence, Information Technology (Malware Attack, Hacking
- **Built Environment Failures**-power plant or dam failures.
- **Bridge Collapse Due to Design Faults**

3) Technological Hazards

- **Information Technology** - Loss of Connectivity, Hardware Failure, Lost/Corrupted Data, Application Failure
- **Utility Outage** - Communications, Electrical Power, Water, Gas
- **Fire/Explosion** - Fire (Structure), Explosion (Chemical, Gas, or Process failure)

- **Hazardous Materials** - Hazardous Material spill/release, Freight Transportation Accidents,
- **Supply Chain Interruption** - Supplier Failure (Water, Electricity, Gas and Transportation Interruption).

4) Disaster Event Response

314. Most important in managing any kind of emergency l and the army move into action to address such broad, regional or nation-wide hazards.

315. An event involving a technological failure BR, through its Station Master and Divisional Manager must contact the agency responsible for first response, e.g., the Forest Department and local fire departments for forest fires along the alignment, or the military and police in the event of social disruption. **Figure 39** defines the team that needs to be contacted and steps needed to address any disaster.

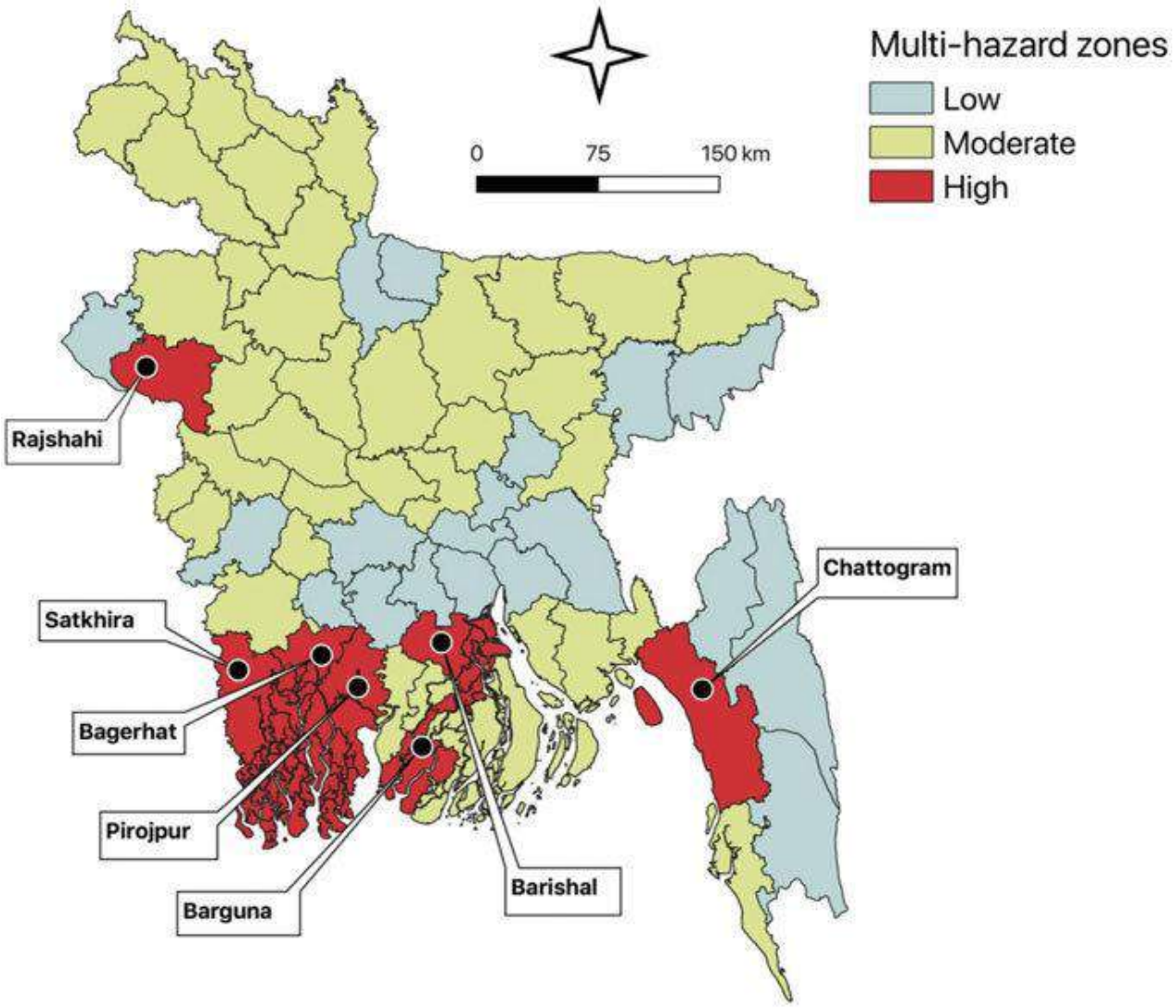


Figure 38: Multi-hazard map of the Project Corridor

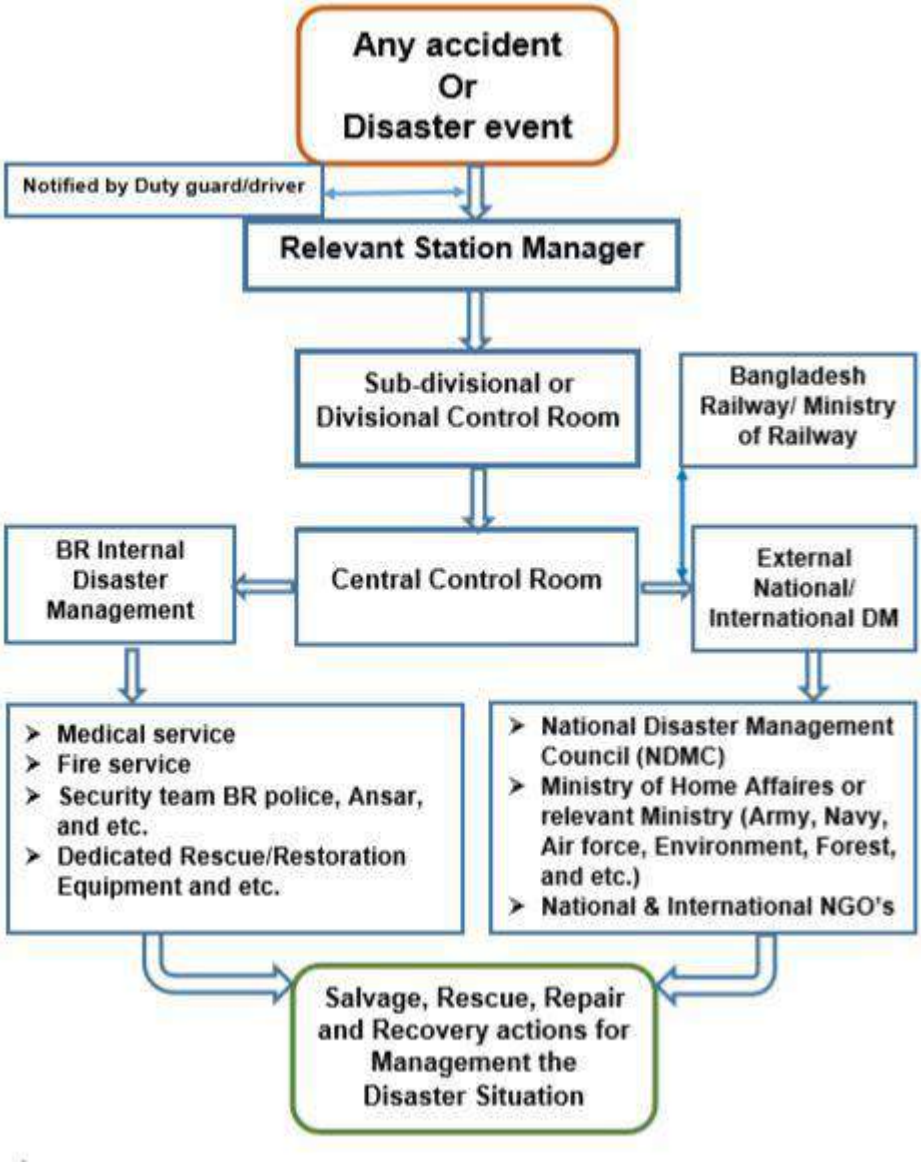


Figure 39: BR Team Composition for Accident or Disaster Event Management

5) Disaster Preparedness Protocols

316. Disaster Management mechanism in Bangladesh Railway can be maintained at a high level of preparedness and efficiency by keeping all resources readily available and in good condition. Resources include both Railway and non-Railway staff and material including medical, personnel, transport, volunteers, police and fire services. Details of these resources, their location, contact numbers and other details have been identified, compiled and placed in a "Data Bank". This Data Bank is available in the Divisional DM Plans of BR.

317. The following actions may be taken for informing the station staff and workers, visitors about an ensuing disaster event (for examples, event of fire, forecast of cyclone, and other type of local accidental event) for evacuation and undertaking protection measures.

- Early warning system to be in place. Establish and install an efficient alarming system covering all work and stations to alert the inside people about an ensuing danger and evacuate the area for assembling in the designated safer area. The Control room manager will decide on declaring an emergency alert, in case an accident necessitates the evacuation of people.
- In case of toxic chemical spill or accidental release during transportation, the Control room manager will immediately seal the area with appropriate signage, informs the relevant BR officer and undertake actions for decontamination measures.

- The weather report and flood report should be regularly monitored by the Control room manager and in case if there is a forecast for a flood or cyclone, the people at the train and station should be notified and measures should be taken to save life and assets.
- Coordinate emergency planning with public emergency services to stabilize incidents involving the hazards at the site. A coordination link should be maintained with the local Civil Defence Department, Fire Services and Medical Services
- Adequate firefighting equipment, e.g., fire extinguishers of different types and adequate water points/connections at different strategic locations must be planned and installed according to requirements.
- Training on local, divisional and central level of BR need to arrange to know disaster management related issues.

318. Sometime during the first month of the construction period BR will organize a training session for its staff and the contractor on how best to response to a natural or human-caused disasters, by applying the protocol shown in **Figure 39** and providing lists of the names and contact information for the key contact people to alert.

River Training Works (RTW)

319. The CSC will undertake visual inspections, looking for erosion of embankment on RTW slopes, particularly any gully erosion; then formulate and implement erosion protection measures, by applying both standard civil engineering and bioengineering techniques such as fascines and stacked brush matts.

320. Movements of vessels in the navigation channel will be maintained through careful planning of bridge span work over the navigation channels, low traffic times, and with traffic controls in place. The contractor will place channel boundary buoys in the water to guide vessels around danger areas.

321. Morphological changes of river banks due to RTW actions will be regularly monitored, and remedial bank protection work must be implemented immediately, if changes occur.

Bentonite Management

322. The large pilings needed to support large bridges will be either bored or driving into the ground, some into the river. Bentonite, a fine white clay, is often used to lubricate the pile driving head to facilitate drilling. Bentonite is pumped into the borehole and lubricated the boring drill, but then must be recovered since once in the water, although not toxic remains in suspension for a long time interfering with local photosynthesis. If the contractor decides to use this material, BR will require a bentonite recover and recycle plan accounting for full recovery of the bentonite used. At the same time BR will encourage the contractor to use local muds or biodegradable polymers.

1) Operation Period

Noise

323. Train noise along this corridor has been a fact of life for many years. The noise level at bridges has been predicted to be within the national standard, the risk of increased noise during the operating stage will be mitigated with 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 maintenance. These steps will reduce train noise significantly.

Surface Water Quality and Hydrogeology

324. Construction of piers, especially in the permanent water sections, may result in temporary erosion and deposition actions, potentially impacting shorelines and causing water pollution. Therefore, the bridges and culverts will be properly designed and built, in line with existing bridges and the latest hydrological model results. The water quality tests will focus on sampling both upstream and downstream of the bridge construction sites, to establish change in these sites over time.

Bridges and Culverts ≤100 m

325. There are 190 proposed new minor bridges on the Up Line (right side track facing toward Chattogram) and 145 on the Down Line (left side track facing toward Chattogram). The total length of each varies from 3 m to <16 m. All minor bridges on the Down Line are designed as Reinforced Concrete (RCC) box culverts. On the Up Line 179 new minor bridges are proposed with RCC box culverts and the remaining 11 bridges are pipe culverts which have been proposed matching with the new existing Up Line bridges.

326. There are 28 proposed new major bridges on the Up Line and 22 on the Down Line. Length of the proposed bridges varies from 16 m to less than 100 m.

327. Nearly all the smaller bridges and culverts will be totally rebuilt to allow the heavier, faster trains to use the line, and to accommodate the wider embankment base.

328. Essential for culvert placement will be protection of the downstream discharge end of the culvert from erosion and creation of large washed-out plunge pools leading the degradation of the culvert.

329. The same precautions (excluding drilling mud) and measures listed above apply to these smaller structures, just not the high degree and intensity.

330. Timing of the reconstruction will be essential since the monsoon period of late May through September is not recommended as construction during this time could lead to disastrous erosion and bank destabilization and construction worker safety issues.

Cumulative Effects

331. **Induced Effects**- Induced effects occur when Project-generated effects stimulate, often-unexpected, negative or positive impacts. The newly operating train line will attract and facilitate private vehicle and bus users to switch to the train, thereby reducing fossil fuel consumption and emission of greenhouse gases. At the same time, the increase number of trains will put new pressure on all municipal services, which need to be improved to deal with the large liquid and solid waste loads, and passenger movements.

332. The reconstruction of 7 stations along with improvement of 18 stations will attract small business development around the stations (albeit minimally as only local trains will be stopping) which may stress water and waste services, while at the same time stimulating the economy, or adding to the competition among shop owners.

333. Finally, the added train service will induce more travel by local people, increasing commerce along the line, helping local producers to bring products to market.

334. BR is aware of these potential impacts and will monitor the increase in transport operators focusing on the new rail service and ask authorities to hand out operating licenses only after consultation with BR.

335. **Cumulative Effects-** are those arising when an area is subjected to impacts from the Project under study in addition to existing other ongoing works or future undertakings, which could have combined negative or positive effects for the physical ecological and social environment in the Project area. A number of contributing projects are described below.

336. Component 1: Conversion of Tongi–Bhairab Bazar-Akhaura MG Double Track into DG Double Track by Phasing into Dhaka-Chittagong Corridor. The level of future train traffic is expected to significantly increase between Dhaka and Chattogram (within the Project).

337. Component 4: Conversion of the existing Chittagong-Dohazari (47.04 km) MG Single Line Track into DG. This component will increase both BG expresses and BG container trains in the Project corridor and create the final link for the Dhaka to Cox's Bazar train network. Cumulative effects will be the steep rise in tourism with the new trains and station as well as pressure in the infrastructure of Cox's Bazar

338. Component 3: Construction of a new DG Line and Conversion of the existing Fouzderhat-Chittagong Port Yard (CGPY) (11.28 km) MG Single Line Track into DG. This component will increase freight service, i.e., BG container trains in the Project corridor.

339. The cumulative effect of Components 1, 3 and 4 will mean more freight and passenger train movements, more air pollution noise and congestion at level crossings, as well as greater pressure on all services at the train stations. BR has anticipated this and designed the stations to accommodate the throughput of a much larger operating network with more and larger trains, plus of course a growing freight fleet.

340. Component 6: Construction of a new single line DG rail link from the proposed Chakaria station to Matarbari Deep Sea Port on the Bay of Bengal will provide the means for the movement of a large number of freight trains between Matarbari and the Dhirasram ICD.

341. DCRP (Dohazari Cox's Bazar Railway Project): Construction of 103.477 Km new Single Line Dual Gauge Railway Track from Dohazari to Cox's Bazar via Ramu is establishing connectivity with Cox's Bazar and providing India with ready access to the Trans Asian Railway Corridor. The Government set a target to complete the whole Project by 2022, which would connect Bangladesh with the Trans-Asian Railway, a network across Europe and Asia, and boost the country's trade with Myanmar, China and Thailand. This will over time greatly increase train traffic with cumulative effects for all components of the environment as well as the transport, and tourism sectors.

342. Paralleling the rail corridor development, the Government is planning the establishment an LNG regasification terminal at Moheshkhali near Cox's Bazar. The terminal with a 1.0 million standard ft^3/day capacity is expected to be built by 2024 or 2025. Although LNG will be transported via 42-inch diameter pipeline, through Moheshkhali to Feni via Anwara and Fouzderhat in Chattogram, to the national grid, future container train traffic will also grow as LNG may also be transported via railway network (within the Project Corridor) throughout the country where the gas netrwork has not reached.

343. The GoB is constructing a deep sea port, four 600 MW coal-fed power plants, along with communication networks, including rail lines and roadways at Matarbari, about 25 km from Sonadia Island. The port would be used to receive coal, which could power an entire new industrial zone in the far southeast of the country. The daily requirement of coal will be over 60,000 tons. A freight rail line is proposed, and will link this industrial zone into the Dohazari-Cox's Bazar line at a junction point at Chakaria station. The future train traffic is expected to significantly increase between Dhaka and Chattogram (within the Project) as a major portion of this coal will be transported via Dhaka-Chattogram railway corridor, to the other coal fired power plants located north and north east of the country.

344. All of the mentioned Projects will generate cumulative impacts around and in this Project corridor. These cumulative impacts will lead to more noise, and air pollution, specifically trackside noise pulses as trains pass. The concentration of total particulate matter from diesel combustion will further contaminate the trackside air mass. This will be in addition to that generated by the existing operations. The doubling in the frequency of train movements will also increase the dust during the dry season from December through mid-April. Trains moving at speed raise dust clouds along the alignment as far as 25 m on either side of the tracks, and for at least 150 m along it. The increase in train movement will of course also result in more passengers travelling to the train stations, hence increased traffic of vehicles coming to drop off and pick up passengers. The cumulative effect will therefore be more frequent noise events, increased air quality degradation and dustier rail corridor, access roads and parking areas near the stations.

345. The Project designers are aware of these cumulative effects and have designed the Project to operate under these conditions. All cumulative impacts associated with this Project will be mitigated to a level that will reduce noise significantly and as much as possible. These measures have been defined in detail in this EIA and specifically in the EMP.

The Project and Climate Change Issues

346. To conduct this analysis, a review available data from the Department of Disaster Management, Department of Environment and Bangladesh Meteorological Department, international and national Climate Change reports, especially the fifth IPCC Assessment report was completed. Data on relevant impacts and vulnerability projections due to global and regional temperature changes, sea level rise, and rainfall fluctuation were assembled and were

used to adjust the design of the railway embankments, station buildings, all major and minor bridges and other infrastructure, making them more climate-resilient.

1) Climate Change Impacts Considerations

347. **Climate Projections: Temperature** - The IPCC 5th assessment report (AR5) indicates that if greenhouse gas (GHG) emissions continue unabated the global mean temperatures will continue to rise over the 21st Century. Global surface temperature change by the end of the 21st Century is likely to exceed 2.5°C relative to 1986 to 2005 for all RCP (Representative Concentration Pathway[5]) scenarios except RCP2.6, and warming will continue beyond 2100 under all RCP scenarios except RCP2.6. **Table 40** show the projected change in global mean surface air temperature.

Table 40: Projected Change in Global Mean Surface Air Temperature (likely range)

Time Period (base year - 1986 to 2005)	Temperature (^{0}C)			
	RCP 2.6	RCP 4.5	RCP 6.0	RCP 8.5
2046-2065	0.4 to 1.6	0.9 to 2.0	0.8 to 1.8	1.4 to 2.6
2081-2100	0.3 to 1.7	1.1 to 2.6	1.4 to 3.1	2.6 to 4.8

Even though, IPCC assessment reports do not provide any country level projections, the Comprehensive Disaster Management Programme (CDMP II) of the Bangladesh Department of Disaster Management (Ministry of Disaster Management & Relief) the PRECIS (Providing Regional Climates for Impacts Studies) model results were in used to get climate change scenarios for Bangladesh. **Table 41** show the projected temperature change for Bangladesh under PRECIS scenarios.

Table 41: Projected Temperature Change for Bangladesh under CC Scenario

Time Period	Average Temperature (^{0}C)		
	Annual	Monsoon (Jun-Sep)	Winter (Dec-Feb)
(base year 1961-1990, Mean)	24.6	31.83	16.2
2011-2041 (increase)	1.49	1.50	1.80
2071-2100 (increase)	4.34	3.43	5.37

348. When compared with RCP scenario data, the Bangladesh projections suggest only RCP 8.5 comes close the temperature increases projected by the PRECIS work.

349. **Climate Projections: Precipitation** - AR5 reports that, in the long term, global precipitation will increase with increased global mean surface temperature. Global mean precipitation will increase at a rate per degree Celsius smaller than that of atmospheric water vapour. It will likely be increased by 1 to 3%/^{0}C for scenarios other than RCP2.6, for RCP2.6 the range increase will be 0.5 to 4% / ^{0}C at the end of the 21st century [11].

350. Analysis of past trend of rainfall (CDMPII, 2013) study reveals that all-Bangladesh annual normal rainfall has not changed much in Bangladesh. For a period of 30 years (1980-2009), the annual normal rainfall is found to be 2,306 mm, such rainfalls were 2,298 and 2,314 mm during 1960-1989 and 1970-1999, respectively. On the other hand, Bangladesh normal rainfalls in different seasons show some mixed trend. Pre-monsoon (March-May) and post-monsoonal (October-November) normal rainfalls have increased and the monsoonal (June-

[5] An RCP is a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC for its fifth Assessment Report (AR5) in 2014. Four RCPs have been selected for climate modeling and research, which describe different climate futures focusing in sea level and temperature increases which are considered possible depending on how much greenhouse gases are emitted in the years to come. The numbers refer to radiative forcings (global energy imbalances), measured in watts per square metre, by the year 2100

September) normal rainfall has decreased over the three time periods (1960-89, 1970-99 & 1980-2009). The winter (December-February) normal rainfall has increased in the last two periods compared to the first period. The change in projected precipitation for Bangladesh, as found by PRECIS run (CDMP II report) is presented in the following **Table 38**.

Table 42: Projected Precipitation Change for Bangladesh under CC Scenario

Time Period	Precipitation(mm/day)		
	Annual	Monsoon (Jun-Sep)	Winter (Dec-Feb)
(base year 1961-1990)	3.5	7.24	0.59
2011-2041 (increase)	0.64	1.40	-0.05
2071-2100 (increase)	0.90	1.43	0.03

351. **Climate Projections: Sea Level Rise** - AR5 predicted, it is very likely that the rate of global mean sea level rise (**Table 43**) during the 21st century will exceed the rate observed during 1971–2010 for all Representative Concentration Pathway (RCP) scenarios due to increases in ocean warming and loss of mass from glaciers and ice sheets

Table 43: Global Mean Sea Level Rise (values shown as median and likely range)

Time Period (base year 1986-2005)	Sea Level Rise (m)			
	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2020	0.08 [0.06 to 0.10]	0.08 [0.06 to 0.10]	0.08 [0.06 to 0.10]	0.08 [0.06 to 0.11]
2050	0.22 [0.16 to 0.28]	0.23 [0.17 to 0.29]	0.22 [0.16 to 0.28]	0.25 [0.19 to 0.32]
2080	0.35 [0.24 to 0.48]	0.41 [0.28 to 0.54]	0.40 [0.28 to 0.53]	0.51 [0.37 to 0.67]
2100	0.44 [0.28 to 0.61]	0.53 [0.36 to 0.71]	0.55 [0.38 to 0.73]	0.74 [0.53 to 0.98]

352. It is very likely that in the 21st century and beyond, sea level change will have a strong regional impact, with some places experiencing significant sea level changes which are very important for low lying coastal countries such as Bangladesh. However, no local SLR data based on the AR5 could be found for Bangladesh. The potential impact of SLR on the infrastructures of the proposed Project is therefore described based on available literatures and inferences.

353. **Flood Flow** - Bangladesh is located at the confluence of three major river basins: the Ganges, Brahmaputra and Meghna, and the impact of climate change on a river, mainly on its flood flow may be viewed as a complex interaction between climate, hydrology, hydraulics and morphology of the river system. In order to assess such complex interactions mathematical modelling is essential (Kamal, 2011-12). Local climate change scientists used an estimate of between 27 and 32cm global SLR by 2050 for the Bay of Bengal (Dasgupta, Kamal, Haque, Sharifuzzaman, & Nishat, March, 2014), which has become the basis for infrastructure design changes.

354. A recent study conducted by CEGIS to investigate flood flow changes of the Meghna River due to climate change and sea level rise. The GCM precipitation projections along with the sea level rise scenarios given by IPCC were used to construct different climate change scenarios namely A1B and A2 for the periods of 2030s, 2050s and 2080s. The study indicated that annual

flow of Meghna River will decrease by 4% by 2030, 6% by 2050 and 6% by 2080 for A1B scenario. For A2 scenario, the changes are 14% decreases (2030), 4% decrease (2050) and 11% increase (2080) (Hossain, et al., 2015).

355. A study on projected flow of Brahmaputra River conducted by IWFM and BUET reveals that, the change of monthly flow for monsoon seasons is predicted to increase 7-12%, 4-13% and 4-13% for 2020s, 2050s and 2080s respectively. The change of monthly flow for Pre-monsoon seasons is predicted to increase 28-56%, 23-60% and 17-92% for 2020s, 2050s and 2080s respectively (Paul, Islam, Hasan, & Rahman, 2015).

356. On a different study, the Climate Change Cell of Department of Environment (DoE) with technical support from Institute of Water Modelling (IWM) conducted a study to assess the impact of Climate Change and Sea Level Rise on Monsoon Flooding. The study projected 23 cm rise of sea level by the end of 2100 and an increase of precipitation by 13%. (Haque, Hassan, Masud, & Tarun Kanti Magumder, 2009).

357. **Storm Surge**: The World Bank (World Bank et al, 2010) conducted a GIS-based research in Bangladesh to delineate vulnerable zone in coastal areas to larger storm-surges and sea-level rise in a changing climate by 2050 during 2010. The Project developed an inundation risk map (**Figure 40**) under climate change condition following IPCC AR4 ([11].

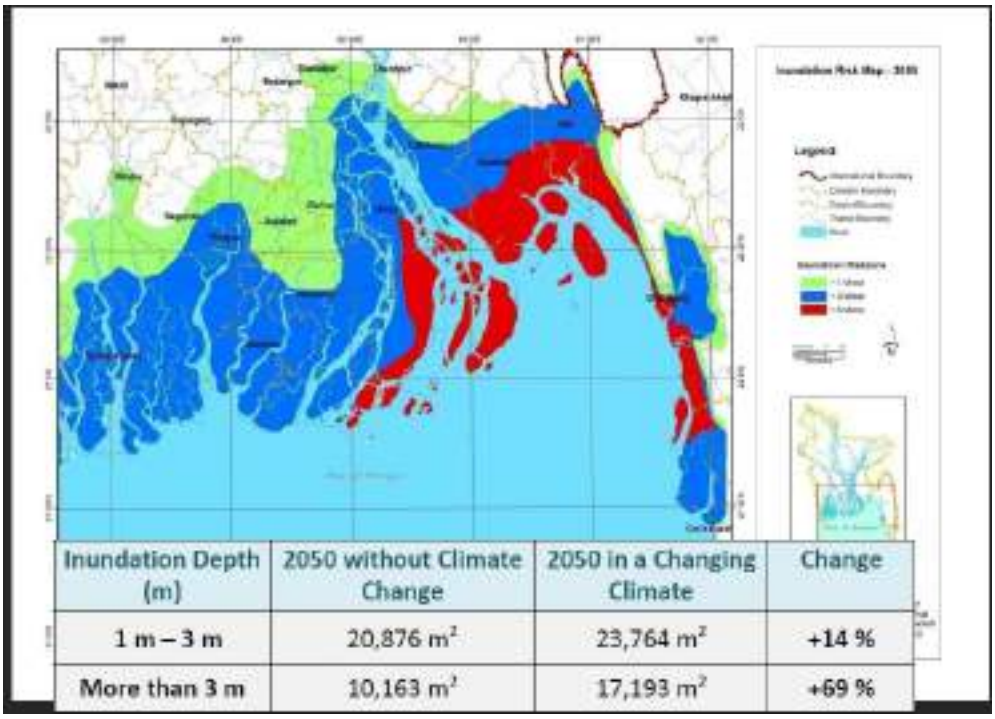


Figure 40: Storm Surge Inundation Area (2050 in a Changing Climate)

2) Adaptation Measures

358. **Climate Change Effects on Track and Embankment Design** - The embankment materials and designs were modified to withstand unusually high rainfall. The design included increased height of railway embankments, and increased sizes of drainage channels and culverts, to accommodate additional rainfall and potential flooding. Bridge and culvert construction will be scheduled during pre and post monsoon seasons to avoid potential disasters caused by excessive rainfall and consequent flooding.

359. **Climate Change Effects on River Flows and Bridge, Culvert Sizing** - The major bridges are being designed for 100-year return period + climate effect flows. The smaller bridges are being designed for 50-year return period. The Padma Bridge environmental study included an extensive evaluation of possible climate change effects and the need to consider increasing the freeboard at the bridge (WARPO, 2005)[6]. The study concluded that the climate induced

[6] WARPO. 2005. Impact Assessment of Climate Changes on the Coastal Zone of Bangladesh**.** Available with the Bangladesh Bridge Authority, Dhaka and BR Project offices."

sea level rise (**Figure 41**) could be between 0.32 m and 0.88 m, causing a backup into the freshwater streams. The study showed that at Daulatkhan in the Shahabazpur channel, high tide levels would increase between 0.30 m and 0.80 m (but with a very low level of certainty). It was further estimated that such a change would not affect the existing sizing, which already accommodates (by 0.5 m) climate change water level fluctuations as defined by BIWTA.

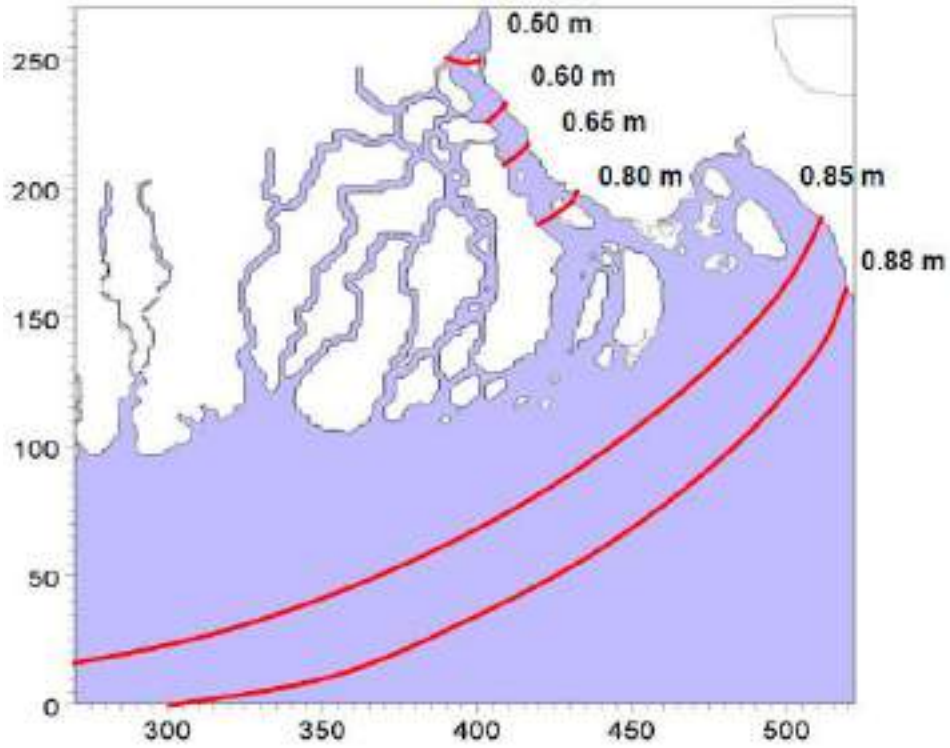


Figure 41: Water Level Rise (m) in Meghna Estuary due to 0.88 m Climate-Change Induced Sea Level Rise; (1st red contour line). Units are km

360. The study concluded that the climate-induced sea level rise could be between 0.32 m and 0.88 m, backing up the freshwater upstream. At Daulatkhan in Shahabazpur channel, high tide levels would increase between 0.30 and 0.80 m (but with a very low probability). It was further estimated that such a predicted elevated sea level rise would lead to an average 0.15-0.32 m water level rise at the Padma Bridge.

361. By applying the same principle to the Project rivers, the climate-induced sea level rise experienced at the four large bridge crossing points may be as much as 0.5 m.

362. By modelling the 100-year storm for the bridge design and the 50-year storm for all culverts, plus incorporating a climate risk algorithm, the bridge design engineers feel confident that climate risk has been accommodated and no further changes to bridge and culvert designs are anticipated.

Environmental Benefits and Enhancements

1) Solar panels

363. Solar panels will partially power the cooling and electrical system of each station and building, reducing the carbon emission significantly, lowering the need to draw energy from the grid. This will reduce the carbon-footprint of each station and building by as much as 30%. **Figure 42** shows the solar panel system installed at the roof of Bangladesh Bank and suggest to install similar system.

2) Rainwater Harvesting

364. The collected rainwater will be stored in a cistern or tank above the station and building, and used for all non-potable purposes. This will reduce the need for groundwater extraction and will provide savings on energy used to pump water. **Figure 42** is a diagram of rain water harvesting system for household and a solar panel installation.

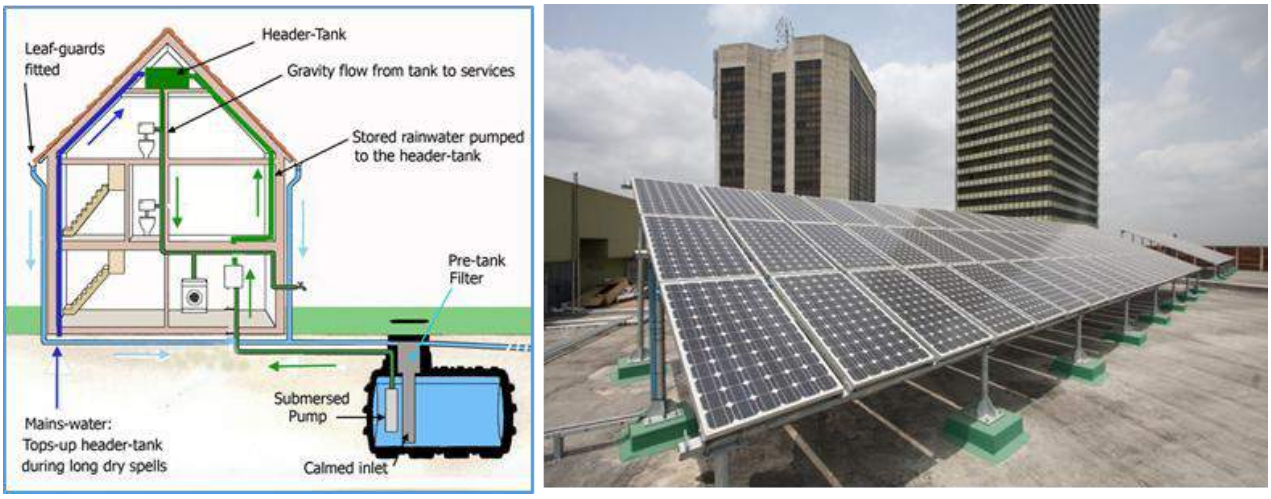


Figure 42: Rainwater Harvesting System (L) and Solar Panels (R)

3) Universal Design - Station Access

365. Universal design in building modern railway stations is to be applied wherever applicable for the benefit of elderly passengers and those with disabilities. The station sites should be landscaped and have optimum parking facilities and ramp access for people requiring access assistance. In addition, easy entry, ground level entrances without stairs, buttons and other controls that can be distinguished by touch, bright and appropriate lighting, etc., have been included in the designs for all new stations; in accordance with international universal design for the elderly and persons with disabilities.

4) Traffic Diversion and Fuel Savings

366. The Project will divert road users to the improved train service. This should in turn reduce road traffic congestion and air pollution. Moreover, the increase in the number of people moving from one place to another per litre of fuel will also help reduce GHG emissions.

5) Reduction of Carbon Footprint

367. Carbon footprint is commonly described as the total amount of carbon dioxide (CO_2) and other greenhouse gases (GHG) emissions released per unit time during the operation of the Project. For this Project, the life cycle includes pre-construction through to the operating and maintenance phases.

368. Regional air quality may benefit since the added rail service will divert road traffic to rail. However, during the operational stage of the Project, the localized air quality will be impacted due to the generation of air emissions by the added diesel train locomotive traffic.

6) Employment Generation

369. The construction activity requires both skilled and unskilled workers at different levels and thus will create ample job opportunity for the local population during the construction phase. A significant number of labours will come from the neighbouring districts. The Project will also open up many business opportunities for the small vendors, allowing them to sell and move their good more effectively. The products grown locally can be transported to other parts of the country in a much faster way.

7) Economic Development

370. The proposed Project will be vital for the economic development. The travel time from Dhaka to Cox's Bazar will be cut down drastically. The present traffic jams on the roads can be avoided largely. The entire districts within the Project alignment can be developed to an industrial destination and can offer more employment opportunities to the local population.

8) LED Lighting in Railway Station and Other Buildings

371. LED lights are up to 80% more efficient than traditional lighting such as fluorescent and incandescent lights. 95% of the energy in LEDs is converted into light and only 5% is wasted as heat. This is compared to fluorescent lights which convert 95% of energy to heat and only 5% into light. LED lights also draw much less power than traditional lighting; a typical 84-watt fluorescent can be replaced by a 36-watt LED to give the same level of light. Less energy use reduces the demand from power plants and decreases greenhouse gas emissions. Therefore, it is suggested to use LED lights in proposed Project, especially in railway station, residential building, office building, street lighting, and also on the bridges/culverts.

9) Green Development Plan

372. Under this Project, a tree plantation programme has been proposed. The objective of the tree plantation and replacement programme is to compensate for the loss of trees due to the proposed implementation of Laskam-Chinki Astana to Chattogram railway line. Other major objectives of the programme are to protect the affected cultural/sensitive areas (within 100 m from the RoW boundary) and to enhance the health of the existing ecosystem.

373. Due to the implementation of the Project in total 137,222 numbers of tree need to be cut at pre-construction and construction periods, among which 41,652 timber trees, 14,380 timber and fruit trees, 16,866 fruit trees, 15,449 firewood, 1,773 medicinal trees, 3,4463 banana trees, 6,377 bamboo trees, 5,032 cane bush and 1,230 papaya of different sizes. The proposed tree plantation and replacement programme (TPRP) will plant at least three times the actual trees cut down. These trees will be planted on both sides of the proposed new alignment, proposed station building areas, and new station access road areas (associated facilities). The species for the proposed tree replacement has been selected based on the statistics of the lost vegetation and suitability for the intended purpose. This was done in consultation with a senior ecologist and local communities. The main consideration for selection of species for the railway Project is to protect the railway embankment from erosion and habitat for biotic species, minimize visual impacts, improved aesthetics and ecological conservation as well as commercial benefits.

374. Therefore, it is proposed that the Project will plant more than a total of (137,222×3) 411,666 new trees during the construction and post-construction stages of the Project. A detail tree plantation programme is provided in **Annex 12**.

7. Stakeholder Engagement and Public Consultation

7.1 Introduction

375. The public consultation with different stakeholders was carried out in compliance with EIA guidelines and 2012 Participation Guideline. The objective of the consultations was to inform the Project-affected people about the Project, to know the present status of environmental, social and ecological condition in the area, probable impact of the proposed Project and to seek possible solutions of impacts from the participants. Two rounds of stakeholder consultation have been arranged throughout the Project corridor. The objective of the first round was to disclose the proposed Project and second round was to disclose the draft environmental management plan (EMP) along with mitigation measures suggested by the local people during the first round of consultation.

7.2 Objectives

376. Public consultation is a cornerstone of responsible infrastructure development—especially for a transformative project like the electrification of the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway corridor. The process ensures that the voices of affected communities, stakeholders, and institutions are heard and integrated into project planning and design.

377. Public consultation is being conducted during Scoping and baseline surveys, Environmental and Social Impact Assessment (ESIA), Resettlement Action Plan (RAP) preparation, Design finalization and disclosure. Consultations are held with local residents, business owners, NGOs, city corporations, and technical experts, ensuring that the project reflects both national priorities and local realities.

7.3 Methodology

378. The approach for discussion, consultation and participation was structured in such a way that it would offer a platform to all the stakeholders where they may discuss, share and debate their opinions. The GoB acts and policies as well as policy/guidelines of the Project followed in designing and performing the consultation and participation process. The process was initiated through conducting necessary stakeholder consultation meetings (SCMs) in the Project area (Component 1). Despite the local practice of purdah (seclusion of women) from public gatherings, the team encouraged the participation of women in the stakeholder's meetings. Thus, both men and women were in attendance in the consultation meetings, particularly in primary stakeholders' consultation meetings. These SCMs were preceded by meetings with local administration at the Upazila and District levels. In sum, multi-level consultations were carried out, starting with initial meetings with local administration, SCMs, and FGDs. The process continued at individual level also through various surveys undertaken in this Project.

7.3.1 Checklist Used for Public Consultation

379. For the Narayanganj–Dhaka–Chattogram and Tongi–Joydebpur railway electrification, public consultation follows a structured checklist aligned with Bangladesh's EIA Guidelines (1997) and international safeguards (e.g., ADB, World Bank). While the full checklist is typically included in the Terms of Reference (ToR) which approved by Department of Environment (DoE) Bangladesh attached in the appendix.

7.3.2 Consultant Checklist

380. For the Narayanganj–Dhaka–Chattogram and Tongi–Joydebpur railway electrification, the consultant's responsibilities are guided by the Terms of Reference (ToR) issued by Bangladesh Railway and aligned with international best practices (e.g. ADB, World Bank). Based on procurement documents and feasibility contracts, Consultant Checklist used during project implementation:

7.3.3 Key Findings from Public Consultation

381. The outcomes of the consultation meetings were very helpful in minimizing the impacts of the Project. First, the location of all the mosques, schools, madarasa, temples and other CPRs

are presented to the designer to save them. Second, compensation for the affected structures on BR land will be given by the Project at market rates. Third, based on discussion at the consultation meetings, the Project has designed special compensation packages for the poorer families and livelihood restoration for the affected families. It was explained clearly at the meetings that land for land as an alternative was not an option in this Project; however, adequate compensation will be paid and the Project will assist their location and rehabilitation of the affected families. Finally, the rapid assessment and FGDs provided helpful data for designing appropriate level of supports for relocation and re-establishment of businesses by the informal settlers.

7.3.4 Expectations of the People

382. People living along the Narayanganj–Dhaka–Chattogram and Tongi–Joydebpur corridor have high hopes for the electrification initiative, viewing it as a gateway to cleaner, faster, and more inclusive transport. Based on recent public consultations, here's a snapshot of what communities and stakeholders expect-

383. Transport Improvements- Faster and more reliable trains for daily commuters and long-distance travellers, Reduced travel time between industrial hubs and residential zones, better punctuality and safety compared to diesel-powered services.

384. Environmental Benefits- Cleaner air in congested cities like Dhaka and Narayanganj, Lower noise pollution near schools, hospitals, and residential areas, Reduced carbon emissions, aligning with climate goals.

385. Economic Opportunities- Job creation during construction and operations, Boost to local businesses through improved connectivity, Enhanced trade logistics, especially via Chattogram Port.

386. Social Inclusion- Affordable mobility for low-income workers and students, Improved access to education, healthcare, and markets, Protection of vulnerable groups through resettlement and livelihood restoration plans.

387. Governance & Transparency- Clear communication about project impacts and timelines, Fair compensation for land acquisition and displacement, Grievance redress mechanisms that are accessible and responsive.

7.3.5 Findings from Focus Group Discussion

388. Recent focus group discussions (FGDs) conducted in areas like Narayanganj, Dhaka, Tongi, and Chattogram have revealed valuable insights into public perceptions, concerns, and expectations surrounding the railway electrification project. These discussions included diverse participants—students, workers, business owners, and urban planners—aged 20 to 50 years.

389. The community recommendations are: Introduce alternative routes to reduce bottlenecks at critical intersections like Chashara in Narayanganj, implement congestion pricing and regulate auto-rickshaw operations to ease traffic flow, ensure inclusive consultation, especially with informal workers and low-income residents, provide job opportunities during construction and operation phases. These findings underscore the need for coordinated planning, transparent communication, and community engagement to ensure the railway electrification project delivers on its promises of sustainability and inclusivity.

Figure 43: FGDs' Pictures

7.4 Key Informant Interview (KII)

390. Consultation with individuals like local leaders, village workers or persons with special knowledge or experience about resettlement activities and implementation; they want proper resettlement and value of property including tress, infrastructures and others.

Figure 44: KIIs' Pictures

7.4.1 Summary of the KII

391. Key Informant Interviews (KIIs) are in-depth conversations with individuals who possess specialized knowledge about a project, community, or sector. For the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur railway electrification, KIIs were conducted with stakeholders such as Bangladesh Railway officials, Environmental Expert, transport experts, Resettlement Expert and local government representatives.

392. Urgency for modernization- Diesel trains are outdated and inefficient. Environmental Priorities-Electrification aligns with Bangladesh's climate goals. Public demand- Communities want faster, cleaner, and more reliable transport. Implementation Challenges-Land use conflicts, funding gaps, and coordination hurdles.

7.5 Follow-Up Programs

393. Follow-up to the Project Disclosure - During public consultations, a number of issues were raised by the participants, and Bangladesh Railway and the Consultant assured them that BR would follow up the following issues, provide all environmental documentation and address the issues stressed at the sessions. The information to be passed and issues to be addressed were,

394. Details on how river bank erosion along the three large bridges has been mitigated by the specialist and Provision by the social assessment team of more specific information on the rehabilitation of private property likely damaged during construction and compensation to the Project Affected People.

7.6 Summary of Consultation

395. The summary of the comments/suggestions shared by the audience are presented in Table 44. The comments rose during public consultation provided by the Consultant are summarised as well.

Table 44: Summary of Public Hearing Issues and Proponent's Response

Number	Issue Raised	Reply from Consultants
PC-1: Project Disclosure Meeting		
01.	As a result of this Project agricultural land will be affected. It will be a very good decision, if Government can make employment opportunity for affected person.	Government obviously thinks about the affected people. The affected person will get proper compensation and they will be added in the construction actives.
02.	Long -time construction will cause dust and noise pollution; what type of action will take to reduce this pollution	Proper mitigation measure will be taken during construction period to minimize dust and noise pollution
03.	Social forestation along with the other trees and vegetation will be affected due to the Project activities	The affected person will get proper compensation. Three trees will be planted instead of one which will be demolished during the construction period
04.	Many homeless people have taken shelter in the land of BR. They work in different industry. They have no other place to stay. Before starting the Project, accommodation should be available for these helpless people.	Consultant noted the point of optimism.
05.	Due to the implementation of the Project, existing environment will be imbalanced. What will be the solution for existing educational institute, mosque, temple etc	It is true that existing environment will be affected but it is manageable through implementation of appropriate mitigation measures i.e. watering twice a day to reduce dust pollution.
PC-2: Project Disclosure Meeting		
06.	We respect the decision of our Government This Project will be constructed by thinking of loss and benefit of local people.	Government thinks about general people. Necessary changes are included in several times to respect of the local people.
08.	Due to the implementation of the Project, number of trains will increase which will pose more accident. Also. At the point of level crossing where actually most of the accident happen, will proper guard system incorporate in the proposed Project	For movement of people there will be a number of underpass and overpass. In the point where many people cross the railway, these underpass and overpass will be constructed over this place. All the existing level crossing will be improved to avoid accident with proper guard system.
09.	Lack of underpass and overpass accident is increasing day by day. In the new Project should add more underpass and overpass.	Consultant noted the point of optimism.
10.	Many shops, market, house are located in the railway right of way, and if the Project is within the area what will the owner do or get compensation.	Consultant noted the point of optimism.

Number	Issue Raised	Reply from Consultants
11.	Regarding waste management take necessary measures to keep the environment clean along with assurance of proper compensation for private land acquisition and resettlement, alternative settlement for the affected person should be include in the Project	It is true that existing environment will be affected but it is manageable through implementation of appropriate mitigation measures, i.e., watering twice a day to reduce dust pollution. Consultant noted the point of optimism.
12.	Long-time construction will cause Dust and Noise pollution, what type of action will take to reduce this pollution	Proper mitigation measure will be taken during construction period to minimize dust and noise pollution
13.	As a result of this Project agricultural land will be affected. It will be a very good decision, if Government can make employment opportunity for affected person.	Government obviously thinks about the affected people. The affected person will get proper compensation and they will be added in the construction actives.
14.	Cutting trees causes the negative impact on environment. How it will be managed? What will be solution about the tree owner?	If one tree will need to cut then three seedlings will be planted. Compensation will be given to the tree owner.
PC-3: Project Disclosure Meeting		
15.	The Project deserves to be applauded. To progress development of the country such kind of Project are very important. But special care should take in the level crossing where most of the railway related accident meet.	Thank you for your good positive comments. Consultant noted the point of optimism.
16.	How about the land acquisition due to the implementation of the Project especially in congested densely populated areas? Who will bear the cost of land acquisition?	Land acquisition will be minimum. Bangladesh railway have maximum land for the Project. It will need a small amount of land acquisition for the Project. If land acquisition is required, the Government will determine the land price on the basis of market price. The price of the land to be paid according to that rate.
17.	How to determine the value of the land?	A separate team is working for the social and resettlement issues
18.	Good drainage system will be needed. Without it water logging/congestion will be a major problem.	Consultant noted the point of optimism.
19.	Tree plantation plan is very appreciable to protect the environment and vegetation cover.	Thank you for your suggestion. We have plan for tree plantation. It will be three to four times higher than cuttings trees.
PC-4: Project Disclosure Meeting		
20.	We will get benefit from the Project. We can go different area very fast if the Project will be implemented. The local people co-operate with you for this Project.	Thank you for your suggestion.
21.	Such kind of Projects are very necessary for our economy. But a large number of trees will be cut for this Project. So, the number of planting trees should be doubled compare to cutting trees.	Thank you for your suggestion. We have plan for tree plantation. It will be three to four times higher than cuttings trees.
PC-1: EMP Disclosure Meeting		

Number	Issue Raised	Reply from Consultants
22.	Fast construction is expected. Long term construction will cause health hazards due to air, water and noise pollution to the local people.	The construction activity will run according to the Environmental Management Plan which ensure that a very impact will be faced by the locality.
23.	At the time of construction period the drainage system can easily get blocked and which will create water logging. So special measure must be taken.	All of the construction activities will be done with a view to mitigate every negative impact. Precautionary measure will be taken in order to prevent water logging.
24.	It's a good initiative by Bangladesh Government and they appreciated it and will cooperate during implementation.	Thank you for your positive comments.
25.	Safety system at all level crossings must be ensured.	Consultant noted the point of optimism.
26.	Ensuring proper compensation to the actual Project affected people for which monitoring the whole compensation programme is very necessary.	Consultant noted the point of optimism. This will be informed to the rehabilitation committee.
27.	Waste generated during the Project period should be disposed of properly.	Waste management plan will be followed to minimize waste related damages.
28.	Take precautionary steps to minimize the damage of public infrastructure, fisheries and agricultural sector.	A number of mitigation plans are included with the EMP of the Project. These will help to avoiding huge losses of infrastructure and other assets like fisheries, agriculture and tree cutting etc.

396. . The outcome of the Information Disclosure Meeting will be fruitful during implementation of the Project.

7.6.1 No Objection Certificate — NOC

397. A No Objection Certificate is an official document issued by a competent authority stating that it has no objection to the proposed activity or project. It is often a prerequisite for approvals, especially in projects involving land use, environmental clearance, or utility installation. In this project NOC is needed for land use which is already taken from the authority (Annex 9). If needed further NOC for any reason in that case necessary action will be taken from the project.

8. Mitigation Measures

8.1 Introduction

398. Mitigation measures are designed to minimize or eliminate negative impacts—environmental, social, and technical—that may arise during the planning, construction, and operation of the electric traction system. These measures are informed by feasibility studies, stakeholder consultations, and Environmental and Social Impact Assessments. The key objectives are protecting the environment by reducing emissions, noise, and ecological disruption, ensure community safety and well-being during construction and operation, preserve infrastructure integrity and minimize disruption to existing services, promote sustainable development through energy-efficient transport.

8.1.1 Residual Risk Assessment

399. Residual risk refers to the level of risk that remains after mitigation measures have been implemented. In the context of railway electrification, this includes technical, environmental, social, and operational risks that may still pose challenges even after safeguards are in place.

400. Technical Risks

- Incompatibility with existing infrastructure (e.g. bridges, tunnels, signaling systems)
- Power supply instability or substation failure
- Maintenance challenges due to limited local expertise

401. Environmental Risks

- Electromagnetic interference affecting nearby sensitive equipment
- Potential disruption to ecosystems during construction
- Visual impact of overhead lines in urban and rural landscapes

402. Social Risks

- Land acquisition disputes or delays
- Community resistance due to lack of awareness or misinformation
- Safety concerns near densely populated areas

403. Operational Risks

- Coordination issues between diesel and electric services during transition
- Delays in procurement or commissioning of electric rolling stock
- Inadequate training for railway staff on new systems

8.1.2 Key Mitigation Measures

404. Air Quality: The Construction period -Earth filling, vehicular movements and construction activities are likely to produce dust in the local air shed and will also produce various air pollutants including CO2, SO2, NO and NOx, as well as PM10 and PM2.5. These emissions will be marginal during construction since mitigation measures will be strictly enforced, requiring the contractor to control noise, dust and other air emissions. Provision for dust suppression such as regular watering of traffic routes and work areas during the construction period, will reduce the dust emissions. Measures are also defined in the EMP requiring contractors to reduce the emission of toxic gases by adopting eco-friendly engineering practices.

405. The operating period -During the operating period air pollution issues will also be addressed by the installation of oxidation catalytic converters on all new locomotive purchases. The gradual replacement of aging locomotives will also help to reduce air pollutants, especially PM2.5. The electrification of the entire network is also being discussed.

406. Noise and Vibrations: The Construction Period - It is anticipated, that during the construction activities, peak noise will be generated from the operation of diesel fuelled construction equipment, bridge piling work occurring at the same time as excavation, bulldozer operation, compaction activities and vehicles movement. The construction of substation will introduce new noise sources from the use of powered mechanical equipment, operation of diesel generators and batch plants and the carrying out of the other construction activities (e.g., erection or dismantling of formwork and hammering). These will produce noise and vibrations to a considerable extent.

407. The standard noise level associated with different construction equipment, will be a steady 65–70 dBA during working hours up to a distance of 20 m from the work sites and the average noise level decreases by 6 dBA with every doubling of the distance from the source reading. The equipment and machineries will produce collective noise depending on source type and number, weather condition, distances and duration of working period. The spatial distribution of the sources, land use and natural or man-made barrier are important for noise propagation to the receptor. As the proposed construction corridor is 50 m wide and clear of structures, there will be negligible noise impact on the nearby receptors, as they are located outside the construction corridor, or an average of more than 70 m away from the proposed rail track, 12 bridges/culverts and the substation area. However, the noise generated from the construction activities will be managed through implementation of noise mitigation measures; such as use of sound proofing of construction equipment, working hour restriction to the daylight period at vicinity of sensitive receptors, and implementation of attenuation measures at nearest receptors, if required. Noise measurements will continue throughout the construction stage, periodically.

408. It is anticipated that double stack line will involves 2 locomotives at same time, which will increase the noise level by only about 3 dBA than the single stack. Furthermore, the total number of double stack train movements would be half of a single stack operation. Therefore, noise level will not be significantly increased in case of double stack operations.

409. During operations the noise impact will be addressed by improving the maintenance of tracks, wheels, use of disc brakes, and quieter locomotives as a result of fleet renewal. As a part of the Environmental Monitoring Plan, BR will implement a quarterly air and noise quality monitoring programme during the construction period and up to two (2) years into the operating period (Defects Notification Period), with sample collection occurring at the same locations as per the baseline study.

410. Vibration: The vibration measurements indicated that during the construction, vibration may be generated by some machines, i.e., mainly jack hammer and pile drilling machines and vibratory compactors. This equipment operating on ground may generate a PPV of 7.0 mm/s. Pile drivers with 30 kJ energy may generate a PPV of 4.3 mm/s at a distance of 10 metres, from the source. However, these machines will be located at least 30 m far away from the nearby structures. At this distance the vibration levels will be within the PPV 2.5 mm/sec level defined as the threshold for cosmetic damage to buildings. During operations, the vibration may be generated some extent due to movement of freight trains on 6.2 km new freight rail line running through paddy land. Given that all sensitive features are located more than 30 m from the track, vibration will not be an issue.

411. Drainage and Surface Water Quality: The blockage of the surface drainage system and hydrological alterations are the critical issues for this Project and were major concerns expressed by the stakeholders at the public consultations completed by BR's consultant. Without careful planning the local villages around the substation are likely to experience increased flooding due to storm water runoff blocked by the built-up of the substation area and thus, a drainage network around the substation areas will be designed to channelize the water to nearby canal system to manage the drainage congestion in the catchment area.

9. Environmental Management Plan

9.1 General

412. The Environmental Management Plan (EMP) defines a set of mitigation and monitoring actions to be taken, in response to potential impacts predicted to take place during the pre-construction, construction and operating period of the Project. Both mitigation and monitoring actions are presented in **Table 45.** It not only defines impacts and mitigative and monitoring actions to be implemented, but also, where, when and who will be responsible for implementing them. The EMP describes well known and best practice mitigative actions to be taken to prevent negative impacts from taking place and if that is not possible, to mitigate them to an acceptable level. In addition, this EMP defines:

- The measures to off-set or compensate irreversible negative impacts;
- The institutional arrangement for the implementation of the EMP; and
- The means to enhance and maximize positive impacts.

9.2 Objectives of the EMP

413. The objectives of the Environmental Management Plan (EMP) for the proposed Electric Traction Project on the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur sections of Bangladesh Railway:

- Identify and Mitigate Environmental Impacts -Ensure that all potential environmental risks—such as air and noise pollution, habitat disruption, and waste generation—are identified and addressed through appropriate mitigation strategies.
- Ensure Regulatory Compliance- Align project activities with national environmental laws and international standards, including those of development partners like the Asian Development Bank (ADB) and World Bank.
- Promote Sustainable- Development Support the transition to a low-emission, energy-efficient railway system that reduces reliance on fossil fuels and contributes to Bangladesh's climate goals.
- Safeguard Public- Health and Safety Minimize risks to nearby communities, workers, and passengers during construction and operation through safety protocols and awareness programs.
- Establish Monitoring and Accountability- Mechanisms Define clear roles, responsibilities, and performance indicators for environmental monitoring throughout the project lifecycle.
- Facilitate Stakeholder- Engagement Encourage transparency and community participation through consultations, grievance redress mechanisms, and public disclosure of environmental performance.

414. The EMP (**Table 45**) will be the main tool with which BR will manage environmental effects. The mitigative measures are considered successful when the impacts have either been eliminated or the residual effect complies with the environmental quality standards, policies, and legal requirements set by DoE. Mitigative measures are tracked via the monitoring programme, described in the EMP tables, and focuses on monitoring the mitigation successes applied during the construction and operating periods of the Project. These objectives are embedded in the broader vision of creating a **"Green Railway"** that not only modernizes infrastructure but also prioritizes environmental stewardship and social responsibility

9.3 Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)

1) Pre-Construction Period

415. During the process, 11 (Eleven) adverse impacts are identified during the pre-construction period, which should be properly addressed to reduce impact during the Project phases or totally eliminate the objective of completing an EIA. These include, a tree replacement plan in

place, minimizing land requirements through adjustment with the new alignment, and having a process in place that protects the identified PCRs and CPRs during consultations for protection.

2) Construction Period

416. BR identified 20 mitigative and 20 monitoring actions that will need to be implemented if significant construction-related effects are to be minimized (**Table 45**).

417. Of these, the most important will be the effects deriving out from the placement of the two-six-meter-high embankment paralleling the existing rail line for around 365.90 km. The movement of huge truck-loads of material and pumping of dredged sand, generating noise and dust as well as traffic bottlenecks, will need to be properly managed. Dust suppression and limits to truck traffic during low noise periods, as well as care with fleet maintenance will be important. Ensuring the trucks and construction machinery to remain idle for minutes when not in use, will markedly reduce the emissions and provide considerable fuel savings.

418. The embankment slopes will easily erode if not revegetated quickly. Therefore, the contractor will implement a rehabilitation programme of tree plantation as the work is completed.

419. To better track the air and noise pollution, the contractor will be required to undertake a compliance monitoring programme, testing the parameters defined in Chapter IV. Noise monitoring will be completed at the identified PCRs and selected CPRs (closest schools, mosques and residences). The schedule will be more or less the same as the sampling completed during the field work for this EIA.

420. Another common impact may be the failure of contractors to properly maintain work camps, allowing sewage to leak, garbage to be left unmanaged, fuel to leak and even bitumen to spill over the ground near the asphalt batch plant occupational health and safety practices are often ignored, the contractor either not providing adequate safety equipment or not enforcing its use. Contractors will be required to provide hard hats, ear plugs, dust masks, eye protection, and deliver OHS training sessions at least once a year.

421. This is particularly true if bentonite drilling mud is used during the pile boring operations on the six larger rivers. Contractors will be required to provide a bentonite recovery plan, should this material be used.

422. Finally, the Project will require concrete since all piles; piers and large culverts will be cast at casting yards requiring the establishment of a mobile concrete batch plant, generating noise and dust. The contractor will be required to have dust and noise suppression features built into any concrete batch plant. The plant will need to be located at a DoE approved site, at least 500 m from the nearest occupied dwelling.

3) Operating period

423. Although the existing line has been in operation for years, producing some noise, dust and air pollution, ten mitigative and monitoring actions will need to be implemented during the Defects Notification Period years starting at the end of the construction years. Three important impacts that BR will address are:

- Possible inadequate clean up and rehabilitation of contractor's camps and yards and borrow areas and failure to maintain mitigation measures such as tree plantings;
- Added noise and air pollution from a large increase in rail traffic, impacting on local sensitive receptors; and
- Lack of adequate new safety measures/equipment accounting for the large increase in train traffic across the level crossing.

424. These impacts, mitigative measures and monitoring requirements are listed in detail in the EMP table **(Table 45**).

Table 45: Environmental Mitigation and Monitoring Measures for the Project

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
1. PRE-CONSTRUCTION PHASE									
1.1 Trees and Landscape	Trees and saplings within an approximately 50 m RoW of the alignment, workers camp setting, and station areas will be cut down during pre-construction period resulting in potential ecological and economic loss.	Notice of removal of trees will be provided. BR or local NGOs will ensure compensation and planting of at least three trees for every one cut. A basic tree replacement plan has been prepared and is included as Annex. As each section of the construction work is completed, trees and understory vegetation must be planted, in order to help stabilise the cleared areas and attract some wildlife such as birds.	At all Project sites, particularly new rail embankments, rebuilt stations and at temporary sub grade storage areas	The replanting programme, as defined in Annexure will be updated and completed early during the Pre-Construction period. Cutting will take place throughout the pre-construction period and replanting immediately after each section of rail line is completed	Local NGOs / CSC or PIU of BR.	To Confirm that a tree cutting and replanting programme is fully ready to implement during the pre-construction period. To Confirm that this planting plan is in agreement with local people who lost food-trees.	During the pre-construction period / monthly/ throughout the pre-construction and construction period	Tree replanting plan and record of compensation	Contractor/ Engineer
1.2 Land acquisition	Design encroaches on private land. Based on preliminary topographical and social survey data of Project, the Project involves land acquisition of along the proposed alignment and station areas. As per the findings of the LARP survey, thousands of structures will be lost out of which are residential, commercial, residential cum commercial and CPRs and rest are other types will need to be relocated.	The detailed guidelines for land acquisition and compensation are found in the RP, which must be applied. BR is making very significant efforts to minimise resettlement but some is unavoidable due to the illegal occupation of BR owned land. BR has revised the alignment at least 2X to reduce land requirements	At all Project sites, particularly land acquisition areas and affected agricultural land embankments, rebuilt stations and at temporary sub grade storage areas	Throughout the pre-construction period	Local NGOs / CSC or PIU of BR.	To be monitored by implementation NGO hired by BR	During the design phase when final alignment is fixed/ daily/ throughout the preconstruction phase	Revised alignment drawings at sensitive areas, as defined by local communities	INGOs and DC/ PIU of BR
	By the acquisition of lands, people will lose their income and employment	Direct and indirect loss of income will be compensated as prescribed in the RP and must be implemented prior to construction taking place.	Along the alignment	Early during the Feasibility Study work, During detailed design stage and implementation stage	Local NGOs / CSC or PIU of BR.	Livelihood restoration plan need to be implemented through INGO according to the RP.	During pre-construction period / daily/ throughout preconstruction phase	Local people are getting employment opportunity in Project	INGOs and DC/ PIU of BR
1.3 Heritage and Culture	CPRs were identified by the social assessment team, and all are located in the new RoW and will have to make way for the rail line	The CPRs to be relocated in stages, after consultation with local communities, Local communities will be compensated for dismantling and relocating these sites.	Along the alignment of CPR sites exist.	Early during the Feasibility Study work, during detailed design stage; always prior to construction starting in the area where the site is located	Local NGOs / CSC or PIU of BR.	Inspect relocation and protection activates during this period and obtain written agreement from local communities	Pre-construction phase / Inspect at least 2 times during relocation activities	Record of inspection on file	INGOs and DC/ PIU of BR. See Details in RP
1.4 Infrastructure - Utility Relocation	Some utility lines such as electric transmission lines, gas pipelines, and water supply pipelines are shifted or accessed without proper approval or knowledge, leading to damage.	Utilities will only be removed and relocates with proper agency approvals and permits.	Along the alignment	Permits and locations will be established and included in construction drawing and relocation will take place prior to construction	Relevant authority / CSC or PIU of BR.	Confirm that permits. Location and relocation site plans have been approved	Pre-construction phase / Inspect at least 2 times during relocation activities	Inspection report including copies of permits or records on file	Utility agencies /PIU of BR
1.5 Safety and level crossings	Inadequate planning and design consideration could add to the risk of accidents at new level crossings and even cause train operating problems	The level crossing issue will be carefully examined by BR and designs incorporate safety features to protect the public but also recognise	All level crossings	Design and decision during the pre-construction period and later as traffic builds and	Local NGOs / CSC or PIU of BR.	Need to confirm by inspection that traffic is rapidly clearing after train crosses the level crossing.	During pre-construction period / monthly/ through	Incident report	Contractor /BR

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
		the need to move traffic and include a rapid crossing clearing system		problems arise, grade separations will be added by BR		Gateman should be at level crossing to aware the pedestrian.	pre-construction phase		
1.6 Transportation of Construction materials	With millions of m^3 of construction materials to be moved there is the potential for serious local negative air quality, noise and traffic problems	A materials transport plan will be prepared in consultation with the contractor, prior to the start of construction	For the construction site	During pre-construction stage	Contractor/ The CSC	Monitor to Implement the material transport plan daily.	During pre-construction stage / daily / throughout preconstruction phase	Inspection report	Contractor / BR
1.7 Station Design	Inadequate sizing of station sewage and garbage management facilities, leading to chronic problems during the operation of the new and upgraded stations.	The design of all waste, water and access for each station is will be designed, using the estimated passenger through-put at each station.	For all stations and buildings	During the Project feasibility or design stages	The CSC	Compare the estimate of station passenger/user throughput for 2030 and check that sewage. Garbage and water system can cope with the discharges	Prior to final design being completed / monthly / preconstruction phase	A table showing each station, daily passenger loads. waste production and waste management capacity	The CSC / PIU
1.8 Labour Standards	Poorly prepared labour standards, leading to infractions regarding child labour, minimum wage, forced labour, and unsanitary working conditions and unsafe water supplies	BR will strictly adhere to DoE and other international standards as defined in the EIA text	At all construction sites, and at all times	At all times and for the entire construction period	Contractor / CSC or PIU of BR.	Confirm that these standards are specifically incorporated into the contract documents either as clauses or by appending this EMP to the contract.	Once as contract documentation is being prepared / once/ during pre and construction	Copy of the contract section that has the labour standards section or a listing if the section and clause numbers on file	CSC and Contractor / PIU
1.9 Technical Capacity to undertake all environmental work	Inability of contractor and EU or CSC to implement the EIA and its EMP resulting in a breakdown of safeguards implementation.	BR to conduct a 1.5 day briefing and training for contractors and BR staff on EIA and EMP implementation, surveys and data recording	The CSC office	1.5 day	Contractor / CSC or PIU of BR.	Need to monitor the training knowledge at work site by visiting work site and offices	During pre-construction/ Monthly	Monitoring report	The CSC and Contractor /PIU
1.10 Environmental Clauses in Construction Contracts	No specific environmental clauses in contracts will provide BR and the CSC with few tools to force the contract to comply with requirements defined in the EIA and its EMP	Specific environmental clauses will be added to contract specifications and a separate environmental bill-of-quantities section will be prepared	The CSC office	-	Contractor / CSC or PIU of BR.	The environmental specification need to be followed during construction period	-	Environmental specification report	The CSC/PIU
2. CONSTRUCTION PHASE									
2.1 The Construction Environmental Management Work Plan (CEMWP)	Contractor does not prepare a work plan defining details on when mitigation and monitoring actions are to take place, in relation to the work and then the EMP requirements are not implemented properly.	The CSC will assist contractor prepare the EMWS, but interim payment (mobilisation) will be delayed until the EMWS is submitted to the CSC.	N/A	Within 1 month of the successful contractor mobilising	Contractor / CSC or PIU of BR.	Confirm that a EMWS has been prepared	Within 1 month of contractor mobilisation / once/preconstruction	EMWS-draft	Contractor, with help from CSC / PIU
2.2 Air Quality and Dust	The ambient levels of CO_2, NO_x, SO_x, $PM_{2.5}$, and PM_{10} may increase at busy stations and construction areas leading to temporary localised air pollution.	A dust suppression programme will be used at all times during construction of embankment, stations and placement of ballast Dust suppression to include watering and suppression equipment on batch plant, as well as vehicle speed restrictions to ≤35 km/h., and finally rapid revegetation including grass seeding.	All sites, as identified in the monitoring table of this EMP	Twice daily or as required	Contractor/ CSC	Need to check daily the level of dust at construction site. Also need to interview the workers on dust level at worksite.	At construction sites / quarterly / four years	Completed data table and short analysis	Contractor, with help from CSC / CSC

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
		Ambient air quality testing for SO_2, NO_2 and $PM_{2.5}$, PM_{10} same locations as ambient-conditions survey, conducted quarterly at 8 stations, including same stations as during EIA and PCRs such as mosques, hospitals and schools, and immediate remedial actions taken 2 exceedances occur at any one site	All sites, as identified in the monitoring table of this EMP	One sampling station per location. Each sampling station will include two sampling points per station. Quarterly monitoring over the four years construction period	Contractor/ CSC	Throughout the construction period: During dry season undertake air quality testing for CO, SO_2, NO_2, $PM_{2.5}$, and PM_{10} at major bridge and station and buildings construction sites.		Completed data table and short analysis	Contractor, with help from CSC / CSC
2.3 Noise	Work sites will be noisy due pile driving, operation, power generator, rock crushing/ batch plants and movement of construction vehicles, as well as the constant movement of trains along the existing line.	Keep noise pollution at ≤ 60 dB (Bangladesh standard) levels at mosque, school, populated area and other sensitive sites by use of low noise equipment or erection of temporary baffles. Work timing restrictions if noise levels, based on field measures indicate exceedances of existing conditions. 8 stations, 4X/yr at PCRs. Contractor will also be required to use only well maintained functioning equipment.	Sensitive sites (PRCs) within 50 m of rail RoW in the vicinity of the sensitive receptors.	Throughout the construction period, and based on noise measurement surveys	Contractor/ CSC	Sample at least 8 sensitive sites within 50 m of rail RoW in the vicinity of the sensitive receptors. Take noise readings at sensitive receptors 2 times/day during full work activities, 2 times/month	Construction period / quarterly / four years	Data summarised in to monthly data summary table (one row per date sampled)	Contractor, with help from CSC /CSC
Topography, Landscape and Soils									
2.4. Topography and Landscape changes	Visual intrusion from large piles of embankment materials and ballast obstructing views and excavation along the edge of the alignment leaving large unsafe holes is possible.	Embankment site to be planted trees to promote natural vegetation; as well as fast growing grasses such as vetiver/napitar. Material stockpiles will be removed as soon as work is completed and the area re-landscaped. Same applies to borrow areas.	Embankment areas of the proposed alignment area as well as at all borrow areas used during construction	Throughout the construction period.	Contractor/CSC	Inspection/ consultation with adjacent households and railway authority to get opinion on work being completed.	Construction and operation stage/ Mthly inspection / Long term	Include as part of inspection report or checklist	Contractor/ CSC
2.5 Erosion	Clearing topsoil in proposed embankment area can lead to loss of nutrient and erosion particularly along the >14 km of cut slopes and dust from unprotected storage sites. The erosion risk at embankment slopes is possible. Gully erosion along the exposed track slope during rainy season may damage smother field crops in adjacent areas.	Topsoil storage areas must be protected during the dry season, wind erosion by covering. Rapid revegetation and use of hydro-seeding and jute erosion protection mats will be applied in areas where erosion is noted during the regular monthly inspections	At all work sites, in the impact corridor	Inspection as part of the engineering inspection cycle and reporting to CSC	Contractor/CSC	Inspect storage areas and record state of storage areas with 2 photos, and then report level of erosion and on-site dust. Inspect embankment construction areas for erosion and repair	As part of regular construction inspection / weekly / four years	Description of status of erosion control measures being implemented	Contractor /CSC
Water Resources		Site borrow for embankment material will not be allowed							
2.6 Hydrology, Drainage and Surface Water Quality	1) Earthwork activities during construction of embankment may result in drainage congestion	Ensure all earthworks are constructed according to design and specifications. Wastes, effluents and other contaminant materials at camp/work	Throughout alignment earthworks inspection at all work camps and major construction sites such as bridges and embankments	Inspect weekly to ensure that drainage is properly maintained at earthworks.	Contractor/CSC	Site inspection Inspect waste and field management at camps and record actions taken when non-compliance recorded. Conduct surface water	Construction and operation stage/ Monthly inspection/ Long term	Test data., presented in tabular/organised form	Contractor/ CSC

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
	2) The surface water at workers camp and Project site areas may become pollute due to faecal, organic and other contamination. Disposed wastes and effluents from the construction sites may cause further degradation of surface water.	sites to be stored, handled, transported and disposed in planned manners. Garbage disposal service to be provided, Concrete refuse, reused or disposed of without habitat loss; All other effluents not to be disposed of directly into natural waters, but via settling basins to allow suspended sediment to settle out. Quarterly surface water quality testing programme, with sampling design as defined in the EIA will be completed during the construction period; i.e., 2 water crossings each US and DS at crossings.	as well as at culvert construction sites. WQ sampling at all bridge construction sites-upstream and downstream. See EMP monitoring Table and Contract specifications for details	WQ sampling to be conducted quarterly or as agreed jointly between the CSC and the contractor		quality testing for pH, Turbidity, Temperature, DO, BOD_5, COD, TSS, TDS, oil and grease	Complete WQ testing at stations as defined in this EIA, quarterly for 4 years for the 9 parameters listed:		
2.7 Groundwater	The potential exists for drinking water sources to be contaminated by the seepage of wastes from workers' camps through the soil profile into the GW aquifer (particularly if wells access the shallow aquifer).	Workforce camps will be located away from water resources. All practical measures such as provision of septic tanks, garbage bags, and other sanitation facilities will be implemented at the construction camps to prevent the wastewater and solid wastes from entering well and groundwater recharge areas. 6 Wells used for drinking will be tested 2X a year to ensure portability.	Throughout the alignment, especially where the pile drilling to 30 m depth is conducted, and where any new wells were dug.	If new wells are dug and toilet facilities built near wells	Specialised subcontractor to collect and test samples/CSC	where the pile drilling to 30 m depth is conducted and/or where any new wells are dug or a well becomes a camp potable water supply, testing to be undertaken for pH, TP, Mn, Fe, As, Oil and Grease and E. Coli,	Every 6 months or until difference over 1 years does not vary significantly, Reduced to once a year.	Completed data table and short analysis	Contractor/ CSC
Waste Management									
2.8 Waste Management	Construction camp wastes are often poorly managed and can lead to chronic pollution of surface and groundwater.	Contain all solid wastes at designated location within construction sites. Service machinery and vehicles strictly at designated maintenance workshops where waste oils and lubricants can be collected and recycled. The monthly monitoring report will provide compliance update	All construction camp and contractor operations areas, such as batch plants and maintenance yards	Complete monthly and submit to CSC	Contractor/CSC	Undertake good housekeeping practices inspection at least every 2 months and report results and record what actions taken to mitigate	At construction sites / monthly / four years	Weekly compliance checklist	Contractor/ CSC
Land use, Population and Culture									
2.9 Land Use	The most significant potential impacts on land use in the study area will be the removal of agricultural land (primarily rice paddy) for the construction of the proposed rail embankment, station access roads and associated facilities.	Land acquisition / requisition will be in accordance with the laws of Bangladesh and as defined in the Project RP, which specifies agreed to entitlement a grievance mechanism and timetable for implementation. It will be used by BR as its mitigation guide concerning this issue.	At all Project sites, particularly land acquisition areas and affected agricultural land embankments, rebuilt stations, buildings, and at temporary sub grade storage areas	Throughout the construction period	Contractor/CSC	No action needed since this is being thoroughly monitored and completed by the social safeguards team and local NGOs	Prior to start of clearing work at any proposed construction area where land acquisition is involved / monthly/ four years	Copy of reporting from social safeguards team	INGO and DC/ PIU of BR
2.10. Health and Vector Borne Diseases	Personal and occupational health issues, stemming from unsanitary toilet facilities, lack of potable water and sanitary washing areas can lead to common disease outbreaks in work camps.	Undertake check and cleaning at all sites and areas where clean conditions should exist. Provision of potable water, sanitary toilet facility and hygienic	All work sites and particularly at Construction camps All work areas and camps	At least 2 times per week	Contractor/CSC	Undertake checks at all sites and instruct contractors to take immediate action if non-compliance identified	At construction sites / weekly / four years	Compliance checklist	Contractor /CSC

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
	Construction work creates areas for water to form stagnant puddles; Also, water can collect in old equipment waste tyre dump stored outside, ideal breeding areas for malaria and dengue mosquitoes.	accommodation for workers at camp sites. All potable water supplies will be tested semi annually Provision of First-Aid facility for them. Ensure that these facilities are cleaned and disinfected regularly. Inspect for stagnant water and puddles every 3 days, including stored construction materials such as tyres and old oil drums–empty to prevent water ponding.							
2.11 Worksite Safety Management	Poor safety oversight and management of the worksites by the contractor, leads to accidents and unsafe working conditions	Construct fences separating the construction sites at rail stations from public access, and manage train movements collaborating with BR dispatch staff. Contractors must at all times ensure the local people needing to move from one side of the construction area to another can do so effectively and without undue delay.	All construction areas	Conduct inspections as part of regular inspections or at least every 2 months	The CSC/BR	Conduct regular inspection	At construction sites / monthly / four years	Record compliance for inclusion in audit report	Contractor /CSC
	Labour standards ignored or not complied with leading to infractions of basic labour standards as defined by ILO conventions	**No use of child labour permitted** that no workers under the age of 14 may be hired as general labours, and no workers under the age of 17 are to be hired for hazardous jobs such work on scaffolding, and structures elevated above the ground, etc. **No Bonded labour-**All forms of bonded labour and forced labour, as defined by ILO Conventions 29 & 105 **Equal treatment, equal opportunity- as defined by** ILO Conventions 100 & 111 and ILO Code of Practice for HIV/AIDS 85. No discrimination based on race, caste, origin, religion, disability, gender, sexual orientation, union or political affiliation, or age; no sexual harassment **Minimum wage**- BR expects the contractor to pay all employees according to Bangladesh Labour Act standards.	All work areas under the contractor and subcontractor control	Throughout the construction period	Contractor/CSC	Random check of 10% of the labour force, and check that labourers have contract letters and check age, working conditions and documentation	At start of Construction period and complete every 6 months / four years	Monitoring report with photographs	Contractor/ CSC
2.12 HIV Awareness	Due to influx of workers in the Project area, AIDS/HIV may spread in local community	Workers health training programme will be organised during construction period to aware the health and hygienic issues. Training to be	All construction camps	Conduct at work camps every six months	Contractor/CSC	As part of monthly inspection review all OHS requirement looking for poor enforcement as well distribution of proper safety equipment	Every 6 months /4-year construction period	Record of compliance for inclusion in audit report	Contractor /CSC's health specialist

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
		provided by health specialist such as a local NGO							
Occupational Health and Safety									
2.13-Personal Safety Equipment (PSE)	Contractor does not provide adequate PSE or properly enforces its use, leading to accidents	Workers will be provided with appropriate personal protection equipment, such as safety boots, helmets, gloves, protective clothing, goggles and ear protection, and contractor will enforce its use, so long as safety does not suffer due to this action	At all constriction sites	Continuously throughout the construction years	Contractor/CSC	Conduct monthly check to review PSE compliance.	At construction sites / monthly / four years	Confirmation note in inspection reporting documentation	Contractor/ CSC
2.14 The Construction Period Environmental Completion Reporting	Contractor fails to prepare a summary report defining the mitigation and monitoring actions completed and what needs to be continued during the Operating period. The result is a failed or weakened environmental safeguards programme.	Prepare a completion report and deliver to the CSC.	N/A	Monitoring Reports to be prepared monthly and quarterly; Completion Report to be completed within the last 4 months of the Project	Contractor /The CSC	Collect monitoring and completion reports and confirm compliance	Monitoring Report (every month and quarter) and Completion Report (Once at the end of construction period / four years	Report during and after completion of mitigation and monitoring actions specified in the EMP	Contractor / CSC
2.15 Terrestrial and Aquatic Flora and Fauna	The clearing of trees and associated understory vegetation and construction of a 2-7m high by 129 km-long embankment will reduce the habitat for mostly birdlife, given that the aquatic and terrestrial faunal is limited to common and pest species. Small patches of wetland will be covered by the embankment	A rapid revegetation / tree replanting programme will permit the rail-side habitat to recover quickly The rapid reestablishment of pre-construction surface draining will help to bring wet areas, somewhat reduced (marginally) by the new embankment to re-establish pre-construction habitat conditions.	Along the alignment, trees cutting, camp areas and River site areas	Throughout the construction period	Contractor/CSC	As part of the monthly site inspection, examine embankments, new stations and buildings, subgrade storage areas, to confirm these facilities are not contributing to environmental degradation	throughout the construction period / Monthly / four years	Monthly throughout the construction period Checklist as part of the monthly reporting	Contractor/ CSC
2.16 Fisheries	The bridge construction will give a negative impact on the fish species, these are •Behavioural 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 behaviour.	Shall, in consultation with Fisheries Department, develop and implement a plan to offset the loss of fish and fish habitat associated with the carrying out of the Project Shall manage effluent produced by the Project from construction camp, office, workshops and, etc., by ensuring that effluent is collected and treated if required before being discharged into the environment Change in behavioural responses by fishes to increased suspended sediment concentrations include impairment of feeding, impaired ability to locate predators and reduced breeding activity.	Bridge sites	During construction stage	Contractor / The CSC	Confirm not to turbid the surface water	At construction sites / daily / four years	Monitoring report	Contractor / CSC
2.17 Heritage and Culture	CPRs will be affected by the rail line construction	BR has defined a plan to prevent undue damage to these sites and/or	At all heritage and cultural sites	Throughout the construction period	Contractor/ CSC	For PCRs, discuss actions taken with local officials and get agreement that this is appropriate.	Prior to the start of construction	Inspection report or checklist	Contractor/ CSC

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
		relocate the CPRs, which will have to be completed before the work begins							
2.18 Resettlement	loss of access to land by tenants and informal occupants and loss of employment and workdays	livelihood restoration activities and schemes will be to improve or at least restore the pre-Project standards the APs enjoyed, which also complies with ADB SPS (2009) requirements	At the Project area	During pre-construction and construction periods	INGO / CSC or BR	Monitoring required to check the implementation of RP during pre-construction stage also check with all AP whether or not they received full compensation	Prior to the start of construction	Inspection report or checklist	Contractor/ CSC
2.19 Livelihood	Most of the Aps of this area are engaged in agriculture, fisheries, and business whose livelihood will be impacted due to land acquisition	Affected households/persons will receive replacement value of the land and other assets before relocation. Likewise, loss of standing crops and trees will be compensated at market price.	At the Project area	During pre-construction and construction periods	INGO / CSC or BR	Monitor the livelihood restoration plan	Prior to the start of construction	Inspection report or checklist	Contractor/ CSC
2.20 Vulnerable Community	Vulnerable communities may displace who live below poverty line, the landless, the elderly, women- and children-headed households, Indigenous Peoples, ethnic minorities, natural resource dependent communities or other displaced persons who may not be protected through national land compensation or land titling legislation	These groups should be identified either through the process of Environmental and Social Impact Assessment (Performance Standard 1) or through the social baseline studies component of resettlement planning.	For the entire construction area	Prior to the final payment to the contractor	INGO / CSC or BR	Monitor and draw special attention to vulnerable communities to protect their interest	Prior to the start of construction	Inspection report or checklist	Contractor/ CSC
3. OPERATING PHASE									
3.1 The Construction Period Environment Completion Report	Failure to adopt measures and continue mitigation actions defined in the Construction Period Environmental Completion report.	Assign environmental expertise to obtain, examine and take necessary actions defined in the Construction Period Environmental Completion report.	For the entire construction area	Prior to the final payment to the contractor	Contractor / CSC or BR or its EU if in place	Record that the report in in the hands those responsible for maintaining existing measures and completing those required	Prior to final payment to contractor / Once	Completion report in file	Contractor/CSCs and PIU
3.2 Construction Period Decommissioning	Inspection of sites to be decommissioned by contractor, are: work camps; fuels storage areas waste dump sites; construct access roads But not undertaken, leading to chronic environmental problems due to a lack of proper clean-up.	Undertaken a Complete construction area inspection.	The entire length of the line	Within the first quarter of operations and before final payment made to contractor.	Contractor / CSC or BR or its EU if in place	Inspect to be sure that work camps, fuel storage areas, waste dumps, toilet facilities, construction access roads have been properly decommissioned and no chronic contamination is likely.	Prior to contractors final payment / Once	Decommissioning checklist	Contractor/CSCs and PIU
3.3 Air Quality & Dust	Degradation of local air quality due to increased train traffic.	Maintain locomotives according to factory specifications and accelerate decommissioning of > 20 year old locomotives.	N/A	Semi-annual air quality monitoring years 1 and 2 of the operating period and if I regular exceedances are found remedial actions to improve air quality will be implemented.	Contractor / CSC or BR or its EU if in place	Undertake air quality monitoring at 4 of stations sampled during the construction period and sample CO, SO_2, NO_2 and $PM_{2.5}$ and PM_{10}	Sample 2 times/year for years 1 and 2 two samples per station or 16 samples per year.	Annual air quality table and analysis	Contractor/CSCs and PIU.
3.4 Surface and Ground Water Quality	Contamination of soil caused due to spillage of petroleum derivatives and other chemicals due to rail accidents.	Rail accidents and spills will be managed through a spill contingency protocol.to be distributed to all BR management for implementation if a spill should occur	Applicable to all rail line operations, not just this Project	To be developed during the pre-construction period and implemented as soon as it is	BR or its EU if in place	Prepare and implement spill contingency plan in hand	Prepared as soon as operations begin/ Once	The spill contingency plan and distributed to rail operations units	Contractor/CSCs and PIU

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
				completed used as a spill protection handbook					
3.5 Noise	Noise monitoring has identified a number of sensitive sites where noise is already exceeding accepted levels and as such creating more discomfort for local people	Install noise attenuation features at the sensitive sites - e.g. berms. Plantings and noise barriers-based on noise monitoring recognising existing train noise. Also, noise attenuation equipment such as disk brakes rubber padding under the rail and a rail grinding schedule. If the noise level added from the operation of the second rail line exceeds 3 dBA (on top of background noise) immediate measures such as noise barriers, noise shielding window panes etc. must be taken.	To be determined, based on construction period measurements, but generally around schools close-by residences and hospitals and shops	Monitoring to be conducted during years 1 and 2 of the operating period, based on the sample design defined in this EIA	Contractor / CSC or BR or its EU if in place	Noise measurements to be continued at noise sensitive sites as defined during pre-construction and construction measurements 2 times/year at 8 sites along	Operating years 1 2/ 2 times per year/DL phasse.	Annual noise measurement tables, highlighting exceedances.	Contractor/CSCs and PIU
3.6 Employment and Livelihood and Ribbon Settlement	The area along the rail line will attract settlements and undesired structures including commercial facilities particularly near the railway stations.	Since this is very difficult to control, BR will as a minimum post the area as private property and permitting only agricultural activities, no structures. BR will mount RoW patrols to enforce these conditions.	Along the entire corridor	Posting at start of operating period in all areas were line passes through urban areas.	Contractor / CSC or BR or its EU if in place	Inspect to be sure that basic actions as defined have been taken and that removed signs are replaced	Operating years 1 and 2/ As part of operating inspection by BR	Record of removal actions and photos	Contractor/CSCs and PIU
3.7 Level Crossings	Inadequate safety at level crossings and stations leading to more and more frequent accidents, with vehicles, people and livestock. Also see Item 1.6 in this table.	Reduce Vehicle – train and human and livestock train accident by implementing sufficient awareness programme. and provide signage and internationally approved crossing structures/signalling. 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	Mainly at authorised and unauthorised level crossing areas	Based on ongoing BR studies and consultation with local authorities	Contractor / CSC or BR or its EU if in place	Inspect crossings at least 1/yr to check operation and collect incident records for each crossing	Operating years 1,2/ Quarterly	Inspection report/tables	Contractor/CSCs and PIU
3.8 Waste Management	Garbage is thrown and sewage discharged onto the tracks from trains leads to chronic contamination of the corridor and nearby drainage areas	Provide adequate waste bins and waste biodegradable waste bags on trains. Establish strict fines for garbage throwing Initiate a programme of retrofitting trains with sewage collection tanks to be pumped out at collection stations for delivery to STPs.	Along the entire operating rail line	At all times	Contractor / CSC or BR or its EU if in place	Count bins and extent of maintenance Record no of trains with Sewage tanks	Operating years 1, 2/ weekly/Take annual inventory	Data table record of counts, location and time	Contractor/CSCs and PIU
3.9 Station Operations	New stations will attract more passengers and as such more waste to manage. No sewage or waste management will quickly lead to highly polluted conditions in around the stations.	Waste management system will be inspected by BR weekly to ensure sanitary operations and each station will have janitorial staff. Problems identified will be immediately rectified by add services, upgraded waste management systems or both	At all stations	At all times with weekly inspection and dedicated janitorial services	BR or its EU if in place, and dedicated janitorial service at each station	Inspect that station waste facilities; capable of handling user wastes and the services are being employed to maintain the stations. Collect 4-5 photo records	Operating years 1, 2 / Semi-annually/DL phase	Inspection report and photo record for the new and remodelled stations	Dedicated janitorial service at each station of BR/ PIU

Project Period and Environmental Parameters	Project Impact	MITIGATION				MONITORING			
		Mitigation Measures	Location	Timing/ Duration	Who will Implement / Supervise	Details of Monitoring Action to be Undertaken	When / Frequency /Duration	Output Provided	Who will implement/ Supervise
3.10 Flora and Fauna	Impact on terrestrial and aquatic flora and fauna including birds, fish, dolphin, and etc.	Comparison study should be conducted at the 2nd year of operational stage. The purpose of this biodiversity study is to check and confirm any major changes due to construction and operation of the railway bridge. If any major impact observed, further mitigation measures should be taken without any delay.	Project site	At all times with weekly inspection and dedicated janitorial services	BR or its EU if in place, and dedicated janitorial service at each station	Confirm a comparative analysis has been conducted during 2nd year of operation to check impact on biodiversity such as dolphin, birds, fish due to construction of the railway bridge	During 2nd year of operation / Once/ DL phase	Biodiversity assessment report	Contractor/CSCs and PIU

9.4 Environmental Monitoring Budget

425. Parameters of various environmental components will be adversely affected due to implementation of the Project. Therefore, a budget has been estimated to handle the mitigation and monitoring measures to be implemented during the pre-construction and operational periods of the Project.

426. **Table 46** shows the estimated costs of implementing the EMP mitigation and monitoring measures, including the tree replanting programme (account for >35% of the total cost), estimated at USD 1,070,000. The cost of implementing the EMP monitoring measures during operation, including air quality and noise, has been estimated at USD 66,720.

427. The environmental training will also be to BR and the Contractor's workforce by the CSS, and will be held at various stages of the Project cycle. The major issues, to be focused on during the training, are the efficient implementation of environmental mitigation measures compliance monitoring and reporting. Each of the training aspects will be delivered over a two-day period. **Table 46** shows the cost for environmental mitigative and monitoring cost during all phases of the Project.

Table 46: EMP Implementation Cost during Construction and Operational Period

Description	Unit	Qty.	Unit Cost	Total Cost during Construction Period				Total Costs for Mit. & Moni.
				Year 1	Year 2	Year 3	Year 4	
1. Pre-Construction Period		lump sum cost prior to starts of construction						$8,000
Pre-Construction Period Total								**$8,000**
2. Construction Period - 4 years								
2.1 Environmental Mitigative Measures of Contractor								
Baseline Establishment		lump sum once time cost prior to starts of construction						$30,000
Preparation of Environmental Management Work Schedule	no.	8	$165	$330	$330	$330	$330	$1,320
Protection of Terrestrial Flora and Fauna	no.	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Noise attenuation measures	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Dust management	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Protection of wetlands/Ponds/Rivers	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Protection of borrow pits and dredging site impacts	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Air Quality monitoring	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Boat and vehicular traffic management	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920

Description	Unit	Qty.	Unit Cost	Total Cost during Construction Period				Total Costs for Mit. & Moni.
				Year 1	Year 2	Year 3	Year 4	
Disposal of construction debris and other waste materials	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Sewage management plan including installation of STP, WTP	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Servicing and operating equipment	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Occupational safety	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Implementation of dredged material disposal plan	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Provision of viaduct and cross drains	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
Construction camp and yard facilities	month	48	$165	$1,980	$1,980	$1,980	$1,980	$7,920
2.2 Environmental Monitoring Measures								
Air Quality monitoring	no.	128	$610	$19,520	$19,520	$19,520	$19,520	$78,080
Noise level measurement	no.	128	$300	$9,600	$9,600	$9,600	$9,600	$38,400
Vibration measurement	no.	128	$300	$9,600	$9,600	$9,600	$9,600	$38,400
Water quality monitoring (Surface)	no.	160	$550	$22,000	$22,000	$22,000	$22,000	$88,000
Water quality monitoring (Ground water)	no.	48	$550	$6,600	$6,600	$6,600	$6,600	$26,400
Dredged material quality testing	no.	128	$550	$17,600	$17,600	$17,600	$17,600	$70,400
2.3 Environmental Enhancement Measures								
Environment friendly facilities in railway stations	will include in Engineering costs							$0
Provision for LED lighting	will include in Engineering costs							$0
Provision for solar power	will include in Engineering costs							$0
Rainwater harvesting plant	will include in Engineering costs							$0
Green development plan - implementation of tree plantation programme	as of Appendix			$80,000	$80,000	$80,000	$80,000	$320,000
2.4 Institutional Strengthening and Capacity Building of PIU								
Capacity building of PIU	LS	4	$60,000	$15,000	$15,000	$15,000	$15,000	$60,000

Description	Unit	Qty.	Unit Cost	Total Cost during Construction Period				Total Costs for Mit. & Moni.
				Year 1	Year 2	Year 3	Year 4	
2.5 Reporting and Report Production								
Monthly Environmental Report	no.	48	$1,600	$19,200	$19,200	$19,200	$19,200	$76,800
Semi-annual Environmental Report (National)	no.	4	$3,500	$7,000	$7,000	$7,000	$7,000	$28,000
Semi Annual Report (International)	no.	2	$7,300	$7,300			$7,300	$14,600
2.6 Environmental Training								
Workforce training	no.	12	$2,000	$6,000	$6,000	$6,000	$6,000	$24,000
Construction Period Total				**$250,670**	**$250,670**	**$250,670**	**$250,670**	**$995,280**
3. Defects Notification (Operating) Period - 2 years						**Year 1**	**Year 2**	**Total**
Air quality monitoring	no.	32	$610			$9,760	$9,760	$19,520
Noise Level and Vibration Measurement Monitoring	no.	64	$600			$19,200	$19,200	$38,400
Surface water quality monitoring	no.	16	$550			$4,400	$4,400	$13,200
Defects Notification Liability (Operating) Period Total						**$33,360**	**$33,360**	**$66,720**
Summary of all mitigative and monitoring measures				**Total**				
1. Pre-Construction Period				$8,000				
2. Construction Period - 4 years				$995,280				
3. Operating Period - 2 years				$66,720				
Grand Total - EMP Implementation Cost				**$1,070,000**				

428. The EMP should be strictly implemented right from 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.

Reporting

1) Key Parties Involved in Monitoring and Evaluation

429. The monitoring and evaluation of environmental management measures envisaged are critical activities in implementation the Project work. 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 programme on schedule. The rational for the reporting system is based on accountability to ensure that the measures proposed as a part of EMP are implemented. Therefore, the major participants in the implementation process are:

430. **Bangladesh Railway and its PIU:** BR is overall responsible for the implementation of the environmental mitigation measures and execution of the Project and the sole responsibility would lie with BR's PIU and its CSC reporting on the implementation of the EMP.

431. **Construction Supervision Consultant (CSC):** will cooperate with the PIU and implementation the mitigation measures, and developing the required training material for BR. The various tasks to be performed during the Project cycle on site will be:

- Monitoring of the progress of the Project on the implementation of the environmental provisions as per planned schedule.
- Supervising and implementing the mitigation measures.
- Assisting the contractor at the site by providing appropriate advice on mitigation measures and conducting regular audits on compliance and effectiveness of mitigation measures; and
- Reporting on the mitigation and monitoring progress.

432. The environmental expert team of the CSC 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 DoE and the ADB.

The Contractor: The contractor will be responsible for undertaking much of the field surveys, in compliance with EMP specification.

Reporting Requirements

433. Two types of environmental reports will be submitted to BR and the ADB. They will contain air, noise, and water quality data, maps, diagrams, plans, tables, etc. These will be:

- Monthly Environmental sections in the monthly engineering progress reports from the contractor to BR; and
- Semi-Annual Environmental Monitoring Report prepared by CSC and the contractor.

1) Monthly Environmental Inspection Report

434. During the construction period, environmental reporting will be required monthly, which will be prepared by the contractor. The monthly reports will consist of a completed environmental compliance checklist developed using the EMP and approved by the CSC such that actions necessary for each relevant mitigative action are identified and a summary of all actions recorded.

2) Semi Annual Environmental Monitoring and Compliance Report

435. During the construction period, environmental inspection reports will be prepared monthly by the contractor as well as with periodic inspections by the CSC. The semi-annual report shall consist of a completed environmental compliance checklist developed using the EMP and approved by the CSC together with a summary of significant items from the current and previous five monthly reports with an indication of trends, either positive or negative. The EIA contains eight predefined mandatory sampling specifications that the contractor will be required to adhere to. At the training workshop, the contractor will receive survey worksheets that will need to be completed for each sampling station and submitted to the CSC.

436. The CSC, under the guidance of the PIU reserves the right to increase the frequency of sampling, should noncompliance by the contractor become a problem and which could result in additional work for the contractor. The payment of the additional sampling and its related works will be borne by the Contractor and will be based on a justification statement for additional sampling from the CSC.

10. Grievance Redress Mechanism (GRM)

10.1 BR's Institutional Grievance Redress Mechanism (GRM)

437. the Institutional Grievance Redress Mechanism (GRM) used by Bangladesh Railway, aligned with national practices and development partner guidelines. The GRM is designed to provide a transparent, accessible, and accountable process for addressing concerns, complaints, or grievances from stakeholders—especially those affected by railway projects. It ensures that issues are resolved promptly and fairly, without the need for legal action. Key Features of the GRM:

- **Multiple Access Points** Stakeholders can submit grievances through online platforms (like grs.gov.bd), in person, via email, or through project field offices.
- **Designated Grievance Redress Officers (GROs)** Each project or division has assigned officers responsible for receiving, documenting, and resolving complaints.
- **Time-Bound Resolution** Complaints are typically addressed within a defined timeframe (e.g., 15–30 days), with escalation procedures if unresolved.
- **Documentation and Tracking** All grievances are logged in a **Management Information System (MIS)** to ensure traceability and accountability.
- **Appeal Mechanism** If complainants are dissatisfied with the resolution, they can escalate the issue to higher authorities or appeal committees.
- **Gender and Inclusion Sensitivity** Special provisions exist to support women, indigenous communities, and vulnerable groups during the grievance process

438. The Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur electric traction upgrade, the GRM plays a vital role in: Addressing land acquisition or resettlement issues, Managing construction-related disruptions. Ensuring community safety and awareness. Building trust between Bangladesh Railway and local stakeholders.

10.2 Grievance Redress Mechanism (GRM)

439. The Project will establish a Grievance Redress Mechanism (GRM) to address complaints and grievances made to the Grievance Redress Committee (GRC) about any irregularities, the GRC will try to resolve the issues/conflicts amicably and quickly to ensure the Project implementation proceeds unhindered and in compliance with ADBs SPS 2009.

440. The GRM is intended to provide a clear step-by-step process, enabling a grievance to be examined and prompt resolution established. The overriding principles of the GRM are that it must be non-threatening, easily accessible, quick and impartial, delivering decisions to the complainant in an unbiased and non-political manner. The GRM has been developed through public consultation as well as the application of past best practice on BR Projects where donor-funds were used.

441. The GRM and Committee is very similar to the set up for the social sector, but simplified and separated since resolving social issues usually takes much longer than dealing with environmental complaints. Therefore, the following somewhat simplified process is defined in this chapter.

10.2.1 Formation and Operation of (GRM)

442. The Grievance Redress Committees (GRCs) will be organized within the Joydebpur, Tongi, Laksam, Feni, Pubail, Mandabag, Kamalapur, Fotullha, and Shitakunda administrative areas for the Project. Prior to the start of construction, BR representative will meet with Upazila Nirbahi Officers (UNOs) or Upazila Chairman along with the local Mayor/Chairman to request each to nominate Committee members, who could form part of GRC, and meet when the complaints are received. The GRC will be as follows:

- BR Deputy Director or Representative
  GRC Chair
- UpazilaParishad Chainman or Senior Representative
  GRC Committee Member
- Female member of concerned ward(s) of the UP

GRC Committee member

- Local NGO Representative
  GRC Committee member (Social)
- Department of Environment (DoE) representative from District
  GRC Committee member

443. In order to function effectively, the GRC will have five permanent members, with the DoE representative replacing the local NGO for purely environmental issues and a female representing the affected people. In order to convene a GRC meeting a quorum of three people will be required. Further, the GRC would only be convinced if direct communication between the contractor, the complainant and the engineer cannot solve the issue quickly. Once the complaint reaches the GRC, then the GRC has two weeks to render a decision, based on discussion with both parties involved. The GRC will be used as the third step when filling a complaint.

10.2.2 Scope

444. The scope of the Grievance Redress Mechanism (GRM) for the proposed Electric Traction Project on the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur sections of Bangladesh Railway. The GRM is designed to cover a wide range of issues that may arise throughout the planning, construction, and operational phases of the project. Its scope includes:

- Environmental and Social Concerns
  - Dust, noise, or pollution during construction
  - Disruption to local ecosystems or water bodies
  - Community health and safety risks
- Land Acquisition and Resettlement
  - Disputes over compensation or land ownership
  - Delays in resettlement or livelihood restoration
  - Inadequate consultation with affected persons
- Construction-Related Grievances
  - Damage to private property or public infrastructure
  - Traffic congestion or access restrictions
  - Labor-related complaints (e.g. wages, working conditions)
- Operational Phase Issues
  - Safety concerns near electrified tracks
  - Service disruptions or noise from electric trains
  - Maintenance-related disturbances
- Institutional and Procedural Complaints
  - Delays in grievance resolution
  - Lack of transparency or communication
  - Discrimination or exclusion in the grievance process

445. The GRM is structured to be:

- Accessible to all stakeholders, including vulnerable groups
- Responsive with time-bound resolution protocols
- Transparent with documentation and tracking via MIS
- Escalatory with multiple tiers of appeal if initial resolutions are unsatisfactory

446. This mechanism is aligned with national systems like the Government of Bangladesh's central GRM platform and international best practices. It plays a crucial role in building trust, ensuring accountability, and supporting the project's social license to operate.

10.2.3 Grievance Procedures

The Grievance Procedures Steps Flow Chart is shown in **Figure 45**.

447. **Step 1-** The complaints will be advised to first attempt to settle the complaints through direct communication with the person or by a phone, and call to the local BR office. If the discussion with the complaint/ community is successful, the contractor will be responsible for undertaking corrective measures as defined in the grievance decision and recording decision and filing that with BR, via the Engineer/contractor or the BR.

448. **Step 2-** Should the complaint not be addressed within a week; the next level is to notify the Upazila office and BR of the unresolved issue. The Upazila official will then communicate either to the contractor or BR and solution will be discussed with the complaint within one working week. If more time is required, the Upazila or BR should directly communicate directly with the complaint describing the reason of the delay.

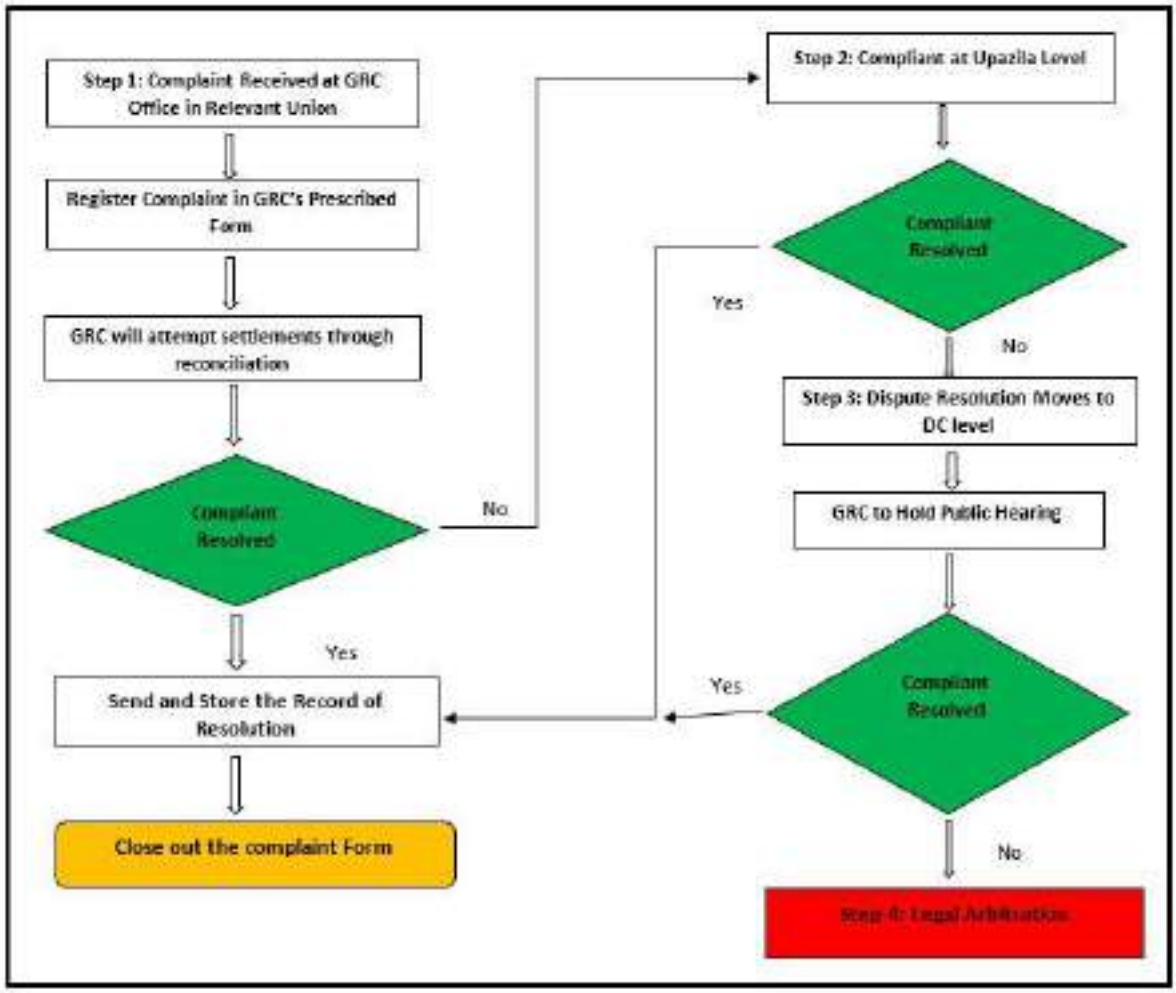


Figure 45: Grievance Solution Steps Flow Chart

449. **Step 3-** If step 2 fail to resolve the issue within two weeks of the receipt of the complaint the GRC should be formed and a formal hearing undertaken. At this point, a decision must be rendered within two weeks or the complaint concerned will be deemed correct and immediate and mitigate action will be required and fully executed within five days of the end of the two week period.

450. **Step 4-** If step 3 fails to resolve the issue, the complaint may proceed to legal arbitration.

451. The verdict of the judiciary will be final. In case communities and individuals who believe that they are adversely affected by the Project interventions may submit complaints to existing Project-level GRM.

452. The representative of BR will advertise information to all respective stakeholders. Prior to start of the construction, grievance redress steps should be circulated at every relevant UP office as well as train stations of intervention areas.

453. The BR or representative of BR will prepare the leaflet/poster in the local language describing the Project work and post it for stakeholders to read, before the start of the construction. The BR representative will check to ensure that the posters are well displayed and provide clear contact instructions so that PAPs can get access the support. This procedure and monitoring report will be reported to ADB in quarterly basis.

11. Emergency Response Plan

11.1 Introduction

454. The Emergency Response Plan (ERP) is a structured framework designed to prepare for, respond to, and recover from emergencies that may arise during the construction and operation of the electric traction system. It ensures the safety of workers, passengers, nearby communities, and infrastructure.

455. The key Objectives is:

- **Minimize injury, loss of life, and property damage** in the event of accidents or disasters
- **Ensure rapid and coordinated response** to electrical faults, fires, derailments, or natural hazards
- **Define clear roles and responsibilities** for emergency personnel and stakeholders
- **Maintain continuity of operations** and restore services swiftly after an incident

The high-voltage overhead catenary systems and substations, the ERP must address:

- Electrical hazards (e.g. electrocution, arc flash)
- Fire risks from equipment failure or short circuits
- Train collisions or derailments due to power loss
- Natural disasters (e.g. floods, cyclones) affecting power infrastructure

This plan is typically integrated into the broader Environmental and Social Management Plan (ESMP) and updated regularly based on stakeholder feedback and evolving risks.

11.2 Natural Hazards

456. Bangladesh is highly vulnerable to climate-related and geophysical hazards. For this railway corridor, the most pertinent risks include:

- Flooding
  - Seasonal monsoon floods can submerge tracks and substations
  - Flash floods in hilly areas near Chattogram pose sudden threats
- Cyclones and Storm Surges
  - Coastal areas, especially near Chattogram, are exposed to tropical cyclones
  - High winds and storm surges can damage overhead catenary systems and power infrastructure
- Lightning Strikes
  - Bangladesh has one of the highest lightning fatality rates globally
  - Overhead lines and substations are particularly vulnerable
- Earthquakes
  - While less frequent, the region lies in a seismically active zone
  - Structural integrity of elevated tracks and substations must be ensured
- Landslides
  - Particularly relevant in the Chattogram Hill Tracts during heavy rains
  - Can obstruct tracks and damage infrastructure
- Extreme Heat and Drought
  - Rising temperatures may affect equipment performance and increase fire risk
  - Heatwaves can also impact worker safety during construction and maintenance

457. Electric traction systems are more sensitive to environmental disruptions than diesel systems. Hazards like flooding or lightning can:

- Interrupt power supply
- Damage sensitive electrical components
- Delay operations and increase maintenance costs

Risk Mitigation Strategies is:

- Elevating substations and critical infrastructure above flood levels
- Installing lightning arrestors and surge protection systems
- Designing wind-resistant catenary structures
- Integrating early warning systems and climate-resilient materials

11.3 Natural Disaster Detection System

458. For the Electric Traction Project on the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur sections of Bangladesh Railway, a Natural Disaster Detection System (NDDS) would be a critical component of risk management and operational resilience. While specific systems for this corridor haven't been detailed publicly yet, here's what such a system would typically involve. To monitor, detect, and alert railway authorities about imminent natural hazards—such as floods, cyclones, landslides, or earthquakes—that could disrupt electric traction infrastructure or endanger lives.

459. Core Components of Natural Disaster Detection System (NDDS) are:

Real-Time Weather Monitoring

- Integration with Bangladesh Meteorological Department (BMD) and global weather APIs
- Early warnings for cyclones, lightning, and extreme heat

Flood Detection Sensors

- Water level sensors near vulnerable bridges, culverts, and substations
- Automated alerts when thresholds are exceeded

Seismic Sensors

- Ground motion detectors in seismically active zones
- Linked to automatic train control systems to halt operations if needed

Landslide Monitoring

- Slope stability sensors and rainfall thresholds in hilly areas like Chattogram
- Use of satellite imagery and drones for terrain surveillance

Lightning Protection & Detection

- Lightning arrestors on overhead catenary systems
- Real-time lightning strike tracking to pre-empt outages

Integration with Railway Operations

- **Automatic Alerts to Control Centres**
  - Triggered by sensor thresholds or external warnings
  - Enables rapid decision-making (e.g. halting trains, rerouting, power shutdown)
- **Emergency Response Activation**
  - Links to the Emergency Response Plan (ERP) for coordinated action
  - Mobilization of maintenance and rescue teams
- **Data Logging & Risk Mapping**

- Historical data used to refine hazard maps and improve infrastructure design

460. Natural Disaster Detection System (NDDS) would enhance safety and reliability of electric traction, reduce downtime and damage to infrastructure, support climate resilience and disaster preparedness goals.

11.4 Seven steps in emergency response

461. The structured outline of the seven key steps in emergency response, tailored for the Electric Traction Project on the Narayanganj–Dhaka–Chattogram and Tongi–Joydevpur sections of Bangladesh Railway. This framework ensures a coordinated, efficient, and adaptive response to emergencies-especially important in electrified railway systems where hazards can escalate quickly.

1. Preparedness

- Develop and regularly update the Emergency Response Plan (ERP)
- Train staff and contractors on emergency protocols
- Conduct drills and simulations for high-risk scenarios (e.g. electrical fires, derailments)

2. Early Warning and Detection

- Monitor real-time data from weather systems, seismic sensors, and flood detectors
- Integrate alerts from national agencies like the Bangladesh Meteorological Department
- Use automated alarms and communication systems to notify control centers

3. Activation of Emergency Protocols

- Trigger predefined response levels based on severity
- Notify emergency response teams, local authorities, and first responders
- Shut down power systems if electrical hazards are detected

4. Evacuation and Containment

- Safely evacuate passengers, workers, and nearby residents if needed
- Isolate affected areas (e.g. substations, overhead lines)
- Deploy fire suppression or containment equipment

5. Medical and Rescue Operations

- Provide first aid and coordinate with local hospitals
- Mobilize trained rescue teams for trapped or injured individuals
- Ensure safe access routes for ambulances and emergency vehicles

6. Damage Assessment and Recovery

- Inspect infrastructure for structural or electrical damage
- Document losses and initiate temporary repairs
- Restore services in phases, prioritizing critical routes

7. Post-Incident Review and Improvement

- Conduct debriefings with all involved teams
- Analyse response effectiveness and identify gaps
- Update ERP and training programs based on lessons learned

11.5 Emergency Response Planning

462. Emergency Response Planning is the process of anticipating, preparing for, and managing emergencies that may arise during the construction and operation of railway electrification infrastructure. It ensures that all stakeholders—from railway staff to local communities—know how to respond swiftly and safely to incidents. The core objectives of Emergency Response Planning are, protect human life and health during emergencies, minimize damage to railway

assets and surrounding environments, ensure continuity of operations and rapid recovery, Coordinate effectively with emergency services and local authorities

Table 47: Components of the ERP

Component	Description
Hazard Identification	Mapping risks like electrical faults, natural disasters, and human error
Emergency Roles & Teams	Assigning trained personnel for first response, evacuation, and communication
Communication Protocols	Establishing hotlines, alarms, and coordination with fire, police, and hospitals
Evacuation Plans	Defining safe routes and procedures for passengers, workers, and nearby residents
Training & Drills	Regular simulations to test readiness and improve response time
Post-Incident Recovery	Damage assessment, service restoration, and psychological support
Continuous Improvement	Updating the ERP based on lessons learned and stakeholder feedback

11.6 Training program

463. Bangladesh Railway has at least ten large projects, which require the implementation of multi-year mitigative and monitoring actions, as defined in the Environmental Impact Assessments completed for each component. Most of these Projects are funded by lending agencies such as Asian Development Bank, World Bank, Japan International Cooperation Agency, European Investment Bank, Korean Bank, and others, whose dedicated environmental guidelines must be followed in their investment projects. In all lending agency or GoB funded projects, BR is responsible for ensuring that pre-construction, construction the CSC will manage the EMP, with the contractor undertaking the survey. Operating period mitigative and monitoring tasks, defined the EIA's EMP, are completed on time, and in a technically sound manner. During pre-construction and construction, consultant will assist, but BR will be directly responsible during operation. Operating period mitigation and monitoring will require field surveys, analyses, and technical reporting by BR to DoE. Further, BR will receive environmental reports from the CSC, with inputs from the contractor. The CSC will evaluate and comment on the technical content, etc.

464. Generally, this Project will require four years of construction mitigation and monitoring (undertaken mainly by the contractor(s) activity and the implementation of around two years during the operating period (Defects Notification). The reporting requirements will also be considerable. Therefore, the unit must be trained and ready to take on varied tasks and be able to report to international lending agencies.

465. The environmental specialist of the PIU will have to deliver pre-construction and operating period monitoring, data analysis and reporting, and be able to present information to senior staff, etc. During the construction period, the specialist will operate in an oversight mode, supervising and interacting with the CSC, the contractors, and the funded agency. The person assigned to the position will have a background in environmental management and assessment and be required obtain necessary training, to improve EIA implementation and

compliance monitoring skills. The specialist will focus on building environmental awareness among the BR engineering staff running specific Projects, provide technical advice on environmental issues, prepare screenings of proposed undertakings, and warn BR managers if a proposed project has any red-flag issues.

1) Proposed Training Programme for PIU

466. Based on a knowledge of the environmental capacity of BR, and resulting from consultation with agency staff, two training experiences will be delivered (**Table 48**).

Table 48: Basic Training Courses (tentative)

Session No.	Name of the Training Exercise	Suitable for the BR Staff	Duration	National	International
1.	a. Environmental and Social Safeguards Operation Guidelines of ADB, WB, JICA, etc., and basic difference among them b. Environmental Management Plan (EMP) Preparation and Implementation, c. Presentation on relevant legislation, OHS, requirements Provision of ECC and NOCs	Jr, Mid & Senior	1 Day	National	International
2.	a. Land acquisition, Resettlement Policy & Practices b. Geographical Information System & Geo-technologies for rail management	Jr, Mid & Senior	½ Day	National	International

467. The training course duration, methodology, content will be based on standard international content and presented by national or international expert(s).

468. The Project will take four years for construction. The Nangalkot, Fajilpur, Baro-Takia, Sitakund, Kumira, Bhatiyari, and Pahartali stations will be newly constructed; and during this time compliance monitoring will be needed. Overall task will include the inspection and monitoring of work at 25 railway stations. Therefore, it is essential to involve local government and other Divisional/District agencies to support BR with the implementation of the EMP. However, based on the 4 consultation sessions completed, it is clear that the local government has limited capacity in and knowledge of environmental and social issues, yet considerable interest was expressed to get involved. BR will engage this interest and get local communities involved in compliance monitoring of the contractor. BR will instruct the CSC to devise a number of pilots programmes with local villagers and invite representatives from local government offices such as District Administrative Offices, Bangladesh Inland Water Transport Authority (BIWTA), Forest Department, Department of Environment, Department of Fisheries, Department of Public Health Engineering, to participate.

469. The cost of implementation of this Institutional building will be covered by the general budget of the Narayanganj–Dhaka–Chattogram and Tongi Joydevpur Section of Bangladesh Railway Project. BR will use funding from loan and ensure that these funds are applied toward the achievement of the Project's success. It is estimated that for in-Bangladesh training, the costs would be around USD 350-400 per person including fees, food and accommodation, not including the cost of having international specialists deliver the training. Since the CSC will be required to have international level expertise, they could deliver this training as part of the work and at no extra cost. The delivery of training courses outside Bangladesh, would cost five to six times more per person, not to mention logistics, visas, etc. Table 46 includes these costs. Narayanganj–Dhaka–Chattogram and Tongi Joydevpur Section of Bangladesh Railway Project.

11.7 Monitoring Terminal Maintenance, Signaling system, Fire system and Management

470. The comprehensive overview of how Monitoring, Terminal Maintenance, Signaling Systems, Fire Systems, and Management are typically structured for an electric traction railway corridor like Narayanganj–Dhaka–Chattogram and Tongi–Joydebpur:

471. **Monitoring & Terminal Maintenance**

- **Remote Diagnostics & Predictive Maintenance Systems (RDPMS)** These systems use **IoT sensors** and **AI/ML analytics** to monitor:
  - Voltage, current, vibration, and temperature of equipment
  - Remaining useful life of components
  - Real-time alerts for faults or anomalies
- **Terminal Maintenance Protocols**
  - Scheduled inspections of substations, catenary systems, and control panels
  - Use of **dataloggers** to track equipment status and generate maintenance reports
  - Integration with centralized dashboards for asset tracking and performance analytics

472. **Signaling System Monitoring**

- **Key Assets Monitored**
  - Signals, point machines, track circuits, level crossing gates, and interlockings
  - Power supply units and signaling cables
- **Technologies Used**
  - Edge gateways and cloud-based platforms for real-time data transmission
  - Predictive analytics to forecast failures and optimize maintenance schedules
  - GIS-based dashboards for spatial visualization of asset health
- **Benefits**
  - Reduced downtime and improved safety
  - Early detection of faults like signal blanking or cable degradation

473. **Fire Detection & Safety Systems**

- **Integrated Fire Alarm Systems**
  - Smoke and heat detectors in substations, control rooms, and relay huts
  - Automatic alerts to control centers and emergency services
- **Monitoring via Dataloggers**
  - Fire detection systems can be linked to dataloggers for real-time alerts and historical analysis
- **Emergency Response Integration**
  - Fire systems are tied into the Emergency Response Plan (ERP) for rapid containment and evacuation

474. **Management & Coordination**

- **Centralized Control Centers**
  - Oversee signaling, power, and safety systems
  - Use **Train Control and Management Systems (TCMS)** to coordinate subsystems like doors, brakes, and surveillance
- **Asset Management Systems**

- Maintain digital records of inspections, repairs, and performance
- Support decision-making for budgeting and lifecycle planning

- **Stakeholder Interfaces**
  - Maintenance teams, supervisors, and OEMs access data via dashboards
  - Alerts and reports are disseminated through mobile apps or SMS for rapid action

EMP Implementation Arrangements

475. The approved EIA and the certificate from DoE will activate the EIA implementation phase, i.e., the actions to mitigate and monitor the predicted impacts of Project construction and operation.

476. BR is committed to assign a dedicated environmental officer 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 EU is established BR will assign at least one safeguards specialist to deal with the Project safeguard matters.

477. Prior to construction, BR will be responsible for implementing at least seven mitigative and monitoring measures, according the timetable defined in the EMP, and submitting a final monitoring checklist for use during the construction period. 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, prepare their mandatory work plan, and deliver the required documentation.

478. The contractor will implement all 20 mitigative and monitoring actions (EMP), providing environmental safeguard compliance updates as a section of the overall DCCRPPF Project's monthly progress report. The contractor will also submit semi-annual summaries of surveys, findings, and compliance. During the pre-mobilization workshop, BR or its CSC will review these requirements, which are all defined in the EIA and its EMP. Construction bid documents have been prepared with specific environmental Bill of Quantities section to be used for the calculation of environmental penalties.

479. The contractor will prepare monthly and semi-annual progress reports on EMP implementation, in cooperation with the CSC appointed by BR. All reports will be submitted to BR via the CSC. The quarterly reports will include a compliance monitoring checklist, reporting on the progress of all 20 construction period actions. Incidents of significant contamination and pollution caused by the contractor's activities will be reported. Recommendation will be made for mitigation of environmental damage and for the prevention of any recurrences.

Implementation Time Table

480. During the construction period the work will be completed in around fifteen steps, with seven of them addressing environmental safeguards. They are:

PRE-CONSTRUCTION PERIOD

1) Preparation of Tender Documents
2) Completion of EIA and its EMP
3) Insertion of Environmental Clauses
4) Invitation to bid using approved documentation
5) Bid Evaluation, Clarifications and Contract Award
6) Relocation of involuntary resettlement
7) Environmental Safeguards briefing and training of contractors

CONSTRUCTION PERIOD

8) Construction mobilisation work commences
9) Contractor prepares Construction Environment Work Plan and undertakes monitoring

10) Work continues for four years until completed
11) Monthly environmental compliance reporting by contractor
12) Semi annual reporting

OPERATING PERIOD (Defects Notification Period)

13) Contract Supervision Consultant - working with EU prepares construction period semi-annual monitoring reports
14) Testing and Commissioning-end of Construction-Defect period
15) Final Environmental Safeguards Monitoring report

Tentative EMP Monitoring Schedule

A tentative EMP Implementation Schedule has been provided in **Figure 46**.

Tasks	Year 1				Year 2				Year 3				Year 4				Year 1				Year 2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Pre-Construction Period - General and Non-site-specific Measures																								
Engagement of a team to look after environmental, safety and risk management issue																								
Approval of Environmental Specialist																								
Discussion of Scope Of Works																								
Approval of Approach and Methodology																								
Approval of Construction Environmental Management Plan																								
Preparation and Approval of Env Equipment																								
Preparation and Approval of Env Forms																								
Preparation and Approval of Env Checklists																								
2. Construction Period																								
Mitigative Measures																								
Env Compliance Monitoring Measures																								
Tree Plantation Program																								
Environmental Training																								
Env Compliance Reporting																								
Monthly Inspection Report																								
Semi-annual Env Report																								
3. Operational Period (Defects Notification)																								
Mitigation Measures																								
Monitoring Measures																								
Env Compliance Reporting																								
Monthly Inspection Report																								
Semi-annual Env Report																								

Figure 46: Tentative Implementation Schedule

Reporting Mechanism for Environmental and Social Monitoring Programme

481. 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:

- The Project's PIU with its environmental expertise;
- The Contractor;
- The CSC (usually an international firm) also known as the Construction Supervision Consultant (CSC); and
- Bangladesh Department of Environment (DoE).

482. **BR's Project-Level PIU:** The PIU, will oversee the implementation of all safeguard items in the EMP and the construction contract. When the CSC is appointed, BR's technical management of the work will be delegated to the CSC, but final approval will always pass through BR. Semi-annual audit reports will be submitted to ADB, who may undertake periodic inspection trips to confirm that safeguards are fully implemented. The organizational framework for implementation of the EMP during construction stage and Operational Stage are provided in **Figure 47.**

483. **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 CSC in charge. Therefore, the CSC will work closely with the BR's Regional office.

484. **Construction Supervision Consultant (CSC)**: 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.

485. **Contractor(s):** The contractor will prepare monthly data summmarises and submit these to the CSC, and work with the CSC to prepare the semi-annual monitoring reports.

486. **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.

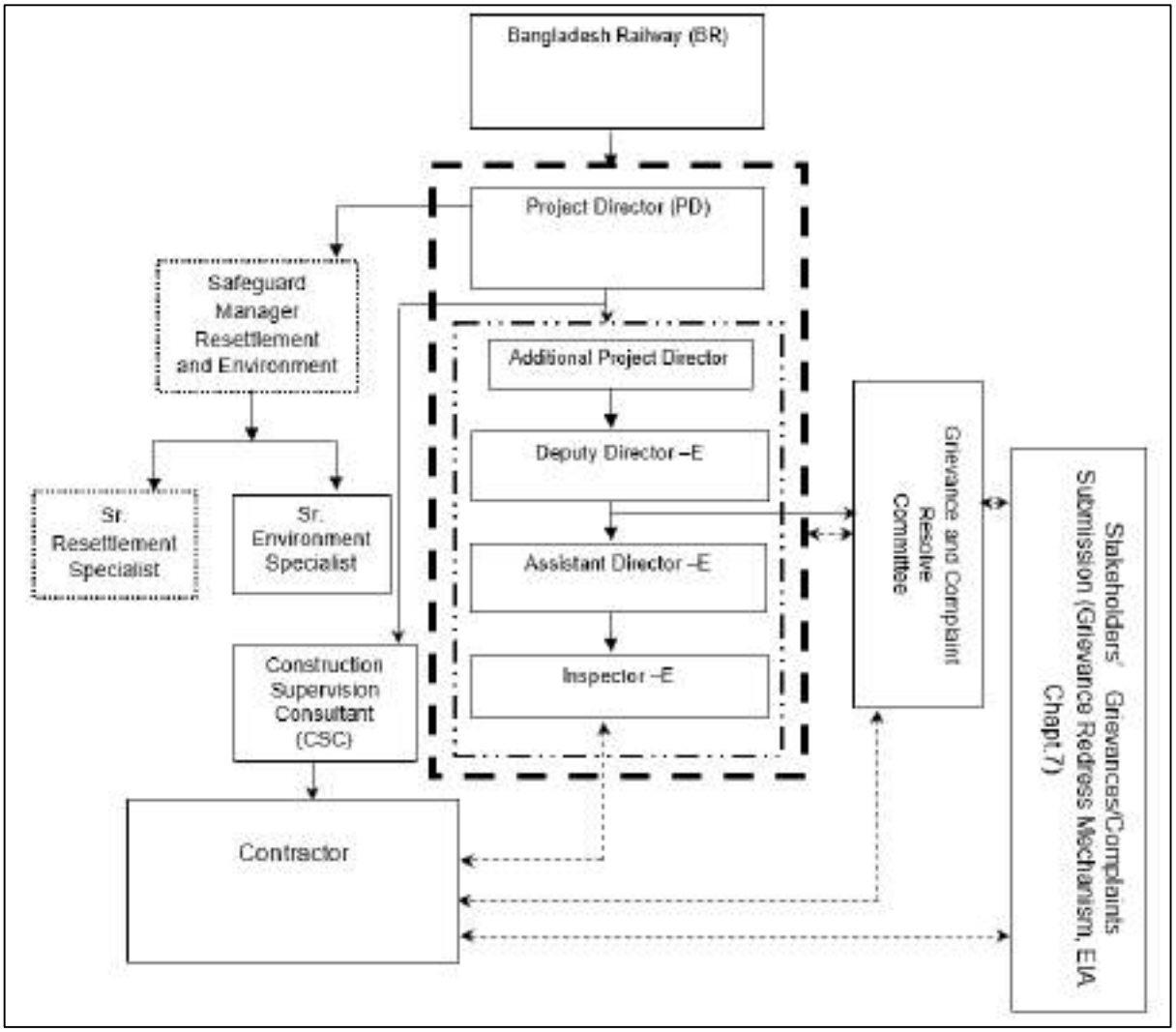


Figure 47: Safeguards Implementation, Grievance Management and Reporting Work Flow during the Project Construction and Defects Notification Stage

= Component Implementation Unit (CIU)

= Environment and Resettlement/Social Sector Expertise

= As specified in Resettlement Plan

= Reporting/Command/Communication

= Coordination

E = Environment

12. CONCLUSIONS AND RECOMMENDATIONS

487. The design of the rail embankments for the Laksam-Chinki Astana-Chattogram rail line upgrading work takes into consideration the overall strategy for conversion of the Dhaka-Chattogram rail corridor into dual gauge, allowing broad gauge traffic to use the system.

488. Potential negative impacts were identified in relation to design, construction, and operation period activities; then mitigation measures were specified to prevent or reduce all negative impacts to acceptable levels. These results were presented in the EMP (EIA Chapter IX). The EMP includes a description of when, where and by whom the mitigative action and the monitoring follow-up will be implemented.

489. Given that all work will be mostly confined to the railway's Right of Way, there is little chance that impacts will extend beyond the 100 m wide corridor of impact centre over the rail line. The likelihood and scale of construction impacts will be reduced through careful implementation of the pre-construction mitigative measures.

490. No red-flag environmental safeguard issues were identified.

491. The EIA listed 11 mitigative actions needing to be addressed during the pre-construction period, another 11 during the construction period and 11 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 completed quarterly during the construction period and semi-annually for the Defects Notification years of the operating period.

492. Construction period testing will be conducted by the contractor and will focus on biophysical and ecological surveys used to determine change. The CSC will inspect contractor work areas, their waste disposal sites, their rehabilitation/revegetation, proper landscaping, re-establishment of local access and debris clearance from reconstructed culverts.

493. Most of the pre-construction and operating period measures will be implemented by BR, while the construction period measures will be the contractor's responsibility, enforced by the Construction Supervision Consultant (CSC), and overseen by BR.

494. The surface water along the proposed alignment is dominated by the Feni, Muhuri and Dakatia Rivers. Surface water samples were collected on June and November, 2018 at five specific locations one station, 50 m upstream and one station 50 m downstream of the rail crossing areas, for a total of 20 samples. The existing surface water quality test results showed that, with the exception of dissolved oxygen (DO) the surface water quality is within DoE standards. Therefore, during the construction period, surface water quality needs to be protected against any polluted due to construction activities.

495. Air quality and noise level measurements were carried out on June and November 2018 at 8 locations for a total 32 sample covering day and night along the Project alignment. The data for CO, SO_2, O_3, VOC, $PM_{2.5}$, and PM_{10} showed that none of the test result exceeded the DoE acceptable limits.

496. The existing noise level within the study area varied from 51 dBA to 67 dBA during day time and 58 dBA to 73 dBA during night time which is above the standard of mixed zone land use (DoE, 1997), also slightly above the standard of the commercial zone land use, which is the legal designation for the railway corridor. Noise generated from the construction machinery, vehicle movements, sounds of construction/demolition of station buildings and associated facilities will have temporary impacts and for a limited period of time in any single location. Given the high background noise, machinery noise will raise the area noise levels by <3 dBA.

497. Twenty-one construction stage impacts were identified and addressed in the EIA. These include: loss of productive agricultural lands and loss of topsoil; impairment of surface water drainage, constriction of existing water bodies leading to flooding and dewatering, air, noise, and vibration impacts due to construction vehicles, equipment, and machinery operation, poor dust control during construction activities; inadequate management of spoil disposal, irresponsible construction rivers and on river banks, and weak application of occupational health and safety measures by the contractor.

498. The most serious impacts during the construction period was predicted to be the completion of a 2–7 m high and almost 20 m wide embankment enlargement, requiring millions of tons of fill material extending over more than 100 km of rail line. Most of that material will be dredged (with permits) from nearby rivers, and pumped as a slurry to the work sites. As much ballast as possible will be hauled by rail and where not possible necessary by truck. As well, most bridges and culverts will be totally replaced, except those recently constructed on the Laksam-Chinki Astana Down Line. Other potential problems, including the failure of the contractor to follow environmentally responsible operating procedures, or to provide proper housing or clean, hygienic quarters for the workers.

499. Once the rail line is in operation, access restrictions, air quality degradation in the local area and safety at level crossing will become permanent negative impacts. The noise modelling completed suggested that beyond 50 m, from the track the rail line noise will be a minor impact. The attenuation measures proposed by BR, including improved brake shoes, grinding of track to make it as smooth as possible, maintenance of, reducing 'flanging', wheel squeal and gradual retirement of old locomotives and replacing them with far less noisy newer models, would reduce noise levels even more.

500. The contractor will be required to conduct quarterly air, water and noise quality monitoring and submit reports to the CSC and BR. The contractor's environmental safeguard personnel will have to attend a mandatory training workshop on EMP implementation prior to/ during contractor mobilization.

501. The climate risk associated with sea level rise, and the related adjustment of bridge deck clearances, were calculated. Although climate change effects for this Project were estimated to be minor, 0.3-0.5 m freeboard will be added to bridge deck heights, and culvert diameters will be increased to accommodate the 100-year flood.

502. The establishment of the Project Environment Unit within the Project PIU is essential, and will both simplify the job of implementing environmental safeguards, and add credibility, since some experts will reside in BR, overseeing the entire EIA procedure, instead of relying on the expertise of the outside Consultant.

503. Social impacts especially associated with land acquisition and the need to relocate people and to use productive agricultural lands, will be significant and will affect thousands of people. The procedure for determining entitlement and compensation is defined in the Project RP, which BR will follow closely. BR shall implement the actions defined in these documents.

504. BR will fully implement the EIA's environmental management plan, and both monthly and semi-annual monitoring will be used to adjust the monitoring programme as needed. Should data problems be noted, BR will recommend immediate actions to modify mitigative actions. The appropriate level of environmental oversight will be provided by these activities, along with timely reporting, and will demonstrate to the ADB and DOE that the natural environment is protected, while the rail line is upgraded and the system becomes fully operational.

505. The potential impacts at large bridge construction sites were identified and, focusing on pile driving in water, use of drilling lubricants, work camp operation near the river bank and work over a navigation channel. To address these issues a separate EMP, designed to deal with all possible effects that might endanger the river's aquatic environment, has been prepared and will be implemented.

506. The construction/reconstruction of stations and other buildings will be managed through a programme of maximum recycling of materials and treatment of all wastes and dust suppression. Each station and associated buildings will be designed to accommodate sewage, waste, water, and lighting requirements. Universal design features have been included in all station designs.

507. BR concludes that that this EIA is complete and addresses all relevant likely impacts and plans to implement a full set of time-bounded mitigative and monitoring actions. The application of the detailed CEMWP prepared by the contractors, will ensure that the biophysical, ecological and socio-cultural environments are not unduly affected by the work or the operation of the upgraded line.

13. REFERENCES

[1] F. Pasquill. 1961, *Atmospheric Diffusion: The Dispersion of Windborne Material from Industrial and other Sources,* London: D. Van Norstand Company, Ltd

[2] MoEF. 2016, *Convention & treaties, [Online*], Available at http://www.moef.gov.bd/html/protocol/protocol_main.html

[3] Bangladesh Railway. 2018, *Bridges Inspection Report of Component 2*

[4] Bangladesh Railway. 2018, *Feasibility Study of Conversion of MG to DG of Tongi-Bhairab Bazar-Akhaura of Dhaka Chittagong Cox's Bazar Railway Project Preparatory Facility*

[5] Bangladesh Railway. 2018, *Feasibility Study for Conversion of Laksam-Chinki Astana-Chittagong MG Double Track into DG Double Track*

[6] M. A. Rashid. 1991, *Analysis of seasonal and annual rainfall trends in Bangladesh*

[7] B. M. D. (BMD). 2013-2017, *Database: Rainfall, Temperature and Relative Humidity, Wind Speed, and Wind Direction for Dhaka and Comilla Station*

[8] Wikipedia. 2015, *Geology of Bangladesh*

[9] Bangladesh Bureau of Statistics. 2013, *Bangladesh Population Census 2010*

[14] BBS. 2012, *Statistical Yearbook of Bangladesh*

[15] H. Brammer. 1996, *The Geography of the Soils of Bangladesh*

[16] S. Zahiruddin. 1993, *Bangladesh National Building Code*

[19] SMRTS. 2006, *SAARC Regional Multimodal Tranport Study*

[20] BBS. 2013, *Report of the Household Income & Expenditure survey 2010*

[21] SRDI. 1997, *Physiography of Bangladesh," Soil Resource Development Institute,* Ministry of Agriculture, GoB, Dhaka,

[22] ADB. 2010, *Methodology for Estimating Carbon Footprint of Road Projects-Case Study:India*

[23] BMD. 2013, *Meteorological Database 2013," Bangladesh Meteorological Department*

[24] J. Schroeder and D. Jugloff. 2012, *Interpretation of 24-hour sampling data: Development of 24-hour ambient air quality criteria and their use in Ontario*

[25] Environmental Conservation Rules. 1997, Department of Environment, Ministry of Environment and Forestry, GoB

[26] UNESCAP. 1999, *Development of the Trans-Asia Railway-in the Southern Corridor of Asia-Europe Route*

[27] DoE. 2022, Amended by notification SRO 220-Law/2005

[31] S. Cropper., 1993, *The Management of Endengered Plants,* CSIRO, East Malbourne

[32] F. Goldsmith and C. Harrison. 1976, *Description and Analysis of Vegetation*

[33] M. Khan, R. M.M. and A. M.M. *2001, Red Data Book of Vascular Plants of Bangladesh, p. 179,* Dhaka: National Harberium

[34] H. Ara, B. Khan and S. Uddin. 2013, *Red Data Book of Vascular Plants of Bangladesh*, vol. 2, p. 280, Dhaka: National Harberium

[35] Z. Ahmed, Z. Begum, M. Hasan, M. Khondker, S. Kabir, A. Ahmed, A. Rahman and E. Haque. 2008a, *Encyclopedia of Flora and Fauna of Bangladesh, Angiosperms: Dicotyledons (Acanthaceae-Asteraceae),* vol. 6, pp. 1-408, Dhaka, Asiatic Society of Bangladesh,

[36] Z. Ahmed, Z. Begum, M. Hasan, M. Khondker, S. Kabir, A. Ahmed, A. Rahman and E. Haque. 2008b, Encyclopedia of Flora and Fauna of Bangladesh, *Angiosperms: Monocotyledons (Orchidaceae-Zingiberaceae),* vol. 12, pp. 1-552, Dhaka, Asiatic Society of Bangladesh

[37] Z. Ahmed, Z. Begum, M. Hassan, M. Khondker, S. Kabir, M. Ahmed, A. Ahmed, A. Rahman and E. Haque. 2008*, Encyclopedia of Flora and Fauna of Bangladesh, Angiosperms: Dicotyedons (Acanthaceae-Asteraceae),* Vols. 6, 2008, p. 1-408. Dhaka: Asiatic Society of Bangladesh

[38] M. Alexiades. 1996, *Selected Guidelines for Ethno Botanical Research: A Field Manual*, , p. 305, The New York Botanical Garden, New York

[39] B. Hyland. 1972, A *Technique for Collecting Botanical Specimens in Rain Forest*, Flora Malesiana Bulletin, vol. 26, pp. 2038-2040

[40] K. I. M. Siddique, Z. Ahmed, Z. H. M. Begum, M. Khondker, M. Rahman, S. Kabir, M. Ahmad, A. Ahmed, A. Rahman and E. Haque. 2007*, Encyclopedia of Flora and Fauna of Bangladesh in Angiosperms: Mnocotyledons Agavaceae-Najadaceae,* Dhaka, Asiatic Society of Bangladesh, pp. 1-399.

[43] H. Brammer. 1996, *The Geography of the Soils of Bangladesh,* Dhaka, The University Press Limited

[44] A. Rahman, S. Huq and G. Conway. 2000, *Surface Water Systems of Bangladesh,* Dhaka:, The University Press Limited,

[45] A. Nishat, S. Huq, S. Barua, R. A.H.M.A. and A. Khan. 2002, *Bio-ecological Zones of Bangladesh*, Dhaka, The World Conservation Union (IUCN)

[46] M. Khan and A. Huq. 2001, *The vascular flora of Chunati Wildlife Sanctuary in South Chittagong, Bangladesh,* vol. 8, pp. 47-64

[47] MOEF. 2012, *Wildlife (Conservation and Security) Act*, Dhaka, Bangladesh Gazetteri

[48] IUCN Bangladesh. 2003, *Bangladesher Biponno Bonnoprani*, p. 294.

[49] IUCN. 2015, *Red List of Threatened Species*, Version: 2015-4

[50] Ara, H., Khan and Uddin, S. N. 2013, *Red data book of vascular plants of Bangladesh*, vol. 2, p. 280, Dhaka, Bangladesh National Herberium

[51] Wildlife Conservation and Security Act. 2012, Bangladesh Gazette

[52] BBS. 2012, *Statistical Yearbook of Bangladesh*

[53] M. A. Rahman and A. Muyeed. 2005, *Urban Air Pollution: A Bangladesh Perspective - Transactions on Ecology and the Environment*

[54], Bangladesh National Building Codes. 1993, 1st ed., Housing and Building Research Institute and Bangladesh Standards and Testing Institution, Dhaka

[57] M. S. Hossain and M. H.-u. Rashid. 2018, *"http://en.banglapedia.org/index.php?title=Surface_Water," 2018.* Available at http://en.banglapedia.org. [Accessed 21 08 2018].

[58] M. A. Rahman and A. –Muyeed. 2005, *Urban Air Pollution: A Bangladesh Perspective - Transactions on Ecology and the Environment*

List of Annexes

Annex 1: Surface Water Quality Test Results

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.119.519/520.08.00.049.2024.186 MCO Date:24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_11 Kamalapur" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	0.97	Ascorbic Acid Method
2	Iron	mg/L	0.68	Phenanthroline Method
3	Manganese	mg/L	0.23	PAN Method
4	Copper	mg/L	0.08	Bicinchoninate Method
5	Zinc	mg/L	0.06	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.009	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:57 PM	24-10-2024 01:16 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:13 PM
Md. Abdur Rahman	**Md. Rukul Amin**	**Hasna Hena Rahman**	**Tahmina Begum**	**Dr. Md. Alamgir Hossain**
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.5199520.00.00.049.2024.186 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_10 Pahartoli" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	1.84	Ascorbic Acid Method
2	Iron	mg/L	2.28	Phenanthroline Method
3	Manganese	mg/L	0.28	PAN Method
4	Copper	mg/L	0.19	Bicinchoninate Method
5	Zinc	mg/L	0.11	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.017	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:08 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Rabul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.51.9/520.08.08.049.2024.186 MCO Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_9 Joydebpur" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	1.75	Ascorbic Acid Method
2	Iron	mg/L	3.30	Phenanthroline Method
3	Manganese	mg/L	0.5(0)	PAN Method
4	Copper	mg/L	0.31	Diethyldithiocarbamate Method
5	Zinc	mg/L	0.06	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.008	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:18 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Rezia Hesa Rahman	Tanvirra Begam	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.189 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_6 Pubail" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	1.47	Ascorbic Acid Method
2	Iron	mg/L	1.39	Phenanthroline Method
3	Manganese	mg/L	0.38	PAN Method
4	Copper	mg/L	0.40	Bicinchoninate Method
5	Zinc	mg/L	0.10	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.012	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:18 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	**Md. Rahat Anin**	**Hasna Hena Rahman**	**Tahmina Begum**	**Dr. Md. Alamgir Hossain**
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.186 MCD Date 24-10-2024

Md. Normul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_7 Tongi" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	2.03	Ascorbic Acid Method
2	Iron	mg/L	0.97	Phenanthroline Method
3	Manganese	mg/L	0.53	PAN Method
4	Copper	mg/L	0.26	Bathocuproine Method
5	Zinc	mg/L	0.16	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.009	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:27 PM	24-10-2024 01:18 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Rahul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/529.00.00.049.2024.106 MCD Date:24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_8 Fatulla" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	2.03	Ascorbic Acid Method
2	Iron	mg/L	1.91	Phenanthroline Method
3	Manganese	mg/L	0.19	FAS Method
4	Copper	mg/L	0.45	Bicinchoninate Method
5	Zinc	mg/L	0.05	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.013	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:16 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Rahul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.118.519/520.00.00.049.2024.166 MCD Date:24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_5 Ashuganj" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	2.38	[illegible]
2	Iron	mg/L	1.82	[illegible]
3	Manganese	mg/L	0.67	[illegible]
4	Copper	mg/L	0.44	[illegible]
5	Zinc	mg/L	0.13	[illegible]
6	Chromium (Hexavalent)	mg/L	0.017	[illegible]

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:10 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.188 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_4 Mandabag" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	2.38	Ascorbic Acid Method
2	Iron	mg/L	1.96	Phenanthroline Method
3	Manganese	mg/L	0.52	PAN Method
4	Copper	mg/L	0.19	Bicinchoninate Method
5	Zinc	mg/L	0.07	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.011	Diphenylcarbazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:16 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:45.113.618520.00.00.049.2024.106 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_2 Chinki Astana" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	1.84	Ascorbic Acid Method
2	Iron	mg/L	1.36	Phenanthroline Method
3	Manganese	mg/L	0.220	PAN Method
4	Copper	mg/L	0.41	Bathocuproin Method
5	Zinc	mg/L	0.14	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.005	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:18 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Rahul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

Nil: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.5195520.00.00.049.2024.186 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_1 kumira" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	1.97	Ascorbic Acid Method
2	Iron	mg/L	2.24	Phenanthroline Method
3	Manganese	mg/L	0.146	PAN Method
4	Copper	mg/L	0.54	Bicinchoninate Method
5	Zinc	mg/L	0.09	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.013	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:16 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	**Md. Rahat Amin**	**Hasna Hena Rahman**	**Tahmina Begum**	**Dr. Md. Alamgir Hossain**
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.186 MCD Date 24-10-2024

Md. Nazmul Hasain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water Sample for "SS_3 Laksam" from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 24-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Obtained Result	Analysis Methods
1	Phosphate	mg/L	2.24	Ascorbic Acid Method
2	Iron	mg/L	2.41	Phenanthroline Method
3	Manganese	mg/L	0.70	PAN Method
4	Copper	mg/L	0.26	Bicinchoninate Method
5	Zinc	mg/L	0.18	Zincon Method
6	Chromium (Hexavalent)	mg/L	0.027	Diphenylcarbohydrazide Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:37 PM	24-10-2024 01:18 PM	24-10-2024 12:57 PM	24-10-2024 01:14 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Rahul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB. 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 294/CC, DPHE, CL, Dhaka

Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100013	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nill & Dated: 19-09-2024	Sample Source: Surface Water
Sent by: Md. Nazmul Hossain , , , Dhaka.	Dist:Gazipur, Upa:
Care Taker: Md. Nazmul Hossain (S : 01, SS_6 Pubail)	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	5.0	5.69	mg/L	Multimeter	-
2	EC	-	124	µS/cm	Multimeter	-
3	pH	6.5-8.5	7.1	-	pH Meter	-
4	Temperature	20-30	25.3	°C	Thermometer	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
Signature
02.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
02.10.2024

Countersigned/Approved by:

1.) Name: Mita Sarker
Designation: Senior Chemist
Signature
02/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
02/10/2024
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881027, Fax: 88-02-9882000, Email: wqmac_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka — Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100914	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nil & Dated: 19-09-2024	Sample Source: Surface Water
Sent by:Md. Nazmul Hossain ., , Dhaka.	Dist:Gazipur, Upa:
Care Taker: Md. Nazmul Hossain (S : 02. SS_7 Tongi)	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	5.90	mg/L	Multimeter	-
2	EC	-	390	µS/cm	Multimeter	-
3	pH	6.5-8.5	6.9	-	pH Meter	-
4	Temperature	20-30	26.1	°C	Thermometer	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	02.10.2024	1.) Name: Mita Sarker Designation: Senior Chemist	02/10/2024
2.) Name: Taslima Akhter Designation: Sample Analyzer	02.10.2024	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	02/10/2024 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: exprso_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka

Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100015	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/NII & Dated: 19-09-2024	Sample Source: Surface Water
Sent by:Md. Nazmul Hossain ,, , Dhaka	Dist:Narayanganj, Upa:
Care Taker: Md. Nazmul Hossain (S : 03, SS_8 Fatullah)	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	5.95	mg/L	Multimeter	-
2	EC	-	150	µS/cm	Multimeter	-
3	pH	6.5-8.5	7.1	-	pH Meter	-
4	Temperature	20-30	24.8	°C	Thermometer	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
Signature
02.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
02.10.2024

Countersigned/Approved by:

1.) Name: Mita Sarker
Designation: Senior Chemist
Signature
02/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
02/10/2024
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmic_central_lab@yahoo.com

Lab Memo: 339/ CC, DPHE, CL, Dhaka — Date: 16-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100140	Sample Receiving date: 01-10-2024
Ref. Memo No: NH/2024/Nill & Dated: 01-10-2024	Sample Source: Surface Water
Sent by:Nazmul Hasan ,Kamalapur , Dhaka.	Dist:Dhaka, Upa:
Care Taker: Nazmul Hasan (Sample : 03)	Union , Vill.:Kamalapur
Sample Collection date: 01-10-2024	Date of Testing: 01/10/2024-13/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	6.10	mg/L	Multimeter	-
2	EC	-	340	µS/cm	Multimeter	-
3	pH	6.5-8.5	7.1	-	pH Meter	-
4	Temperature	20-30	25.0	°C	Thermometer	-

Comments: Sample was collected & supplied by client.
N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by: — Signature

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
16.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
16.10.2024

Countersigned/Approved by: — Signature

1.) Name: Mita Sarker
Designation: Senior Chemist
16/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882093, Email: wqrasc_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka

Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100019	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nil & Dated: 19-09-2024	Sample Source: Surface Water
Sent by:Md. Nazmul Hossain ... Dhaka.	Dist:
Care Taker: Md. Nazmul Hossain Paharitoli	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	4.11	mg/L	Multimeter	-
2	EC	-	244	µS/cm	Multimeter	-
3	pH	6.5-8.5	6.1	-	pH Meter	-
4	Temperature	20-30	25.8	°C	Thermometer	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Alam 02.10.2024	1.) Name: Mita Sarker Designation: Senior Chemist	
2) Name: Taslima Akhter Designation: Sample Analyzer	02.10.2024	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	02/10/2024

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9883927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 339/CC, DPHE, CL, Dhaka

Date: 16-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100141	Sample Receiving date: 01-10-2024
Ref. Memo No: NH/2024/Mill & Dated: 01-10-2024	Sample Source: Surface Water
Sent by Nazmul Hasan ,Joydebpur , Gazipur.	Dist:Gazipur, Upa:
Care Taker: Nazmul Hasan (Sample : 04)	Union:, Vill: Joydebpur
Sample Collection date: 01-10-2024	Date of Testing: 01/10/2024-13/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	6.15	mg/L	Multimeter	-
2	EC	-	117	µS/cm	Multimeter	-
3	pH	6.5-8.5	6.9	-	pH Meter	-
4	Temperature	20-30	25.3	°C	Thermometer	-

Comments: Sample was collected & supplied by client.
N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
Signature
16.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
16.10.2024

Countersigned/Approved by:

1.) Name: Mita Sarker
Designation: Senior Chemist
Signature
16/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76187, Fax: , Email: wqmac_comillazonallab@yahoo.com

Lab Memo: 98/1,DPHE Zonal Lab,Comilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090154	Sample Receiving date:
Ref. Memo No: NRBD Railway & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railwey , Dhaka	Dist:Comilla, Upa:
Core Taken: SS_1 Kumira,Surface Water	Union:, Vill:
Sample Collection date:	Date of Testing: 23/09/2024-26/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	4.85	mg/L	Multimeter	-
2	EC	-	293	µS/cm	Multimeter	-
3	pH	6.5-8.5	6.99	-	pH Meter	-
4	Temperature	20-30	30.3	°C	Thermometer	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantitation, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by:
1.) Name: Sachchidananda Das
Designation: Sample Analyzer
Signature
SACHCHIDANANDA DAS
Zonal Laboratory, Cumilla.
2.) Name:
Designation:

Countersigned/Approved by:
1.) Name: Kanai Lal Das
Designation: Junior Chemist
Signature
KANAI LAL DAS 30/9/24
Junior Chemist
Zonal Laboratory, Cumilla.
2.) Name:
Designation:

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76107, Fax: , Email: wqmsc_comillazonallab@yahoo.com

Lab Memo: 98/2,DPHE Zonal Lab,Comilla Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CON2024090155	Sample Receiving date:
Ref. Memo No: NWBO Railway & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Com Taker: SS_2 Chinki Astana,Surface Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-26/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	3.95	mg/L	Multimeter	-
2	EC	-	223	µS/cm	Multimeter	-
3	pH	6.5-8.5	6.97	-	pH Meter	-
4	Temperature	20-30	30.3	°C	Thermometer	---

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantification, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Sachchidananda Das Designation: Sample Analyzer	SACHCHIDANANDA DAS Sample Analyzer Department of Public Health Engineering (DPHE) Zonal Laboratory, Comilla.	1.) Name: Kanai Lal Das Designation: Junior Chemist	KANAI LAL DAS Junior Chemist Department of Public Health Engineering (DPHE) Zonal Laboratory, Comilla 30/09/24
2.) Name: Designation:		2.) Name: Designation:	

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76187, Fax: , Email: wpssc.comillazonallab@yahoo.com

Lab Memo: 9873,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090156	Sample Receiving date:
Ref. Memo No: NMGD Railway & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Care Taker: SS_3 Laksam,Surface Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-26/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	6.86	mg/L	Multimeter	-
2	EC	-	124	µS/cm	Multimeter	-
3	pH	6.5-8.5	6.87	-	Multimeter	-
4	Temperature	20-30	30.4	°C	Thermometer	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantification, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by:

1.) Name: Sachchidanada Das
Designation: Sample Analyzer
Signature
SACHCHIDANANDA DAS
Senior Chemist
Department of Public Health Engineering (DPHE)
Zonal Laboratory, Cumilla.

2.) Name:
Designation:

Countersigned/Approved by:

1.) Name: Kanai Lal Das
Designation: Junior Chemist
Signature
KANAI LAL DAS
Junior Chemist
Department of Public Health Engineering (DPHE)
Zonal Laboratory, Cumilla.
30/09/24

2.) Name:
Designation:

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76167, Fax: , Email: wqmsc.comillazonallab@yahoo.com

Lab Memo: 9864 DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090157	Sample Receiving date:
Ref. Memo No: NIIBO Railway & Dated: 23/09/2024	Sample Source: Others
Sent by Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Case Taker: SS_4 Mandabag,Surface Water	Union:, Vill:
Sample Collection date:	Date of Testing: 23/09/2024-26/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	5.30	mg/L	Multimeter	-
2	EC	-	113	µS/cm	Multimeter	-
3	pH	6.5-8.5	7.25	-	Multimeter	-
4	Temperature	20-30	30.3	°C	Thermometer	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantification, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by:
1.) Name: Sachchidananda Das
Designation: Sample Analyzer
Signature
SACHCHIDANANDA DAS
Sample Analyzer
Zonal Laboratory, Cumilla
2.) Name:
Designation:

Countersigned/Approved by:
1.) Name: Kanai Lal Das
Designation: Junior Chemist
Signature
KANAI LAL DAS
Junior Chemist
Zonal Laboratory, Cumilla
30/09/24
2.) Name:
Designation:

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-78187, Fax: , Email: wpmsc.comillazonallab@yahoo.com

Lab Memo: 96/5,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090158	Sample Receiving date:
Ref. Memo No: NWBO Railway & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Care Taker: BS_5 Ashuganj Surface Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-26/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Dissolved Oxygen (DO)	6.0	2.46	mg/L	Multimeter	-
2	EC	-	246	µS/cm	Multimeter	-
3	pH	6.5-8.5	7.01	-	Multimeter	-
4	Temperature	20-30	30.4	°C	Thermometer	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantitation, BDS: Bangladesh Drinking Standard. AAS: Atomic Absorption Spectrophotometer.

Test Performed by:
1.) Name: Sachchidananda Das
Designation: Sample Analyzer
Signature
SACHCHIDANANDA DAS
Sample Analyzer
Department of Public Health Engineering (DPHE)
Zonal Laboratory, Comilla.
2.) Name:
Designation:

Countersigned/Approved by:
1.) Name: Kanai Lal Das
Designation: Junior Chemist
Signature
KANAI LAL DAS
Junior Chemist
Department of Public Health Engineering (DPHE)
Zonal Laboratory, Comilla.
30/09/24
2.) Name:
Designation:

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.001.2024.164 MCD Date 07-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water (06 Nos.) Samples from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil , Date:01-10-2024

Date of Sample Received: 01-10-2024
Date of Testing: 01-10-2024 - 06-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standard		Tongi, Dhaka.	Pubail	Fatullah Narayanganj	Mandabag	Pahartoli, Chittagong.	Chinki Astana, Chittagong	Analysis Methods
			Bangladesh ECR 2023	WHO-2011							
1	BOD_5	mg/L	--	--	13.9	15.4	11.13	17.6	20.7	17.9	5 day BOD test
2	Nitrate (as NO_3^-)	mg/L	45	50	5.21	3.80	4.37	4.15	4.88	5.30	Cadmium Reduction Method

NB: Results are applicable for the above mentioned sample.

07-10-2024 12:31 PM	07-10-2024 12:58 PM	07-10-2024 12:38 PM	07-10-2024 03:30 PM	07-10-2024 03:00 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority
Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No46.113.519/529.00.00.001.2024.184 MCD Date 07-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Surface Water (05 Nos.) Samples from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil , Date:01-10-2024

Date of Sample Received: 01-10-2024
Date of Testing: 01-10-2024 - 06-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standard		Kamalapur, Dhaka.	Joydebpur, Gazipur.	Ashuganj, B-Baria.	Laksam, Comilla.	Kumira, Chittagong.	Analysis Methods
			Bangladesh ECR 2023	WHO-2011						
1	BOD_5	mg/L	--	--	11.2	22.5	20.3	16.6	22.3	5-day BOD test
2	Nitrate (as NO_3^-)	mg/L	45	50	6.19	4.42	5.30	4.42	5.30	Cadmium Reduction Method

NB: Results are applicable for the above mentioned sample.

07-10-2024 12:21 PM	07-10-2024 12:58 PM	07-10-2024 12:38 PM	07-10-2024 03:30 PM	07-10-2024 03:30 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hosna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Annex 2:
Ground Water Quality Test Results

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.518/520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_11 Kamalapur" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.44	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.10	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

10/24/24, 5:13 PM CM REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519.520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_10 Pahartoli" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.51	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.06	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:13 PM CM REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_9 Joydebpur" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.02	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.038	PAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:16 PM

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_6 Pubail" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.43	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.18	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Rukul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:15 PM ON REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/820.00.00.049.2024.185 MCD Date:24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_7 Tongi" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.37	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.22	PAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:15 PM ON REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/S20.00.00.049.2024.185 MCD Date:24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_7 Tongi" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.37	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.22	PAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:21 PM ON REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_5 Ashuganj" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.22	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.36	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519.520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_4 Mandabag" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.54	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

10/24/24, 5:22 PM DM REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519.520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_3 Laksam" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.28	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.11	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:17 PM ON REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_1 Kumira" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.39	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.02	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	**Md. Ruhul Amin**	**Hasna Hena Rahman**	**Tahmina Begum**	**Dr. Md. Alamgir Hossain**
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

10/24/24, 5:13 PM DN REQUEST Water Data Letter

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.049.2024.185 MCD Date 24-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water Sample for "SS_2 Chinki Astana" from TUMAS TURKISH ENGINEERING CONSULTING CONTRACTING CO.
Ref: Nil, Date:22-10-2024

Date of Sample Received: 22-10-2024
Date of Testing: 22-10-2024 - 22-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Obtained Result	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Iron	mg/L	0.3-1.0	0.3	0.032	Phenanthroline Method
2	Manganese	mg/L	0.4	0.4	0.04	FAN Method

NB: Results are applicable for the above mentioned sample.

24-10-2024 12:40 PM	24-10-2024 01:20 PM	24-10-2024 12:57 PM	24-10-2024 01:15 PM	24-10-2024 05:12 PM
Md. Abdur Rahman	Md. Ruhul Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

about:blank 1/1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 338/ CC, DPHE, CL, Dhaka — Date: 16-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100138	Sample Receiving date: 01-10-2024
Ref. Memo No: NII/2024/NII & Dated: 01-10-2024	Sample Source: Ground Water
Sent by:Nazmul Hasan ,Kamalapur , Dhaka.	Dist:Dhaka, Upa:
Care Taker: Nazmul Hasan (Sample : 01)	Union:, Vill.:Kamalapur
Sample Collection date: 01-10-2024	Date of Testing: 01/10/2024-13/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chloride	150-600	25	mg/L	Titrimetic	-
3	pH	6.5-8.5	6.7	-	pH Meter	-

Comments: Sample was collected & supplied by client.
N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, LOQ - Limit of Quantitation

Test Performed by: Signature

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
16.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
16.10.2024

Countersigned/Approved by: Signature

1.) Name: Mita Sarker
Designation: Senior Chemist
16/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmic_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka — Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100017	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nill & Dated: 19-09-2024	Sample Source: Ground Water
Sent by:Md. Nazmul Hossain ,, , Dhaka.	Dist:Gazipur, Upa:
Care Taker: Md. Nazmul Hossain (S : 02, SS_7 Tongi)	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration prosant	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chloride	150-600	15	mg/L	Titrimetic	-
3	pH	6.5-8.5	6.6	-	pH Meter	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by: Signature

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
02.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
02.10.2024

Countersigned/Approved by: Signature

1.) Name: Mita Sarker
Designation: Senior Chemist
02/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
02/10/2024
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-8892003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka — Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100018	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nill & Dated: 19-09-2024	Sample Source: Ground Water
Sent by:Md. Nazmul Hossain ,, , Dhaka.	Dist:Narayanganj, Upa:
Care Taker: Md. Nazmul Hossain (S : 03, SS_8 Fatullah)	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chloride	150-600	20	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.0	-	pH Meter	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:

1.) Name: Md. Saiful Alam Khasru — Signature — 02.10.2024
Designation: Sample Analyzer

2.) Name: Taslima Akhter — Signature — 02.10.2024
Designation: Sample Analyzer

Countersigned/Approved by:

1.) Name: Mita Sarker — Signature — 02/10/2024
Designation: Senior Chemist

2.) Name: Md. Biplab Hossain — 02/10/2024
Designation: Chief Chemist

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmic_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka — Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100017	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nill & Dated: 19-09-2024	Sample Source: Ground Water
Sent by:Md. Nazmul Hossain ,, , Dhaka.	Dist:Gazipur, Upa:
Care Taker: Md. Nazmul Hossain (S : 02, SS_7 Tongi)	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chloride	150-600	15	mg/L	Titrimetic	-
3	pH	6.5-8.5	6.6	-	pH Meter	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by: Signature

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
02.10.2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
02.10.2024

Countersigned/Approved by: Signature

1.) Name: Mita Sarker
Designation: Senior Chemist
02/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
02/10/2024
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 294/ CC, DPHE, CL, Dhaka — Date: 02-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100019	Sample Receiving date: 19-09-2024
Ref. Memo No: MNH/2024/Nill & Dated: 19-09-2024	Sample Source: Ground Water
Sent by:Md. Nazmul Hossain ... , Dhaka.	Dist: Chittagong
Care Taker: Md. Nazmul Hossain Paharioli	Union:, Vill.:
Sample Collection date: 19-09-2024	Date of Testing: 19/09/2024-01/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chloride	150-600	80	mg/L	Titrimetic	-
3	pH	6.5-8.5	6.9	-	pH Meter	-

Comments: Sample was collected & supplied by client in non-prescribed bottle & received in non-acidified condition.
N.B: AAS - Atomic Absorption Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Alam 02.10.2024	1.) Name: Mita Sarker Designation: Senior Chemist	
2.) Name: Taslima Akhter Designation: Sample Analyzer	02.10.2024	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	02/10/2024 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 339/ CC, DPHE, CL, Dhaka

Date: 16-10-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2024100139	Sample Receiving date: 01-10-2024
Ref. Memo No: NH/2024/Nill & Dated: 01-10-2024	Sample Source: Ground Water
Sent by:Nazmul Hasan ,Joydebpur , Gazipur.	Dist:Gazipur, Upa:
Care Taker: Nazmul Hasan (Sample : 02)	Union:, Vill :Joydebpur
Sample Collection date: 01-10-2024	Date of Testing: 01/10/2024-13/10/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chloride	150-600	20	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.2	-	pH Meter	-

Comments: Sample was collected & supplied by client.
N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, LOQ - Limit of Quantitation.

Test Performed by: Signature

1.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
Alam 16-10-2024

2.) Name: Taslima Akhter
Designation: Sample Analyzer
16-10-2024

Countersigned/Approved by: Signature

1.) Name: Mita Sarker
Designation: Senior Chemist
16/10/2024

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76167, Fax: , Email: wqmsc_comillazonallab@yahoo.com

Lab Memo: 99/1,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090159	Sample Receiving date:
Ref. Memo No: NWBD Railway(2) & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Care Taker: SS_1 Kumira, Underground Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-30/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	Chloride	250	100	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.55	-	pH Meter	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantification, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by: Signature
1.) Name: Sachchidananda Das
Designation: Sample Analyzer
SACHCHIDANANDA DAS
Sample Analyst
Zonal Laboratory, Cumilla.
2.) Name:
Designation:

Countersigned/Approved by: Signature
1.) Name: Kanai Lal Das
Designation: Junior Chemist
KANAI LAL DAS 30/9/24
Junior Chemist
Zonal Laboratory, Cumilla
2.) Name:
Designation:

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76167, Fax: , Email: wqmsc_comillazonallab@yahoo.com

Lab Memo: 99/2,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090160	Sample Receiving date:
Ref. Memo No: NWBD Railway(2) & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Care Taker: SS_2 Chinki Astana, Underground Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-30/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	Chloride	250	70	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.52	-	Multimeter	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantitzation, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorbtion Spectrophotometer.

Test Performed by:	Countersigned/Approved by:
1.) Name: Sachchidananda Das Designation: Sample Analyzer Signature SACHCHIDANANDA DAS Sample Analyzer Department of Public Health Engineering (DPHE) Zonal Laboratory, Cumilla.	1.) Name: Kanai Lal Das Designation: Junior Chemist Signature KANAI LAL DAS 30/09/24 Junior Chemist Department of Public Health Engineering (DPHE) Zonal Laboratory, Cumilla
2.) Name: Designation:	2.) Name: Designation:

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76167, Fax: , Email: wqmsc_comillazonallab@yahoo.com

Lab Memo: 99/3,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090161	Sample Receiving date:
Ref. Memo No: NW/BD Railway(2) & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Care Taker: SS_3 Laksam, Underground Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-30/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.375	mg/L	AAS	0.001
2	Chloride	250	790	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.64	-	Multimeter	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantitization, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by:
1.) Name: Sachchidananda Das
Designation: Sample Analyzer
2.) Name:
Designation:
Signature
SACHCHIDANANDA DAS
Sample Analyzer
Junior Chemist
Zonal Laboratory, Comilla

Countersigned/Approved by:
1.) Name: Kanai Lal Das
Designation: Junior Chemist
2.) Name:
Designation:
Signature
KANAI LAL DAS
Junior Chemist
30/09/24
Zonal Laboratory, Comilla

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76597, Fax: , Email: wqmsc.comillazonallab@yahoo.com

Lab Memo: 99/Ll,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090162	Sample Receiving date:
Ref. Memo No: NWBD Railway(2) & Dated: 23/09/2024	Sample Source: Others
Sent by:Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist:Comilla, Upa:
Care Taker: SS_4 Mandabag, Underground Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-30/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.020	mg/L	AAS	0.001
2	Chloride	250	40	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.28	-	Multimeter	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantitization, BDS: Bangladesh Drinking Standard, AAS: Atomic Absorption Spectrophotometer.

Test Performed by:	Countersigned/Approved by:
1.) Name: Sachchidananda Das Designation: Sample Analyzer Signature SACHCHIDANANDA DAS Sample Analyzer Zonal Laboratory, Comilla.	1.) Name: Kanai Lal Das Designation: Junior Chemist Signature KANAI LAL DAS Junior Chemist Zonal Laboratory, Comilla. 30/09/24
2.) Name: Designation:	2.) Name: Designation:

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Senior Chemist
Department of Public Health Engineering
Comilla Zonal Lab, Ranir Bazar, Comilla
Phone: 081-76167, Fax: , Email: wqmsc.comillazonallab@yahoo.com

Lab Memo: 995,DPHE Zonal Lab,Cumilla — Date: 30/09/2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: COM2024090163	Sample Receiving date:
Ref. Memo No: NI/BD Railway(2) & Dated: 23/09/2024	Sample Source: Others
Sent by: Md. Nazmul Hossain ,Bangladesh Railway , Dhaka	Dist: Comilla, Upa:
Care Taker: SS_5 Ashugonj, Underground Water	Union:, Vill.:
Sample Collection date:	Date of Testing: 23/09/2024-30/09/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.006	mg/L	AAS	0.001
2	Chloride	250	90	mg/L	Titrimetic	-
3	pH	6.5-8.5	7.36	-	Multimeter	-

Comments: Sample was collected & supplied by the client. LOQ- Limit of Quantitization, BDS: Bangladesh Drinking Standard. AAS: Atomic Absorbtion Spectrophotometer.

Test Performed by:
1.) Name: Sachchidananda Das
Designation: Sample Analyzer
Signature
SACHCHIDANANDA DAS
Senior Chemist
Department of Public Health Engineering (DPHE)
Zonal Laboratory, Cumilla.
2.) Name:
Designation:

Countersigned/Approved by:
1.) Name: Kanai Lal Das
Designation: Junior Chemist
Signature
KANAI LAL DAS
Junior Chemist
Department of Public Health Engineering (DPHE)
Zonal Laboratory, Cumilla
30/09/24
2.) Name:
Designation:

Page 1 of 1

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No: 46.113.519/520.00.00.001.2024.166 MCD Date 07-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water (05 Nos.) Samples from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:01-10-2024

Date of Sample Received: 01-10-2024
Date of Testing: 01-10-2024 - 06-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Ashuganj, B-Baria.	Mandabag.	Laksam, Comilla.	Chinki Astana, Chittagong.	Kumira, Chittagong.	Analysis Methods
			Bangladesh ECR 2023	WHO-2011						
1	Total Chlorine	mg/L	--	--	0.03	0.02	0.06	0.02	0.20	DPD Method
2	Total Coliforms	CFU/100 mL	0	0	0	0	0	0	0	Membrane Filtration
3	Fecal Coliform	CFU/100 mL	0	0	0	0	0	0	0	Membrane Filtration

NB: Results are applicable for the above mentioned sample.

07-10-2024 12:34 PM	07-10-2024 12:56 PM	07-10-2024 12:37 PM	07-10-2024 03:28 PM	07-10-2024 03:00 PM
Md. Abdur Rahman	Md. Rafiul Anik	Hasan Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.519/520.00.00.001.2024.165 MCD Date 07-10-2024

Md. Nazmul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground Water (05 Nos.) Samples from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil, Date:01-10-2024

Date of Sample Received: 01-10-2024
Date of Testing: 01-10-2024 - 06-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standards		Kamalapur, Dhaka.	Joydebpur, Gazipur.	Tongi.	Pubail.	Fatullah, Narayanganj.	Analysis Methods
			Bangladesh ECR 2023	WHO-2011						
1	Total Chlorine	mg/L	--	--	0.02	0.10	0.15	0.07	0.06	DPD Method
2	Total Coliforms	CFU/100 mL	0	0	0	0	0	0	0	Membrane Filration
3	Fecal Coliform	CFU/100 mL	0	0	0	0	0	0	0	Membrane Filration

NB: Results are applicable for the above mentioned sample.

07-10-2024 12:34 PM	07-10-2024 12:58 PM	07-10-2024 12:36 PM	07.10.2024 03:20 PM	07-10-2024 03:03 PM
Md. Abdur Rahman	Md. Rubel Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Dhaka Water Supply and Sewerage Authority

Office of the Deputy Chief Microbiologist
Microbiology & chemical Division
(Dhaka WASA Central Laboratory)
Asad gate, Mohammadpur
Dhaka-1207, Tel-48122751
E-mail: dwasacentrallaboratory@gmail.com

Memo No:46.113.518520.00.00.001.2024.164 MCD Date 07-10-2024
Md. Naimul Hossain
TUMAS TURKISH ENGINEERING
CONSULTING & CONTRACTING CO.

Subject: Testing Report of Supplied Underground (01 Nos.) Samples from TUMAS TURKISH ENGINEERING CONSULTING & CONTRACTING CO.
Ref: Nil , Date:01-10-2024

Date of Sample Received: 01-10-2024
Date of Testing: 01-10-2024 - 05-10-2024

Water Quality Analysis Report

SN	Parameters	Units	Drinking Water Standard		Pahartoli, Chittagong.	Analysis Methods
			Bangladesh ECR 2023	WHO-2011		
1	Total Chlorine	mg/L	--	--	0.05	DPD Method
2	Total Coliforms	CFU/100 mL	0	0	0	Membrane Filtration
3	Focal Coliform	CFU/100 mL	0	0	0	Membrane Filtration

NB: Results are applicable for the above mentioned sample.

07-10-2024 12:31 PM	07-10-2024 12:59 PM	07-10-2024 12:38 PM	07-10-2024 02:30 PM	07-10-2024 03:00 PM
Md. Abdur Rahman	Md. Rubal Amin	Hasna Hena Rahman	Tahmina Begum	Dr. Md. Alamgir Hossain
Lab. Assistant	Assistant Chemist	Assistant Microbiologist	Chemist	Deputy Chief Microbiologist

NB: 1. Samples supplied to the laboratory by client.
2. This report is valid only for particular sample tested and can not be used for publicity.
3. Reports are not allowed to be used or reproduced for any commercial purpose.

Annex 2: Ambient Air Quality Monitoring Test Results

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT AIR QUALITY ANALYSIS REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Incl Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Air Quality Analysis Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

Sample Locations and GPS Coordinates	Concentration present of different parameter for ambient air quality. All units are considered in µg/m³								
	SPM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	NH_3	O_3	Pb
Test result of Ambient Air Quality, Aligang, Futullah, Narayangonj. GPS Coordinate: 23°39'19.3"N 90°28'07.9"E	110	67	32	29	19	457	36	15	0.03
Test result in Ambient Air Quality Electric Loco Shed (Kamlapur). GPS Coordinate: 23°43'28.2"N 90°25'39.4"E	121	75	36	33	22	532	45	13	0.04
Test result in Ambient Air Tongi_SS07. GPS Coordinate: 23°54'40.0"N 90°24'35.9"E	111	69	30	27	18	432	25	15	0.02
Test Duration (hours)	24	24	24	24	24	24	24	8	24
Method of Analysis	Gravimetric (EPA Standard)			NEDA-Visible at 540nm	TCM-Visible at 560 nm	Iodine penta-oxide Method	TCM-Visible at 560 nm	UV-method 352 nm	AAS after acid digestion
Air Pollution Control rules 2022 (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022)	NYS	150	65	80	80	5000	400	100	0.5
IFC/WBG, Environmental, Health, and Safety Guidelines for Ambient air quality (APRIL 30, 2007)	NYS	150 24(h)	75 24(h)	200 (1h)	125 24(h)	NYS	NYS	100 8(h)	NYS

Abbreviation: IFC/WBG= International Foundation Corporation/ World Bank Group, NYS=Not yet set.

Comments: High volume air sampler has been used for collecting ambient air from Electric Loco Shed (Kamlapur), Aligang (Fatullah) and Tongi_SS07 (Gazipur) locations. Total mass (micro-gram) of pollutants (SMP, PM_{10}, $PM_{2.5}$ NO_2, NH_3, O_3 SO_2, CO & Pb) is divided by volume (m^3) to get micro-gram per cubic meter (µg/m^3) concentration of above-mentioned air quality parameters. As per Ambient Air Quality Standard under air pollution (control) rules 2022, (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022), the values of ambient air quality parameters were within the standard limit of these three locations.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO.:05.007.20

AMBIENT AIR QUALITY ANALYSIS REPORT

Client Name	:	TÜMAŞ Turkish Engineering Consulting & Contracting Co.
Office Address	:	House No: 3, Navana Sambilan, Road No: 23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Incl Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Air Quality Analysis Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

Sample Locations and GPS Coordinates	Concentration present of different parameter for ambient air quality. All units are considered in µg/m³								
	SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	NH_3	O_3	Pb
Test result of Ambient Air Quality, Deshipara, Jaydebpur Gazipur GPS Coordinate: 24°00'57.9"N 90°24'23.5"E	75	51	27	21	13	321	21	18	0.02
Test result in Ambient Air Quality Ashugonj Silo Road, B,Baria; GPS Coordinate: 24°02'17.2"N 90°59'59.9"E	123	87	41	22	17	347	23	13	0.03
Test result in Ambient Air Mandabag, Brahmanbaria GPS Coordinate: 23°43'17.9"N 91°08'59.0"E	64	42	21	9	4	231	13	17	0.01
Test Duration (hours)	24	24	24	24	24	24	24	8	24
Method of Analysis	Gravimetric (EPA Standard)			NEDA-Visible at 540nm	TCM-Visible at 560 nm	Iodine penta-oxide Method	TCM-Visible at 560 nm	UV - method 352 nm	AAS after acid digestion
Air Pollution Control rules 2022 (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022)	NYS	150	65	80	80	5000	400	100	0.5
IFC/WBG, Environmental, Health, and Safety Guidelines for Ambient air quality (APRIL 30, 2007)	NYS	150 24(h)	75 24(h)	200 (1h)	125 24(h)	NYS	NYS	100 8(h)	NYS

Abbreviation: IFC/WBG= International Foundation Corporation/ World Bank Group, NYS=Not yet set.

Comments: High volume air sampler has been used for collecting ambient air from Deshipara,Jaydebpur (Gazipur), Ashugonj Silo Road (B,Baria),and Mandabag, Brahmanbaria locations. Total mass (micro-gram) of pollutants (SMP, PM_{10}, $PM_{2.5}$ NO_2, NH_3, O_3 SO_2, CO & Pb) is divided by volume (m^3) to get micro-gram per cubic meter (µg/m^3) concentration of above-mentioned air quality parameters. As per Ambient Air Quality Standard under air pollution (control) rules 2022, (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022), the values of ambient air quality parameters were within the standard limit of these three locations.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.gecibd.org House # 3/F, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01793322929, 01715592414 info@gecibd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.307.20

AMBIENT AIR QUALITY ANALYSIS REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Incl Overhead Catenary & Sub-Station) in Between Narayanganj-Dhaka-Chattogram Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample	:	Ambient Air Quality Analysis Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

Sample Locations and GPS Coordinates	Concentration present of different parameter for ambient air quality. All units are considered in $\mu g/m^3$								
	SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	NH_3	O_3	Pb
Test result in Ambient Air Quality Ajghora, Laksham, Cumilla GPS Coordinate: 23°12'32.1"N 91°08'59.2"E	74	45	20	10	7	210	16	11	0.01
Test result of Ambient Air Quality, Chinki Astana Railway Station (Baroyerhat) GPS Coordinate: 22°53'17.3"N 91°32'16.5"E	101	82	42	27	21	426	35	12	0.04
Test result in Ambient Air Quality Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram GPS Coordinate: 22°28'34.1"N 91°43'46.3"E	83	54	24	16	11	234	13	16	0.02
Test Duration (hours)	24	24	24	24	24	24	24	8	24
Method of Analysis	Gravimetric (EPA Standard)			NEDA-Visible at 540nm	TCM-Visible at 560 nm	Iodine penta-oxide Method	TCM-Visible at 560 nm	UV-method 352 nm	AAS after acid digestion
Air Pollution Control rules 2022 (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022)	NYS	150	65	80	80	5000	400	100	0.5
IFC/WBG, Environmental, Health, and Safety Guidelines for Ambient air quality (APRIL 30, 2007)	NYS	150 24(h)	75 24(h)-	200 (1h)	125 24(h)	NYS	NYS	100 8(h)	NYS

Abbreviation: IFC/WBG= International Foundation Corporation/ World Bank Group, NYS=Not yet set.

Comments: High volume air sampler has been used for collecting ambient air from Ajghora, Laksham (Cumilla), Chinki Astana Railway (Baroyerhat), Dakkin Sonaichori, (Kumira) locations. Total mass (micro-gram) of pollutants (SMP, PM_{10}, $PM_{2.5}$ NO_2, NH_3, O_3 SO_2, CO & Pb) is divided by volume (m^3) to get micro-gram per cubic meter ($\mu g/m^3$) concentration of above-mentioned air quality parameters. As per Ambient Air Quality Standard under air pollution (control) rules 2022, (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022), the values of ambient air quality parameters were within the standard limit of these three locations.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.gecbd.org House # 3/E, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01783322929, 01715592414 info@gecbd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT
CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT AIR QUALITY ANALYSIS REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Incl Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Air Quality Analysis Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

Sample Locations and GPS Coordinates	Concentration present of different parameter for ambient air quality. All units are considered in $\mu g/m^3$								
	SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	NH_3	O_3	Pb
Test result in Ambient Air Quality Pahartoli, Chattogram) GPS Coordinate: 22°20'33.8"N 91°48'43.0"E	93	74	35	21	14	424	19	13	0.03
Test result of Ambient Air Pubalil Rail Crossing GPS Coordinate: 23°56'00.8"N 90°29'53.0"E	60	54	27	16	10	239	14	15	0.02
Test Duration (hours)	24	24	24	24	24	24	24	8	24
Method of Analysis	Gravimetric (EPA Standard)			NEDA-Visible at 540nm	TCM-Visible at 560 nm	Iodine penta-oxide Method	TCM-Visible at 560 nm	UV-method 352 nm	AAS after acid digestion
Air Pollution Control rules 2022 (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022)	NYS	150	65	80	80	5000	400	100	0.5
IFC/WBG, Environmental, Health, and Safety Guidelines for Ambient air quality (APRIL 30, 2007)	NYS	150 24(h)	75 24(h)	200 (1h)	125 24(h)	NYS	NYS	100 8(h)	NYS

Abbreviation: IFC/WBG= International Foundation Corporation/ World Bank Group, NYS=Not yet set.

Comments: High volume air sampler has been used for collecting ambient air from Pahartoli, Chattogram and Pubalil Rail Crossing locations. Total mass (micro-gram) of pollutants (SMP, PM_{10}, $PM_{2.5}$ NO_2, NH_3, O_3 SO_2, CO & Pb) is divided by volume (m^3) to get micro-gram per cubic meter ($\mu g/m^3$) concentration of above-mentioned air quality parameters. As per Ambient Air Quality Standard under air pollution (control) rules 2022, (schedule 3 & 5, rule-1), Govt. of Bangladesh (SRO No 255-law/2022), the values of ambient air quality parameters were within the standard limit of these two locations.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	TÜMAŞ Turkish Engineering Consulting & Contracting Co.
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Aligang, Futullah, Narayangonj GPS Coordinate: 23°39'19.3"N 90°28'07.9"E	47.2±4.2	54.3	42.2
2.	Test result of Ambient Noise Level at Electric Loco Shed (Kamlapur); GPS Coordinate: 23°43'28.2"N 90°25'39.4"E	62.4±5.4	67.6	55.3
3.	Test result of Ambient Noise Level at Tongi_SS07 (Gazipur) GPS Coordinate: 23°54'40.0"N 90°24'35.9"E	47.2±3.7	44.4	41.1
Bangladesh Standard according to the Sound Pollution (Control) Rules- 2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: *Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.*

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels were within residential area at Aligang, Futullah, Narayangonj and Tongi_SS07 (Gazipur) and within commercial area at Electric Loco Shed (Kamlapur).

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name : TÜMAŞ Turkish Engineering Consulting & Contracting Co.
Office Address : House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name : Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample : Ambient Noise Level Report
Sampling date : 7-18 October 2024
Reporting date : 22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Ajghora, Laksham, Cumilla GPS Coordinate: 23°12'32.1"N 91°08'59.2"E	42.6±2.4	57.4	34.7
2.	Test result of Ambient Noise Level at Chinki Astana Railway Station (Baroyerhat) GPS Coordinate: 22°53'17.3"N 91°32'16.5"E	52.6±2.4	57.4	34.7
3.	Test result of Ambient Noise Level at Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram GPS Coordinate: 22°28'34.1"N 91°43'46.3"E	56.3±3.4	65.2	50.2
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels was within residential area at and at Ajghora, Laksham, Cumilla and within mixed area at Chinki Astana Railway Station (Baroyerhat) and Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.gecltd.org House # 3/E, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01793322929, 01715592414 info@gecltd.org; gecl.org@gmail.com

Annex 3: EMF LEVEL REPORT

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO.:05.007.20

EMF LEVEL REPORT

Client Name : **TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address : House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name : Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample : EMF Level Report
Sampling date : 7-18 October 2024
Reporting date : 22 October 2024

Description of analysis

Table: Result of EMF at different locations

SL	Sample Locations and GPS Coordinates	Magnetic flux density	
		EMF (mG)	EMF (μT)
1	EMF Level at Aligang, Futullah, Narayangonj. GPS Coordinate: 23°39'19.3"N 90°28'07.9"E	0.1	0.01
2	Test result of Ambient Noise Level at Electric Loco Shed (Kamlapur). GPS Coordinate: 23°43'28.2"N 90°25'39.4"E	0.2	0.02
3	EMF Level at Tongi_SS07 (Gazipur). GPS Coordinate: 23°54'40.0"N 90°24'35.9"E	0.3	0.03
4	EMF Level at Deshipara, Jaydebpur Gazipur. GPS Coordinate: 24°00'57.9"N 90°24'23.5"E	0.1	0.01
5	EMF Level at Ashugonj Silo Road, Brahmanbaria. GPS Coordinate: 24°02'17.2"N 90°59'59.9"E	0.16	0.016
6	EMF Level at Mandabag, Brahmanbaria. GPS Coordinate: 23°43'17.9"N 91°08'59.0"E	0.1	0.01
Non-Ionizing Radiation Protection (ICNIRP) 2009			
Typical maximum public exposure		2.0	0.2
Beneath large power lines		200	20
Time-weighted average (TWA)		2000000	200000
International Agency for Research on Cancer (IARC) 2002			
IARC 2002		40	4

Comments: HTC 522 EMF meter was used for measuring magnetic flux density at the above mentioned 6-locations. Magnetic flux density limit has set as per Non-Ionizing Radiation Protection (ICNIRP)-2009 and International Agency for Research on Cancer (IARC) 2002.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.geclbd.org House # 3/E, 6th Floor, South Kallyanpur Dhaka-1207 Tel:+88-02-8091314, 01715225159, 01793322929, 01715592414 info@geclbd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT
CONSULTANTS LTD.

Cert NO: 05.007.20

EMF LEVEL REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	EMF Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

Table: Result of EMF at different locations

SL	Sample Locations and GPS Coordinates	Magnetic flux density	
		EMF (mG)	EMF (μT)
1	EMF Level at Ajghora, Laksham, Cumilla. GPS Coordinate: 23°12'32.1"N 91°08'59.2"E	0.1	0.01
2	EMF Level at Chinki Astana Railway Station (Baroyerhat). GPS Coordinate: 22°53'17.3"N 91°32'16.5"E	0.3	0.03
3	EMF Level at Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram. GPS Coordinate: 22°28'34.1"N 91°43'46.3"E	1.2	0.12
4	EMF Level at Pahartoli, Chattogram. GPS Coordinate: 22°20'33.8"N 91°48'43.0"E	0.2	0.02
5	EMF Level at Pubalil Rail Crossing. GPS Coordinate: 23°56'00.8"N 90°29'53.0"E	0.1	0.01
Non-Ionizing Radiation Protection (ICNIRP) 2009			
Typical maximum public exposure		2.0	0.2
Beneath large power lines		200	20
Time-weighted average (TWA)		2000000	200000
International Agency for Research on Cancer (IARC) 2002			
IARC 2002		40	4

Comments: HTC 522 EMF meter was used for measuring magnetic flux density at the above mentioned 5-locations. Magnetic flux density limit has set as per Non-Ionizing Radiation Protection (ICNIRP)-2009 and International Agency for Research on Cancer (IARC) 2002.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

Annex 4: Noise Level Monitoring Test Results

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name : **TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address : House No: 3, Navana Sambilan, Road No: 23, Banani, Dhaka, Bangladesh.
Project Name : Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample : Ambient Noise Level Report
Sampling date : 7-18 October 2024
Reporting date : 22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)				
		Type of Zone	DoE standard	Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Aligang, Futullah, Narayangonj GPS Coordinate: 23°39'19.3"N 90°28'07.9"E	Salience Zone	50	47.2±4.2	54.3	42.2
2.	Test result of Ambient Noise Level at Tongi_SS07 (Gazipur) GPS Coordinate: 23°54'40.0"N 90°24'35.9"E	Salience Zone	50	47.2±3.7	44.4	41.1
3.	Test result of Ambient Noise Level at Electric Loco Shed (Kamlapur); GPS Coordinate: 23°43'28.2"N 90°25'39.4"E	Commercial Zone	70	62.4±5.4	67.6	55.3

Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)	
Industrial Zone	75
Commercial Zone	70
Mixed Zone	60
Residential Zone	55
Silence Zone	50
IFC Standard; General EHS Guidelines (Noise Management) - April 2007	
Industrial, Commercial	70
Residential, Institutional, Educational	55

Note:

1. Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs.
2. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.

Comments: The standard level of ambient noise has set up by Bangladesh as a Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006. The average ambient noise levels were within the standard limit of salience zone at Aligang, Futullah, Narayangonj and Tongi_SS07 (Gazipur) as per noise pollution control rules (2006). And the average ambient noise level was found at Electric Loco Shed (Kamlapur) which beyond the standard limit of mixed zone and within the limit of commercial zone.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.geclbd.org House # 3/E, (6th Floor), South Kallyanpur, Dhaka-1207 Tel :+88-02-8091314, 01715225159, 01793322929, 01715592414 info@geclbd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 06.007.20

AMBIENT NOISE LEVEL REPORT

Client Name : **TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address : House No: 3, Navana Sambilan, Road No: 23, Banani, Dhaka, Bangladesh.
Project Name : Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample : Ambient Noise Level Report
Sampling date : 7-18 October 2024
Reporting date : 22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)				
		Type of Zone	DoE standard	Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Deshipara, Jaydebpur, Gazipur. GPS Coordinate: 24°00'57.9"N 90°24'23.5"E	Salience Zone	50	48.4±3.2	54.3	44.2
2.	Test result of Ambient Noise Level at Ashugonj Silo Road, Brahmanbaria. GPS Coordinate: 24°02'17.2"N 90°59'59.9"E	Residential Zone	55	54.1±3.3	65.3	47.3
3.	Test result of Ambient Noise Level at Mandabag, Brahmanbaria. GPS Coordinate: 23°43'17.9"N 91°08'59.0"E	Salience Zone	50	43.3±2.1	50.4	41.4
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)						
Industrial Zone		75				
Commercial Zone		70				
Mixed Zone		60				
Residential Zone		55				
Silence Zone		50				
IFC Standard; General EHS Guidelines (Noise Management) - April 2007						
Industrial, Commercial		70				
Residential, Institutional, Educational		55				

Note:
1. *Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs.*
2. *IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.*

Comments: The standard level of ambient noise has set up by Bangladesh as a Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, the average ambient noise levels were found at Deshipara, Jaydebpur Gazipur and Mandabag, Brahmanbaria which were within the standard limit of silence zone. But the average ambient noise level was found at Ashugonj Silo Road, Brahmanbaria which was within residential zone and silence zone as per noise pollution control rules (2006).

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	TÜMAŞ Turkish Engineering Consulting & Contracting Co.
Office Address	:	House No: 3, Navana Sambilan, Road No: 23, Banani, Dhaka, Bangladesh.
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)				
		Type of Zone	DoE standard	Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Ajghora, Laksham, Cumilla. GPS Coordinate: 23°12'32.1"N 91°08'59.2"E	Salience Zone	50	42.6±2.4	57.4	34.7
2.	Test result of Ambient Noise Level at Chinki Astana Railway Station (Baroyerhat). GPS Coordinate: 22°53'17.3"N 91°32'16.5"E	Residential Zone	55	52.6±2.4	57.4	35.1
3.	Test result of Ambient Noise Level at Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram. GPS Coordinate: 22°28'34.1"N 91°43'46.3"E	Mixed Zone	60	56.3±3.4	65.2	50.2
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)						
Industrial Zone		75				
Commercial Zone		70				
Mixed Zone		60				
Residential Zone		55				
Silence Zone		50				
IFC Standard; General EHS Guidelines (Noise Management) - April 2007						
Industrial, Commercial		70				
Residential, Institutional, Educational		55				

Note:
1. Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs. Night Time 21.00 to 06.00 hrs.
2. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.

Comments: The standard level of ambient noise has set up by Bangladesh as a Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, the average ambient noise level was within standard limit of silence zone at Ajghora, Laksham, Cumilla. However, the average ambient noise level was found at Chinki Astana Railway Station (Baroyerhat) within the limit of residential and silence zone and the average ambient noise level was within the limit of residential and mixed zone at Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO. 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name : **TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address : House No: 3, Navana Sambilan, Road No: 23, Banani, Dhaka, Bangladesh.
Project Name : Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.

Description of Sample : Ambient Noise Level Report
Sampling date : 7-18 October 2024
Reporting date : 22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)				
		Type of Zone	DoE standard	Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Pahartoli, Chattogram. GPS Coordinate: 22°20'33.8"N 91°48'43.0"E	Mixed Zone	60	56.2±4.4	63.2	49.2
2.	Test result of Ambient Noise Level at Pubalil Rail Crossing. GPS Coordinate: 23°56'00.8"N 90°29'53.0"E	Silence Zone	50	45.2±1.7	48.2	40.1

Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)	
Industrial Zone	75
Commercial Zone	70
Mixed Zone	60
Residential Zone	55
Silence Zone	50
IFC Standard; General EHS Guidelines (Noise Management) - April 2007	
Industrial, Commercial	70
Residential, Institutional, Educational	55

Note:
1. *Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs.*
2. *IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.*

Comments: The standard level of ambient noise has set up by Bangladesh as a Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, the average ambient noise level was found within silence zone at Pubalil Railway Crossing. However, the average ambient noise level at Pahartoli, Chattogram was found which was within the standard limit of mixed and residential zone.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.gecltd.org House # 3/E, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8001314, 01715225159, 01703322929, 01715592414 info@gecltd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Aligang, Futullah, Narayangonj GPS Coordinate: 23°39'19.3"N 90°28'07.9"E	47.2±4.2	54.3	42.2
2.	Test result of Ambient Noise Level at Electric Loco Shed (Kamlapur); GPS Coordinate: 23°43'28.2"N 90°25'39.4"E	62.4±5.4	67.6	55.3
3.	Test result of Ambient Noise Level at Tongi_SS07 (Gazipur) GPS Coordinate: 23°54'40.0"N 90°24'35.9"E	47.2±3.7	44.4	41.1
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: *Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.*

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels were within residential area at Aligang, Futullah, Narayangonj and Tongi_SS07 (Gazipur) and within commercial area at Electric Loco Shed (Kamlapur).

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO.:05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	TÜMAŞ Turkish Engineering Consulting & Contracting Co.
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Deshipara, Jaydebpur Gazipur GPS Coordinate: 24°00'57.9"N 90°24'23.5"E	48.4±3.2	54.3	44.2
2.	Test result of Ambient Noise Level at Ashugonj Silo Road, B,Baria; GPS Coordinate: 24°02'17.2"N 90°59'59.9"E	54.1±3.3	65.3	47.3
3.	Test result of Ambient Noise Level at Mandabag, Brahmanbaria. GPS Coordinate: 23°43'17.9"N 91°08'59.0"E	43.3±2.1	50.4	41.4
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07.00 to 22.00 hrs,

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels were within residential area at Deshipara, Jaydebpur Gazipur and at Mandabag, Brahmanbaria and within mixed area at Ashugonj Silo Road area.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.gecibd.org House # 3/F, 8th Floor, South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01793322929, 01715592414 info@gecibd.org, gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.807.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Ajghora, Laksham, Cumilla GPS Coordinate: 23°12'32.1"N 91°08'59.2"E	42.6±2.4	57.4	34.7
2.	Test result of Ambient Noise Level at Chinki Astana Railway Station (Baroyerhat) GPS Coordinate: 22°53'17.3"N 91°32'16.5"E	52.6±2.4	57.4	34.7
3.	Test result of Ambient Noise Level at Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram GPS Coordinate: 22°28'34.1"N 91°43'46.3"E	56.3±3.4	65.2	50.2
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels was within residential area at and at Ajghora, Laksham, Cumilla and within mixed area at Chinki Astana Railway Station (Baroyerhat) and Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development

www.gecbd.org House # 3/F, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01793322929, 01715582414 info@gecbd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO.:05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Pahartoli, Chattogram) GPS Coordinate: 22°20'33.8"N 91°48'43.0"E	56.2±4.4	63.2	49.2
2.	Test result of Ambient Noise Level at Pubalil Rail crossing GPS Coordinate: 23°56'00.8"N 90°29'53.0"E	45.2±1.7	48.2	40.1
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs,

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels were within residential area at and at Pubalil Rail crossing and within mixed area at Pahartoli, Chattogram).

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development
www.gecltd.org House # 3/E, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01793222029, 01715582414 info@gecltd.org, gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Ajghora, Laksham, Cumilla GPS Coordinate: 23°12'32.1"N 91°08'59.2"E	42.6±2.4	57.4	34.7
2.	Test result of Ambient Noise Level at Chinki Astana Railway Station (Baroyerhat) GPS Coordinate: 22°53'17.3"N 91°32'16.5"E	52.6±2.4	57.4	34.7
3.	Test result of Ambient Noise Level at Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram GPS Coordinate: 22°28'34.1"N 91°43'46.3"E	56.3±3.4	65.2	50.2
Bangladesh Standard according to the Sound Pollution (Control) Rules- 2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels was within residential area at and at Ajghora, Laksham, Cumilla and within mixed area at Chinki Astana Railway Station (Baroyerhat) and Dakkin Sonaichori, Sitakhundu, (Kumira) Chattogram.

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

A House of Environmental Monitoring, Research, Pollution Control, Management & Development
www.gecibd.org House # 3/E, (6th Floor), South Kallyanpur, Dhaka-1207 Tel: +88-02-8091314, 01715225159, 01793322929, 01715592414 info@gecibd.org; gecl.org@gmail.com

GLOBAL ENVIRONMENT CONSULTANTS LTD.

Cert NO: 05.007.20

AMBIENT NOISE LEVEL REPORT

Client Name	:	**TÜMAŞ Turkish Engineering Consulting & Contracting Co.**
Office Address	:	House No:3, Navana Sambilan, Road No:23, Banani, Dhaka, Bangladesh
Project Name	:	Feasibility Study and Detailed Design for Introduction of Electric Traction (Including Overhead Catenary & Sub-Station) in Between Narayanganj–Dhaka–Chattogram and Tongi-Joydevpur Section of Bangladesh Railway.
Description of Sample	:	Ambient Noise Level Report
Sampling date	:	7-18 October 2024
Reporting date	:	22 October 2024

Description of analysis

SL. NO	Sample Locations and GPS Coordinates	Measured Noise Level (LAeq) dBA (Day time)		
		Average	Maximum	Minimum
1.	Test result of Ambient Noise Level at Pahartoli, Chattogram) GPS Coordinate: 22°20'33.8"N 91°48'43.0"E	56.2±4.4	63.2	49.2
2.	Test result of Ambient Noise Level at Pubalil Rail crossing GPS Coordinate: 23°56'00.8"N 90°29'53.0"E	45.2±1.7	48.2	40.1
Bangladesh Standard according to the Sound Pollution (Control) Rules-2006 (day time)				
Industrial Area		75		
Commercial Area		70		
Mixed Area		60		
Residential Area		55		
IFC Standard; General EHS Guidelines (Noise Management) - April 2007				
Industrial, Commercial		70		
Residential, Institutional, Educational		55		

Note: Bangladesh Noise Pollution Control Rules 2006; Day Time: 06.00 to 21.00 hrs, Night Time 21.00 to 06.00 hrs. IFC Noise Management, April 2007; Day Time 07:00 to 22.00 hrs.

Comments: The standard level of ambient noise has set up by Bangladesh as Noise Pollution (Control) Rules 2006 ("SRO no 212-law/2006"). According to the Noise Pollution (Control) Rules 2006, average noise levels were within residential area at and at Pubalil Rail crossing and within mixed area at Pahartoli, Chattogram).

Md. Golam Mostafa
Chief Executive Officer
Environmental Analysis & Development
Global Environment Consultants Ltd (GECL).

MOHD NUR E ALAM SIDDIQUE
Director (Analysis & Development)
Analytical & Environmental Laboratory (GECL)
B.Sc (Hons) M.Sc (SUST) M. Phil (DU),
PhD Research Fellow (NU).

Annex 5: Pictural Evidence for Environmental Data Monitoring

Sl	Station Name	Air Quality Monitoring	Noise Monitoring	EMF Monitoring

1.	SS_1 Kumira			
				
		Collection of Surface Water		Collection of Ground Water

		 		 
2.	SS_2 Chinki Astana	Air Quality Monitoring 	Noise Monitoring 	EMF Monitoring 
		Collection of Surface Water		Collection of Ground Water

				
3.	SS_3 Laksam	Air Quality Monitoring 	Noise Monitoring 	EMF Monitoring 

		Collection of Surface Water	Collection of Ground Water
			
4.	SS_4 Mandabag	Air Quality Monitoring	Noise Monitoring	EMF Monitoring
				

<table>
<tr><td></td><td></td><td>Collection of Surface Water</td><td>Collection of Ground Water</td></tr>
<tr><td></td><td></td><td>  </td><td>  </td></tr>
<tr><td>5.</td><td>SS_5
Ashuganj</td><td>Air Quality Monitoring</td><td>Noise Monitoring</td><td>EMF Monitoring</td></tr>
<tr><td></td><td></td><td> 
</td><td> 
</td><td> 
</td></tr>
</table>

		Collection of Surface Water	Collection of Ground Water
			
6.	SS_6 Pubail	Air Quality Monitoring	Noise Monitoring	EMF Monitoring
				

		Collection of Surface Water	Collection of Ground Water
			
7.	SS_7 Tongi	Air Quality Monitoring	Noise Monitoring	EMF Monitoring
				

<table>
<tr><td></td><td></td><td>Collection of Surface Water</td><td colspan="2">Collection of Ground Water</td></tr>
<tr><td></td><td></td><td>  </td><td colspan="2">  </td></tr>
<tr><td>8.</td><td>SS_8
Fatulla</td><td>Air Quality Monitoring</td><td>Noise Monitoring</td><td>EMF Monitoring</td></tr>
<tr><td></td><td></td><td>  </td><td>  </td><td>  </td></tr>
</table>

<table>
<tr><td></td><td></td><td colspan="2">Collection of Surface Water</td><td>Collection of Ground Water</td></tr>
<tr><td></td><td></td><td colspan="2">  </td><td>  </td></tr>
<tr><td rowspan="2">9.</td><td rowspan="2">EMU Workshop (Joydebpur)</td><td>Air Quality Monitoring</td><td>Noise Monitoring</td><td>EMF Monitoring</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
</table>

		Collection of Surface Water	Collection of Ground Water
			
10.	Electric Loco Workshop & Chattogram Electric Loco Shed (Pahartali)	Air Quality Monitoring	Noise Monitoring	EMF Monitoring
				

		Collection of Surface Water	Collection of Ground Water	
				
11.	Dhaka Electric Loco Shed (Kamalapur)	Air Quality Monitoring	Noise Monitoring	EMF Monitoring
				

		Collection of Surface Water	Collection of Ground Water
			

Annex 6: Tree Plantation and Replacement Programmes

The objective of the tree plantation and replacement programme is to compensate for the loss of trees due to the proposed implementation of Laskam-Chinki Astana to Chittagong railway line. Other major objectives of the programme are to protect the affected cultural/sensitive areas (within 50 m from the RoW boundary) and to enhance the health of the existing ecosystem.

The project alignment in total 137,222 tree will be cut among them 41,652 timber trees, 14,380 timber and fruit trees, 16,866 fruit trees, 15,449 firewood, 1,773 medicinal trees, 34,463 banana trees, 6,377 bamboo trees, 5,032 cane bush and 1,230 papaya of different sizes will be cut due to the implementation of the project at pre-construction and construction periods. The proposed tree plantation and replacement programme (TPRP) will plant at least three times the actual trees cut down. These trees are calculated on both sides of the proposed new alignment, proposed station building areas, and new station access road areas (associated facilities). Therefore, a total of (137,222×3) 411,666 new trees will be planted during the construction and post-construction stages of the project.

Tree Plantation Sites in the Project Areas

- ✓ Along the slopes of the constructed new railway line both side embankment. Almost existing all tree will be cut (around 137,222 trees) for dual gaze construction, so new seedling will be planted whole chainage from Laskam-Chinki astana to Chittagong.
- ✓ Existing station premises and constructed new stations premises viz. Laksam Jn., Naoti, Langalkot, Hasanpur, Shisor, Dakatia, Gonoboti, Sairshadi, Feni, Kalidah, Fazilpur, Notun Muhuriganj, Chinki Astana, Mastan Nagar, Mirersaai, Bar-Takia, Baroiardala, Sitakundo, Barkundo, Kumira, Batiara, Fouzderhat, Pahartoli, and Bottoli Railway Station.
- ✓ Along the affected cultural/sensitive areas (within 50 m from the RoW boundary)
- ✓ Embankments in cut sections and new constructed culvert premises.
- ✓ Seedling will be distributed among the community people where railway land insufficient.
- ✓ Special emphasis on beatification programme along embankment near Feni, Mohori, Dakatia and Selonia River alignment area.

1) Selection of Tree Species

The species for the proposed tree replacement has been selected based on the statistics of the lost vegetation and suitability for the intended purpose. This was done in consultation with senior ecologist and local communities. The main consideration for selection of species for the railway project is to protect the railway embankment from erosion and habitat for biotic species, minimize visual impacts, improved aesthetics and ecological conservation as well as commercial benefits. Accordingly, the list of tree species proposed to be planted is as follows:

Table 1: List of Proposed Tree Species

Timber		
Sl.	Local name	Scientific name
1.	Gamar	Gmelia arborea
2.	Mehegoni	Swietenia mahagoni
3.	Chikrasi	Chickrasia tabularis
4.	Telsur	Hopea odorata
5.	Garjan	Dipterrocarpus terbinatus
6.	Kat badam	Terminalia calappa
7.	Shegun	Tectona grandis
8.	Epil–epil	Leucaena leucocephala
9.	Rain tree	Samania saman
Medicinal		
1.	Horitoki	Terminallia cebula
2.	Arjun	Terminalia arjuna
3.	Ashok	Saraca indica
4.	Chalmugra	Hydnocarpus kurzii
5.	Neem	Azadirachta indica
6.	Ulatkambal	Abroma augusta
7.	Shimul	Bombax ceiba
8.	Amloki	Phyllanthus emblica
9.	Bohera	Terminalia bellirica
Palm		
1.	Narikel	Cocos nucifera
2.	Supari	Areca catechu
3.	Tal	Borassus flabellifer
4.	Khajur	Phoenix sylvestris

Ornamental		
Sl.	Local name	Scientific name
1.	Jau	Casuarina littoralis
2.	Sonalu	Cassia fistula
3.	Jarul	Lagerstoemia speciosa
4.	Kisnochura	Delonix regia
5.	Radhachura	Peltophorum pterocarpum
6.	Polash	Butea monosperma
7.	Kodom	Anthocephalus kadamba
8.	Bokul	Mimusops elengi
9.	kanchon	Bauhinia purpurea
10.	Mahua	Madhuca indica
11.	Sarnachapa	Michelia champaca
12.	Naghesor	Mesua nagassarium
Fruit		
1	Kalojam	Syzyzum cumini
2	Bilimbi	Averrhoa bilimbi
3	Jalpai	Elaeocarpus robustus
4	Latkon	Baccaura ramiflora
5	Tetul	Tamirindus indica
6	Dewoa	Artocarpus lacucha

2) Guidelines of Tree Replacement

According to the prevailing practice in Bangladesh, the Forest Department generally recommends to plant minimum two trees for each tree felled for any development project. However, in consultation with BR, the Consultant recommends to plant three saplings for each tree felled. Total available space for the tree replacement on the side slopes of railway embankment and stations and cultural/sensitive areas is approximately 365.90 km, (365.90km x 2) times the construction width of say 40 m minus to embankment.

3) Implementation Agreement

The Forest Department (FD) is generally responsible for plantation of all government owned sites. It is a common practice in Bangladesh that the Forest Department performs the task by themselves. However, the FD will be encouraged to involve BR, the PAPs, especially vulnerable poor and women, in the plant replacement programme. The Forest Department will provide all technical and other supports in planning and developing the plantations. However, the implementation arrangement for the project is unique than any other tree replacement programme in country that was agreed in consultation with BR and Consultant. It was decided that BR will be responsible for the successful implementation of tree plantation and replacement programme without involving PAPs and FD.

The tasks of the BR are as follows:

- ✓ training of the local BR staff on tree maintenance
- ✓ preparation of the tree replacement programme 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
- ✓ supervision of nurseries for raising saplings

4) Responsibility

It was decided that the Contractor will be responsible for planting trees throughout the alignment and other areas as prescribed above. The Contractor will need to procure and raise saplings until they survive. They can set up nurseries in consultation with BR and the Engineer at the early stage of the project. Alternatively, the Contractor can purchase saplings from the local nursery. The Environmental Officer of BR 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 a dialogue with the FD 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.

5) Budget

The budget for the proposed tree replacement programme is provided in Table 2. The budget also includes maintenance for first one years from the date of plantation to ensure that all planted saplings will survive and provision for an additional plantation is available. The plantation on the slopes of railway embankment, in the stations and along the affected cultural/sensitive areas will be taken up after completion of construction work. 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 fertilizers etc. The budget also includes measure required for maintenance of plantation, such as watering, weeding, fertilizer application, replacing of dead saplings (if any), etc. for the first one years after planting. The proposed values of trees of the project are presented in **Table 2**. The estimated amounts for afforestation are Tk 2,45,25,000 (approx. USD 306,562).

Table 2: Estimated budget for afforestation and tentative distance.

Tree Types	Kilometres	Name of the Species & Space (Seedling to seedling)	Total Number of Plants	Rate	Total Cost
Palm	20 km (3 row)	2m×2m= 500 seedling/km	30,000	150	4,500,000
Medicinal	30 km (3 row)	2m×2m= 500 seedling/km	45,000	150	6,750,000
Fruit tree	30 km (2 row)	2m×2m= 500 seedling/km	30,000	150	4,500,000
Timber	30km (2 row)	2m×2m= 500 seedling/km	30,000	150	4,500,000
Ornamental	19 km (3 raw)	2m×2m= 500 seedling/km	28,500	150	4,275,000
Total	**129 km×2 side = 258**		**163,500×2=327,000**		**24,525,000**

Annex 7: Compliance Monitoring Checklist

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
1. PRE-CONSTRUCTION PHASE						
1.1 Trees and Landscape	Trees and saplings within an approximately 50 m RoW of the alignment, workers camp setting, and station areas will be cut down during pre-construction period resulting in potential ecological and economic loss.	Notice of removal of trees will be provided. BR or local NGOs will ensure compensation and planting of at least three trees for every one cut. A basic tree replacement plan has been prepared and is included as Annex. As each section of the construction work is completed, trees and understory vegetation must be planted, in order to help stabilise the cleared areas and attract some wildlife such as birds.	To Confirm that a tree cutting and replanting programme is fully ready to implement during the pre-construction period. To Confirm that this planting plan is in agreement with local people who lost food-trees.			
1.2 Land Acquisition	Design encroaches on private land. Based on preliminary topographical and social survey data of Project, the Project involves land acquisition of along the proposed alignment and station areas. As per the findings of the LARP survey, thousands of structures will be lost out of which are residential, commercial, and residential cum commercial and CPRs and rest are other types will need to be relocated.	The detailed guidelines for land acquisition and compensation are found in the LAP and RP, which must be applied. BR is making very significant efforts to minimise resettlement but some is unavoidable due to the illegal occupation of BR owned land. BR has revised the alignment at least 2X to reduce land requirements	To be monitored by implementation NGO hired by BR			
1.3 Employment and Livelihood	By the acquisition of lands, people will lose their income and employment	Direct and indirect loss of income will be compensated as prescribed in the LAP and RP and must be implemented prior to construction taking place.	Livelihood restoration plan need to be implemented through INGO according to the RAP.			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
1.4 Heritage and Culture	CPRs were identified by the social assessment team, and all are located in the new RoW and will have to make way for the rail line	The CPRs to be relocated in stages, after consultation with local communities, Local communities will be compensated for dismantling and relocating these sites.	Inspect relocation and protection activates during this period and obtain written agreement from local communities			
1.5 Infrastructure - Utility Relocation	Some utility lines such as electric transmission lines, gas pipelines, and water supply pipelines are shifted or accessed without proper approval or knowledge, leading to damage.	Utilities will only be removed and relocates with proper agency approvals and permits.	Confirm that permits. Location and relocation site plans have been approved			
1.6 Safety and level crossings	Inadequate planning and design consideration could add to the risk of accidents at new level crossings and even cause train operating problems	The level crossing issue will be carefully examined by BR and designs incorporate safety features to protect the public but also recognise the need to move traffic and include a rapid crossing clearing system	Need to confirm by inspection that traffic is rapidly clearing after train crosses the level crossing. Gateman should be at level crossing to aware the pedestrian.			
1.7 Transportation of Construction materials	With millions of m^3 of construction materials to be moved there is the potential for serious local negative air quality, noise and traffic problems	A materials transport plan will be prepared in consultation with the contractor, prior to the start of construction	Monitor to Implement the material transport plan daily.			
1.8 Station Design	Inadequate sizing of station sewage and garbage management facilities, leading to chronic problems during the operation of the new and upgraded stations.	The design of all waste, water and access for each station is will be designed, using the estimated passenger through-put at each station.	Compare the estimate of station passenger/user throughput for 2030 and check that sewage. Garbage and water system can cope with the discharges			
1.9 Labour Standards	Poorly prepared labour standards, leading to infractions regarding child labour, minimum wage, forced labour, and unsanitary working conditions and unsafe water supplies	BR will strictly adhere to ADB and other international standards as defined in the EIA text	Confirm that these standards are specifically incorporated into the contract documents either as clauses or by appending this EMP to the contract.			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
1.10 Technical Capacity to undertake all environmental work	Inability of contractor and ESSU or Engineer to implement the EIA and its EMP resulting in a breakdown of safeguards implementation.	BR to conduct a 1.5 day briefing and training for contractors and BR staff on EIA and EMP implementation, surveys and data recording	Need to monitor the training knowledge at work site by visiting work site and offices			
1.11 Environmental Clauses in Construction contracts	No specific environmental clauses in contracts will provide BR and the Engineer with few tools to force the contract to comply with requirements defined in the EIA and its EMP	Specific environmental clauses will be added to contract specifications and a separate environmental bill-of-quantities section will be prepared	The environmental specification need to be followed during construction period			
2. CONSTRUCTION PHASE						
2.1 The Construction Environmental Management Work plan (CEMWP)	Contractor does not prepare a work plan defining details on when mitigation and monitoring actions are to take place, in relation to the work and then the EMP requirements are not implemented properly.	The Engineer will assist contractor prepare the EMWS, but interim payment (mobilisation) will be delayed until the EMWS is submitted to the Engineer.	Confirm that a EMWS has been prepared			
2.2 Air Quality and Dust	The ambient levels of CO_2, NO_x, SO_x, $PM_{2.5}$, and PM_{10} may increase at busy stations and construction areas leading to temporary localised air pollution.	A dust suppression programme will be used at all times during construction of embankment, stations and placement of ballast Dust suppression to include watering and suppression equipment on batch plant, as well as vehicle speed restrictions to ≤35 km/h., and finally rapid revegetation including grass seeding. Ambient air quality testing for SO_2, NO_2 and $PM_{2.5}$, PM_{10} same locations as ambient-conditions survey, conducted quarterly at 6 stations, including same stations as during EIA and PCRs such as mosques, hospitals and schools, and	Need to check daily the level of dust at construction site. Also need to interview the workers on dust level at worksite. Throughout the construction period: During dry season undertake air quality testing for CO, SO_2, NO_2, $PM_{2.5}$, and PM_{10} at major bridge and station and buildings construction sites.			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
		immediate remedial actions taken 2 exceedances occur at any one site				
2.3 Noise	Work sites will be noisy due pile driving, operation, power generator, rock crushing/ batch plants and movement of construction vehicles, as well as the constant movement of trains along the existing line.	Keep noise pollution at ≤ 60 dB (Bangladesh standard) levels at mosque, school, populated area and other sensitive sites by use of low noise equipment or erection of temporary baffles. Work timing restrictions if noise levels, based on field measures indicate exceedances of existing conditions. 6 stations, 4X/yr at PCRs. Contractor will also be required to use only well maintained functioning equipment.	Sample at least 6 sensitive sites within 50 m of rail RoW in the vicinity of the sensitive receptors. Take noise readings at sensitive receptors 2 times/day during full work activities, 2 times/month			
Topography, Landscape and Soils						
2.4. Topography and Landscape changes	Visual intrusion from large piles of embankment materials and ballast obstructing views and excavation along the edge of the alignment leaving large unsafe holes is possible.	Embankment site to be planted trees to promote natural vegetation; as well as fast growing grasses such as Vetiver/Napitar. Material stockpiles will be removed as soon as work is completed and the area re-landscaped. Same applies to borrow areas.	Inspection/ consultation with adjacent households and railway authority to get opinion on work being completed.			
2.5 Erosion	Clearing topsoil in proposed embankment area can lead to loss of nutrient and erosion particularly along the >14 km of cut slopes and dust from unprotected storage sites. The erosion risk at embankment slopes is possible. Gully erosion along the exposed track slope during rainy season may damage smother field crops in adjacent areas.	Topsoil storage areas must be protected during the dry season, wind erosion—by covering. Rapid revegetation and use of hydro-seeding and jute erosion protection mats will be applied in areas where erosion is noted during the regular monthly inspections	Inspect storage areas and record state of storage areas with 2 photos, and then report level of erosion and on-site dust. Inspect embankment construction areas for erosion and repair			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
Water Resources						
2.6 Hydrology, Drainage and Surface Water Quality	1) Earthwork activities during construction of embankment may result in drainage congestion 2) The surface water at workers camp and Project site areas may become pollute due to faecal, organic and other contamination. Disposed wastes and effluents from the construction sites may cause further degradation of surface water.	Ensure all earthworks are constructed according to design and specifications. Wastes, effluents and other contaminant materials at camp/work sites to be stored, handled, transported and disposed in planned manners. Garbage disposal service to be provided, Concrete refuse, reused or disposed of without habitat loss; All other effluents not to be disposed of directly into natural waters, but via settling basins to allow suspended sediment to settle out. Quarterly surface water quality testing programme, with sampling design as defined in the EIA will be completed during the construction period; i.e., 2 water crossings each US and DS at crossings.	Site inspection Inspect waste and field management at camps and record actions taken when non-compliance recorded. Conduct surface water quality testing for pH, Turbidity, Temperature, DO, BOD_5, COD, TSS, TDS, oil and grease			
2.7 Groundwater	The potential exists for drinking water sources to be contaminated by the seepage of wastes from workers' camps through the soil profile into the GW aquifer (particularly if wells access the shallow aquifer).	Workforce camps will be located away from water resources. All practical measures such as provision of septic tanks, garbage bags, and other sanitation facilities will be implemented at the construction camps to prevent the wastewater and solid wastes from entering well and groundwater recharge areas. 3 Wells used for drinking will be tested 2X a year to ensure portability.	where the pile drilling to 30 m depth is conducted and/or where any new wells are dug or a well becomes a camp potable water supply, testing to be undertaken for pH, TP, Mn, Fe, As, Oil and Grease and E. Coli,			
Waste Management						

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
2.8 Waste Management	Construction camp wastes are often poorly managed and can lead to chronic pollution of surface and groundwater.	Contain all solid wastes at designated location within construction sites. Service machinery and vehicles strictly at designated maintenance workshops where waste oils and lubricants can be collected and recycled. The monthly monitoring report will provide compliance update	Undertake good housekeeping practices inspection at least every 2 months and report results and record what actions taken to mitigate			
Land use, Population and Culture						
2.9 Land Use	The most significant potential impacts on land use in the study area will be the removal of agricultural land (primarily rice paddy) for the construction of the proposed rail embankment, station access roads and associated facilities.	Land acquisition / requisition will be in accordance with the laws of Bangladesh and as defined in the Project LAP and RP, which specifies agreed to entitlement a grievance mechanism and timetable for implementation. It will be used by BR as its mitigation guide concerning this issue.	No action needed since this is being thoroughly monitored and completed by the social safeguards team and local NGOs			
2.10. Health and Vector Borne Diseases	Personal and occupational health issues, stemming from unsanitary toilet facilities, lack of potable water and sanitary washing areas can lead to common disease outbreaks in work camps. Construction work creates areas for water to form stagnant puddles; Also, water can collect in old equipment waste tyre dump stored outside, ideal breeding areas for malaria and dengue mosquitoes.	Undertake check and cleaning at all sites and areas where clean conditions should exist. Provision of potable water, sanitary toilet facility and hygienic accommodation for workers at camp sites. All potable water supplies will be tested semi annually Provision of First-Aid facility for them. Ensure that these facilities are cleaned and disinfected regularly. Inspect for stagnant water and puddles every 3 days, including stored construction materials such as tyres and	Undertake checks at all sites and instruct contractors to take immediate action if non-compliance identified			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
		old oil drums–empty to prevent water ponding.				
2.11 Worksite Safety Management	Poor safety oversight and management of the worksites by the contractor, leads to accidents and unsafe working conditions	Construct fences separating the construction sites at rail stations from public access, and manage train movements collaborating with BR dispatch staff. Contractors must at all times ensure the local people needing to move from one side of the construction area to another can do so effectively and without undue delay.	Conduct regular inspection			
	Labour standards ignored or not complied with leading to infractions of basic labour standards as defined by ILO conventions	No use of child labour permitted that no workers under the age of 14 may be hired as general labours, and no workers under the age of 17 are to be hired for hazardous jobs such work on scaffolding, and structures elevated above the ground, etc. **No Bonded labour-**All forms of bonded labour and forced labour, as defined by ILO Conventions 29 & 105 **Equal treatment, equal opportunity- as defined by** ILO Conventions 100 & 111 and ILO Code of Practice for HIV/AIDS 85. Nodiscrimination based on race, caste, origin, religion, disability, gender, sexual orientation, union or political affiliation, or age; no sexual harassment **Minimum wage**- BR expects the contractor to pay all employees according to Bangladesh Labour Act standards.	Random check of 10% of the labour force, and check that labourers have contract letters and check age, working conditions and documentation			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
2.12 HIV Awareness	Due to influx of workers in the Project area, AIDS/HIV may spread in local community	Workers health training programme will be organised during construction period to aware the health and hygienic issues. Training to be provided by health specialist such as a local NGO	As part of monthly inspection review all OHS requirement looking for poor enforcement as well distribution of proper safety equipment			
Occupational Health and Safety						
2.13-Personal Safety Equipment (PSE)	Contractor does not provide adequate PSE or properly enforces its use, leading to accidents	Workers will be provided with appropriate personal protection equipment, such as safety boots, helmets, gloves, protective clothing, goggles and ear protection, and contractor will enforce its use, so long as safety does not suffer due to this action	Conduct monthly check to review PSE compliance.			
2.14 The Construction Period Environmental Completion Reporting	Contractor fails to prepare a summary report defining the mitigation and monitoring actions completed and what needs to be continued during the Operating period. The result is a failed or weakened environmental safeguards programme.	Prepare a completion report and deliver to the Engineer.	Collect monitoring and completion reports and confirm compliance			
2.15 Terrestrial and Aquatic Flora and Fauna	The clearing of trees and associated understory vegetation and construction of a 2-6m high by 97.01 Km-long embankment will reduce the habitat for mostly birdlife, given that the aquatic and terrestrial faunal is limited to common and pest species. Small patches of wetland will be covered by the embankment	A rapid revegetation / tree replanting programme will permit the rail-side habitat to recover quickly The rapid reestablishment of pre-construction surface draining will help to bring wet areas, somewhat reduced (marginally) by the new embankment to re-establish pre-construction habitat conditions.	As part of the monthly site inspection, examine embankments, new stations and buildings, subgrade storage areas, to confirm these facilities are not contributing to environmental degradation			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
2.16 Fisheries	The bridge construction will give a negative impact on the fish species, these are •Behavioural 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 behaviour.	Shall, in consultation with Fisheries Department, develop and implement a plan to offset the loss of fish and fish habitat associated with the carrying out of the Project Shall manage effluent produced by the Project from construction camp, office, workshops and etc. by ensuring that effluent is collected and treated if required before being discharged into the environment Change in behavioural responses by fishes to increased suspended sediment concentrations include impairment of feeding, impaired ability to locate predators and reduced breeding activity.	Confirm not to turbid the surface water			
2.17 Heritage and Culture	CPRs will be affected by the rail line construction	BR has defined a plan to prevent undue damage to these sites and/or relocate the CPRs, which will have to be completed before the work begins	For PCRs, discuss actions taken with local officials and get agreement that this is appropriate.			
2.18 Resettlement	loss of access to land by tenants and informal occupants and loss of employment and workdays	livelihood restoration activities and schemes will be to improve or at least restore the pre-project standards the APs enjoyed, which also complies with ADB SPS (2009) requirements	Monitoring required to check the implementation of RP during pre-construction stage also check with all AP whether or not they received full compensation			
2.19 Livelihood	Most of the habitants of this area are engaged in agriculture, fisheries, and business whose livelihood will be impacted due to land acquisition	Affected households/persons will receive replacement value of the land and other assets before relocation. Likewise, loss of	Monitor the livelihood restoration plan			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
		standing crops and trees will be compensated at market price.				
2.20 Vulnerable Community	Vulnerable communities may displace who live below poverty line, the landless, the elderly, women- and children-headed households, Indigenous Peoples, ethnic minorities, natural resource dependent communities or other displaced persons who may not be protected through national land compensation or land titling legislation	These groups should be identified either through the process of Environmental and Social Impact Assessment (Performance Standard 1) or through the social baseline studies component of resettlement planning.	Monitor and draw special attention to vulnerable communities to protect their interest			
3. OPERATING PHASE						
3.1 The Construction Period Environment Completion Report	Failure to adopt measures and continue mitigation actions defined in the Construction Period Environmental Completion report.	Assign environmental expertise to obtain, examine and take necessary actions defined in the Construction Period Environmental Completion report.	Record that the report in in the hands those responsible for maintaining existing measures and completing those required			
3.2 Construction Period Decommissioning	Inspection of sites to be decommissioned by contractor, are: work camps; fuels storage areas waste dump sites; construct access roads But not undertaken, leading to chronic environmental problems due to a lack of proper clean-up.	Undertaken a Complete construction area inspection.	Inspect to be sure that work camps, fuel storage areas, waste dumps, toilet facilities, construction access roads have been properly decommissioned and no chronic contamination is likely.			
3.3 Air Quality & Dust	Degradation of local air quality due to increased train traffic.	Maintain locomotives according to factory specifications and accelerate	Undertake air quality monitoring at 4 of stations sampled during the			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
		decommissioning of > 20 year old locomotives.	construction period and sample CO, SO_2, NO_2 and $PM_{2.5}$ and PM_{10}			
3.4 Spill Contingency Planning	Contamination of soil caused due to spillage of petroleum derivatives and other chemicals due to rail accidents.	Rail accidents and spills will be managed through a spill contingency protocol.to be distributed to all BR management for implementation if a spill should occur	Prepare and implement Spill contingency plan in hand			
3.5Noise	Noise monitoring has identified a number of sensitive sites where noise is already exceeding accepted levels and as such creating more discomfort for local people	Install noise attenuation features at the sensitive sites - e.g. berms. Plantings and noise barriers-based on noise monitoring recognising existing train noise. Also noise attenuation equipment such as disk brakes rubber padding under the rail and a rail grinding schedule. If the noise level added from the operation of the second rail line exceeds 3 dBA (on top of background noise) immediate measures such as noise barriers, noise shielding window panes etc. must be taken.	Noise measurements to be continued at noise sensitive sites as defined during pre-construction and construction measurements—2 times/year at 8 sites along			
3.6 Employment and Livelihood and Ribbon Settlement	The area along the rail line will attract settlements and undesired structures including commercial facilities particularly near the railway stations.	Since this is very difficult to control, BR will as a minimum post the area as private property and permitting only agricultural activities, no structures. BR will mount RoW patrols to enforce these conditions.	Inspect to be sure that basic actions as defined have been taken and that removed signs are replaced			
3.7 Level Crossings	Inadequate safety at level crossings and stations leading to more and more frequent accidents, with vehicles, people and livestock. Also see Item 1.6 in this table.	Reduce Vehicle – train and human and livestock train accident by implementing sufficient awareness programme and provide signage and internationally approved crossing structures/signalling. Installation of modern railway crossing and gate systems. Pedestrian foot over	Inspect crossings at least 1/yr to check operation and collect incident records for each crossing			

Project Period and Environmental Parameters	Project Impact	Mitigation Measures	D: Details of Monitoring Action to be Undertaken	What Work has been Undertaken and Where	Specific Date(s) Matching "D"	Who Undertook the Work
		bridges will be building and increased as the need develops. Training to crossing guards will be enhanced				
3.8 Waste Management	Garbage is thrown and sewage discharged onto the tracks from trains leads to chronic contamination of the corridor and nearby drainage areas	Provide adequate waste bins and waste biodegradable waste bags on trains. Establish strict fines for garbage throwing Initiate a programme of retrofitting trains with sewage collection tanks to be pumped out at collection stations for delivery to STPs.	Count bins and extent of maintenance Record no of trains with Sewage tanks			
3.9 Station Operations	New stations will attract more passengers and as such more waste to manage. No sewage or waste management will quickly lead to highly polluted conditions in around the stations.	Waste management system will be inspected by BR weekly to ensure sanitary operations and each station will have janitorial staff. Problems identified will be immediately rectified by add services, upgraded waste management systems or both	Inspect that station waste facilities; capable of handling user wastes and the services are being employed to maintain the stations. Collect 4-5 photo records			
3.10 Flora and Fauna	Impact on terrestrial and aquatic flora and fauna including birds, fish, dolphin, and etc.	Comparison study should be conducted at the 2nd year of operational stage. The purpose of this biodiversity study is to check and confirm any major changes due to construction and operation of the railway bridge. If any major impact observed, further mitigation measures should be taken without any delay.	Confirm a comparative analysis has been conducted during 2nd year of operation to check impact on biodiversity such as dolphin, birds, fish due to construction of the railway bridge			

Annex 8: Glossary of Terms

Adverse impact:	It is an environmental impact that is harmful to human interests over either the short or long term.
Amphibians:	Amphibians are amphibious organisms i.e. able to live both on land in water, such as frogs, toads or newts.
Avifauna:	Avifauna are the birds that live in a certain place or at a certain time.
Baseline studies	Work done to collect and interpret information on the status and trends of the environment likely to be affected by a development action.
Beneficial Impact:	It is an impact that improves resources, the economy and/ or the quality of life for a population.
Benthos:	It is the community of organisms that live on, in, or near the seabed, also known as the benthic zone.
Biodiversity:	(Biological diversity) is the variety and variability among living organisms.
Charland/ Char:	It is a tract of land surrounded by a river, sea, lake or stream. The land is developed due to erosion and accretion of river.
Compensation:	It is payment in cash or kind to the recipients of unavoidable negative and/ or residual impacts.
Culvert:	A structure, smaller than a bridge, which allows water to pass underneath a road.
Decibel (dB):	A logarithmic scale used to denote the intensity, or pressure level, of a sound relative to the threshold of human hearing. A step of 10 dB is a ten-fold increase in intensity or sound energy which, to the human ear, sounds a little more than twice as loud.
Drainage congestion:	Drainage congestion is the local abundance of surface water due to sudden high inflow or impeded outflow.
Eco-park	**Eco-park** a short form of Ecological Park. It is exploited as an amusement park without hampering its natural environment so that the bio-diversity remains unaffected there. Generally, a particular area of a forest is demarcated and brought under intensive management for this purpose. Sometimes forest areas having special natural features are selected as eco-parks. Flora of the concerned area gets preference for such consideration. Beauty offered by the nature is opened to the visitors. Moreover, efforts to attract and entertain the visitors are also visible in the eco-parks.
Ecology	The study of the relationships and interactions between various organisms and their environment
Ecosystem (ecological system):	Ecosystem is a marine, freshwater or terrestrial linkage of dynamic and interactive components normally divided into two major categories – biotic (living) and abiotic (non-living).
Enhancement	It is the improvement of the environmental performance of a project beyond that required for mitigation where the benefits of such enhancement significantly exceed the costs.
Environmental impact:	Environmental impact is the change in the state or functioning of an environmental resources or component caused by the action(s) of a project.

Endangered Species:	Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among those are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from a significant danger of extinction
Flora:	The plant species found in a given area
Fauna:	A collective term denoting the animals occurring in a particular region or period
Floodplain:	The area of low, flat ground on one or both sides of a stream or river channel subject to flooding.
Guide bund:	It is defined as the site of a barrage, weir, bridge, etc. To guide the river flow through the confined waterway without causing damage to the structure and its approaches. They are provided in the direction of flow, both upstream and downstream of the barrage of one or both flanks depending or requirement.
Habitat:	The natural home or environment for a plant or animal
Hazard:	A type of event that causes damages and/ or loss of human life, land use and /or the environment, e.g., floods, erosion, earthquakes, pollution.
Mammals:	Vertebrates comprising humans and all other animals that nourish their young with milk secreted by mammary glands
Mitigation:	Mitigation is any action taken to reduce unacceptable negative impacts. It includes both design changes to the project and operational strategies.
Mouza:	A Bangla word for the smallest government administrative area corresponding to a village revenue unit.
Monitoring:	Systematic measurement and/or observation of environmental and social variables in time and space.
Plankton:	the aggregate of passively floating, drifting, or somewhat motile organisms occurring in a body of water, primarily comprising microscopic algae and protozoa.
River Training:	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.
Reptiles:	Reptiles are cold-blooded, air-breathing vertebrates comprising alligators, crocodiles, lizards, snakes, turtles, etc. Reptiles crawl or move on their belly (such as snakes) or on small short legs (such as lizards).
River Training:	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.
Sediment:	Solid particles transported and deposited by water, glaciers and wind.
Species:	A uniform, interbreeding population distributed over time and space
Sensitive Receivers:	Receivers are affected in some way by a particular external stimulus, generally noise or vibration
Stakeholder engagement:	It is the process by which an organization involves people who may be affected by the decisions it makes, or can influence the implementation of its decisions. They may support or oppose the decisions, be influential in the organization or within the community in which it operates, hold relevant official positions or be affected in the long term.
Stakeholders:	Those who may be potentially affected by a proposal or project.

Terrestrial:	Living on land (as opposed to in water)
Topography:	Topography is the study and description of the physical features of an area
Union:	Smallest unit of local self-government comprising several villages.
Upazila:	Upazila is an administrative sub-division of a district.
Wildlife:	Organisms that can survive in their natural environment within any human assistance. The four general types are: mammals, amphibians, reptiles and birds, however some classifications also include plants and microorganisms such as protozoans and bacteria.
Sensitive Receivers:	Receivers are affected in some way by a particular external stimulus, generally noise or vibration
Habitat:	The natural home or environment for a plant or animal

Annex 9: No Objection Certificates (NOC)

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
গাজীপুর উন্নয়ন কর্তৃপক্ষ
গাজীপুর

স্মারক নং-২৫.৫৭.৩৩০০.০০২.১৩.০০৩-২৩-

তারিখ: ১৩/০৪/২০২৫ খ্রি.

বিষয়: বাংলাদেশ রেলওয়ে কর্তৃক বাস্তবায়নাধীন "Feasibility Study and Detail Design for introduction of Electric Traction (including Overhead Catenary & Sub-station) in between Narayangonj-Dhaka-Chattogram and Tongi-Joydevpur Section of Bangladesh Railway Project" এর আওতায় Electric Traction, Overhead catenary system along the railway track, Traction sub-station, Maintenance workshop and Loco shed নির্মাণের জন্য গাজীপুর জেলার গাজীপুর সদর উপজেলার দেশীপাড়া মৌজায় ১০.৮১ একর ও টঙ্গী থানার দত্তপাড়া মৌজায় ১.১৯৯০ একর ভূমি ব্যবহারে গাজীপুর উন্নয়ন কর্তৃপক্ষের অনাপত্তি প্রদান প্রসঙ্গে।

সূত্র: বাংলাদেশ রেলওয়ে স্মারক নং-৫৪.০১.১৫০০.১১৫.০৭.১১৯.২৩-১১;

তারিখ: ০৪/০৩/২০২৫ খ্রি.

উপর্যুক্ত বিষয় ও সূত্রের পরিপ্রেক্ষিতে জানানো যাচ্ছে যে, বাংলাদেশ রেলওয়ে কর্তৃক বাস্তবায়নাধীন "Feasibility Study and Detail Design for introduction of Electric Traction (including Overhead Catenary & Sub-station) in between Narayangonj-Dhaka-Chattogram and Tongi-Joydevpur Section of Bangladesh Railway Project" এর আওতায় Electric Traction, Overhead catenary system along the railway track, Traction sub-station, Maintenance workshop and Loco shed নির্মাণের জন্য গাজীপুর জেলার গাজীপুর সদর উপজেলার দেশীপাড়া মৌজায় ১০.৮১ একর ও টঙ্গী থানার দত্তপাড়া মৌজায় ১.১৯৯০ একর ভূমি ব্যবহারের বিষয়ে গাজীপুর উন্নয়ন কর্তৃপক্ষের অনাপত্তি চাওয়া হয়েছে। বাংলাদেশের উত্তরাংশের সাথে পূর্বাঞ্চলের আধুনিক রেল যোগাযোগ স্থাপনের জন্য প্রস্তাবিত ভূমি ব্যবহারের প্রয়োজন হবে মর্মে সূত্রোক্ত পত্রে উল্লেখ করা হয়েছে।

বর্ণিতাবস্থায়, সরকারি প্রয়োজন ও জনস্বার্থে বিষয়োক্ত প্রকল্প বাস্তবায়নের জন্য নিম্নবর্ণিত শর্ত প্রতিপালন সাপেক্ষে গাজীপুর জেলার সদর উপজেলার দেশীপাড়া মৌজায় ১০.৮১ একর ও টঙ্গী থানার দত্তপাড়া মৌজায় ১.১৯৯০ একর ভূমি ব্যবহারের বিষয়ে গাজীপুর উন্নয়ন কর্তৃপক্ষের অনাপত্তি প্রদান করা হলো:

শর্তাবলী:

(১) ভূমি অধিগ্রহণ সংক্রান্ত বিদ্যমান সরকারি নীতিমালা অনুসরণ করতে হবে;

(২) প্রস্তাবিত জমিসমূহে অবকাঠামো নির্মাণের মাধ্যমে কোন অবস্থাতে কোন রাস্তার যান চলাচল/পথচারী চলাচলে বিঘ্ন ঘটানো যাবে না, বিশেষত কোন Access Road বন্ধ করা যাবে না;

(৩) ক্ষতিগ্রস্থ প্রতি মালিকদের বিধি মোতাবেক যথাযথ ক্ষতিপূরণ পরিশোধ করতে হবে;

(৪) মহাসড়ক আইন, ২০২১ এবং মহাসড়ক ল্যান্ড জোনিং নীতিমালা, ২০২০ যথাযথভাবে অনুসরণ করতে হবে;

(৫) সকল ধরণের নির্মাণকাজ এবং প্রকল্প পরিচালনার ক্ষেত্রে বায়ু দূষণ (নিয়ন্ত্রণ) বিধিমালা, ২০২২; কঠিন বর্জ্য ব্যবস্থাপনা বিধিমালা, ২০২১ এবং বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ ও বিধি যথাযথভাবে অনুসরণ করতে হবে;

(৬) প্রস্তাবিত জমিসমূহের মধ্যে বিভিন্ন দপ্তর/মন্ত্রণালয়/সংস্থা/সংগঠনের নিজস্ব জমিসমূহ স্ব স্ব মন্ত্রণালয়/দপ্তর/সংস্থা/সংগঠনের সাথে দ্বিপাক্ষিক আলোচনার মাধ্যমে জমি ব্যবহারের অনাপত্তিপত্র গ্রহণ করতে হবে;

(৭) বিশদ অঞ্চল পরিকল্পনা (২০২২-২০৩৫) খণ্ড-১ এর পরিশিষ্ট ৬.১ অনুযায়ী প্রস্তাবিত প্রকল্প এলাকার ৯.৪০% অংশ জলধারণ এলাকা হিসেবে সংরক্ষিত রাখতে হবে এবং প্রকল্প বাস্তবায়নকালে আবশ্যিকভাবে অনাচ্ছাদিত ও soakable Green রাখতে হবে;

(৮) পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত পদ্ধতিতে ছাড়পত্র গ্রহন করতে হবে;

(৯) কর্মরত শ্রমিকের পেশাগত স্বাস্থ্য ও নিরাপত্তা নিশ্চিত করতে হবে;

(১০) উপযুক্ত অগ্নিনির্বাপক ব্যবস্থা রাখতে হবে এবং অগ্নিকান্ড কিংবা অন্য কোন দুর্ঘটনার সময় জরুরি নির্গমন ব্যবস্থা থাকতে হবে এবং

(১১) প্রকল্পসৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উল্লিখিত যে কোন শর্ত লঙ্ঘনে করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

সংযুক্তি: বাংলাদেশ রেলওয়ে প্রকল্পে ব্যবহারের জন্য গাজীপুর জেলার সদর উপজেলার বেলীপাড়া মৌজায় ১০.৮১ একর ও টঙ্গী থানার দত্তপাড়া মৌজায় ১.১১১৫ একর ভূমির মৌজা ও দাগভিত্তিক জমির পরিমানের (১ পৃষ্ঠা) উপর গাজীপুর উন্নয়ন কর্তৃপক্ষের স্বাক্ষর সম্বলিত অনাপত্তি।

(কামরুল হাসান সোহাগ) ৪/১২
নগর পরিকল্পনাবিদ
গাজীপুর উন্নয়ন কর্তৃপক্ষ

কামরুল হাসান সোহাগ
নগর পরিকল্পনাবিদ(ভঃপ্রা)
গাজীপুর উন্নয়ন কর্তৃপক্ষ
গাজীপুর।

মহাপরিচালক
বাংলাদেশ রেলওয়ে
আব্দুল গনি রোড, ঢাকা

সদয় অবগতির জন্য অনুলিপি (জ্যেষ্ঠতার ক্রমানুসারে নয়):

১। সচিব, রেলপথ মন্ত্রণালয়, রেলওয়ে ভবন, আব্দুল গনি রোড, ঢাকা।
২। প্রকল্প পরিচালক, "Feasibility Study and Detail Design for introduction of Electric Traction (including Overhead Catenary & Sub-station) in between Narayangonj-Dhaka-Chattogram and Tongi-Joydevpur Section of Bangladesh Railway Project", বাংলাদেশ রেলওয়ে, সিমান্তবি, চট্টগ্রাম।
৩। চেয়ারম্যান মহোদয়ের ব্যক্তিগত কর্মকর্তা, গাজীপুর উন্নয়ন কর্তৃপক্ষ, গাজীপুর।
৪। অফিস কপি।

Land Details: As below;

Land Acquisition Schedule (Tongi) Thana/Upazila: Tongi, District: Gazipur Mouza Name: Duttapara, J. L. No: 42, Sheet No: 02				
Sl No	**Plot No**	**Khotian No-**	**Type of Land**	**Amount of Land (Acre)**
1	2910	490	Chala	0.0260
2	2911	311, 414	Khama	0.3346
3	2912	573	Khama	0.58
4	2913	221	Khama	0.1279
5	2940	94, 237, 648, 725	Khama	0.1311
Total Land				**1.1995**

Land Acquisition Schedule (Joydebpur) Unioun: Salna, Thana/Upazila: Gazipur Sadar, District: Gazipur Mouza Name: Deshipara, J. L. No: 29				
Sl No	**Plot No**	**Khatian No**	**Type of Land**	**Amount of Land (Acre)**
1	325	8	Bari	0.0375
2	326	8	Bari	0.0387
3	324	8	Bari	0.0971
4	328	8	Bari	0.1413
5	329	50, 97	Bari	0.3758
6	330	8	Chala	2.7685
7	331	9	Sail	0.6240
8	323	8	Chala	1.2858
9	341	51	Sail	0.0614
10	342	109	Sail	0.1291
11	343	109	Amon	0.6046
12	344	10	Amon	0.6916
13	345	66	Chala	0.0234
14	346	27	Sail	0.1393
15	347	88	Sail	0.1197
16	348	89	Sail	0.1053
17	349	10	Amon	1.1493
18	350	34	Sail	0.2467
19	358	35	Amon	0.0352
20	359	109	Sail	0.1095
21	360	51	Amon	0.1841
22	361	90	Sail	0.0158
23	371	6	Pukur	0.1882
24	374	65	Chala	0.5551
25	375	108	Chala	0.0624
26	376	87	Chala	0.5251
27	377	89	Chala	0.3261
28	378	88	Chala	0.1391
29	379	27	Chala	0.0309
Total Land				**10.81**

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

(স্থানীয় সরকার)

০৭নং আজগরা ইউনিয়ন পরিষদ কার্যালয়

ডাকঘরঃ আজগরা বাজার, উপজেলাঃ লাকসাম, জেলাঃ কুমিল্লা, বাংলাদেশ।
Web: www.azgoraup.comilla.gov.bd email: ajgaraup.931.cum@gmail.com Mobile: 01318377931

স্মারক নম্বর ৭৩/২৫ তারিখ ২৭/০৮/২০২৫

অনাপত্তি ছাড়পত্র

০১. Applicant's Name : Md Habibur Rahman
project Director, Feasibility Study and Detailed Design for Introduction of Electric traction (Including Overhead Catenary & Sub Station) in Between Narayanganj-Dhaka-Chattogram and Tongi Joydevpur Section of Bangladesh Railway, Bangladesh Railway CRB Chattogram.

০২. Project Name: Introduction of Electric Traction (Including Overhead Catenary & Sub Station) in Between Narayanganj-Dhaka-Chattogram and Tongi Joydevpur Section of Bangladesh Railway.
Email: pdetnc@railway.gov.bd
Phone Number: 01711506126

০৩. কারখানা/প্রকল্পের তফসিল

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরণ	জমির পরিমাণ
কুমিল্লা	লাকসাম	পাওতলী, জেএল নং ৩৩২		৩৭১,৩৫৮,৩৫৯,৩৬০ এবং ৩৭২	নাল	০.৬৮৫৭ একর
কুমিল্লা	লাকসাম	কোমড্ডা, জেএল নং ২৮৬	২২	১৪০, ১৩৯	নাল	০.৩০২৭
					মোট জমির পরিমাণ	০.৯৮৮৪

০৪. কারখানা/প্রকল্পের উৎপাদিত/উৎপাদিত পণ্যের নাম: Electric Traction System

উপরোক্ত তথ্যাদির আলোকে " Introduction of Electric Traction (Including Overhead Catenary & Sub Station) in Between Narayanganj-Dhaka-Chattogram and Tongi Joydevpur Section of Bangladesh Railway " কে Electric Traction System পরিচালনার জন্য নিম্নবর্ণিত শর্তসাপেক্ষে অনাপত্তি সনদপত্র প্রদান করা হলো।

শর্তাবলী:

০১. Bangladesh Railway, CRB, Chattogram কে Electric Traction System স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।

০২. পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত পদ্ধতিতে ছাড়পত্র গ্রহণ করতে হবে।

০৩. কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তা নিশ্চিত করতে হবে।

০৪. উপর্যুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে এবং অগ্নি কান্ড কিংবা অন্য কোন দূর্ঘটনা সময়ের জন্য জরুরি নিয়ন্ত্রণ ব্যবস্থা করতে হবে।

০৫. বায়ু ও শব্দ দূষণ করা যাবে না।

০৬. Bangladesh Railway, CRB, Chattogram কে Electric Traction System এর সৃষ্ট তাবল্য বর্জ্য অপরিশোধিত অবস্থায় বাহিরে নির্গমন করা যাবে না।

উপরে উল্লেখিত যে কোন শর্ত লঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কারখানা/প্রকল্পের বিরুদ্ধে ব্যবস্থা নেওয়া যাবে।

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীল

মোঃ শওকত আলী
নির্বাহী উপজেলা কর্মকর্তা
ও
প্রশাসক
আজগরা ইউনিয়ন পরিষদ
লাকসাম, কুমিল্লা।

Annex 10: Approved ToR from Department of Environment (DoE)

PTerms of Reference (ToR)

for

Environmental Impact Assessment (EIA)

of

Introduction of Electric Traction (including overhead catenary & sub-station) of Narayanganj–Dhaka–Chattogram and Tongi Joydevpur Section of Bangladesh Railway

Bangladesh Railway

Ministry of Railways

---

1. Entrepreneur Information

Entrepreneur : Md. Habibur Rahman
Designation : Project Director, Feasibility study and Detailed Design for Introduction of Electric Traction (including overhead catenary & sub-station) of Narayanganj–Dhaka–Chattogram and Tongi Joydevpur Section of Bangladesh Railway.

Phone Number : 01711506126
Email : pdetnc@railway.gov.bd

Name, title, phone number and e-mail of the person responsible for any inquiry related to environmental impact assessment:

Syed Nazmul Husain
Team leader (EIA)
Cell: +880 1711131242 (WhatsApp)
Email: nazmulhusain6@gmail.com

2. EIA Team

TÜMAŞ TURKISH ENGINEERING CONSULTING & CONTRACTING CO. referred as "the Sub-Consultant has been contracted by Innovate Engineering & Development Ltd., to carry out the environmental study and prepare the EIA report for the proposed project. The sub-consultants team members have more than 14 years of professional experience working in environmental impact assessment (EIA) study in Bangladesh. The composition of EIA team is provided below.

Name	Academic qualification	Experience	Area of Expertise	Signature
Syed Nazmul Husain	• **M.Sc. Environmental Science,** Jahangirnagar University, 2018 • **Post Graduate Diploma in Environmental Engineering,** Institute of Technology Sepuluh Nopember, Indonesia, 2015, • **Master of Public Health (MPH),** North South University Bangladesh, 2014, • **Master Degree in Disaster Management (MDM),** Institute of Disaster Management and Vulnerability Studies,	13 years	Environmental Engineering, (EIA, EMP. ESIA, ESMP, CEMP EMMP, SWM, L A P , R A P , GAP, Stakeholder consultation, Climate Change, Design of ETP, WTP and Environmental monitoring	

	University of Dhaka, 2012,			
Mohd Nur E Alam Siddique	• PhD Research Fellow Dept. of Chemistry, National University Bangladesh, 2019. • M.Phil in Inorganic and Analytical section, DU, 2001, • M.Sc in Analytical & Environmental Chemistry, SUST, 1995.	31 years	Environmental Science, EIA, ESIA, EMP, GIS and Remote sensing , Solid waste management, Climate change	

3. Need of the Project and Benefits

Bangladesh is one of the most densely populated countries in the world. For this reason, transportation is a challenge here. Within the country Narayanganj-Joydebpur and Tongi-Chattogram corridor has higher population density compared to others. But, the transport infrastructure is not sufficient to provide the satisfactory facility. Worldwide railway is recognized as best land transportation system from the economic and environmental perspective. Bangladesh Railway, the only railway operator in the country, carries single digit percentage of passenger and freight along the said corridor. Main challenges to increase the market share of Bangladesh Railway in transport sector are its limited sectional capacity and lower average speed. Another concern is that, it uses diesel-electric locomotive, which is not environment friendly. To overcome these obstacles and improve the service quality of Bangladesh Railway, the organization has planned to introduce Electric traction for the train operation. Bangladesh Railway is expecting to get following benefits from the proposed electric traction project in the proposed corridor:

a) Higher average speed.
b) Higher sectional capacity.
c) Reduced operating and maintenance cost.
d) Higher revenue.
e) Reduced environmental pollution.

4. Project Description

The Project contains implementation of electric traction in Narayanganj-Dhaka-Chattogram (336.89 km), Fouzderhat-CGPY (10.2km), Pubail-Dhirasram (7.2 km) and Tongi-Joydevpur (11.27 km) section of Bangladesh Railway. Total number of existing stations is 70 nos. This includes the construction of overhead catenary system along the railway track, 08 (eight) traction sub-station, 02 (two) maintenance workshop, 01 (one) loco shed etc.

In the project Bangladesh Railway will replace Diesel-Electric locomotives with Electric

locomotives. This transition will involve in construction of overhead catenary lines along the railway track. For the power supply traction sub-stations will be constructed, which will supply power to the overhead catenary system from Power Grid. For the purpose controlling the power supply control centers will also be constructed. For the purpose of maintenance of rolling stock two maintenance workshops will be constructed.

5. Project Option/Alternatives

This project is an up gradation of existing operating system for Bangladesh Railway. In this project Bangladesh Railway will construct the overhead catenary system along the existing Railway track. For this reason, there is no alternative for the construction except going through the existing line.

For the construction of Traction sub-stations and workshops Bangladesh Railway has tried to choose Railway land. For, construction of Electric Multiple Unit (EMU) Maintenance workshop Bangladesh Railway has considered tow options at Joydebpur.

Option1:

Location: Joydebpur (Joydebpur Mouza)

Option 2:

Location: Joydebpur (Deshipara Mouza)

Comparison between Option 1 and Option 2:

Option-1	Option-2
i. The outlined land includes **both dry land and a significant water body**, multiple small buildings or structures, indicating **residential or agricultural usage**. ii. Half of the land is **a large water body** likely a pond, suggesting **man-made water retention**. iii. A canal and a kacha road are passing the land. iv. The shape of the land and proximity to a major road suggestion. v. **there are large patches of agricultural land**, suggesting a rural setting.	i The marked area consists of **forested/vegetated land, agricultural fields, and built-up zones**. ii There is a water channel in front of the selected area suggesting natural drainage or irrigation use. iii **Blue-marked areas** indicate potential land parcels for acquisition, possibly for **residential, industrial, or commercial development**. iv **Some part of the selected land is owned by Bangladesh Railway.** v Some structures are visible within the marked zones, indicating **inhabited properties that may require compensation or relocation**.

Option-2 (Selected): Option 2 optimizes capacity for maximum train operation and other infrastructure improvement.

6. Baseline Environment

An inventory and assessment of baseline conditions will be done via the collection of primary and secondary baseline data within and around the project area. The baseline data will be generated in order to give an overall evaluation of the existing environmental and social conditions, values and functions of the area, as follows:

- Physical environment
- Biological environment
- Socio-economic and cultural constraints

For preparation of map, survey data collection will be undertaken within a 1 km radius of the project area/boundary if any ecological critical area (ECA) is located adjacent to the boundary. The methodologies employed to obtain baseline and other data will be clearly detailed, with all limitations and assumptions clearly stated. Data gathered will be presented in both written and graphical form. This will be standard throughout the EIA.

A comprehensive baseline survey will be conducted as part of the EIA in alignment with the requirements of DOE guideline. The assessment will rely on these data and it is necessary to ensure sufficient data are collected to enable a robust assessment.

Collection of general baseline information on existing environmental condition in the project influence area and environmental quality baseline monitoring, along the project corridor and identification of the environmental components that needs study. Baseline assessment will be done based on the available secondary information, field visits and environmental monitoring including but not limited to the following for the Project Site and Area of Influence.

Sampling location, monitoring station:

1. Pahartali, Chattogram
2. Bashbaria, Sitakunda, Chattogram
3. Chinki Astana, Baraiyarhat, Feni
4. Laksam, Comilla
5. Mandabag, Kosba, Brahmanbaria
6. Ashuganj, Brahmanbaria
7. Pubail, Kaliganj, Gazipur
8. Tongi, Gazipur
9. Fatulla, Narayanganj
10. Joydebpur, Gazipur
11. Komlapur, Dhaka

SL	Monitoring/Testing Components (Sample ID)	No. of Samples	Sampling Method	Parameters
1	Air Quality Monitoring	11	Combo ambient air quality monitoring equipment.	SPM, $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO, NH_3, O_3 and Pb.

SL	Monitoring/Testing Components (Sample ID)	No. of Samples	Sampling Method	Parameters
2	Surface Water Quality	11	Collection of samples from the 11 selected sites.	Arsenic (As), Chloride (Cl), pH, Total Clorine, Total Coliforms, Fecal Coliform
3	Groundwater Quality	11	Collection of samples from the 11 selected sites.	Arsenic (As), Chloride (Cl), pH, Total Clorine, Total Coliforms, Fecal Coliform
4	Noise Level Monitoring	11	Noise Meter Model SL- 4023 SD, Data Logger Sound Level	Day Time dB-A (LAeq)
5	Soil Quality Analysis	11	Collection 11 samples from selected site	Direct Shear Test, Grain Size Analysis, Dry Unit Weight, Natural Moisture Content, Specific Gravity Gs, Atterberg Limit, Unconfined Compression test
6	Weather	11	BMD	Temperature, Rainfall, Humidity, Wind speed and Wind direction
7	Electromagnetically Field (EMF) Analyze	11	HTC, EMF-522	Day and Night Electromagnetically Field (EMF) Analyze

Parameters:

Air Quality

Ambient air quality will be continuously monitored for SPM, $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO, NH_3, O_3 and Pb and other regular weather conditions for 24 hours.

Noise

The noise monitoring performed by a trained specialist, using a calibrated Digital Sound Level Meter (SLM) set to Data Logger Sound Level, fast response, and statistical analysis settings. The Sound Level Meter (SLM) was mounted on a tripod at a height of approximately 1.5m, facing in the direction of the apparent predominant noise source. The SLM was programmed to record statistical noise levels for 24 hours at each location and was calibrated before and after the survey.

Ground /Drinking Water Quality

Sampling and analysis of ground/drinking water will be carried for the following parameters: Arsenic (As), Chloride (Cl), pH, Total Clorine, Total Coliforms, Fecal Coliform.

Surface Water Quality

Sampling and analysis of surface water quality will be carried out for the following parameters: Arsenic (As), Chloride (Cl), pH, Total Clorine, Total Coliforms, Fecal Coliform.

Soil Quality

Direct Shear Test, Grain Size Analysis, Dry Unit Weight, Natural Moisture Content, Specific Gravity Gs, Atterberg Limit, Unconfined Compression test.

7. Sampling and Testing

Methodology for Sample collection, Storage and testing

Prior to commencing the field work for the Project, a whole day hands-on training will be provided to the environmental field officers in order to improve the quality of the field work and also to train them as industry best practices. The purpose of the training is to (a) establish, (b) implement, and (c) maintain documented sampling plans and field procedures for environmental monitoring which is designed and authorized by the Team Leader. The sub–contractor maintained high standard of sampling plans and procedures, which included the following issues:

(a) Tests to define the variability and/or repeatability of the environmental monitoring results
(b) Measures to assure the accuracy of the method, which include the calibrations;
(c) Strictly maintain the technical holding time of all samples and be tested within technical holding time;
(d) Sampling plans and procedures are address the factors to be controlled to ensure the validity of the environmental sampling results.

Sampling Plans: Based on pre-defined sampling plan, well-trained field officers collected samples from various locations of the Project area to analysis of various parameters according to the standard method. All the equipment which was used is calibrated. A chain of custody was maintained starting from sampling, preservation, transportation, and finally delivery of samples to the laboratory for testing. The sub-contractor will record the field condition during sampling.

Sampling Procedure: Field officers always maintained predefined documented procedures for sample handling and storing to protect the integrity and identity of the samples.

Sample Handling: The responsible personnel maintained predefined documented procedures for sample handling and storing which protected the integrity and identity of the samples.

Sample Acceptance Procedure: The responsible persons maintained a documented sample acceptance procedure that outline the circumstances and criteria under which samples were accepted or rejected.

Air Quality Sampling, Storing and Testing

The height of the ambient air quality sampler was about one meter which was on a vehicle (pickup). All the samples and data were collected from about 1-1.5 meters' height. The impugners or others pipes should be pre-cleaned and dried before they are used for sampling. For the sampling of SPM, $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO, NH_3, O_3 and Pb all the pipes connections should be checked to prevent leaking. The liquid samples (Absorbing reagents) should be collected in pre-cleaned plastic bottles and stored in cooler box and transported to the ECL analytical laboratory. All samples should be stored below 4^0C in the laboratory. Chain of custody should be maintained for all samples to be submitted to the ECL laboratory. During this field activity will be performed-

- Collection of GPS coordinate of each sampling stations

- Prepare and enlisting control and sub-control points for sample collection
- Collection data from sensitive features location along the alignments, such as hospitals, schools, playgrounds and specially protected natural areas.
- Air quality sample should be collected along the railway alignment, growth center, and all other parameter should be collected as denoted in this TOR.

Photograph of Air, Noise, Electromagnetically Field (EMF) Equipment

Noise

- Noise data should be collected along with 1-hour duration at the nearest sensitive receptor from the Rail line trackside and at 50 m from the source the project corridor.
- Model SL- 4023 SD should be used to collect noise.
- Noise data should be taken during the day time between 06.00-19.00 hours and during the night time (19.00- 06.00 hours).
- Noise measurements should be recorded at least once every 1 minutes or 60 times in one hour. Data should be stored in SD Card during monitoring. Later, these data should have sent to the lab for analysis.

Electromagnetic Field Level

A survey should be conducted to identify the electromagnetic field level at the key locations of the proposed project like sub-station and workshops.

Surface and Groundwater Sampling, Storing and Shipment

In order to Surface water quality analysis for all component of the designed project, Innovate Engineering & Development Ltd field team should use Proper Personal Protection Equipment and materials such as Life jacket, safety shoes, hard hat, and musk, Gloves, sterilizing agent (70% ethanol) also use during sampling of both surface and groundwater. Total Suspended Solids, Dissolved Oxygen, and Oil and Grease should be measure at locations where the growth center crosses a representative number of natural rivers. Innovate Engineering & Development Ltd also should ensure that, all measurement shall be carried out according to the USEPA approved methods, EU standard method or equivalent standard methods.

Samples testing for heavy metals should be collected in pre-cleaned plastic bottles, 10% Nitric Acid to be used to preserve the samples. Total and fecal coli form sampling bottles should be sterilized in autoclave. All the grab samples collected should be immediately stored at 4OC in cooler box and transported to the analytical laboratory DPHE Laboratory directly from the field. For BOD5 analysis, samples were collected in BOD5 bottles and kept in cooler box transported to ECL laboratory within 6 hours. Samples for analysis of COD, TSS and Iron will be collected in pre- cleaned plastic bottles and kept in cooler box and transported to the DPHE laboratory within 6 hours where samples were stored in refrigerator at 40C. Before field visit all canal/river crossing point should be identified by MRD with coordination with JV consultants, if requires.

Surface and Groundwater Measurement

Soil/Sediment Sampling, Storing

7.1 Biological Environment

A summary of the flora and fauna (terrestrial and aquatic) of the area, with special emphasis on rare, endemic, protected or endangered species should be presented. Migratory species should also be considered.

- Information on existing vegetation, proposed vegetation lass and resulting loss and/or fragmentation of habitat for fauna will be presented. Generally, species dependence, niche specificity, community structure and diversity should be considered.
- A description should be given on
  - Habitat of flora
  - Biological diversity importance of the area
  - Invasive and economically important species
  - Anticipated changes to wildlife and vegetation within the study area should also be examined and documented.
  - Information regarding adjacent ecological critical area (ECA) (if any) and a map showing the location.
  - A map(s) illustrating the location of all ecosystem types should be included.

7.2 Socio economic and cultural

The section on socio-economic and cultural environment of related area of Dhaka and Chattogram Division should be provided as detailed description of:

7.2.1 Population Demographics

The survey should be conducted among households (HHs), and the Socio-economic Survey should indicate that the majority of the structures surveyed are residential.

7.2.2 Social infrastructure and facilities

Household size should be identified by average persons per household, majority of households headed by males/females and similar information.
Healthcare infrastructure and facilities should be described.

7.2.3 Literacy

Percentage of literacy and higher education including male female ratio in it should be identified.

7.2.4 Housing Characteristic

General characteristics of house construction in the project area should be identified. Percentage of kutcha, semi Pucca and Pucca houses should be identified in the project influence area.

7.2.5 Infrastructures

The following infrastructures should be surveyed:

a) Sanitation scenario in the proposed project area.

b) Source of Drinking water.

c) Electricity availability.

d) Transportation facility and traffic condition.

8. Location of the project and existing condition

8.1 Project location

Project location map is given below

Fig: Project location Map

There are no archaeological sites, sensitive cultural or biodiversity receptors of international, national, state, or district importance, including protected areas, key biodiversity areas, forest areas, sacred groves, or historical/cultural monuments around the identified proposed sites or along the Railway line alignments.

8.1.1 Climate Zone

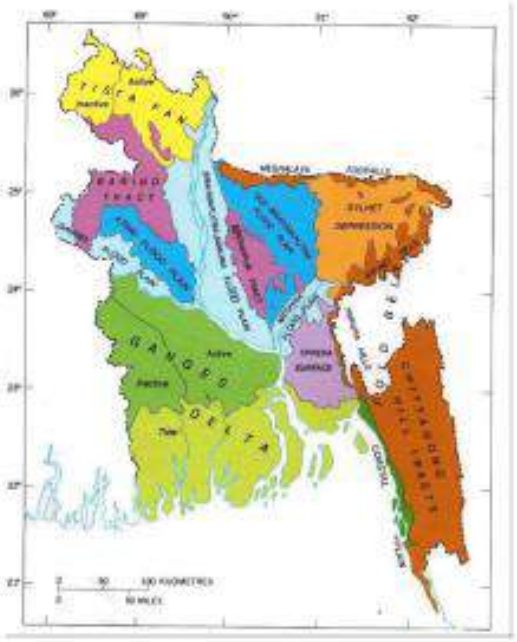
The Project area within the South-Eastern and South-Central zone of Bangladesh. It comprises of the Chattogram sub-region and Dhaka sub-region. The rest of the area has a small range of temperature, rarely goes over a mean of 36°C and below a mean 15°C.

8.1.2 Natural Hazards

The different types of hazards which are most prone to different districts. Specially Chattogram District is prone to cyclone and Feni & Comilla districts are prone to flood.

8.1.3 Physiography

The term "physiography' refers to the form of the earth's surfaces. In the context of physiography, Bangladesh may be classified into three distinct regions (a) floodplains, (b) terraces, and (c) hills each having distinguishing characteristics of its own. The project area contains hills in Chattogram and Comilla area. Near Feni area it contains floodplains physiography. And Other areas contains terrace physiography. Map of the physiographic unit is given below-



8.1.4 Agro-Ecological Zone

Agrological zone Agro ecological Zone land areas recognized on the basis of hydrology, physiography, soil types, tidal activity, cropping patterns, and seasons. In fact, an agrological indicates an area characterized by homogeneous agricultural and ecological characteristics.

8.1.5 Topography

Topography is the configuration of a land surface including its relief and contours, the distribution of mountains and valleys, the patterns of rivers, and all other features, natural and artificial, that produce the landscape. Although Bangladesh is a small country, it has considerable topographic diversity. It has three distinctive features:

- A broad alluvial plain subject to frequent flooding,
- A slightly elevated relatively older plain, and
- A small hill region drained by flashy rivers.

8.1.6 Geology

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 Northeast-deltaic landmass by major river system in this delta. Thus, the geology of Bangladesh is largely characterized by rapid subsidence and filling of the Bengal Basin in which a huge thickness of deltaic sediments was 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 adding to the present Bay Bengal. The soil formation of project area is different in different sections. In some area it is Non calcareous and calcareous brown and grey flood plain soil, in some area it is Deep red brown terrace soil.

9. Potential Significant impact

The approach to the assessment of environmental and social impacts should be based upon the changes in the receiving environment caused by the Project, followed by an assessment of the overall significance of these changes, compared with the baseline condition. This section will predict and assess the project's likely positive and negative, direct and indirect Impacts on physical, biological, socioeconomic environment in the project's area of influence, in quantitative terms as far as possible; identify mitigation measures and any residual negative Impacts that cannot be mitigated; explore opportunities for enhancement: identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics; and examine trans-boundary, and cumulative impacts as appropriate. The environmental significance should be judged in relation to applicable national/international environmental standards. The impact assessment exercise should cover all related project activities and the full project lifecycle (i.e., construction, operations, etc.). Mitigation measures should be coordinated with the Project Engineer to identify the embedded mitigations and determine the need for any additional mitigation measures. The assessment and measures will be site specific. No generic information should be added.

Scope of Land Acquisition and Resettlement

The preliminary study and the scope of land acquisition for the proposed project involves 20.50 acres of land. Initially estimated based on mouza maps and field visits, the revised area, obtained from civil land authorities' records, has reduced additional land acquisition.

Key impacts of the project are summarized based on a census and IoL survey. This includes 72 affected households among which 70 requiring relocation, comprising 20 titled households losing residential/commercial structures, affecting a total of 116 individuals. Additionally, 757 trees are affected by the project.

The relocation process will also involve the relocation of government buildings, including those belonging to BR, through consultation between government institutions and BR.

Overall, the project's impacts highlight the necessity for careful planning and coordination to mitigate disruptions and facilitate relocation efforts for affected households and infrastructure.

10. Risk Assessment and emergency response plan

The environmental assessment for the project should conduct climate change-related research based on globally and nationally published climate change prediction reports focusing particularly on the variability of rainfall intensity, temperature changes, flooding, sea-level rise. These variables are directly related to the functionality and durability of the proposed project.

To conduct the study, a holistic literature review will be conducted with the assistance of the national climate change research agencies, such as the Department of Disaster Management, Department of Environment and Bangladesh Meteorological Department. International and National Climate Change Communication orts, especially the 6th IPCC Assessment report will be reviewed for relevant major sources: formation for Impact and vulnerability projection on global and regional temperature, sea-level, 'rainfall fluctuation and their impacts on proposed infrastructures. These study findings will help in designing climate-resilient infrastructures to be needed. Also, an environmental management plan should be considered for climate-proofing measures for required adaptability with the changed climate situation.

The experts should consider a hazard risk mitigation plan (such as cyclones, tornadoes, droughts, floods, earthquakes, train accidents, etc.) during the initial planning and design stage. Depending on the timing, the results of this will be summarized in the EIA and used to inform the emergency response plan which will be coordinated with the surrounding community and resources.

11. Environmental Management plan (EMP) and Monitoring Plan

In this section the set of mitigation and management measures to be adopted during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority). It may include multiple management plans, sub plans and actions. it should include the following key components:

- Mitigation: Under mitigation, the EMP should:
  - Identify and summarize anticipated significant adverse environmental impacts and risks;
  - Describe each mitigation measure with technical details, including the type of impact to which it relates and the conditions under which it is required (for instance, continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate;

12. Monitoring and follow-up plan

➢ Monitoring: Under monitoring the EMP should:

- Describe monitoring measures with technical details, including parameters to be

measured, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and

- Describe monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation.

➢ Implementation arrangements: Under the implementation arrangements the EMP should:

- Specify the implementation schedule showing phasing and coordination with overall project implementation;
- Describe institutional or organizational arrangements, namely, who is responsible for carrying out the mitigation and monitoring measures, which may include one or more of the following additional topics to strengthen environmental management capability: technical assistance programs, training programs, procurement of equipment and supplies related to environmental management and monitoring, and organizational changes; and
- Estimate capital and recurrent costs and describe sources of funds for implementing the environmental and social management plan.
- Prepare an environmental and social monitoring budget to present the approximate environmental monitoring cost.

13. Instructional Arrangement, Capacity Building and Grievance Redress Mechanism

Assessment of institutional capacity of the implementing agencies should be conducted for effective implementation of environmental management and monitoring plan. To identify the responsible institutes for implementation and supervision of the environmental management and monitoring plan (EMMP). Assessment of training needs of these agencies and propose capacity building measures and institutional arrangements to strengthen these agencies along with the cost estimates.

In this section the grievance redress framework (both informal and formal channels) should be described, prepared for the project, setting out the time frame and mechanisms for resolving complaints about environmental performance.

14. Public Consultation and Disclosure

This section should -

- Describe the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other
- Summarize comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and Indigenous Peoples; and
- Describe the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation as per ECR 2023.
- Perform Focus Group Discussions (FGDs) and Public Consultations Meeting (PCM) for further evaluation.

15. EIA Report structure

The EIA report should be prepared following the "ECR 2023" and "EIA Guidelines for Industries, 2021" published by DoE. The following Table of content has been developed for DoE approval. Therefore, the EIA report of this Project should contain the following Chapters as per the similar Project mentioned above.

16. EIA report structure

Abbreviation and Acronyms

Executive Summary

1. Introduction
1.1 Background
1.2 Scope of the Study
1.3 Project Objectives and Benefits
1.4 Methodology
1.5 EIA Team
1.6 Structure of the EIA Report
1.7 Study Limitations

2. Regulatory and Policy Consideration
2.1 Introduction
2.2 Environmental Legislative Framework
2.3 Relevant Bangladesh Legislation
2.4 Environmental Requirements for the project
2.5 Environmental Standards

2.6 International Agreements and Obligations

3. Project Descriptions

3.1 Project Justification
3.2 Project Description
3.3 Project location
3.4 Amount of land: Amount of land required, land ownership, land acquisition.
3.5 Project Activities and Implementation Schedule.
3.6 Process flow diagram (Material, Water, and Energy Balance)
3.7 Chemical Storage and Hazard Management
3.8 Wastewater Generation
3.9 Use of Hazardous Materials
3.10 Demand for resources and utility services.
3.11 Potential for contamination.

4. Description of The Environment

4.1 Introduction
4.1.1 Site Overview
4.2 Physical Environment
4.2.1 Topography
4.2.2 Climate
4.2.3 Natural Hazards
4.2.4 Physiography
4.2.4 Agro-ecological Zone
4.2.5 Geology and Soil
4.2.6 Hydrology
4.2.7 Drainage
4.2.8 Seismicity
4.2.9 Ecologically Critical Area (ECA)
4.2.10 Environmental Quality Test (Air, Noise, Water and Soil)
4.2.11 Land Use
4.2.12 Existing sources of pollution
4.2.13 Disaster Risk Assessment
4.2.14 Assessment of Disaster of the Project
4.2.15 Sensitive Receivers

4.3 Biological Environment
4.3.1 Flora
4.3.2 Fauna
4.3.3 Bio-ecological Zones
4.3.4 Wetlands
4.3.5 Protected Areas and Endangered Species
4.3.6 Nearest protected area
4.3.7 Sensitive or threatened habitats