Karnaphuli Gas Distribution Company Limited
(A Company of PetroBangla)

# Environmental Impact Assessment (EIA) Report
# On
# Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram

May 2023


**Sustainable Enviro-Tech Services Ltd. (SETS)**
Chowdhury Centre (8th Floor), CDA Avenue, Muradpur, Chittagong, Bangladesh.
Website: www.setslimited.com

# Environmental Impact Assessment (EIA)

# On

## Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram

# Acknowledgements

Sustainable Enviro-Tech Services Ltd. (SETS) is a consultancy firm of Chattogram, Bangladesh has been entrusted with the responsibility of conducting Detail Route Survey and Environmental Study (Environmental Impact Assessment referred to EIA) for "Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project" financed by the Karnaphuli Gas Distribution Company Ltd (KGDCL). SETS expresses its gratitude to the KGDCL, especially to Engr. Mohammed Shafiul Azam Khan, Project Direct, and Engr. Mohammed Shahidur Rahman, Deputy Project Director, KGDCL for entrusting the responsibility to SETS.

SETS is grateful to all staffs of KGDCL, Chattogram who are directly or indirectly involved with Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project for their cordial cooperation in carrying out the study from the very beginning. Besides, SETS is thankful to Mayors (Sitakunda Pourashava, Mirsarai Pourashava and Baraiyarhat Pourashava ) and Chairmans (9 No. Vatiary Union Parishad, 8 No. Sonaichari Union Parishad, 6 No. Basbaria Union Parishad, 5 No. Badobkunda Union Parishad, Baroidala Union Parishad, 15 No. Wahedpur Union Parishad, 12 No. Khaiyachhara Union Parishad, 13 No. Moyani Union Parishad, 9 No. Mirsarai Union Parishad, 8 No. Durgapur Union Parishad, 3 No. Jurarganj Union Parishad) for their cordial support in providing required supports.

SETS is grateful to specialist team consisting of Mr. Muhammad Hafez Ahamed, Environmental Consultant; Dr. Ohidul Alam, Environment and Waste Specialist; Dr. Khaled Misbahuzzaman, Environment and Ecology Specialist; Mr. Shafat Hossen, Water and Natural Resources Specialist; Mr. Iftekhar Uddin, Environment and Industrial Specialist; and Mr. Junayeed Ahmed, Environmental and GIS Specialist for coordinating the studies with due responsibility and persistence.

The EIA study team was comprised of a multi-disciplinary professional. The members of the EIA Team were impressed with the cordial response received from the Officials and of Public Representatives of Municipality, Union Parishads, Local Government Institutions as well as communities within the study area in providing information. Their contributions are gratefully recognized by SETS. Special mention must be made of the people who had given time to respond to the different types of data collection process through informal Focus Group Discussion (FDG), and Key Informant Interview (KII) with local people and other stakeholders concerned as well.

Finally, the study team appreciates and acknowledges the concerns and perceptions of the local people regarding the project and their active participation during the field visits.

TABLE OF CONTENTS

Executive Summary ..... 14
General Information ..... 17
Chapter One ..... 19
Introduction ..... 19
1.1 Background ..... 19
1.2 Objectives ..... 20
1.3 Study area ..... 21
1.4 Scope of EIA study ..... 25
1.5 EIA methodology ..... 26
1.6 EIA study team ..... 29
Chapter Two ..... 30
Legislative Requirements and Policy Consideration ..... 30
2.1 Introduction ..... 30
2.2 Overview of Bangladesh environmental approval process ..... 31
2.3 Relevant Bangladesh legislations ..... 32
2.4 Brief descriptions of relevant Bangladesh regulations ..... 34
2.4.1 Environment ..... 34
2.4.2 Biodiversity and natural resources ..... 42
2.4.3 Gas and energy ..... 45
2.4.4 Environment and health safety ..... 47
2.5 Bangladesh relevant international environmental agreements ..... 48
2.6 Environmental standards relevant to the project ..... 49
1.7 Report format ..... 49
Chapter Three ..... 51
Project Data Sheet ..... 51
3.1 Introduction ..... 51
3.2 Project proponent ..... 51
3.3 Project location ..... 51
3.4 Nature and size of the project ..... 51
3.5 Project concept ..... 51
3.6 Project component ..... 52
3.7 Project activity and schedule ..... 52

3.8 Required resource and utilities ..... 53
3.9 Source of primary fuels ..... 53
Chapter 4 ..... 54
Project Description ..... 54
4.1 Introduction ..... 54
4.2 Objectives of the project ..... 54
4.3 Rationale of the project ..... 55
4.4 Project results ..... 55
4.5 Project output ..... 55
4.6 Project site ..... 56
4.7 Physical works of the Project ..... 56
Chapter Five ..... 58
Existing Environmental Condition ..... 58
5.1 Introduction ..... 58
5.2 Meteorology ..... 59
5.2.1 Rainfall ..... 59
5.2.2 Temperature ..... 62
4.2.3 Relative humidity ..... 63
5.2.4 Wind speed ..... 64
5.3 Geology ..... 65
5.3.1 General geology ..... 67
5.3.2 Topography ..... 67
5.3.3 Seismicity ..... 68
5.4 Hydrology ..... 70
5.4.1 Hydrological network ..... 71
5.4.2 Water resource ..... 72
5.4.3 River morphology ..... 73
5.5 Environmental quality ..... 74
5.5.1 Air quality ..... 74
5.5.2 Noise level ..... 76
5.5.3 Water quality ..... 78
5.5.4 Soil quality ..... 81
5.6 Land resources ..... 82

5.6.1 Agro-ecological zones ..... 82
5.6.2 Land use ..... 83
5.6.3 Land type ..... 83
5.6.4 Soil texture ..... 84
5.7 Ecological resources ..... 85
5.7.1 Bio-ecological zones ..... 85
5.7.2 Floral component ..... 87
5.7.3 Faunal component ..... 88
5.8 Socio-economic condition ..... 91
5.8.1 Administrative bounding ..... 92
5.8.2 Demography ..... 94
5.8.3 Households size ..... 94
5.8.4 Age structure ..... 94
5.8.5 Education ..... 95
5.8.6 Employment and occupation ..... 95
4.8.7 Historical, cultural and archeological sites ..... 96
Chapter Six ..... 98
Impact Prediction and Evaluation ..... 98
6.1 Introduction ..... 98
6.2 Impact assessment methodology and Approach ..... 98
6.3 Identification of potential impact ..... 98
6.4 Construction stage impact ..... 98
6.5 Operation stage impact ..... 104
6. Accidental events ..... 105
Chapter Seven ..... 107
Mitigation Measures ..... 107
7.1 Introduction ..... 107
7.2 Environmental management procedure ..... 108
7.3 Summary of Mitigation measure ..... 108
7.4 Suggested mitigation measures for specific parameters ..... 108
7.4.1 Mitigation plan for air quality deterioration ..... 108
7.4.2 Mitigation plan for water pollution ..... 109
7.4.3 Mitigation plan for sound pollution ..... 110

7.4.4 Mitigation plan for Soil contamination, agricultural activity & fertility control plan ..... 111
7.4.5 Solid waste Management ..... 112
7.4.6 Mitigation plan to protect biodiversity ..... 112
7.4.7 Mitigation plan for fish resource ..... 113
7.5 Analysis & Description of mitigation measures ..... 114
7.6 Identification of immitigable impact & environmental mitigation proposal. ..... 114
7.7 Analysis of impact & Development of a comprehensive management plan ..... 114
Chapter Eight ..... 115
Environmental Management Plan ..... 115
8.1 Introduction ..... 115
8.2 Environmental Policy Statement of KGDCL ..... 115
8.3 Disaster Management Plan ..... 124
8.4 Six Steps in Emergency Response ..... 125
8.5 Environmental Monitoring Plan ..... 125
Chapter Nine ..... 128
Risk Management ..... 128
9.1 Introduction ..... 128
9.2 Risk Assessment ..... 129
9.3 Frequency Analysis ..... 129
9.4 Risk Evaluation ..... 131
9.5 Risk analysis for F-S-M Gas Distribution Network Up-gradation Project ..... 133
9.6 Emergency response planning ..... 135
9.7 Emergency response team ..... 136
Chapter Ten ..... 137
Environmental Monitoring Programme ..... 137
10.1 Introduction ..... 137
10.2 Technical Aspects ..... 137
10.3 Environmental monitoring program ..... 137
10.4 Waste Management ..... 138
10.4.1 Waste disposal plan ..... 138
10.5 Health, environment & safety management plan ..... 139
10.6 Erosion ..... 140
10.7 Air quality monitoring ..... 140

10.8 Noise monitoring ..... 140
10.9 Monitoring of water quality ..... 140
10.10 Monitoring implementation schedule ..... 140
10.11 Monitoring parameters & schedule ..... 140
10.12 Financial aspects of environmental monitoring system ..... 140
10.13 Training of environmental professionals ..... 140
Chapter Eleven ..... 141
Beneficial Impacts ..... 141
11.1 Introduction ..... 141
11.2 Positive impacts of the project ..... 141
Chapter Twelve ..... 143
Public Consultation ..... 143
12.1 Introduction ..... 143
12.2 Methodology and Output ..... 144
12.3 Findings from Focus Group Discussion ..... 146
12.4 Expectations of the People ..... 147
Chapter Thirteen ..... 148
Conclusion and Recommendation ..... 148
13.1 Conclusion ..... 148
13.2 Recommendation ..... 149
Appendix ..... 150

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| AEZ | : | Agro-Ecological Zone |
| ANSI | : | American National Standard Institute |
| APHA | : | American Public Health Association |
| ASME | : | American Society of Mechanical Engineers |
| BADC | : | Bangladesh Agricultural Development Corporation |
| BARC | : | Bangladesh Agriculture Research Council |
| BARI | : | Bangladesh Agriculture Research Institute |
| BBS | : | Bangladesh Bureau of Statistics |
| BIWTA | : | Bangladesh Inland Water Transport Authority |
| BMD | : | Bangladesh Meteorological Department |
| BRRI | : | Bangladesh Rice Research Institute |
| BWDB | : | Bangladesh Water Development Board |
| CGS | : | City Gate Station |
| DAE | : | Department of Agricultural Extension |
| dBA | : | Decibel International scale of noise level |
| DO | : | Dissolved Oxygen |
| DoE | : | Department of Environment |
| DoF | : | Department of Fisheries |
| DPHE | : | Department of Public Health Engineering |
| ECA | : | Environment Conservation Act |
| ECC | : | Environmental Clearance Certificate |
| ECR | : | Environment Conservation Rules |
| EIA | : | Environmental Impact Assessment |
| EMF | : | Environmental Management Framework |
| EMP | : | Environmental Management Plan |
| FD | : | Forest Department |
| FGD | : | Focus group Discussion |
| FRSS | : | Fisheries Resources Survey System |
| GDP | : | Gross Domestic Product |
| GIS | : | Geographical Information System |
| GO | : | Government Organization |
| GTCL | : | Gas Transmission Company Limited |
| HDD | : | Horizontal Directional Drilling |
| HTW | : | Hand Tube well |
| IESCs | : | Important Environmental and Social Components |
| IFGD | : | Informal Focus Group Discussion |
| IUCN | : | International Union for Conservation of Nature |
| KGDCL | : | Karnaphuli Gas Distribution Company Limited |
| KII | : | Key Informant Interview |
| LGED | : | Local Government and Engineering Department |
| LGI | : | Local Government Institution |
| LNG | : | Liquefied Natural Gas |
| MOEF | : | Ministry of Environment and Forest |

| | | |
|---|---|---|
| MMSCFD | : | Million standard cubic feet per day |
| MMcf | : | Million cubic feet |
| MSC | : | Maritime Safety Committee |
| NAP | : | National Agriculture Policy |
| NCS | : | National Conservation Strategy |
| NEMAP | : | National Environment Management Action Plan |
| NEP | : | National Environment Policy |
| NGOs | : | Non-Government Organizations |
| NOC | : | No Objection Certificate |
| NWRD | : | National Water Resources Database |
| O&M | : | Operation and Maintenance |
| PCM | : | Public Consultation Meeting |
| RAP | : | Resettlement Action Plan |
| RLNG | : | Re-gasified Liquefied Natural Gas |
| RoW | : | Right of Way |
| RS | : | Remote Sensing |
| SASEC | : | South Asia Sub regional Economic Cooperation |
| SCADA | : | Supervisory Control and Data Acquisition |
| SIS | : | Small Indigenous Species |
| SoW | : | Scope of Work |
| SRDI | : | Soils Resources Development Institute |
| SCC | : | Site Clearance Certificate |
| TBS | : | Town bordering station |
| TDS | : | Total Dissolved Solids |
| TLV | : | Type-Length-Value |
| TOR | : | Terms of Reference |
| UNCED | : | United Nations Conference on Environment and Development |

## UNIT CONVERSION

| | | |
|---|---|---|
| 1 Ha | : | 10000 $m^2$ |
| 1 m | : | 3.28 feet |
| 1 cm | : | 0.01 m |
| 1 km | : | 0.62 mile |
| 1 ml | : | 1 g |
| 1 L | : | 100 ml |
| 1 feet | : | 0.305 m |
| 1 mm | : | 0.039 inch |
| 1 µm | : | 0.001 mm |
| 1 $mg/m^3$ | : | 0.001 ppm |
| 1 $\mu g/m^3$ | : | 0.001 $mg/m^3$ |

GLOSSARY

| | | |
|---|---|---|
| Air Quality Index | : | The Air Quality Index (AQI) is used for reporting daily air quality. It tells how clean or polluted air is, and what associated health effects might be a concern. The AQI focuses on health affects may experience within a few hours or days after breathing polluted air. |
| Biodiversity | : | Biodiversity refers to the variety of living organisms, including their genetic variations, as well as the habitats in and around dense human settlements. |
| Construction Waste | : | Construction waste or debris is any kind of debris from the construction process. |
| Ecological Resources | : | Ecological resources are natural resources that provide certain necessary but overlooked system maintenance functions within ecosystems. |
| Ecologically Critical Area | : | The Ecologically Critical Area (ECA) is an environmentally protected zone where the ecosystem is considered to be endangered to reach a critical condition by the changes brought through various human activities. |
| Ecosystem Services | : | Ecosystem services are the many and varied benefits to humans provided by the natural environment and from healthy ecosystems. Such ecosystems include, for example, agroecosystems, forest ecosystem, grassland ecosystems, and aquatic ecosystems. |
| Emission Tax | : | Emission taxes involve tax payments that are directly related to the measurement (or estimation) of the pollution caused. |
| Environmental Quality | : | Environmental quality is a general term which can refer to varied characteristics such as air and water purity or pollution, noise, access to open space, and the visual effects of buildings, and the potential effects which such characteristics may have on physical and mental health. |
| Extended Producer Responsibility | : | Extended Producer Responsibility (EPR) is a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products. |
| Focus Group Discussion | : | Focus group discussion is frequently used as a qualitative approach to gain an in-depth understanding of social issues. The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population. |
| Informal consultation meeting | : | A discussion with the relevant academic for which a student must apply. The discussion is to clarify any issues relating to the result for an assessment task, or examination, or the overall grade for the course. |

| | | |
|---|---|---|
| Key Informant Interview | : | Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a wide range of people including community leaders, professionals, or residents who have first-hand knowledge about the community. |
| Land Resources | : | Land resource refers to the land available for exploitation, like non-agricultural lands for buildings, developing townships etc. Land resources occur naturally within environments that exist relatively undisturbed by mankind, in a natural form. |
| Natural Environment | : | 'Natural environment' refers to the non-human-made surroundings and conditions in which all living and non-living things exist on Earth. The common concept of the natural environment encompasses two different components: Ecological units that operate as natural systems (such as soil, vegetation and so on). |
| Organic Farming | : | Organic farming is agriculture that makes healthy food, healthy soils, healthy plants, and healthy environments a priority, along with crop productivity. |
| Right of Way | : | The right of way is the total land area acquired for the construction of the roadway. Its width should be enough to accommodate all the elements of the roadway cross section, any future widening of the road and any public utility facilities that will be installed along the roadway. |
| Vegetation | : | 'Vegetation' describes the total assemblage of plants (including forests). This includes a diversity of plants in a wide range of habitats. |
| Water Audit | : | A household water audit is an assessment of how much water is used and how much water can be saved in the home. Conducting a water audit involves calculating water use and identifying simple ways for saving water in the home. It is important to realize that water use throughout the year often varies with the season. |
| Water Pricing | : | Water pricing is a means of exercising a public policy about water. Water prices have been steadily rising in the past years due to the high demand and the fact that water quality has deteriorated and demands additional processing before it is provided to consumers. |
| Water Resources | : | Water resource, any of the entire range of natural waters that occur on the Earth, regardless of their state (i.e., vapour, liquid, or solid) and that are of potential use to humans. |
| 3R | : | The 3Rs stands for: Reduce: Reduction of waste generation; Reuse: Reuse of products and parts; Recycle: Use of recycled resources. |

# Executive Summary

## Background and project context

Karnaphuli Gas Distribution Company Limited (KGDCL) under Petrobangla is supplying natural gas to different stakeholders in Chattogram and Chittagong Hill Tracts (CHT). KGDCL is playing a vital role in national development by depositing the revenue generated through the sale of gas at the customer level to the government exchequer. The development of Chattogram, the commercial capital, was greatly hindered due to long-term shortage of gas. Due to the problem of gas scarcity and low pressure, despite the huge potential, the industrial factories of Chattogram have not been able to reach the desired production target and build new gas-based industrial factories.

At present, the new and increased gas demand of the industrial customers in Fouzdarhat, Sitakund, Mirsharai areas of Chattogram is increasing tremendously. By 2030, in Fauzdarhat, Sitakunda, Mirsrai (without economic zone) area under KGDCL will have daily gas demand of 400 MMcf. The existing gas distribution infrastructure of KGDCL cannot supply more than 50 MMcf of gas per day. The existing industrial establishments in this area are increasing their production capacity through factory expansion and new factories are being built. Upgradation of the existing gas distribution infrastructure has become necessary to meet the additional 350 mmcfd gas demand of these industries.

The existing gas distribution lines are currently placed at the middle of the constructed Dhaka-Chattogram Highway roads which is unclear due to continuous roads expansion. The present project has been undertaken by KGDCL to avoid safety risk and complication of maintenance works as well as to facilitate new connection and load enhancement process, and thus, to ensure stable gas supply and ease customer delivery services. Under this project the existing distribution network will be replaced by the newly constructed pipelines on north side of the Dhaka-Chattogram Highway Road.

KGDCL has an Environmental Management Unit comprised of professional experts. The environmental team will provide a framework for continual environmental and social management during project implementation period with an aim of improvement in its performance. KGDCL has all the required resources and expertise from concept to commissioning of gas distribution networks available in-house. KGDCL has adopted several customer-friendly initiatives such as multiple customer contact channels in the interest of Customer's convenience.

## Compliance requirements

The construction of gas transmission pipeline project falls under "Red" category according to the Environment Conservation Rules, 1997 and Environmental Protection Rules, 2023. Therefore, this project requires Site Clearance Certificate (SCC) and Environmental Clearance Certificate (ECC) from the Department of Environment (DoE). KGDCL has to conduct an Environmental Impact Assessment (EIA), and then submit report to DoE in order to obtain the SCC and also ECC from DoE. The environmental studies such as EIA are the prerequisites for the selected route where the proposed gas distribution pipeline and installation of associated facilities would be constructed.

Sustainable Enviro-Tech Services Limited (SETS) has been assigned to carry out required environmental studies for this proposed project. Accordingly, a multi-disciplinary team from the SETS has conducted this EIA study and prepared EIA report.

## Project summary

Recently, the new and increased gas demand of the industrial customers in Fouzdarhat, Sitakund and Mirsharai areas of Chattogram is increasing tremendously. By 2030, in Fauzdarhat, Sitakunda, Mirsrai (without economic zone) area under KGDCL will have daily gas demand of 400 MMcf. The existing gas distribution infrastructure of KGDCL cannot supply more than 50 MMcf of gas per day. The existing industrial establishments in this area are increasing their production capacity through factory expansion and new factories are being built. Upgradation of the existing gas distribution infrastructure has become necessary to meet the additional 350 mmcfd gas demand of these industries. In this case, considering GTCL's Barotakia and Shitalpur TBS points as the source of gas, it is possible to improve the gas distribution infrastructure by constructing 57 km 20-inch 150 Psig gas distribution pipeline. This will solve the existing fuel supply problem and promote industrial development.

The proposed project includes construction of gas distribution pipeline from Madam bibir hat, Fouzdarhat to Mirsharai, Baraiyarhat and Off-take Valve station. The distribution line hook up at GTCL'S Barotakia and Sitalpur TBS point. The description is given below:

| | | |
|---|---|---|
| Gas pipeline | : | 20"Φ× 150Psig× 57 km gas distribution pipeline from Madam bibir hat, Fouzdarhat to Barairhat, Mirsharai. The pipeline would cross 50 khals, 27 ponds, 42 ditch, 11 no culvert & 212 no roads. It will be located along (ROW) East side of Dhaka–Chittagong Highway. |
| Off-take valve: station | | 8 nos of different Off-take Valve station at different points of gas pipeline. |
| Interconnection: with TBS point | | Connect the gas pipeline with 2 GTCL'S TBS point as a source of gas supply. These points are Barotakia, Mirsharai and Sitalpur. |

## Existing environmental condition

The data relevant to Rainfall, Temperature, Relative Humidity and Wind speed as climatological information were gathered from the BMD station in Chattogram (nearest BMD station) and then were analyzed. The entire study area has a number of water bodies in the form of lakes, beels, khal, and rivers/ canals. The proposed underground gas transmission line will cross 50 khals, 27 ponds, 42 ditch, 11 no culvert & 212 no roads. The study area including proposed gas transmission pipeline project area is lying under two agro- ecological zones namely: (i) Young Brahmaputra and Jamuna Flood plain and (ii) Madhupur Tract. According to the fisheries officer and local people total 15 fish species belongings to 10 families are found in the depot area. Cyprinidae family was found eight times among this species. The proposed gas trnasmisison pipeline route is covered by coastal and marine water bio-ecological zone.

## Impact prediction and management plan

The project will be implemented along Dhaka-Chattogram Highway Road and therefore, it has impacts on surrounding soil, water, air, vegetation and biodiversity. Vegetation along the proposed project alignment would be damaged because of land development for the construction activities. It would be needed to trimmed many vegetation coverage areas in the project area. These activities may impede habitats of urban flora and fauna; however, none of them are in IUCN threatened category list. There are many local vegetation species which have rapid growth rate and are suitable for Highway areas. Such vegetation species shall be undertaken in order to mitigate the damage and promote the available breeding and roosting space for land-birds, flora-and-fauna, fauna, and subspecies.

The soil of highway areas through which the gas transmission pipeline would pass that would be largely damaged during the construction period. The topsoil of the surrounding areas are likely to be covered with the subsoil from the trench. Moreover, the soil profile of the hole would be altered and loosened. Therefore, the contractor shall carefully dig the trench for laying the gas pipeline. The excavated soil should be appropriate stacked in order to refill the hole and the sequence of the soil profile should be maintained correctly, for example – substratum, Subsoil and Topsoil. In addition, the loosened topsoil must be compacted properly and then covered by rapid growth vegetation to prevent from soil erosion.

A large volume of construction wastes will be generated during the project implementation activities which are mainly solid and liquid wastes. Such wastes should not be dumped in the project site but kept in a container for reuse, recycling and safe disposal in the wastes disposal sites.

The illegal disposal of construction wastes into drainage facilities, lakes and canal/ rivers will damage fish habitats. Therefore, the contractor should take care in order to avoid accidental contamination of the surrounding fish habitats by metallic dust. Locally available chemical absorbents should be kept at hand for use during unwanted contamination. Metallic wastes should be dumped and removed periodically from the project site according to DoE standards.

The construction activities adjacent to rivers, canals and lakes would reduce parental stocks of fish which would temporarily hamper fish production. Fish habitats should be kept as natural as possible by avoiding construction of concrete structure. The interventions in the canals and lakes should be completed within the shortest possible time to minimize loss.

The noise generation from construction activities may deteriorate the quality of habitats of wildlife communities. The noise pollution may be minimized by installing temporary barriers and installing noise reducing devices with the equipment. Besides, no gas pipeline construction should be carried out during the nighttime for safety purposes.

The construction activities would create employment opportunities. Local semi-skilled and unskilled labors should be preferred for both the construction and management work. This would facilitate cooperation from the local people.

This project would be implemented along the Dhaka-Chattogram Highway areas and therefore the gas transmission pipeline would cross many roads, railway lines, bridges, culverts, lakes, canals and rivers. Thus, it may temporarily disrupt communication. So, substitute diversion roads must be ensured when construction work begins. The owners of the land shall be compensated, and their land must be brought back to its preceding condition at the end of the construction phase. Indicative road signs must be placed at the construction sites. Traffic signals and warning for children, women, disabled and other pedestrians should be provided. The positive socio-economic impacts of the project include availability of less expensive and clean fuel, temporary employment for the local population and potential business and industry opportunities.

Most of the negative impacts will be temporal and their magnitude can be brought down to permitted limit according to the EIA study findings. Long term impacts would be mostly positive in consideration of which Site Clearance Certificate (SCC) and Environmental Clearance Certificate (ECC) may kindly be issued.

# General Information

The proposed project is one of the governments prioritized projects. The sustainable supply of gas is an essential component for industrial production. Karnaphuli Gas Distribution Company Limited (KGDCL), under PetroBangla is attempting to increase its gas supply facilities in order to cover majority of the industrial hubs and residential areas in Chattogram. Therefore, KGDCL has planned to implement a gas distribution network upgradation project. The general information regarding the implementing project is mentioned below:

**(a) Project:**

Name of the project: *Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram*

Name of project promoter: Karnaphuli Gas Distribution Company Limited (KGDCL)

১৩৭/এ, সিডিএ এভিনিউ, ষোলশহর, চট্টগ্রাম

ফোনঃ +৮৮০২৩৩৪৪৫২৭৯৬, ফ্যাক্সঃ ০৩১ ৬৫৬২৩৯

ইমেইলঃ info@kgdcl.gov.bd

ওয়েবঃ www.kgdcl.gov.bd

Project responsible persons: (1) Mr. Engr. Mohammed Shafiul Azam Khan,
Designation: Project Director,
Mobile: 0000-000000
E-mail: xyz@gmail.com
(2) Engr. Mohammed Shahidur Rahman,
Designation: Deputy Project Direct
Mobile: 01794-367936
E-mail: xyz@gmail.com

KGDCL has own expertise team for conducting Environmental Impact Assessment (EIA) of the proposed implementing project. However, the specifically responsible person for conducting EIA of the ongoing project is: (1) Mr. Engr. Xyz Xyz
Designation:
Mobile:
E-mail:

**(b) Environmental Consultancy Firm:**


## Sustainable Enviro-Tech Services Limited (SETS)

Chowdhury Centre (8th Floor), CDA Avenue, Muradpur, Chittagong, Bangladesh.

E-mail: hafiz01819@yahoo.com

Website: www.setslimited.com


SETS is a Chattogram based Environmental Consultancy firm in Bangladesh. It provides many environmental services in order to bring sustainable environment and development. The provided services include - Initial Environmental Examination (IEE), Environmental Impact Assessments (EIA), Environmental Management Plan (EMP), Environmental Management System (EMS), Environmental Health and Safety (EHS) Management, Green House Gas (GHG), Ozone Depletion Substance (ODS), Stack Emission Monitoring/Testing, Indoor Air quality Monitoring/Testing, Noise/Sound Quality Monitoring/Testing, Temperature Quality Monitoring/Testing, Humidity Quality Monitoring/Testing, Water and Wastewater Testing Services, and Effluent Treatment Plant (ETP). SETS has a multi professional team who conduct the assigned activities. The expertise team that is assigned for conducting EIA of the ongoing gas distribution network upgradation project is as follows:

| Name | Expertise | Signature |
|---|---|---|
| Hafez Ahammad | Team Leader/ Environmental Consultant | |
| Dr. Ohidul Alam | Deputy Team Leader/ Waste Specialist | |
| Prof. Dr. Khaled Misbahuzzaman | Restoration Ecology | |
| Engr. Jalal Ahmed | Gas pipeline | |
| Shafat Hossen | Water Resources Specialist | |
| Iftekhar Uddin | Industrial Environment | |
| Junayed Ahmed | Environment and GIS | |
| Ehsanul Karim | Logistics Communication | |
| | | |
| | | |

# Chapter One
# Introduction

## 1.1 Background

Karnaphuli Gas Distribution Company Limited (KGDCL) under Petrobangla is supplying natural gas to various categories of customers in the regions of Chattogram and Chittagong Hill Tracts (CHT). KGDCL is playing a vital role in national development by depositing the revenue generated through the sale of gas at the customer level to the government exchequer. The development of Chattogram, the commercial capital, was greatly hindered due to long-term shortage of gas. Due to the problem of gas scarcity and low pressure, despite the huge potential, the industrial factories of Chattogram have not been able to reach the desired production target and build new gas-based industrial factories.

At present, the new and increased gas demand of the industrial customers in Fouzdarhat, Sitakund, Mirsharai areas of Chattogram is increasing tremendously. By 2030, in Fauzdarhat, Sitakunda, Mirsrai (without economic zone) area under KGDCL will have daily gas demand of 400 MMcf. The existing gas distribution infrastructure of KGDCL cannot supply more than 50 MMcf of gas per day. The existing industrial establishments in this area are increasing their production capacity through factory expansion and new factories are being built. Upgradation of the existing gas distribution infrastructure has become necessary to meet the additional 350 mmcfd gas demand of these industries.

To meet the country's overall gas shortage, the government started importing LNG from abroad. The process of connection to new industrial plants started with imported RLNG. At present, the new and increased gas demand of industrial customers in Faujdarhat, Sitakund and Mirsarai areas of Chittagong is increasing greatly. In this case, considering GTCL's Barotakia and Shitalpur TBS points as the source of gas, it is possible to improve the gas distribution infrastructure by constructing 57 km 20 inch 150 Psig gas distribution pipeline. This will solve the existing fuel supply problem and promote industrial development.

However, due to insufficient gas infrastructure of KGDCL in the area, it is not possible to meet the energy demand. The project has been proposed with the aim of meeting the stated energy needs and maintaining continuity of development.

KGDCL has planned to execute a project titled *'Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram'* under their own finance. Karnaphuli gas has undertaken the project to replace and extend existing gas pipeline network to increase supply, resolve problem with supply pressure & leakage in pipeline in the Chattogram regions (Fouzdarhat, Sitakunda, Mirsarai).

The existing gas distribution lines are currently placed at the middle of the constructed Dhaka-Chattogram Highway roads which is unclear due to continuous roads expansion. The present project has been undertaken by KGDCL to avoid safety risk and complication of maintenance

works as well as to facilitate new connection and load enhancement process, and thus, to ensure stable gas supply and ease customer delivery services. Under this project the existing distribution network will be replaced by the newly constructed pipelines on north side of the Dhaka-Chattogram Highway Road.

The existing gas supply network in Bangladesh is mainly traditional which is sometimes unwantedly impedes in sustainable gas supply due to leakage and low pressure. However, sustainable gas supply is essential to support meet customer's requirements and subsequently to promote economic growth of Bangladesh. The present gas network of the Chattogram City has been recognized and prioritized by Government of Bangladesh (GoB) for expansion of transmission capacity for augmentation of power generation of the region for promoting industrialization and commercial units which resulted in enormous gas demand in the area. Therefore, expansion of the existing gas transmission and distribution network becomes very essential to meet the demand of gas in the described area.

Under this circumstance, KGDCL has taken an initiative under the financial support from GoB for construction of about 57 km along the Dhaka-Chattogram Highway roads under Chattogram division high pressure gas transmission pipeline. Furthermore, an additional space along the Right of Way (RoW) will be considered as a study area.

According to Environmental Conservation Act (ECA), 1995 and Environmental Conservation Rules (ECR), 1997, KGDCL needs to take environmental clearance through the submission of Environmental Impact Assessment (EIA) Report from Department of Environment (DoE) before starting the construction work of gas distribution pipelines. However, the project falls under the Category of Red of ECR which require detail EIA Study. For preparation of Development Project Proforma (DPP), details of existing network information, and EIA is needed.

At this context, KGDCL has planned to engage a bonafied consulting firm for consultancy services for carrying-out Environmental Study of the aforementioned project to facilitate proper design, cost estimation and smooth implementation with a view to entailing in the expected objectives of the said project. Sustainable Enviro-Tech Services Limited (SETS) capable of carrying out such work efficiently and reliably.

The EIA study identified the potential environmental (physical, biological/ ecological) and socio- economic impacts due to construction of the gas transmission pipeline located within Fouzdarhat, Sitakunda and Mirsarai along Dhaka-Chattogram Highway, a detailed Environmental Management Plan (EMP) to mitigate the project oriented negative impacts and to promote beneficial impacts.

## 1.2 Objectives

The main objectives of the study of the project titled '*Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram*' include:

1. Conducting Approval of Terms of References (ToR)/Site Clearance Certificate from DoE;

2. Conducting EIA and achieving ECC/EIA Approval.

The specific objectives of the IEE study include:

- To conduct examination of the environmental and socio-economic consequences of the project in the study area;
- To obtain Site Clearance Certificate (SCC) from the Department of Environment (DoE);
- To initiate consultation with the project affected stakeholders and continue to do so at the EIA stage of the study;
- To prepare a Terms of Reference (ToR) for a detailed EIA;
- To obtain concurrence from DoE;
- To assist Karnaphuli gas in obtaining "No Objection Certificate" (NOCs) or roads cutting permission from Roads and Highway Department & other respective government offices for the concerned area of the project; and
- To assist Karnaphuli gas in getting an Environmental Clearance Certificate (ECC) from the DoE.

## 1.3 Study area

The project area covers Dhaka-Chattogram Highway roads within Chattogram Division along with RoW is located as per Natural Gas Safety Rule, 1991 from the acquisition boundary line. The construction work requires land for the following mentioned purposes:

- gas pipeline installation,
- vehicle movement,
- construction of stack yard, and
- workers/ employees shed.

The required area for construction related activities of this project will be belonging to the ownership of Roads and Highway Department (RHD). In addition, more areas on both sides of RoW which may have direct impact during project activities will cover from the centerline of the existing road alignment and will be considered as study area. Pipelines under this project will be laid along 2-meter from the boundary line of the acquired land. This study covers forty-two (42) regions in Chattogram which are listed in Table 1.1 and Figure 1.1 (a clear map is attached in Appendix).

*Table 1.1: Study area covers forty-two (42) regions in Chattogram*

| SL.N. | Name of Mouza and JL No. | Name of Union Parishad | Upazila |
|---|---|---|---|
| 01 | Kadimpara-58 | 9 No. Vatiary Union Parishad | Sitakunda |
| 02 | Kesobpur-56 | | |
| 03 | Jahanabad-55 | | |
| 04 | Shitalpur-53 | 8 No. Sonaichari Union Parishad | |
| 05 | Dakkinsonaichari-54 | | |

| | | | |
|---|---|---|---|
| 06 | Moddosonaichari-48 | | |
| 07 | Borokumira-46 | 6 No. Bashbaria Union Parishad | |
| 08 | Uttorsonaichari-47 | | |
| 09 | Musazinda-42 | | |
| 10 | Bashbaria-41 | | |
| 11 | Noakhali-33 | 5 No. Barabkunda Union Parishad | |
| 12 | Katgor-32 | | |
| 13 | Mohadevpur-27 | Sitakunda Municipality | |
| 14 | Muradpur-26 | | |
| 15 | Amirabad-25 | | |
| 16 | Sitakunda-28 | | |
| 17 | Dakkinterial-13 | Part of Sitakunda Municipality & Part of 2 No. Baroiyardala Union Parishad | |
| 18 | Kalabari-12 | 2 No. Baroiyardala Union Parishad | |
| 19 | Dormupur-11 | | |
| 20 | Uttorterial-07 | | |
| 21 | Foradpur-06 | | |
| 22 | Borokumoldaha-94 | 15 No. Wahedpur Union Parishad | Mirsarai |
| 23 | Wayedpur-89 | | |
| 24 | Maizgaon-87 | | |
| 25 | Pacchim Koiyarchara-72 | 12 No. Koiyarchara Union Parishad | |
| 26 | Duraro-77 | | |
| 27 | Purbaomoyani-78 | | |
| 28 | Pulmogra-76 | | |
| 29 | Purbomugadiya-73 | Mirsarai Municipality | |
| 30 | Moddomugadiya-71 | | |
| 31 | Mita Nala Rajapur-61 | | |
| 32 | Mita Nala Rajapur-107 | | |
| 33 | Purbomoyani-78 | Part of 13 No. Moayani Union Parsihad | |
| 34 | Pulmugra-76 | | |
| 35 | Mita Sara-54 | 9 No. Mirsarai Union Parishad | |

| | | | |
|---|---|---|---|
| 36 | Purbo Mitanala-51 | | |
| 37 | Durgapur-52 | 8 No. Durgapur Union Parishad | |
| 38 | Haripur-48 | | |
| 39 | Raipur-49 | | |
| 40 | Sonapahar-13 | 3 No. Jurarganj Union Parishad | |
| 41 | Koyalmurari-12 | | |
| 42 | Jamalpur-20 | Baroiyarhat Municipality | |

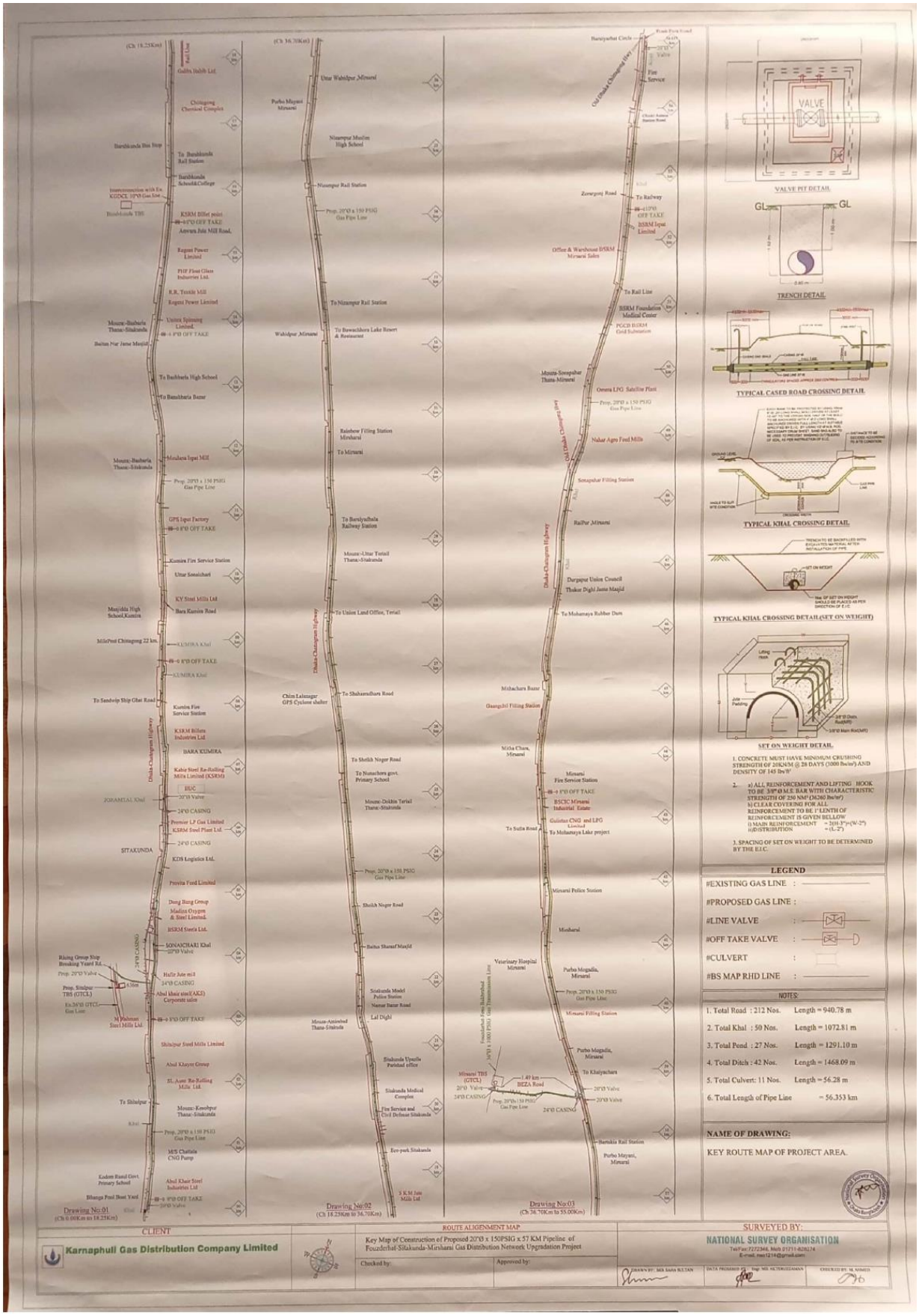


*Figure 1.1: Study area surrounding Chattogram Division*

## 1.4 Scope of EIA study

In order to fulfill the aforementioned requirements, officials of KGDCL and SETS has designed the Scope of Work (SoW) in connection with the Environmental Study under the project titled "*Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram*".

The EIA process aims to support decision making and permitting. Therefore, it is desirable (and part of the requirements set by most international lending institutions) that the Environmental and Social Impact Assessment (ESIA) process shall cover all components of the project through EIA. As per understanding of ToR following key points to be covered in which are given below:

- Selection of RoW from the alternatives and recommending one RoW, which involves minimum agricultural land, minimum households to be displaced, and minimum/ avoiding ecologically sensitive and historical areas.
- Land use/land cover including ecologically critical area, national parks, forest, orchard, cultural heritage site etc. if any, in the site (RoW) selected for the gas distribution pipeline.
- Meteorological data collection of the study area from Bangladesh Meteorological Department (BMD).
- Hydrological and morphological data collection from Bangladesh Water Development Board (BWDB).
- Agricultural data collection from Bangladesh Bureau of Statistics (BBS), Department of Agricultural Extension (DAE) and primary survey.
- Primary and secondary socio-economic data collection from field visit, and population and housing census, 2011 (BBS).
- Collection of environmental quality data including soil investigation, air quality, water quality, noise level etc. from the selected site.
- Source of water during construction and operation.
- Runoff and sanitary waste effluent discharges from labor camps during pre-construction and construction period.
- Establish the environmental and social baseline condition in respect of water resources, noise level, land resources, including land use/land cover, agriculture, fisheries, ecosystems and socio-economic condition.
- Conduct public consultation meetings.
- Identify the Important Environmental and Social Components (IESC).
- Assessment of initial impacts of the proposed project on the environmental and socio-economic components.
- Preparation of outlines for Environmental Management Plan (EMP).
- Preparation of ToR for the EIA study for getting approval of DoE.
- Produce an EIA report, which shall form the basis of obtaining Site Clearance Certificate (SCC) from the DoE.

- Presentation of EIA report to DoE (as required).

## 1.5 EIA methodology

The major purpose of the EIA report is to obtain a SCC for construction of proposed gas pipeline and modification of auxiliary infrastructure. The initial environmental screening revealed that the project would be considered a “red” category project according to the ECR, 1997. Hence, the conduction of full scale ESIA is required. Typically, the preparation of this EIA is based on existing scientific data published in different peer-reviewed journals and documents including primary data collected from field visit.

EIA study is used to find out the estimated potential environmental impacts of a project. The study is initiated with project components along with detailed engineering drawings and layout plan of the construction of proposed gas pipeline and modification of auxiliary infrastructure including the study area boundary from the KGDCL.

To visualize in detail the land-use of the study area, Remote Sensing images were superimposed. Different surveys were conducted by the multi-disciplinary team members to find out the environmental and social baseline condition of the study area. The multi-disciplinary team drew maps of the project area, selected important environmental components, likely to be impacted, and assessed the potential environmental consequences of the project. A systematic procedure was followed to conduct the EIA study which is shown in Figure 1.2.

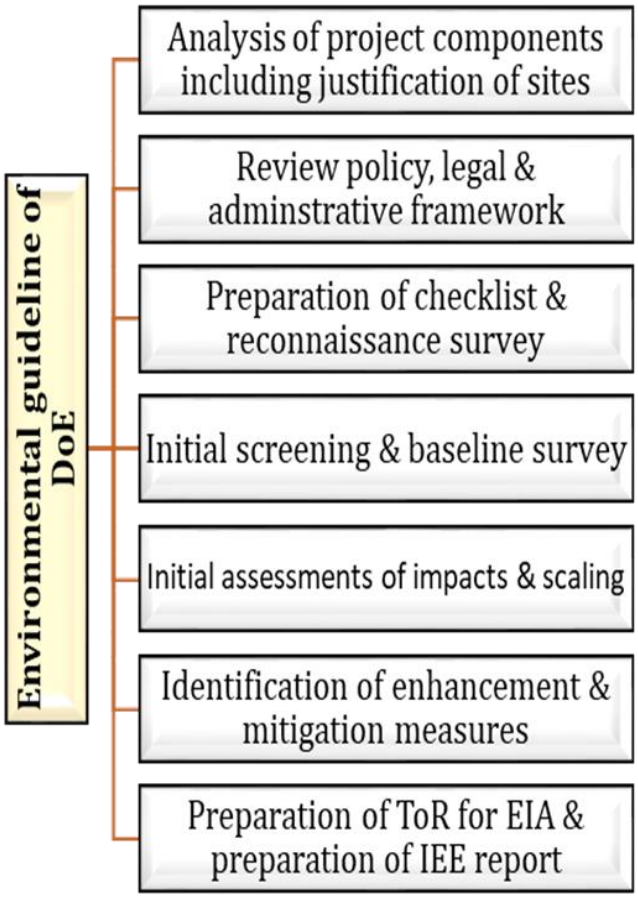


*Figure 1.2: Steps of Initial Environmental Examination (IEE)*

The understanding of the major environmental and social issues related to the project, the environmental and social baseline assessment started with following components step by step. Brief descriptions of each step of EIA are presented in Table 1.2.

*Table 1.2: Steps of EIA development for this project*

| Step | Activities | Description |
|---|---|---|
| **1** | *Analysis of the Project Components* | All the physical components of the project, like construction of pipeline, modification of TBS/CGS/DRS, temporary stack yard, temporary workers/ employees shed etc. were examined rigorously to develop checklist for field survey. The justification of selection of the project site was drawn by using physiographic map, soil and land type map obtained from secondary data/information. |

| | | |
|---|---|---|
| **2** | *Review Policy, Legal and Administrative Framework* | The national laws, by-laws, policies, guidelines, regulation of the GoB and applicable international conventions, treaties and protocols were reviewed to determine the proposed project activities in terms of legal obligations and guidance. The following policies, legal and administrative framework were considered for conducting the IEE study.<br>• National laws and by-laws on environment, forestry, industry, land use, land acquisition, power and energy, building, health and safety, raw material handling, construction and other relevant laws;<br>• National policies on environment, forestry, industry, land use, land acquisition, transport and communication, building, health and safety, raw material handling, construction and other relevant policies; and<br>• International conventions, treaties and protocols on environment, forestry, raw material handling, and others, if any. |
| **3** | *Preparation of Checklist* | Comprehensive checklists of potential environmental components under the physical, biological and social environments were prepared based on various guidelines of agencies e.g., DoE. These checklists were used to conduct field surveys. |
| **4** | *Initial Screening and Baseline Survey* | The lists of all the parameters selected in the previous step were made shorten by identifying their significance considering the project through reconnaissance survey. Data were collected from all possible secondary sources. Then final checklist was prepared and environmental baseline survey for physical, biological and social environment was conducted with the relevant checklists in hand to identify and delineate the significant effects of the project.<br>Public consultation meetings were arranged to inform the proposed interventions of the project to the local stakeholders and collect responses and feedback from them. People participated in the planning process of the project through this mechanism. |
| **5** | *Initial Assessment of Impacts and Scaling* | Short descriptions of existing physical, social and environmental condition of the project sites were prepared. The impacts of project interventions at different stages on the physical, environmental and social components were graded qualitatively (e.g., high, medium, low) in order to identify significance of the impact. |
| **6** | *Identification of Enhancement and Mitigating Measures* | From literature survey and applying expert judgment, lists of enhancement and mitigation measures for beneficial and adverse effects, respectively were prepared. The magnitudes of change in impact assessment were indicated. |
| **7** | *Preparation of ToR for EIA and Preparation of EIA Report* | Based on the IEE findings, a detailed ToR for subsequent EIA study has been prepared. The ToR specially focuses on the adverse impacts of high magnitude. Attention was also given on cumulative and residual impacts. Finally, this EIA Report has been prepared. |

## 1.6 EIA study team

The present EIA Report has been developed by a multi-disciplinary and professionals team of Sustainable Enviro-Tech Services Limited (SETS). Team Leader having extensive with experience with multidisciplinary expertise. The key members of the team have extensive experience in countries around the world and involvement in various prominent EIA, ESIAs and ESMPs projects. The other members of the team have extensive *Introduction* experience across the key sectors and issues likely to arise during the EIA, as shown in Table 1.3.

*Table 1.3: List of EIA development team*

| Sl No | Team Members | Designation |
|---|---|---|
| 1. | Hafez Ahammad | Team Leader/ Environmental Consultant |
| 2. | Dr. Ohidul Alam | Deputy Team Leader/ Waste Specialist |
| 3. | Prof. Dr. Khaled Misbahuzzaman | Ecology Expert |
| 4. | Jalal Ahmed | Gas pipeline Expert |
| 5. | Shafat Hossen | Water Resources Specialist |
| 6. | Iftekhar Uddin | Industry/ Environment Expert |
| 7. | Junayed Ahmed | Environment and GIS Expert |
| 8. | Ehsanul Karim | Logistics Communication |
| 9. | | |
| 10. | | |

# Chapter Two
# Legislative Requirements and Policy Consideration

## 2.1 Introduction

Development projects are governed by legal and institutional requirements set by the national environmental legislation of Bangladesh. Therefore, assessment of relevant legal provisions, policies, strategies and institutional issues are important for any project proponent before execution of a program or plan. Before initiating any development project, e.g. "*Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram*" it is required to obtain environmental clearance from Department of Environment (DoE). The activity of the proposed project is fall under the 'red' category according to the Bangladesh Environment Conservation Rules (ECR) 1997. Therefore, it is necessary to carry out an Environmental Impact Assessment (EIA) including the development of an Environmental Management Plan (EMP), for obtaining environmental clearance from the DoE. This document was released in December 1997 and addresses the EIA for several industrial sectors and activities. The EIA and permitting approaches are depicted in Figure 2.1.

This section of the Environmental Impact Assessment (EIA) describes the key regulatory framework relevant to the project which includes national policy and regulations and also international treaties, conventions and protocols that are applicable for the proposed project. Therefore, for the purposes of this report, only those regulatory requirements that are directly relevant to fulfil the requirement of EIA for this proposed project will be briefly discussed.

In Bangladesh, the environmental approval process is overseen by the Department of Environment (DoE) under the Ministry of Environment, Forest and Climate Change (MOEFCC) and the key regulations which govern this process are: Environment Conservation Act (ECA), 1995 and amendments in 2010, Environment Conservation Rules (ECR), 1997 (including all amendments), and National Environment Policy (NEP), 2018. In addition, DoE ensures the consistent application of environmental rules and regulations, and provides guidance during implementations of all projects.

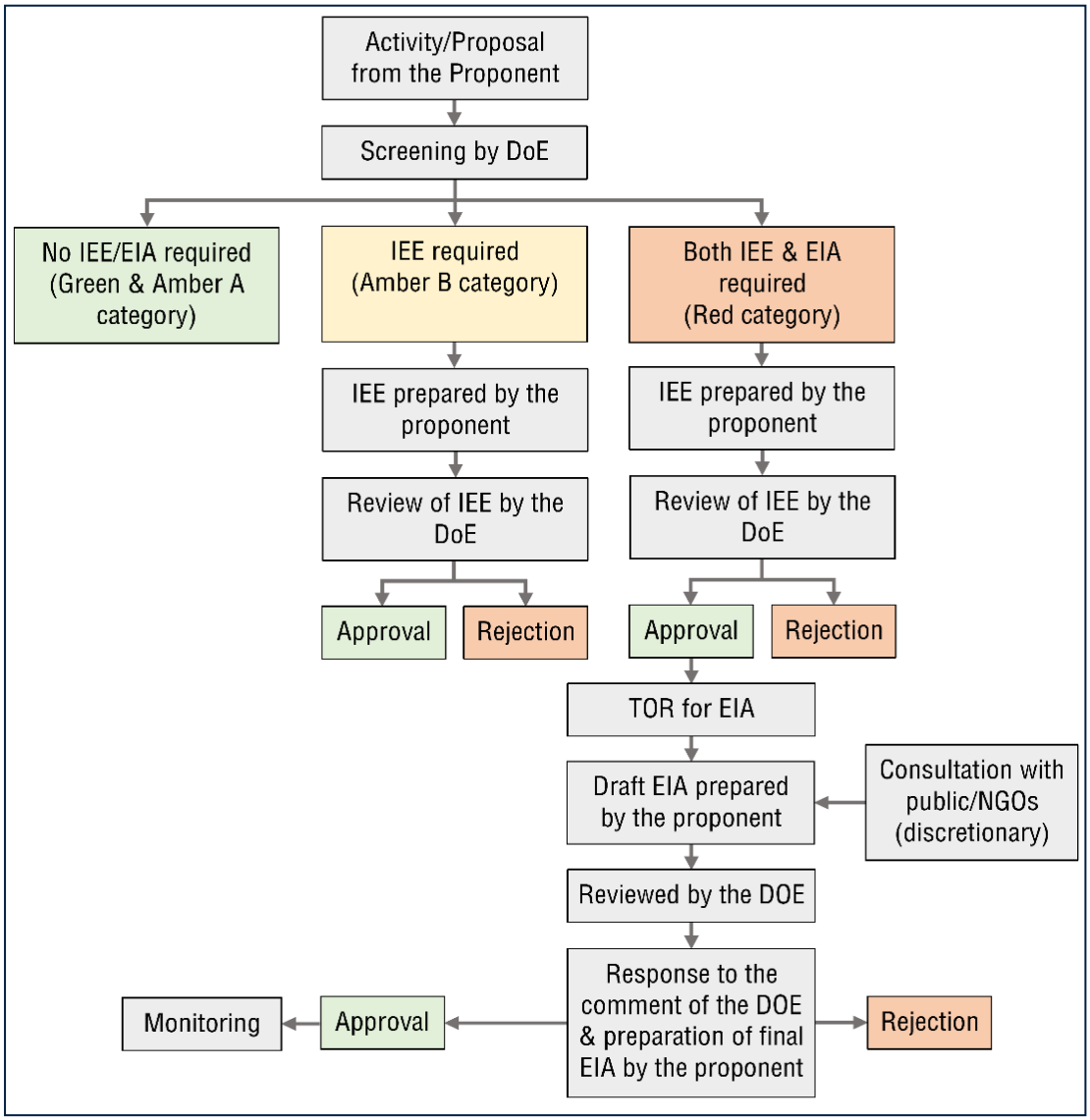


*Figure 2.1: Process of Securing ECC for a Red Category Project.*

## 2.2 Overview of Bangladesh environmental approval process

Industrialization is an essential prerequisite for rapid and sustained economic development and social progress. But it fetches environmental degradation like air, water and soil pollution. So, environmental management is necessary to decrease such environmental pollution and degradation. The Government of Bangladesh provides importance to protect environment and natural resources. The Government has included an article for environmental protection and pursuit of sustainable development.

According to Section 12 of ECA 1995 no industrial unit or project can be established or undertaken without securing an Environmental Clearance Certificate (ECC) from the Director General, DoE. Based on ECR1997, DoE has classified various development interventions according to the potential adverse environmental impacts for the purpose of issuing the ECC. This classification includes:

(i) Green: Assembling & manufacturing of TV, radio, toys etc.
(ii) Orange-A: Dairy farm, poultry, and restaurant
(iii) Orange-B: Glass factory, jute mill, bricks/ tiles
(iv) Red categories: Tannery, urea fertilizer, gas distribution line extension

In accordance with the noted regulations, the proposed project components (i.e., gas transmission and distribution pipelines) fall within the red category following the classification of DoE. As such, the Environmental Impact Assessment (EIA) will be required for submission to DoE to secure Site Clearance Certificate (SCC) followed by ECC. Figure 2.2 shows the process of securing ECC for a red category project.

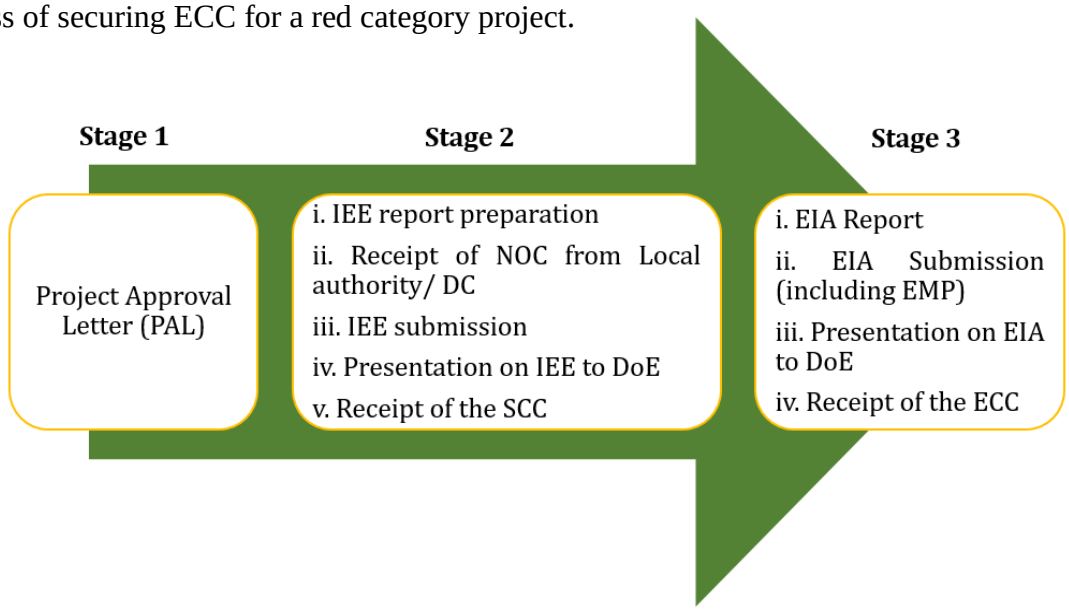


*Figure 2.2: Process for obtaining ECC from DoE for Red Category Project.*

## 2.3 Relevant Bangladesh legislations

The national legislations, policies and plans that are relevant to this proposed project are categorized by sectors and listed below in Table 2.1:

*Table 2.1: Sector-wise Relevant Bangladesh Legislations, Policies and Plans*

| Sector | Legislation |
|---|---|
| Environment and Natural Resources | • Environment Conservation Act, 1995 and amendment in 2010.<br>• Environment Conservation Rules, 1997 and all amendments,<br>• Environment Court Act, 2010,<br>• Bangladesh Biodiversity Act 2017<br>• Wildlife (Conservation and Security) Act, 2012- (Applicable as some species located at the river route expected to be affected due to project activities)<br>• National Environment Policy, 1992<br>• National Environment Policy, 2018<br>• Solid waste management rules, 2021<br>• Environmental conservation rules, 2023<br>• National Environment Management Action Plan (NEMAP), 1995<br>• National Water Policy, 1999<br>• National Energy Policy, 2008<br>• Bangladesh Water Act, 2013<br>• Noise Pollution Control Rules, 2006 |
| Fisheries | • The Protection and Conservation of Fish Act-1950 and<br>• The Protection and Conservation of Fish Rules- 1985 |
| Land Use and cultural heritage | • Antiquities Act 1968<br>• Acquisition and Requisition of Immovable Property Act, 2017<br>• National Land Use Policy- 2001 |
| Power generation, energy, industries and utilities | • Bangladesh Petroleum Act, 1974,<br>• Bangladesh Energy Regulatory Commission Act-2003,<br>• Electricity Act,2018,<br>• Gas Act, 2010,<br>• Telegraph Act, 1985,<br>• Safety Rules, 2003,<br>• National Energy Policy, 2008,<br>• National Industrial Policy, 2010, |

| | |
|---|---|
| Safety and security | • Bangladesh Natural Gas Safety Rules, 1991,<br>• Fire Services Ordinance, 1959<br>• Fatal Accident Act, 1855<br>• Dangerous Cargoes Act, 1953<br>• Explosive Act, 1884<br>• The Penal Code, 1860 |
| Public procurement and port | • The Public Procurement Regulations- 2003 (including all amendments),<br>• Ports Act, 1908 |

## 2.4 Brief descriptions of relevant Bangladesh regulations

National policy, laws and rules relevant to gas transmission pipeline installation, operation and maintenance including associated activities have been preliminary identified under this study. Under the national legal framework, the proposed intervention needs to comply with the environmental legislations of the country and needs to fulfill the requirements to obtain required permissions to implement these activities. The key national policy and legislations that are relevant to this proposed project are briefly described below.

### 2.4.1 Environment

***Environmental Conservation Rules, 2023***

The Ministry of Environment, Forest and Climate Change (MoEFCC) of the People's Republic of Bangladesh has issued a new Environmental Conservation Rules, 2023 on March 2023. This Rules has described the procedure of getting Environmental Clearance Certificate (ECC) from Department of Environment (DoE). This rule has made Environmental Impact Assessment (EIA) compulsory for getting ECC.

Rule-5 of ECR,23 has classified the industries and projects into four categories. These are –

- Green
- Yellow
- Orange
- Red

Each of the category has different procedure to get ECC from the DoE. Among the above four categories Red-categories industries need detailed EIA. Rule-15 of ECR, 2023 has details about the EIA of Red category industry or projects. Rule-16 of ECR, 2023 has urged for an assessment of public opinion of the project or industrial area before undertaking any project. And this public opinion assessment result must be incorporated into the EIA report and Environmental Management Planning of this project or industry. This rule ECR, 2023 has described the details procedure of conducting an EIA study Schedule-10 and Schedule-11.

Schedule-10 has mentioned the outline of an EIA study and Schedule-11 has described details about the EIA study format. According to the Schedule-10, the outline of an EIA study should include the followings:

- The name of the entrepreneur of the project/ industry,
- Details about the EIA team,
- Statement of need of the project/ industry,
- Project description/ concept,
- Other possible options of the project and justification of choosing one of them,
- Description of the existing environment,
- The baseline information of project area (Physical, Chemical, Biological and Social) with the methodology of sampling,
- Location of the project and existing land use scenario,
- Potential significant impacts of the project and the assessment methodology,
- Mitigation and abatement measures,
- Residual impact,
- Environmental Management Plan,
- Monitoring and follow-up plan, and
- Decommissioning plan when necessary.

According to the Schedule-11, an EIA study report should have the following sections and information in details:

- Executive summary of the EIA Study (Non-technical),
- General information about the entrepreneur and the responsible environmental consultant,
- Project description with alternatives,
- Existing environmental condition of project area,
- Impact prediction and evaluation,
- Mitigation measures, and
- Monitoring program.

This schedule-11 also has a format for the report of Environmental Management Planning (EMP). According to this Schedule, the following information should have in an EMP report:

- Introduction with highlighting the project purpose,
- Project description,
- Environmental policy,
- Environmental compliance requirements,
- Environmental impacts and mitigation measures,
- Environmental surveillance, monitoring and auditing,
- Contingency Planning,
- Organizational structure, and
- Budget and implementation programme.

***Bangladesh Environment Conservation Act (ECA), 1995***

The main legislative framework in order to protect environment in Bangladesh is the ECA 1995. This act includes laws for –

- Conservation of the environment,
- Improvement of environmental standards, and
- Control and mitigation of environmental pollution.

The ECA, 1995 has established the DoE, and empowers its Director General (DG), DoE to take measures as he considers necessary which includes –

- Conducting inquiries,
- Preventing probable accidents,
- Advising the government,
- Coordinating with other authorities or agencies, and
- Collecting and publishing information about environmental pollution.

In accordance with Section 12 of this act, no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying rules, an ECC from the DG of DoE. The present IEE study has been carried out in compliance with this Act.

The key legislation to protect environment is the ECA, 1995 in Bangladesh. This act is promulgated for environment conservation, standards, development, pollution control, and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The act has been amended in 2000, 2002, 2007and 2010 for upgrading. The main objectives and strategies of ECA, 1995 are given in Table 2.2.

*Table 2.2: Main objective of ECA, 1995*

| Main objectives | Summarized main strategies |
|---|---|
| • Conservation and improvement of the environment; and<br>• Control and mitigation of pollution of the environment. | • Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/ initiated in the ecologically critical areas;<br>• Regulations in respect of vehicles emitting smoke harmful for the environment;<br>• Environmental clearance;<br>• Regulation of the industries and other development activities' discharge permits;<br>• Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;<br>• Promulgation of a standard limit for discharging and emitting waste; and<br>• Formulation and declaration of environmental guidelines. |

The ECA, 1995 specified that no industrial unit or project shall be established or undertaken without obtaining ECC from DG in a manner prescribed by the rules. The project promoter must obtain ECC from the DG of DoE. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in

punishment of imprisonment or fine or both. The DoE executes the act under the leadership of the DG. The Bangladesh ECA (Amendment), 2000 focuses on:

1) Ascertaining responsibility for Compensation in cases of damage to ecosystems,
2) Increased provision of punitive measures both for fines and imprisonment, and
3) Fixing authority on cognizance of offences.

The Bangladesh ECA (Amendment), 2002 elaborates on:

1) Restriction on polluting automobiles,
2) Restriction on the sale and production of environmentally harmful items like poly-bags,
3) Assistance from law enforcement agencies for environmental actions,
4) Breakup of punitive measures, and
5) Authority to try environmental cases.

***The Bangladesh Environment Conservation Act (Amendment), 2010***

The amendment of ECA, 2010 was done in order to focus emerging environmental challenges in Bangladesh. The ECA, 2010, introduces new rules and restriction includes:

a) Ensure proper management of hazardous wastes to prevent *Environmental Pollution and Health Risk*,
b) No remarked water body cannot be filled up/changed; in case of national interest; it can be done after getting clearance from the respective department;
c) Emitter of any activities/incident will be bound to control emission of environmental pollutants that exceeds the existing emission standards, and
d) Government may declare any ecosystem as "*Ecologically Critical Area*" if it appears to be degraded or expected to be degraded and take all precaution measures to protect that ecosystem. In addition, government shall stop any ongoing activities and will not allow any new developments in the ecosystem after declaration of "*Ecologically Critical Area*".

***The Bangladesh Environment Conservation Rules, 1997***

The first set of environmental rules promulgated under the ECA 95 is the Environment Conservation Rules, 1997 (ECR, 1997). This rule has provided categorization of industries and projects, and identified types of environmental assessments needed against respective categories of industries or projects. So far, this set of rules has been amended three times include: February 2002, August 2002 and April 2003.

These rules set the following things among other:

A. The National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc.,
B. The requirement for and procedures to obtain environmental clearance, and
C. The requirement for IEE and EIA's according to categories of industrial and other development interventions.

According to the DoE, the proposed project is considered under the "Red" category of the ECR, 1997 and therefore, requires both IEE and EIA report submission to DoE for getting ECC.

***National Environment Policy 2018***

Bangladesh government developed National Environment Policy (NEP) 2018 through modification of National Environment Policy 1992 and based on ECA 1995 and ECR 1997. The National Environment Policy envisaged environment conservation, pollution control, biodiversity conservation, and mitigation of the adverse effect of climate change to ensure sustainable development. The sectors which are covered by NEP 2018 and related to the proposed project include in Table 2.3.

*Table 2.3: List of sectors covered by NEP 2018*

| Sectors | Key policies |
|---|---|
| Land Resources Management | • Sustainable land management,<br>• Strategic environmental assessment,<br>• Ensure ecosystem good & services,<br>• Protected area management |
| Water Resources Management | • Water security<br>• Integrated water resources management<br>• Water audit and pricing<br>• Economic valuation of water resources<br>• Ecologically critical and protected area<br>• Conservation of water reservoirs<br>• Payment for ecosystem services |
| Water Resources Management | • Water security<br>• Integrated water resources management<br>• Water audit and pricing<br>• Economic valuation of water resources<br>• Ecologically critical and protected area<br>• Conservation of water reservoirs<br>• Payment for ecosystem services |
| Air Pollution Control | • Use best available technologies<br>• Emission tax<br>• Fuel quality standard<br>• Emission testing certificate |
| Agriculture | • Organic farming<br>• Agricultural pollution<br>• Persistants Organic Pollutants<br>• Wasteland and degraded forestland |
| Biodiversity, Ecosystem Conservation and Biosafety | • Ecosystem diversity<br>• Genetically modified organisms<br>• Biodiversity conservation management plan<br>• Cultural World Heritage<br>• Urban Biodiversity |
| Fisheries and Livestocks | • Protection and restoration of waterbodies<br>• Protect water quality of waterbodies |
| Industrial Development | • 3R (Reuse, reduce and recycling)<br>• Clean development mechanism |

| | |
|---|---|
| | • Value addition of products |
| Energy and Mineral Resources | • Reduce polluting energy usage<br>• Renewable energy<br>• Reduce pollutants in energy |
| Communication and Transportation | • Mass rapid transit<br>• Non-motorized transport<br>• Reduce emissions from transport |
| Other Pollution Control | • Noise and vibration pollution<br>• Chemical pollution<br>• E-waste management |
| Environment Friendly Economic Development | • Energy from waste<br>• Carbon and energy footprint<br>• Resource efficiency |

***Solid Waste Management Rules 2021***

The Solid Waste Management (SWM) Rules, 2021 were published on December 23, 2021, under the Bangladesh ECA, 1995. The regulations define the responsibilities of businesses engaged in SWM and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The regulations also include provisions for the treatment of solid waste such as composting and energy recovery. The main provisions of the SWM rules are given in Table 2.4.

*Table 2.4: List of Provision for SWM as per SWM rule 2021*

| Main provision | Sub provisions |
|---|---|
| Resources recovery from waste | • The principles of management that consider the waste hierarchy, such as the 3Rs, segregation, and reduction, must be followed at all stages from waste generation to final disposal. |
| Responsibilities of waste generators, consumers, and users | • Dispose of waste in accordance with the regulations of authorities including local government.<br>• Dispose of waste separately.<br>• Do not dump, store, or burn waste outdoors. |
| Responsibilities of manufacturers and importers of products | • Collect non-biodegradable products such as glass, plastic, multi-layered packaging, bottles, and cans from consumers and then recycle or dispose of them.<br>• Determine work plans and implementation procedures for recycling and disposal.<br>• Ensure that EPR is properly implemented.<br>• Submit an annual report to the DOE on the amount of plastic recycled.<br>• Raise public awareness of proper SWM. |

The violation of the above provisions in any way are subjected to imprisonment for not more than two years or a fine not exceeding 200,000 taka, or both. The rules also include provisions for the treatment of solid waste such as composting and energy recovery.

***Noise Pollution (Control) Rules, 2006***

All Union Councils, Paurashavas/ Municipalities, City Corporations, and City Development Authority (i.e. RAJUK, CDA, KDA, RDA, CoxDA etc.) are authorized to mark off the areas under their jurisdiction as silent, residential, mixed, and commercial or industrial zones according to the Noise Pollution (Control) Rules, 2006 (Table 2.5). They should also put signs to mark those areas. The act also describes the approved standard limit of sound in the added schedule 1 and 2.

*Table 2.5: Noise Standard as per Classification given by Noise Pollution Rule, 2006*

| Type of area | Acceptable limit of noise level (dB) | |
|---|---|---|
| | Day time | Night time |
| Silent | 45 | 40 |
| Residential | 50 | 45 |
| Mixed | 60 | 50 |
| Commercial | 70 | 60 |
| Industrial | 75 | 70 |

In the schedule 1, silent area means area up-to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/ to be identified by the government. In the silent area it is prohibited to use any kind of horns of vehicles, audio signals and loudspeakers. According to this act, daytime is counted from 6am to 9pm whereas night-time is counted from 9pm to 6am.

***Air quality standard ECR 1997/2007***

The guidelines for air emission in terms of noxious gases and particulate matter are an important strategy to keep our air safe. In Dhaka City, the Air Quality Index (AQI) is frequently found exceeding the hazardous condition i.e. AQI≥300. The existing air quality conditions are mainly focused on Particulate Matter (µm 2.5), but for retaining air quality safe, it is needed to maintain both the noxious gases and particulate matter. As per section 06 of the ECA 1995, the driving of vehicles, emitting smoke that is injurious to health and environment is prohibited. If the Director General or any officer authorized by him is convinced that a vehicle is emitting smoke is harmful for health can stop the vehicle for examination. Air quality standard in Bangladesh and this air quality standard adhere to World Health Organization (WHO) guidelines (Table 2.6). In addition, air emission standard for motor vehicles and mechanized vessels are mentioned in the table.

The Ministry of Environment and Forests has - in exercise of the powers conferred by section 20 of the Bangladesh Environment Conservation Act, 1995 (Act 1 of 1995) - amended the Environment Conservation Rules, 1997 by notification SRO 220-Law/2005 of 19, July 2005

and issued new vehicular emission standards (http://www.doe-bd.org/aqmp/standard.html). Another revision is currently under discussion.

*Table 2.6: Standards for air quality in Bangladesh*

| Sl.N. | Parameter | Concentration ($mg/m^3$) | | Averaging Time |
|---|---|---|---|---|
| | | ECR | WHO/IFC | |
| **(i)** | Carbon Mono-oxide | 0.01 | - | 8 hours |
| | | 0.04 | - | 1 hour |
| **(ii)** | Lead | 0.5 | - | Year |
| **(iii)** | Nitrogen Oxides | 0.1 | 0.04 | Year |
| | | - | 0.2 | 1 hour |
| | | - | 0.2 | 1 hour |
| **(iv)** | Suspended Particulate Matter | 0.2 | - | 8 hours |
| **(v)** | Particulate Matter 10 µm (PM10) | 0.05 | 0.02 | Year |
| | | 0.15 | 0.05 | 24 hours |
| **(vi)** | Particulate Matter 2.5 µm (PM2.5) | 0.015 | 0.01 | Year |
| | | 0.065 | 0.025 | 24 hours |
| **(vii)** | Ozone | 0.235 | - | 1hour |
| | | 0.157 | 0.160 | 8hours |
| **(viii)** | Sulphur Dioxide | 0.08 | - | Year |
| | | 0.365 | 0.125 | 24hours |
| ***Notes: Air quality standard of IFC Guideline is quoted from WHO Guideline.*** ***Source: ECR, 1997*** | | | | |

***The Motor Vehicle Ordinance, 1983***

The Motor Rules, 1983 stated to impose a penalty of maximum two hundred taka for those vehicles that are emitting smokes that poses health hazard in the public places. It also restricts the passenger from smoking in public service vehicles and in any other vehicles with notice of not smoking. This ordinance is enforced occasionally but a regular enforcement would be helpful to reduce air pollution in big cities including Dhaka. However, it is to be noted that amount of the penalty is very low which may be revised as well.

***Bangladesh Environment Court Act, 2010***

The rapid population growth and economic development has imposed pressure on natural resources and ecosystem. Environmental disputes are frequently aroused throughout the country because of development activities. Therefore, Bangladesh government has enacted Bangladesh Environment Court Act, 2010 in order to resolve those disputes and establish justice over environmental and social damage raised due to any development activities. This act allows government to take necessary legal action against any party who creates environmental hazards/damage to environmentally sensitive and ecologically critical areas as well as human society. DoE as government agency can take legal actions if any environmental problem occurs due to the project interventions according to this act, for example –

- Bridges and roads,
- Constructions, and
- Any other development activities.

**Compliance with DoE's Guidelines**

The proposed project activities fall under the 'Red' category according to the ECR, 1997. For projects under this category, it is mandatory to carry out –

- A preliminary IEE study,
- A detailed EIA study including Environmental Management Plan (EMP), and
- Developing a Resettlement Plan for getting ECC from the DoE, if required.

The DoE has issued EIA Guidelines for industries and addresses the IEE and EIA for several industrial sectors and activities. Each Project Proponent shall conduct an IEE or EIA and is expected to consult and follow the DoE Guidelines (attached in the Appendix-III). The provisions of the environment legislations and the EIA guidelines of the DoE have been reviewed under this study. The DoE has issued application procedure for obtaining site/environmental clearance. The application procedure for "Red" category is described and shown above in Figure 2.2.

TGTDCL authority needs to apply for the site clearance from the DG, DoE in FORM3 specified under the ECR, 1997 accompanying with the IEE report according to the procedure. The respective authority after receiving an application in relation to an industrial unit or project of red category, will decide and reply within sixty (60) working days, be approved or the application shall be rejected mentioning appropriate reasons.

Environmental quality standards for air quality, noise, odor, soil, sewage discharge, industrial effluents, and industrial project emissions for Bangladesh are furnished in ECR 1997.

### 2.4.2 Biodiversity and natural resources

***The Forest Act, 1927 and Amendment Act 2000***

One of oldest act in Bangladesh is Forest Act 1927. It provides for reserving forests over which the government has an acquired property right. This act has made many types of unauthorized uses or destruction of forest produce punishable. The government may assign any village community its right to or over any land, which has constituted a reserved forest.

According to the act the government may prohibit certain activities in the declared reserved forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc.

Near the proposed location of the gas transmission pipeline no forest/mangrove forest exists at all. Therefore, the proposed project complies with this requirement of legislation. During the study this law and rules and regulations under it has been reviewed to explore whether the proposed activities of the project violates any provisions of the Forest Act.

The Supplementary Rules of 1959 empowered the concerned governmental bodies to restrict totally and for a specified period, the shooting, hunting or catching of various birds, animals and reptiles in the controlled and vested forests. The Private Forest Ordinance of 1959 provides for the conservation of private forests and for the forestation, in certain cases, of waste-land in Bangladesh.

***Wildlife (Conservation and Security) Act 2012***

The Wildlife (Protection and Safety) Act 2012, passed in parliament on 8th July, 2012. Under this act, the hunting, trapping, killing of wildlife are strictly prohibited. After the establishment of this act, a board will be formed with the concerned members recommended by the government. There are certain provisions kept in this act, e.g. entrance, management, rules and regulation of the protected area etc. If any person without license performs any kind of trade, he will be jailed for at least a year.

***The Land Acquisition and Requisition of Immovable Property Act 2017***

The 'Land Acquisition and Requisition of Immovable Property Act 2017' (gazette in September 21, 2017, henceforth, the Act 2017) repealed the Acquisition and Requisition of Immovable Property Ordinance1982 and is used as the legal support for land acquisition and requisition in Bangladesh. The Act 2017 requires that compensation to be paid for –

(i) Land and assets permanently acquired (including standing crops, trees, houses); and
(ii) Any other damages caused by such acquisition.

The act provides certain safeguards for the owners and has provision for payment of "fair value" for the property acquired. The act, however, does not cover project-affected persons without titles or ownership record, such as informal settler/squatters, occupiers, and informal tenants and lessee (without document) and does not ensure replacement value of the property acquired. The Act 2017 has no provision of transitional allowances for restoration of livelihoods of the non-titled affected persons.

The Deputy Commissioner (DC) determines "market value" of acquired assets considering previous 12 months' period from the date of notice of acquisition served (notice under Section 4 of the Act). The DC office adds 200% premium of the assessed value for Cash Compensation under Law (CCL) of acquired land and 100% premium to the loss of crops due to compulsory acquisition under the Act 2017. The mouza rate of land is generally less than the "market value" as owners customarily report lower values during registration to avoid and/or pay fewer taxes. If the land expected to be acquired has standing crops cultivated by tenant (bargadar) under a legal constitution in written agreement, the law requires that part of the compensation money be paid in cash to the tenant as per the agreement. Places of worship, graveyard and cremation grounds are not to be acquired for any purpose; but in unavoidable cases the land can be acquired subject to replacement (relocation and reconstruction) of those by the executive agency and for this project TDTDCL.

The DC processes land acquisition under the Act 2017 and pays compensation to the legal owners of the acquired land. The Ministry of Land (MoL) is authorized to deal with land acquisition through the DCs. If a project acquires only khas land or land from any other

government department, then the land will be transferred through inter-ministerial meetings following the preparation of acquisition proposal submitted to DC/MoL.

***The Protection and Conservation of Fish Rules, 1985***

These are a set of rules in line with the overall objectives of the Fish Act.

- Section 5 of the Rules requires that "No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters".
- Section 6 of the Rules states: "No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters".

Therefore, the proposed intervention needs to be carried in such a manner that the activities do not cause damage to the inland waters or within coastal waters fisheries.

***The Bangladesh Water Act 2013***

The Bangladesh Water Act 2013 was passed by the government on 6 November 2013 to ensure "integrated development, management, abstraction, distribution, use, protection and conservation of water resources". By virtue of this act all rights over surface water, groundwater, seawater, rainwater and water in the atmosphere is vested on the state. Notwithstanding the above, "rights over the surface water on any private land shall remain with the owners of such land", and such right to use the water shall be subject to the provision of the act. Furthermore, under the provisions of this act, "right to potable water, and to water for hygiene and sanitation shall be treated as the highest priority right".

The act makes a provision for constituting a National Water Resources Council headed by the Prime Minister. The Council is the highest decision-making body and is empowered to make policies, give instructions to develop National Water Resources Plan for integrated development and safe abstraction of water and its proper use to ensure protection and conservation of water resources. The council is also mandated to approve the National Water Resources Plan and ensure is implementation, as well as give advice to the government to enter into agreement through signing memorandum of understanding and/or signing conventions and treaty with any government and international or regional organization to undertake joint survey, exchange data/information with respect to common water resources and it abstraction and development and undertaking joint measures to prevent pollution of common water resources.

The act also makes a provision for approving national water resources plan prepared in accordance with the Water Resources Planning Act, 1992 containing among others the following matters namely:

- Analysis of economic, natural, social, political, environmental, and ecological and institutional elements, characteristics and impact of water resources;
- Integrated use of surface and ground water emphasizing the highest possible use of rainwater;
- Determination of water quality standard;

- Fixation of priority of water use.

The act also makes further provision for:

- Declaration of water stress area and management thereof;
- Preferential use of water in the water stress area and exemption thereof;
- Fixing the lowest safe yield level of aquifer and restrictions on abstracting groundwater; and
- Construction of flood control embankment which states "*to ensure the sustainability of the flood control embankment, no person shall, without the permission of the appropriate authority, be allowed to construct any house, establishment or any other structure on, or on the slope of such embankment*."

Finally, if anybody deliberately violates or ignore the responsibility or protection under this act, in that case, under the provisions of sub-section (2), she/he will get maximum of 5 years' imprisonment or maximum Tk.10, 000 as financial punishment or both the punishments.

***Bangladesh Biodiversity Act2017***

Bangladesh as a dualist country, requires implementing domestic legislation to give legal effect to the provisions of international treaties. After 25 years of the adoption of the Convention on Biological Diversity (CBD), the Bangladesh Biological Diversity Act 2017 was enacted to fulfil the State's international obligations. The law introduces Access and Benefit-Sharing (ABS) mechanism and also promotes research related to biotechnological and also documentation of traditional knowledge.

### 2.4.3 Gas and energy

***Bangladesh Natural Gas Safety Rules (1991)***

The Mineral Gas Safety Rules are extracted mainly from the American Society of Mechanical Engineers (ASME), American National Standard Institute (ANSI) and British Standards (BS) codes and practices, as well as the provisions of the Petroleum Act. The Rules covered different areas such as selection of areas, specification of pipeline crossings of different infrastructure including testing and commissioning of pipelines, pipeline operation and reporting of accidents. The rules also provided guidelines regarding separation distances between and pipelines and public properties.

***The Bangladesh Petroleum Act, 1974***

The Bangladesh Petroleum Act is enabling legislation that allows the GoB to enter into all aspect so petroleum exploration, development, exploitation, production, processing, refining and marketing. In addition, the government is authorized to enter into Petroleum Agreement(s) with any person(s) for the purpose of petroleum operations. The duties of such person(s) are:

- To ensure that petroleum operation is carried out in a proper manner and in accordance with good oil field practice.
- To carry out petroleum operation in any area in a manner that does not interfere with navigation, fishing and conservation of resources.
- To consider the factors connected with the ecology and environment.

Clause 6(2) of the Act sets out certain details related to environment and safety: “In particular, and without prejudice to the generality of the fore going provision, a person engaged in any petroleum operations shall, in carrying out such operations in any area:

- Control the flow and prevent the waste or escape’ in the area, of petroleum or water;
- Prevent the escape in that area of any mixture of water or drilling fluid with petroleum or any other matter;
- Prevent damage to petroleum-bearing strata in any area, whether adjacent to that area or not and;
- Keep separate any petroleum pool discovered in the area.”

Apart from the above, the law provides the following obligations:

- Prescribing places where petroleum maybe imported and prohibiting its import elsewhere;
- Regulating the import of petroleum;
- Prescribing the periods within which licenses for the import of [class i] petroleum shall be applied for, and providing for the disposal, by confiscation or otherwise, of any[ class i] petroleum in respect of which a license has not been applied for within the prescribed period or has been refused and which has not been exported;
- Regulating the transport of petroleum;
- Specifying the nature and condition of all receptacles and pipe-lines in which petroleum may be transported;
- Regulating the places at which and prescribing the conditions subject to which petroleum may be stored;
- Specifying the nature, situation and condition of all receptacles in which petroleum may be stored;

Prescribing the form and conditions of licenses for the import of dangerous petroleum, and for the transporter storage of any petroleum, the manner in which applications for such licenses shall be made, the authorities which may grant such licenses and the fees which may be charged for such licenses; (i) determining in any class of cases whether a license for the transport of petroleum shall be obtained by the consignor. Consignee or carrier;

- Providing for the granting of combined licenses for the import, transport [storage and distribution] of petroleum, or for any of such purposes;
- Prescribing the proportion in which any specified poisonous substance may be added to petroleum, and prohibiting the import, transport or storage of petroleum in which the proportion of any specified poisonous substance exceeds the prescribed proportion;
- Regulating the distribution of petroleum;
- Prescribing the conditions for the appointment of, and the granting of the licenses to, agents, dealers and stockiest;
- Prescribing the form and conditions of agreement between and agent, dealer or stockiest and an oil marketing company;

- Providing for cancellation or restoration of licenses of an agent or a dealer and of agreement between an oil marketing company and an agent, dealer or stockiest; and
- Generally, providing for any matter which in its opinion, inexpedient for proper control over the import, transport, storage and distribution of petroleum."

***The Fire Services Ordinance 1959***

Act, a Conservator is appointed for every port. The Conservator of the Fire Services Ordinance 1959 states that the owner needs to obtain a license under the Ordinance before using premises as a warehouse.

### 2.4.4 Environment and health safety

***The Penal Code, 1860***

The Penal Code, 1860 has some valid provisions related to pollution management, environment protection and protection of health and safety. Some of these are:

- Section 277: Falling Water or Public Spring or Reservoir;
- Section 278: Making Atmosphere Noxious to Health;
- Section 284: Negligent Conduct with Respect to Poisonous Substance;
- Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; and
- Section 286: Negligent Conduct with Respect to Explosive Substance. (Chapter XIV of offences affective Public health, safety, convenience, decency and morals).

***Import and Export Control Act, 1950***

The government may prohibit, restrict or otherwise control the import or export of goods of any specified description, or regulate generally all practices (including trade practices) and procedures connected with the import or export of such goods. No goods of the specified description shall be imported or exported except in accordance with the condition of a license to be issued by the Chief Controller.

***The Fatal Accidents Act, 1855***

An Act to provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. It is mentioned ins. 1, whenever the death of a person shall be caused by wrongful act, neglector default, and the act, neglect or default is such as would (if death had not ensued) have entitled the party injured to maintain an action and recover damages in respect thereof, the party who would have been liable if death had not ensued shall be liable to an action or suit for damages, notwithstanding the death of the person injured, and although the death shall have been caused under such circumstances as amount in law to felony or other crime.

***The Explosives Act, 1884***

The government may for any par to of Bangladesh, make rules consistent with this act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale transport and importation of explosives or any specified class of explosives.

Any person manufacturing, possessing, using, selling, transporting or importing an explosive in contravention of notification issued shall be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine which may extend to Fifty Thousand Taka, in default of which with a further imprisonment for a term which may extend to one year, and in the case of importation by water or land, the owner and master of the vessel or carriage in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine with a further imprisonment for a term which may extend to one year.

***Bangladesh Labor Act 2006 (Amendment Act, 2013)***

Bangladesh Labor (Amendment) Act, 2013 makes a large number of amendments to the 2006 Act. Regulations that aim is to protect the interests and rights of the workers, provision of comfortable working environment, reasonable working conditions, and ensure workers' safety and wellbeing of work force during project lifecycle. In addition, it also stipulated that child under 18 years are not allowed to be employed during project life cycle and therefore, this law requires to be complied.

***Bangladesh LaborRules-2015***

As per Labor Rules, 2015, any establishments who want to employ labor shall have to have service rules and must take permission from the Chief Inspector of labor. Manpower supply agency shall have registration under labor act. Rules prescribed process for investigation of misconduct. Rules also elaborated two festival bonus, provident fund elaborated, details of holidays, health and fire safety and clarification for calculating wages, prescribe form for filling case in the labor court and also approval of factory plan and extension etc.

## 2.5 Bangladesh relevant international environmental agreements

It has been noted that Bangladesh has already had accessed to, ratified or signed a number of important multilateral environmental agreements (MEAs) related to environment protection and conservation of natural resources which shall have to be complied with during implementation of the project. The pertinent one of these are highlighted in Table 2.2 and also brief outlines described in Table 2.7:

*Table 2.7: International Environmental Agreements that are rectified by Bangladesh*

| International environmental agreement | Date ratified |
|---|---|
| Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris 1972) | 3 November 1983 |
| Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar 1971) | 21 September 1992 |
| Convention on Biological Diversity, 1992 | 3 May 1994 |
| Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington1973) – also known as CITES | Amended at Bonn, on 22 June1979 |

| | |
|---|---|
| | Amended at Gaborone, on 30 April 1983 |
| Convention on the Conservation of Migratory Species of Wild Animals (Bonn1979) | 1 December, 2005 |
| Vienna Convention for the Protection of the Ozone Layer (on 22 March 1985) | 2 August 1990 |
| Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) | 2 August 1990 |
| Kyoto Protocol (international protocol to reduce greenhouse gas emissions),1997 | 22 October 2001 |
| United Nations Framework Convention on Climate Change (UNFCCC), 1992 | 1 April, 1993 |
| Rio Summit (United Nations Conference on Environment and Development), 1992 | 3 May, 1994 |
| Basel Convention (Control of Transboundary Movements of Hazardous Wastes and their Disposal), 1992 | 1 April, 1993 |

## 2.6 Environmental standards relevant to the project

As per contract of the project, the study shall have to comply with environmental, health and safety laws of Bangladesh. Present study will follow all available standards from Bangladesh, for example –

- ECR, 2023,
- ECA, 1995 and amendment in 2010,
- ECR, 1997, and
- Noise Pollution Control Rules, 2006

## 1.7 Report format

The EIA Report as part of Environmental Study fulfils the requirements of EIA under ECA, 1995 and ECR, 1997, and is prepared in accordance with the ToR given by KGDCL. The report contains fourteen (14) chapters and these are narrated in Table 1.4.

*Table 1.4: List of chapters for this EIA presentation*

| S. N | Name of chapter | Content of chapter |
|---|---|---|
| 1 | Introduction | This chapter includes the introduction containing background, objectives of the EIA study, scope of the study, and list of the members of EIA study team. |

| | | |
|---|---|---|
| 2 | Legislative Requirements and Policy Consideration | This chapter includes policy, legal and administrative framework describing the relevant policy and legal frameworks for conducting the EIA. |
| **3** | Project Data Sheet | This chapter include project proponent, location, nature & size, concept, component, activity & schedule, required resources & utilities, sources of primary fuels. |
| 4 | Project Description | This chapter illustrates the description of the project. |
| 5 | Existing Environmental Condition | It describes the environmental and social baseline condition with detail on physical environment, water resources, land resources, agricultural resources, fisheries resources, ecological resources and socio-economic condition. |
| 6 | Impact Prediction and Evaluation | It presents the potential impacts during pre-construction, construction and post- construction phases of the project. |
| 7 | Mitigation Measures | |
| 8 | Environmental Management Plan | It describes the outlines of preliminary EMP for minimizing the effect of the negative impacts and enhancement measures for increasing the benefits of the positive impacts and also presents a monitoring plan. |
| 9 | Risk Management | This chapter include risk assessment, frequency analysis, risk evaluation, risk evaluation, emergency response. |
| 10 | Environmental Monitoring Programme | This chapter includes the important environmental components of the physical environment, water resources, land and agriculture, fisheries, ecological resources and socio-economic condition. |
| 11 | Beneficial Impacts | |
| 12 | Institutional Capacity | |
| 13 | Public Consultation | It includes details out about the process and outcome of the public consultation meeting. |
| 14 | Conclusion and Recommendations | This is the concluding chapter of the EIA report with recommendation. |

# Chapter Three
# Project Data Sheet

## 3.1 Introduction

This chapter has provided a full description of project incorporating actual location, general layout, nature & size of the project, project component & activities, requirement of resource & demand, startup of operation, schedule of stuffing, support facilities and services under respective designated sub-headings.

## 3.2 Project proponent

Karnaphuli Gas Distribution Company Limited (KGDCL) a company of Petrobangla is a government agency assigned for up gradation of gas distribution network. This project will be implemented for increasing the existing gas distribution network capacity from 50 MMSCFD to 400 MMSCFD by constructing a 57km- 20 inch 150 Psig gas distribution pipe line as well as constructing 8 nos of different Off-take Valve station which will hook up at GTCL'S Barotakia and Sitalpur TBS point and supply natural gas to new industrial customers and responsible to design, construct, insure, operate, reduce associated risk, and maintain pipelines including associated structures. This project will be implemented by own financing of KGDCL.

## 3.3 Project location

The project "Fouzdarhat-Sitakund-Mirsharai Area Gas Distribution Network Upgradation Project" is located from Fouzdarhat to Mirsharai including Baraiyarhat. The length of the project is 57 km within the district of Chattogram. The construction work will require land for different purposes, e.g. gas pipeline installation, Off-take Valve station, vehicle movement, construction of stack yard and workers/employees shed which will be used by the contractors.

## 3.4 Nature and size of the project

The proposed project falls under the "Red catagory" as per the Environmental conservation rules of 2023. This project will be implemented to increase the existing gas distribution network capacity from 50 MMSCFD to 400 MMSCFD by constructing a 57km- 20-inch 150 Psig gas distribution pipe line along with constructing 8 nos of different Off-take Valve station which will hook up at GTCL'S Barotakia and Sitalpur TBS point. The proposed gas distribution line will interconnect with existing KGDCL gas distribution line. This gas distribution network upgradation project will help to meet up the rising demand of natural gas.

## 3.5 Project concept

KGDCL a company of Petrobangla supply the natural gas to different stakeholder in the region of Chattogram and Chittagong hill tract (CHT). KGDCL play a vital role in national development by depositing the revenue in government fund which collect from the consumers by selling the natural gas. Due to scarcity of gas and low-pressure problem, the industries of

Chattogram region unable to achieve the desired production and cannot establish the new gas base industries. At present, the new and increased gas demand of the industrial customers in Fouzdarhat, Sitakund, Mirsharai areas of Chattogram is increasing tremendously. By 2030, in Faujdarhat, Sitakunda, Mirsrai (without economic zone) area under KGDCL will have daily gas demand of 400 MMcf. The existing gas distribution infrastructure of KGDCL cannot supply more than 50 MMcf of gas per day. The existing industrial establishments in this area are increasing their production capacity through factory expansion and new factories are being built. Upgradation of the existing gas distribution infrastructure has become necessary to meet the additional 350 mmcfd gas demand of these industries. In this case, considering GTCL's Barotakia and Shitalpur TBS points as the source of gas, it is possible to improve the gas distribution infrastructure by constructing 57 km 20-inch 150 Psig gas distribution pipeline. This will solve the existing fuel supply problem and promote industrial development.

## 3.6 Project component

The proposed project includes construction of gas distribution pipeline from Madam bibir hat, Fouzdarhat to Mirsharai, Barairhat and Off-take Valve station. The distribution line hook up at GTCL'S Barotakia and Sitalpur TBS point. The description is given at table 3.1 (below).

*3.1 Description of the gas distribution*

| Sl. No | Major Component | Features | Location |
|---|---|---|---|
| **1** | Gas pipeline | 20"Φ× 150Psig× 57 km gas distribution pipeline from Madam bibir hat, Fouzdarhat to Barairhat, Mirsharai. The pipeline would cross 50 khals, 27 ponds, 42 ditch, 11 no culvert & 212 no roads. | (ROW) East side of Dhaka–Chittagong Highway. |
| **2** | Off-take valve station | 8 nos of different Off-take Valve station | Different points of gas pipeline |
| **3** | Interconnection with TBS point | Connect the gas pipeline with 2 GTCL'S TBS point as a source of gas supply. | Barotakia, Mirsharai and Sitalpur |

## 3.7 Project activity and schedule

The proposed project implementation timeline is July 2021 to November 2023.

Major activities of the project includes gas pipeline route survey, EIA, No objection from Roads and Highway Department (RHD) for proposed project area and also required activities within requisitioned area along the Right of Way (RoW), detailed drawing and design, procurement of materials, temporary storage and stockyard, equipment and vehicle mobilization, pipeline construction, and Pipeline testing, installation of CP system and commissioning and so on.

Specific schedule for action is attached below.

**সময়ভিত্তিক কর্মপরিকল্পনা**

**মৌজদারহাট -সীতাকুন্ড -মিরসরাই গ্যাস বিতরন নেটওয়ার্ক আপগ্রেডেশন প্রকল্পের কর্মপরিকল্পনা ফেব্রুয়ারি'২৩)**

| ক্রমিক নং | কার্যক্রম | | আরম্ভের তারিখ | সম্পাদের তারিখ | বছর-১ (২০২১-২০২২) | | | | | | | | | | | | বছর-২ (২০২২-২০২৩) | | | | | | | | | | | | বছর-৩ (২০২৩-২০২৪) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | জানু | ফেব্রু | মার্চ/২০২১ | এপ্রিল | মে/২০ | জুন/২০ | জুলাই/২০ | আগস্ট/২০ | সেপ্ট | অক্টো | নভে | ডিসে | জানু | ফেব্রু | মার্চ/২০২২ | এপ্রিল | মে/২০ | জুন/২০ | জুলাই/২০ | আগস্ট/২০ | সেপ্ট | অক্টো | নভে | ডিসে | জানু | ফেব্রু | মার্চ/২০২৩ | এপ্রিল |
| ১ | ইআইএ | লক্ষমাত্রা | ০১/০৪/২০২১ | ৩১/০৫/২০২২ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ২ | লাইন পাইপ ও আনুসঙ্গিক মালামাল ক্রয় | লক্ষমাত্রা | ০১/০৪/২০২১ | ৩০/০৬/২০২২ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | দরপত্র দলিল প্রস্তুতকরণ | লক্ষমাত্রা | ০১/০৪/২০২১ | ৩১/০৮/২০২১ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | ০১/০৪/২০২১ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | দরপত্র আহবায়ন, মুল্যায়ন, অনুমোদন ও চুক্তি সম্পাদন | লক্ষমাত্রা | ০১/১১/২০২১ | ৩০/০৪/২০২২ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | লাইন পাইপ ও আনুসঙ্গিক মালামাল সংগ্রহ/সরবরাহ | লক্ষমাত্রা | ০১/০৫/২০২২ | ৩১/০৮/২০২২ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ৩ | ২০" ১৪০ পিএসআই ৫৭ কিলোমিটার লাইন পাইপ স্থাপন, জিটিসিএল এর টিবিএস এর সাথে হুকআপ, বিদ্যমান বিতরন লাইনের সাথে আন্তঃসংযোগ ইত্যাদি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | দরপত্র দলিল প্রস্তুতকরণ | লক্ষমাত্রা | ০১/১১/২০২১ | ৩১/০১/২০২২ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | দরপত্র আহবায়ন, মুল্যায়ন, অনুমোদন ও চুক্তি সম্পাদন | লক্ষমাত্রা | ০১-০২-২০২১ | ৩১/০৩/২০২২ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ৫৭ কিলোমিটার পাইপ লাইন স্থাপন | লক্ষমাত্রা | ০১/০৬/২০২২ | ৩০/০৬/২০২৩ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | পাইপ লাইনের টেষ্টিং এন্ড কমিশনিং | লক্ষমাত্রা | ০১/০৭/২০২৩ | ৩১/০৬/২০২৩ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ৪ | সিপি সিস্টেম স্থাপন ( উপকরণ ক্রয়ের টেন্ডার আহবান, মুল্যায়ন ও চুক্তি সম্পাদনসহ সিপি স্থাপন) | লক্ষমাত্রা | ০১/০৬/২০২২ | ৩১/০৬/২০২৩ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ৫ | প্রকল্প সমাপ্তি, হস্তান্তর | লক্ষমাত্রা | ০১/০৬/২০২৩ | ৩১/০৬/২০২৩ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | অগ্রগতি | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | বিলম্ব | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Legend :** লক্ষমাত্রা: অগ্রগতি: বিলম্ব:

## 3.8 Required resource and utilities

Equipment: During construction phase, the proposed project needs various types of equipment like line pipe, Valve & bend of different size, coating, fittings and CP system

Manpower:

Water:

Power:

## 3.9 Source of primary fuels

# Chapter 4
# Project Description

## 4.1 Introduction

Karnaphuli Gas Distribution Company Limited (KGDCL) under Petrobangla is supplying gas to various categories of customers in Chattogram and Chittagong Hill Tracts (CHT). KGDCL is playing a positive role in national development by depositing the revenue generated through the sale of gas at the customer level to the government exchequer. The development of Chattogram, the commercial capital, was greatly hindered due to long-term shortage of gas. Due to the problem of gas scarcity and low pressure, despite the huge potential, the industrial factories of Chattogram have not been able to reach the desired production target and build new gas-based industrial factories.

To meet the country's overall gas shortage, the government started importing LNG from abroad. The process of connection to new industrial plants started with imported RLNG. At present, the new and increased gas demand of industrial customers at Faujdarhat, Sitakund and Mirsarai areas of Chattogram is increasing greatly.

But due to insufficient gas infrastructure of KGDCL in the area, it is not possible to meet the energy demand. The project has been proposed with the aim of meeting the stated energy needs and maintaining continuity of development.

***Project Implementation Period***

| | |
|---|---|
| (i) Date of Commencement | : July, 2021 |
| (ii) Date of Completion | : October, 2023 |

## 4.2 Objectives of the project

1) To accelerate the industrialization of the country, it has become mandatory work to increase the capacity of the distribution network in the said area from 50 mmscfd to 400 mmscfd.
2) To meet the increased gas demand of the existing customers and supply gas to new industrial customers at Faujdarhat, Sitakund, Mirsarai and Baraiyarhat areas of Chattogram.
3) Construction of gas distribution pipeline of 20" diameter x 150 psig x 57 km from Faujdarhat to Baraiyarhat along Dhaka-Chattogram highway to 400 mmscfd in the said area and inter connection of proposed pipeline with existing network of TBS of GTCL and KGDCL.

## 4.3 Rationale of the project

Faujdarhat, Sitakund, Mirsarai (excluding Mirsarai Economic Zone) area under KGDCL will have a daily gas demand of around 400 million cubic feet by 2030. Barabkund TBS (maximum capacity 70 million) and Mithachara TBS (maximum capacity 7 million) currently under GTCL and KGDCL's existing 10 bar pressure distribution infrastructure (12", 10", 8", 6" and 4" dia. about 30 km). It is not possible to supply more than 50 million cubic feet of gas per day.

Faujdarhat, Sitakund and Mirsarai are one of the largest industrial areas of the country. The existing industrial establishments in these areas have increased their production by expanding their factories. As capacity increases significantly and new industrial plants are coming up, upgradation of existing gas infrastructure has become imperative to meet the additional 350 mmscfd gas demand of these establishments.

In this context, several meetings were held at various levels with the officials of KGDCL with GTCL regarding the source of gas supply, technical and other ancillary issues.

The Project will help to address two critical issues in energy sector in Bangladesh:

1) Overcome the capacity limitation of the existing gas transmission pipeline.

2) Increase operational flexibility and supply reliability of the national gas transmission network.

Upon completion, it is estimated that current level of wellhead gas pressure can be maintained, and additional gas will be produced from KGDCL. The Project is, therefore, expected to make substantial contributions to Bangladesh’s economic growth.

## 4.4 Project results

By constructing a 20" diameter × 57 km pipeline from Fauzdarhat to Baraiyarhat, increasing gas connection to established industries at Fauzdarhat, Shitalpur, Sitakund, Mirsarai and Baraiyarhat areas and supplying additional 350 MMcfd of gas to newly constructed industries.

After the implementation of the project, the following benefits have been achieved.

a) Gas distribution network of KGDCL will be upgraded.

b) The number of new industrial customers will increase.

c) It will be possible to meet the increased gas demand of the existing industrial plants.

d) Government revenue will increase.

## 4.5 Project output

Upgradation of gas distribution network in Chattogram through construction of 20" diameter x 57 km distribution pipeline to supply gas to Fauzdarhat, Shitalpur, Sitakund, Mirsarai and Baraiyarhat areas of Chattogram.

Under the ongoing “Chattogram-Feni-Bakhrabad Gas Transmission Parallel Pipeline Construction Project” there is provision for construction of Chattogram-Feni-Bakhrabad

transmission line of 36-inch diameter with 1000 psig pressure and installation of a 200 mmcfd capacity TBS at Baratakia at Mirsarai.

## 4.6 Project site

Upgradation of the existing network will be possible by constructing a 20 inch diameter 150 psig pressure pipe line through the right of way (ROW) end (east side) of the Dhaka-Chattogram highway under the purview of Road Transport and Highways Department from Mirsarai to Baraiyarhat. The specification of the distribution pipeline to be constructed considering the salinity of the coastal area has been determined.

As it is not possible to lay the pipeline multiple times with the permission of Souz along the Dhaka-Chattogram highway, considering that the proposed pipeline may require gas flow at a pressure of 150 psig in the future, it is proposed to construct the pipeline with 300 class materials.

The proposed 20-inch diameter line should be connected with the two TBSs to be constructed at Baratakia and Shitalpur, along with construction of necessary pipelines and hookup activities. In order to increase the supply of gas to KGDCL's existing distribution network (12", 10", 8", 6" and 4" diameter) on the Dhaka-Chattogram highway, interconnection between the existing and proposed lines is to be established at various points.

## 4.7 Physical works of the Project

For the successful completion of the described project, the following tasks should be performed:

1. Purchase of goods and equipment.
2. Construction of 57 km pipeline of 20 inch diameter with 150 psig pressure through the right of way (RoW) of Dhaka-Chattogram highway under the purview of Road Transport and Highways Department from Madambibirhat in Fauzdarhat to Baraiyarhat at Mirsarai.
3. To connect the proposed 20-inch diameter line with TBS duo to be constructed at Baratakia and Shitalpur, to carry out hookup activities including the construction of necessary pipelines and to establish interconnections at various points between the existing distribution network and the proposed line on the Dhaka- Chattogram highway.
4. Installation of 08 offtake valves of different sizes at different points of the proposed pipeline to meet the gas demand of existing and future customers.
5. Clearing and grading - A 30 m wide Right of Use (RoU) area will be cleared off vegetation and other obstacles such as boulders. Tree felling will not take place.
6. Stringing–Pipes are transported to the site on trucks will be offloaded using side booms. Pipes are then strung adjacent to the trench. Trailers and cranes will be used for maneuvering of pipes. This activity may be done before or after trenching.
7. Trenching - Trenchers and backhoe type excavators will be used to dig the trench for laying the pipeline. The topsoil in agricultural areas will be removed and stockpiled for restoration. The excavated sub-soil will be stockpiled separately for backfill.

8. Bending – Pipes will be bent using a bending machine to the appropriate angle to match the vertical and horizontal alignment of the trench.
9. Welding - Welding will be done using conventional manual/ semi-automatic welding involving a crew of welders and fitters. Once the pipe is strung a line-up crew will position the pipe using side booms in preparation for welding. Pipe strings to be welded will be effectively earthed. During welding, at least one end of the pipe string will be closed to prevent a forced draught effect.
10. Coating: After welding at each weld joint, coating of field joints of bare pipes and the repair of coating shall be done by.
11. Back Filling: Proper backfilling is one of the most critical phases of pipeline construction. Backfill material is intended for filling the pipe trench and providing the required strength to keep the pipe from deflecting from external loading.
12. Re-instatement and Clean Up.

# Chapter Five
# Existing Environmental Condition

## 5.1 Introduction

Sitakunda and Mirsarai Upazillas are coastal areas which are in the southeastern part of Bangladesh. It is situated between 22.33°N and 91.47°E. The area is known for its hilly terrain, which is home to numerous natural and man-made wonders. It is a significant industrial area of the country, and the physical environment of this region has been shaped by both natural and anthropogenic factors. This section includes the existing environmental condition of study area, covering both the natural and social environments. The analysis was completed using a combination of secondary data sources to establish an understanding of the environmental and socio-economic baseline of the project area. The likely impacts on the environment based on the actual and foreseeable events/project activities. Data for this chapter were collected from:

- **Secondary Sources:** This included data from literature reviews, maps and monitoring reports;
- **Primary Sources:** This included gathering information from field surveys, and public consultations in the project area.

The baseline condition of environmental quality in the locality of project site serves as the basis for identification, prediction, and evaluation of impacts. The baseline environmental quality is assessed through secondary data within the impact zone for various components of the environment like air, noise, water and socio-economic etc. Data was collected from secondary sources for the macro-environmental setting like climate (temperature, rainfall, and humidity), physiography, geology etc. Firsthand information has been collected to record the micro-environmental features within and adjacent to the project area. Consultation was another source of information to explain local environmental conditions, impacts, and suggestions etc. The following section describes the baseline environment into four broad categories:

- **Physical Environment:** Geology and Soil, Topology, Land-use, Meteorology and Hydrology;
- **Biological Environment:** Factors related to life such as habitats, aquatic life, fisheries, terrestrial habitats, and flora and fauna;
- **Environmental Quality**: Air, Water and Noise Quality; and
- **Socio-economic Environment:** Anthropological factors like demography, income and infrastructure.

## 5.2 Meteorology

Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, moderately warm temperatures, and high humidity. Regional climatic differences in this flat country are minor. Four meteorological seasons are recognized;

- Pre-monsoon (March, April, and May),
- Monsoon (June to September),
- Post-monsoon (October and November) and
- Winter (December, January, and February)

Generally, pre-monsoon months are hot and humid; monsoon months are humid and rainy, post-monsoon months are quite hot and dry, but the winter months are cool and dry. Southwest monsoon or monsoon is the most important feature of controlling the climate of Bangladesh. More than 71% of the annual rainfall is received during this season. Variability in the onset, withdrawal of monsoon and quantum of rainfall during the monsoon season has profound impacts on water resources, power generation, agriculture, economics, ecosystems, and fisheries in Bangladesh. On the other hand, in winter season, temperature falls sharply in the north and north-western parts of Bangladesh.

### 5.2.1 Rainfall

Monsoon is a prominent season in this area. The annual rainfall in Bangladesh varies regionally between 1,700 and 5,500 mm, see Figure 5.1**.** The maximum measured annual precipitation reached approximately 2500 mm. The minimum annual precipitation was recorded in the very dry year of 1994 where only about 1200 mm was measured. The average monthly rainfall during monsoon (June–September) season from 1980–2013 is 332 mm per month. The variance in the maximum rainfall during monsoon season is 836 mm per month to 552 mm per month, whereas the variance in the minimum rainfall is 136 mm per month to 59 mm per month. The maximum 836 mm per month rainfall was recorded during September of the year 2004.

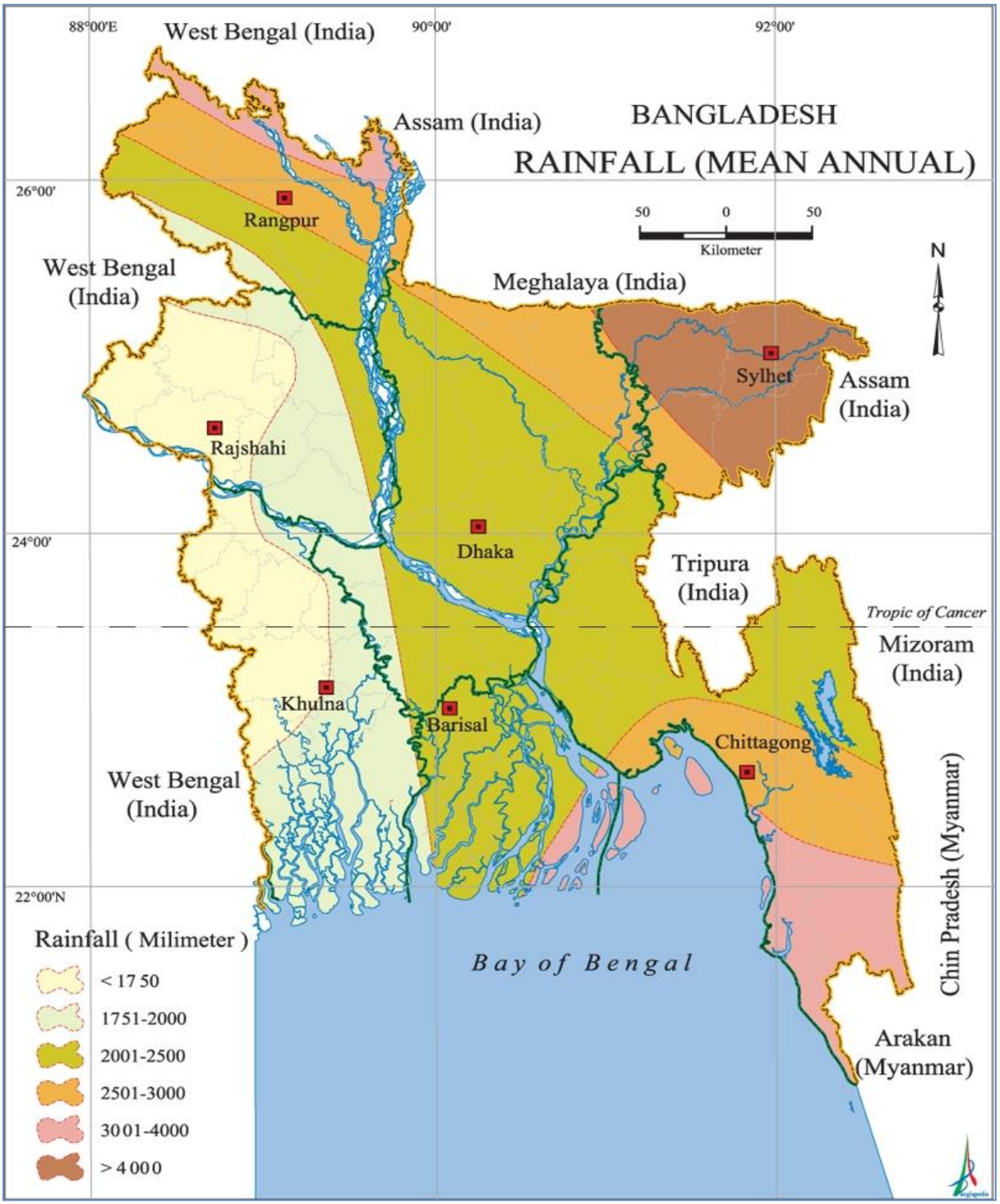


*Figure 5.1: Regional variation in annual rainfall (Source: Banglapedia, retrieved on August 22, 2019)*

Sitakunda-Mirsarai Upazila has a tropical monsoon climate. The area receives a significant amount of rainfall throughout the year, with the monsoon season (June to September) being the wettest. The annual average precipitation in Sitakunda-Mirsarai Upazila is around 2900 mm. Sitakunda receives a significant amount of rainfall throughout the year, with an annual average of 2500 mm. The monsoon season generally starts from June and continues till

September. Mirsarai Upazila receives a significant amount of rainfall throughout the year, with the monsoon season (June to September) being the wettest. According to data from the Bangladesh Meteorological Department, the maximum precipitation in Mirsarai Upazila in 2022 was 397.8 mm in July, while the minimum precipitation was 13.5 mm in December. The mean precipitation for the year was 194.1 mm. Here, is a tabular (Table 5.1) representation of maximum, minimum and mean precipitation of Sitakunda Upazila for the year 2022.

*Table 5.1: Precipitation data of Sitakunda Upazlia, 2022*

| Month | Maximum Precipitation (mm) | Minimum Precipitation (mm) | Mean Precipitation (mm) |
|---|---|---|---|
| Jan | 22.5 | 1.5 | 10.3 |
| Feb | 84.5 | 22.8 | 48.2 |
| Mar | 278.7 | 77.9 | 143.2 |
| Apr | 419.5 | 138.2 | 249.5 |
| May | 598.1 | 177.6 | 379.1 |
| Jun | 1161.9 | 214.6 | 690.3 |
| Jul | 1367.3 | 241.8 | 777.6 |
| Aug | 1188.6 | 241.2 | 661.9 |
| Sep | 639.7 | 200.6 | 410.1 |
| Oct | 218.5 | 46.9 | 132.2 |
| Nov | 35.5 | 14.5 | 24.8 |
| Dec | 7.5 | 1.5 | 4.4 |

Source: BMD

*Table 5.2: Precipitation of Mirsarai Upazila, 2022*

| Month | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) |
|---|---|---|---|
| January | 27.6 | 12.1 | 19.7 |
| February | 30.7 | 14.5 | 22.6 |
| March | 34.0 | 17.7 | 25.8 |
| April | 35.0 | 21.1 | 28.0 |
| May | 35.6 | 23.0 | 29.0 |
| June | 33.8 | 24.3 | 29.2 |
| July | 32.8 | 25.1 | 29.0 |
| August | 32.6 | 25.0 | 28.9 |
| September | 32.7 | 24.1 | 28.6 |

| | | | |
|---|---|---|---|
| October | 32.3 | 22.1 | 26.8 |
| November | 30.4 | 17.5 | 23.8 |
| December | 27.6 | 12.5 | 20.4 |

Source: BMD

### 5.2.2 Temperature

Sitakunda-Mirsarai Upazila has a tropical monsoon climate. The annual average temperature is around 26.9°C, with the maximum temperature of 33.6°C in May and the minimum temperature of 17.2°C in January. The area receives a significant amount of rainfall throughout the year, with the monsoon season (June to September) being the wettest.

The temperature at Sitakunda varies between 20°C to 35°C throughout the year. The maximum temperature is generally observed in April and May, while the minimum temperature is observed in January and December. Mirsarai Upazila is in Chittagong district and has a tropical climate, with high temperatures and humidity levels throughout the year. According to the Bangladesh Meteorological Department, the maximum temperature in Mirsarai Upazila in 2022 was 36.5°C, while the minimum temperature was 11.4°C. The mean temperature for the year was 26.7°C. The highest temperatures were recorded during the summer months of April through August, while the lowest temperatures were recorded during the winter months of December through February. The following table shows the average monthly temperature in Sitakunda for the year 2022.

*Table 5.3: Temperature of Sitakunda Upazila, 2022*

| Month | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) |
|---|---|---|---|
| January | 26.5 | 19.0 | 22.7 |
| February | 28.5 | 20.5 | 24.1 |
| March | 32.5 | 22.1 | 27.3 |
| April | 35.5 | 23.7 | 29.6 |
| May | 36.5 | 25.1 | 30.8 |
| June | 35.0 | 26.0 | 30.5 |
| July | 33.5 | 27.3 | 29.9 |
| August | 33.5 | 26.3 | 29.9 |
| September | 32.0 | 26.3 | 29.2 |
| October | 31.0 | 25.8 | 28.6 |
| November | 28.0 | 23.4 | 25.7 |
| December | 25.5 | 21.2 | 23.3 |

Source: BMD

*Table 5.4: Temperature of Mirsarai Upazila*

| Month | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) |
|---|---|---|---|
| January | 27.6 | 12.1 | 19.7 |
| February | 30.7 | 14.5 | 22.6 |
| March | 34.0 | 17.7 | 25.8 |
| April | 35.0 | 21.1 | 28.0 |
| May | 35.6 | 23.0 | 29.0 |
| June | 33.8 | 24.3 | 29.2 |
| July | 32.8 | 25.1 | 29.0 |
| August | 32.6 | 25.0 | 28.9 |
| September | 32.7 | 24.1 | 28.6 |
| October | 32.3 | 22.1 | 26.8 |
| November | 30.4 | 17.5 | 23.8 |
| December | 27.6 | 12.5 | 20.4 |

Source: BMD

### 4.2.3 Relative humidity

Sitakunda Upazila generally experiences a high level of humidity throughout the year due to its location near the Bay of Bengal. The humidity level tends to be highest during the monsoon season, which usually lasts from June to September.

According to the data from the Bangladesh Meteorological Department, the mean humidity level in Sitakunda Upazila ranges from 78.3% in December to 95.1% in July, with an overall mean humidity level of 89.4% for the year 2022. The highest recorded maximum humidity level was 99% in June, July, August, and September, while the lowest recorded minimum humidity level was 65% in December. It is worth noting that humidity levels can have a significant impact on human comfort and health, as high humidity can lead to feelings of discomfort and exacerbate respiratory conditions. The following part has a tabular representation of maximum, minimum and mean humidity of Sitakunda Upazila for the year 2022.

*Table 5.5: Humidity of Sitakunda Upazila, 2022.*

| Month | Maximum Humidity (%) | Minimum Humidity (%) | Mean Humidity (%) |
|---|---|---|---|
| January | 95.0 | 68.0 | 83.4 |
| February | 97.0 | 68.0 | 86.3 |
| March | 98.0 | 68.0 | 89.8 |

| | | | |
|---|---|---|---|
| April | 98.0 | 68.0 | 91.2 |
| May | 99.0 | 70.0 | 92.9 |
| June | 99.0 | 73.0 | 94.3 |
| July | 99.0 | 75.0 | 95.1 |
| August | 99.0 | 74.0 | 94.8 |
| September | 98.0 | 74.0 | 93.9 |
| October | 98.0 | 70.0 | 91.2 |
| November | 96.0 | 66.0 | 82.4 |
| December | 95.0 | 65.0 | 78.3 |

Source: BMD

### 5.2.4 Wind speed

According to the data from the Bangladesh Meteorological Department, the wind speed in Chittagong district for the year 2022 ranged from a minimum of 4.7 km per hour to a maximum of 37.3 km per hour. The mean wind speed for the year was 14.1 km per hour. The highest wind speeds were recorded during the months of February through September, with a peak in June and July. The lowest wind speeds were recorded during the winter months of December through February. Wind speed data is important for various applications such as aviation, marine transportation, and wind energy generation.

*Table 5.6: Wind speed of Chattogram district across the year*

| Month | Maximum Wind Speed (km/h) | Minimum Wind Speed (km/h) | Mean Wind Speed (km/h) |
|---|---|---|---|
| **Jan** | 32.4 | 4.7 | 11.8 |
| **Feb** | 37.3 | 4.7 | 13.4 |
| **Mar** | 35.8 | 4.7 | 14.5 |
| **Apr** | 35.8 | 4.7 | 14.5 |
| **May** | 35.8 | 4.7 | 14.5 |
| **Jun** | 37.3 | 4.7 | 14.5 |
| **Jul** | 37.3 | 4.7 | 14.5 |
| **Aug** | 37.3 | 4.7 | 14.5 |
| **Sep** | 37.3 | 4.7 | 14.5 |
| **Oct** | 35.8 | 4.7 | 14.2 |
| **Nov** | 35.8 | 4.7 | 13.4 |
| **Dec** | 35.8 | 4.7 | 12.4 |

Source: BMD

## 5.3 Geology

Bangladesh is one of the world's lowest lying countries. Extensive areas are liable to flooding during the monsoon season. This low-lying morphology is reflected in the geological succession in the country which is dominated by thick sequences of Cenozoic deltaic sediments. The Bangladesh geological sequence is dominated by the thick sedimentary sequence of the Bengal basin formed in the shadows of the Himalayan Mountain range. In the north-western part of Bangladesh is a stable shelf with thinner sediments compared to the basin Figure 5.2. Highlands are present to the north, east and west of Bangladesh in India and Myanmar (Burma). Dominated by the Bengal Basin, the structural geology of Bangladesh can be described as follows:

- On the north-western margins of the basin is an Eocene hinge or belt formed by the Ganges running from Rajshahi on the western Indian border towards the northeast border with India (approximate location of Nalkura). This hinge zone divides the thicker Bengal Basin sediments from the thinner northwest shelf sediments which include Gondwana coal sequences.
- Within the Bengal Basin are the Surma Basin in the northeast corner of Bangladesh and in the eastern delta region the Hatiya Trough.
- To the east of the trough are the Chittagong Hills that include the Kaladan Transvers Fault trending in the same direction as the hills – i.e., north–south.

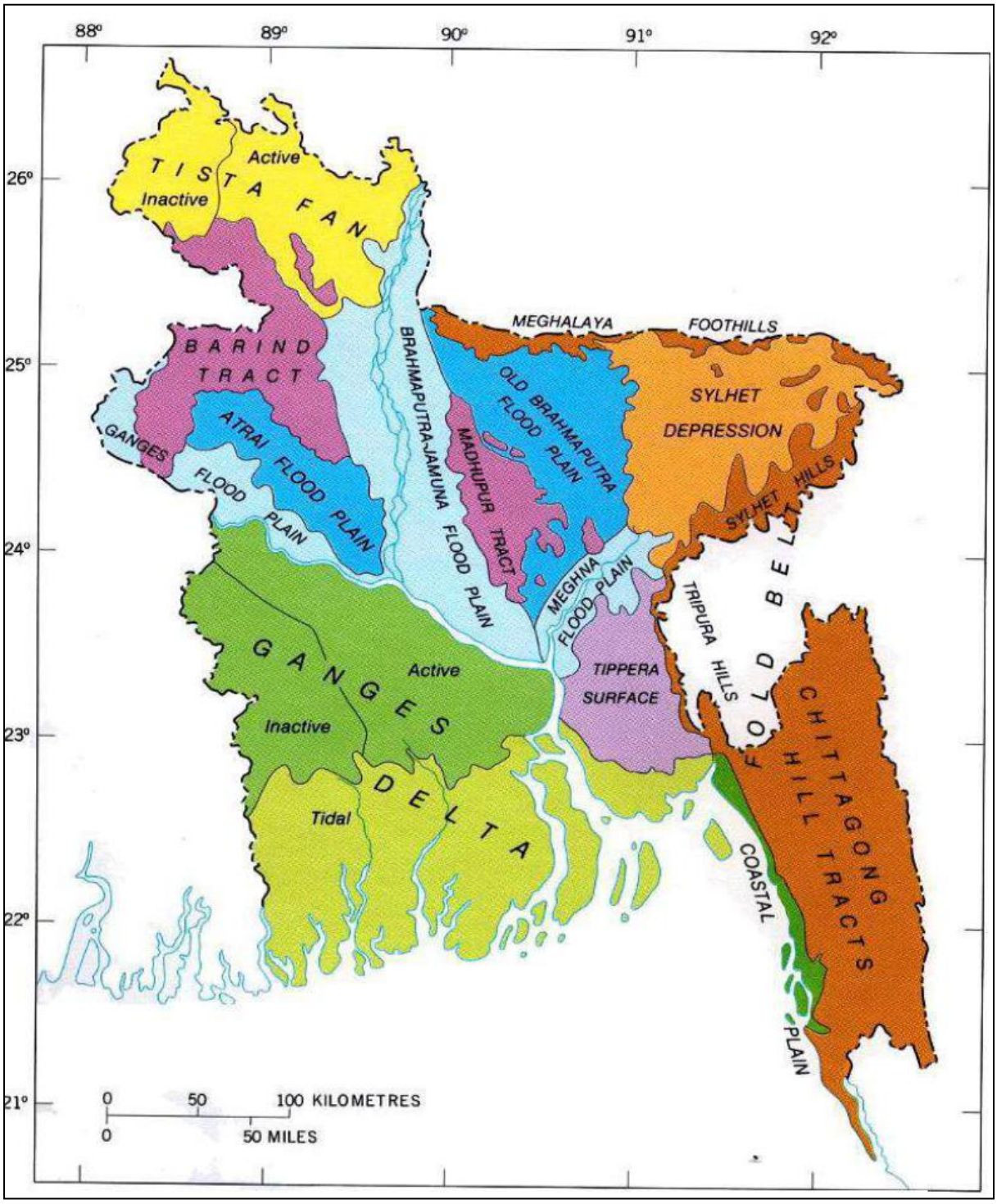


*Figure 5.2: Geology of the Bangladesh*

The general stratigraphy after Quazi, 1986, is described (Table 5.7) as follows:

*Table 5.7: General Stratigraphy of Bangladesh*

| Age | Formation | Approximate Thickness (feet) | Approximate Thickness (meters) |
|---|---|---|---|
| **Quarternary** | Sands and Clays | 3 500 | 1 077 |
| **Miocene-Pliocene** | Sandstone, Siltstone and Shales | 12 000 | 3 692 |
| **Eocene** | Sylhet Limestone | 600 | 185 |
| **Cretaceous-Palaeocene** | Tura Sandstone | 700 | 215 |
| **Jurassic** | Rajmahal Trap | 200 | 62 |
| **Permo-Carbomiferous** | Gondwana Sediments – Including economic coal seams | 1 600 | 492 |
| **Pre-Cambian** | Basement Complex | | |

This generalized stratigraphy is divided by at least six unconformities. The suggested total thickness of the sedimentary package is:

- Stable Shelf Region: 955 to 4,780 feet or 294 to 1,471 meters.
- Deeper Basin or Eastern region: 24,100 to 29,000 feet or 7,414 to 8,985 meters.

### 5.3.1 General geology

The area is mainly composed of Quaternary alluvium, consisting of silt, sand, and clay. The hills in Sitakunda-Mirsarai Upazila are primarily composed of intrusive igneous rocks such as granite and gabbro. The soil in this region is predominantly sandy loam and clay loam, which is suitable for agriculture.

Sitakunda-Mirsarai Upazila is situated in an area of high seismic activity due to its location near the intersection of the Indian Plate and the Burma Plate. This region is characterized by a complex geological history, with multiple geological formations and structures present in the region. The hills in this region are primarily composed of intrusive igneous rocks such as granite, gabbro, and diorite. These rocks were formed because of magmatic activity during the Late Jurassic to Early Cretaceous period, about 150–130 million years ago. These intrusive rocks are overlain by sedimentary rocks of the Surma Group, which were deposited during the Late Cretaceous to Paleocene period, about 100–60 million years ago. The region is in the Bengal Basin, which is a tectonically active area due to the convergence of the Indian and Eurasian Plates. The region is prone to earthquakes due to the presence of several active faults, including the Dauki Fault and the Tripura Fault.

### 5.3.2 Topography

Sitakunda-Mirsarai Upazila is a diverse and complex region in terms of its topography. The area is characterized by the presence of both hills and plains. The hills in this region are mainly

composed of intrusive igneous rocks such as granite and gabbro. These hills form a part of the easternmost extension of the Eastern Ghats, a mountain range that extends from India into Bangladesh. The plains in Sitakunda-Mirsarai Upazila are primarily composed of Quaternary alluvium, consisting of silt, sand, and clay. The area is crisscrossed by numerous rivers, canals, and streams, which have played a significant role in shaping the topography of the region. The topographical features of Sitakunda-Mirsarai Upazila have a significant impact on the region's climate, soil, and vegetation. The hills in this region have a cooler and wetter climate than the surrounding plains, which are hotter and drier. The hills also have different soil types, which are predominantly sandy loam and clay loam, making them suitable for agriculture. The plains, on the other hand, are characterized by fertile alluvial soils, which support a variety of crops.

### 5.3.3 Seismicity

Bangladesh and the Ganges Brahmaputra Delta lies at the junction of three plates: the Indian Plate, the Eurasian Plate, and the Burma Platelet (see Figure 5.3) in one of the world’s most seismically active regions. About 80 million years ago, India was located roughly 6,400 km south of the Asian continent, moving northward at a rate of about 9 m a century. When the Indian plate collided with the Eurasian plate (about 40 to 50 million years ago), its northward advance slowed by about half. The collision and associated decrease in the rate of plate movement are interpreted to mark the beginning of the rapid uplift of the Himalayas.

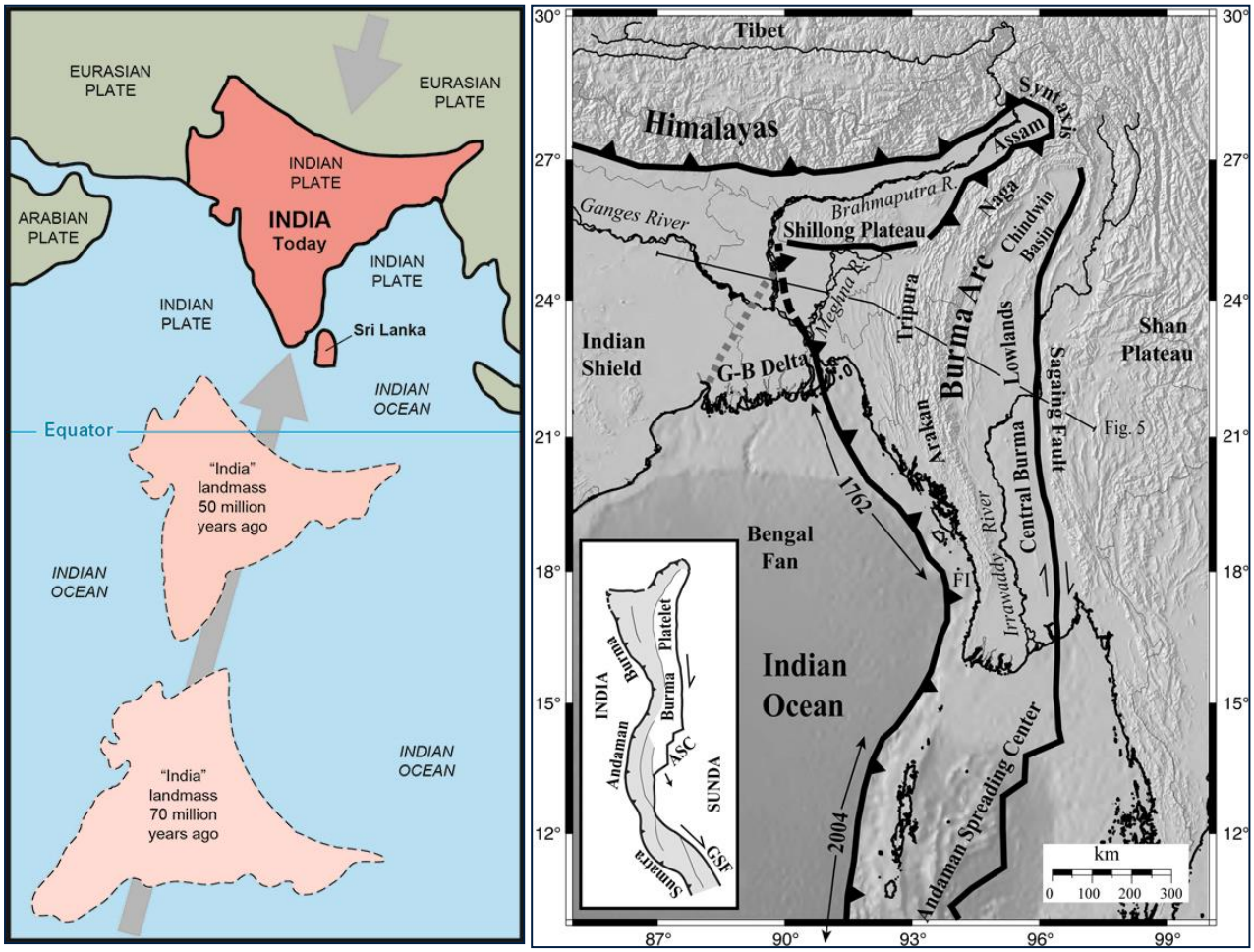


*Figure 5.3: a) Movement of the Indian Plate (source: USGS) and (b) Tectonic conditions of Bangladesh*

Historical records show that at least seven earthquakes with three of them having a magnitude of greater 8 had occurred in and around Bangladesh over the last 100 years. The country is divided into 3 seismic zones (see Figure 5.4) based on the distribution of earthquake epicentres and morpho-tectonics. ***Zone I*** comprises of the northeastern part of the country, the most active zone with the basic seismic coefficient of Z = 0.8. ***Zone II***, Z = 0.6 represents the uplifted Pleistocene Barind and Madhupur and the western extension of the folded belt and includes the study area. ***Zone III*** (Z = 0.4) has the lowest seismic activity.

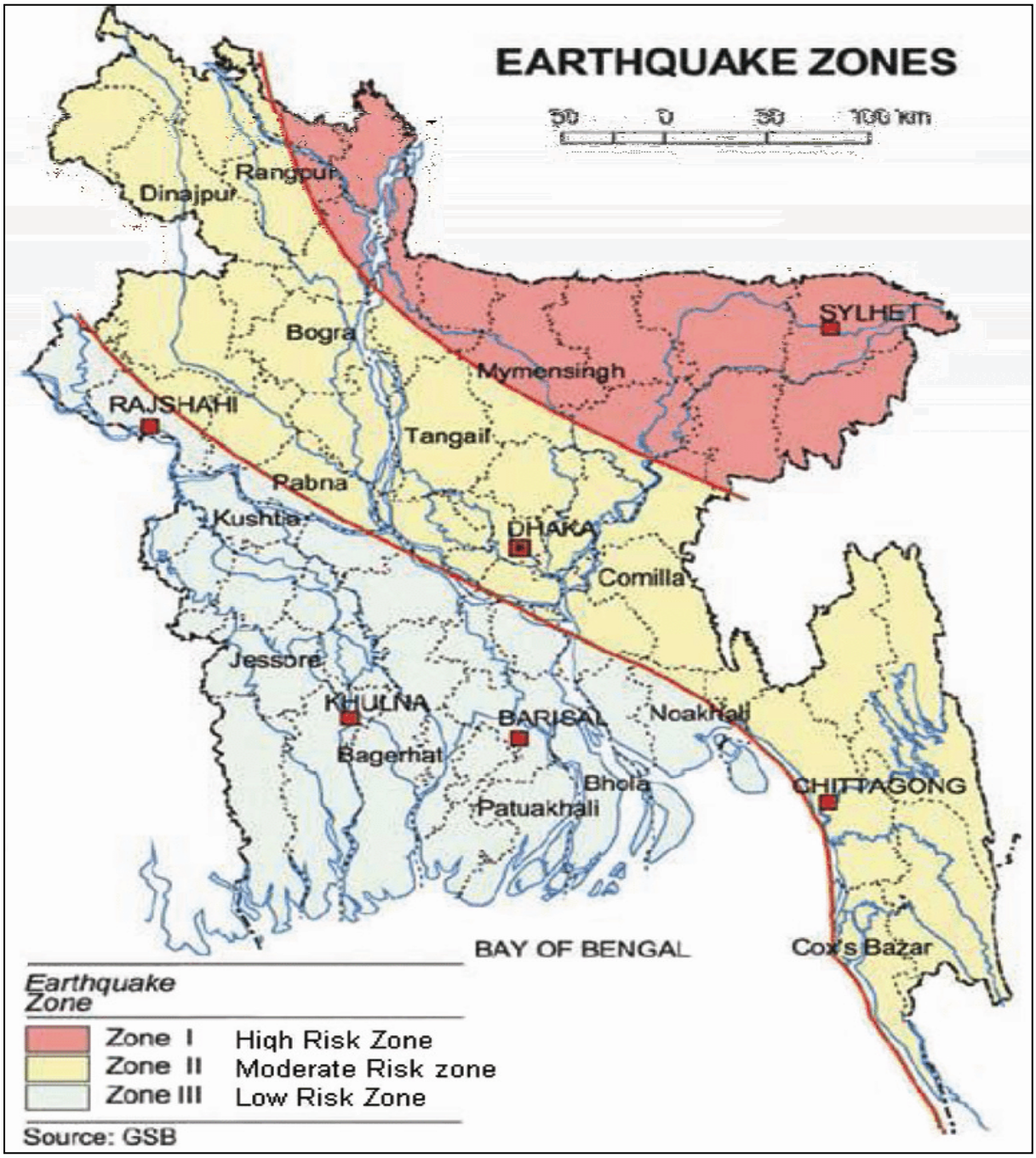


*Figure 5.4: Earthquake Zone of the Study Area*

## 5.4 Hydrology

There exist several surface water bodies, including river, canal, pahari chara, ponds, ditches, and low wetlands along the road alignment in Sitakunda. The water in the river near Sitakunda Pourashava is saline, but it can still serve multiple purposes, such as domestic usage and construction works. Despite its saline nature, the river's water quality can be improved with proper treatment and management methods. Therefore, it is crucial to develop effective strategies to conserve and manage the available surface water resources in Sitakunda to ensure sustainable usage for the benefit of both the community and the environment. Sitakunda

Pourashava is situated in the hydro-geological unit II Holocene Deltaic and Flood Plains. The area has a plentiful supply of groundwater, and the water table remains within the suction limit all year round. Groundwater serves as the primary source of potable water in the subproject area. Deep groundwater is typically free of arsenic and iron and is not saline. It is important to note that proper measures need to be taken to preserve and manage the groundwater resources to ensure sustainable usage and prevent depletion or contamination of the aquifers. Local people depend on the deep tubewell for drinking water and salinity problem is not visible at severe scale. Rainwater harvesting is not common scenario around the project area.

### 5.4.1 Hydrological network

The hydrological network of Chittagong district is bounded by the Bay of Bengal on the south and west, the Naf River with Myanmar on the southeast, and India on the east. The region is characterized by three distinct ecological zones: inter-tidal zone, coastal plains and extensive hill areas. The northern and eastern parts of the region constitute the hilly areas and are commonly known as the Chittagong hill tracts (CHT). This area is covered with a deep evergreen and deciduous forest which is a habitat of many wildlife species such as the Asian Elephant (*Elephas maximus*), White Duck (*Cairina scutulata*), Banrui (*Maris crassicaudata*), Banchhagal (*Capricornis sumatraensis*), Shajaru (*Hystrix indica*) and other endangered species. The coastline consists of a 100 km long sandy sea beach on the Bay of Bengal. The remainder of the region consists of plains. The total area is approximately 19,956 sq km with a hilly area of 1,300 sq km.

Bagakain lake, a true natural deepwater lake about 1.25 km long and covering an area of 21.21 ha, lies to the east of the region. Another true natural lake, Rainkhiangkine, 1.55 km long and covering an area of 32.66 ha, also lies in CHT. The country's largest artificial water reservoir, Kaptai lake, with a surface area of about 77 sq km, also lies in this region on the Karnafuli river. The main rivers of the region originate in the hills. They are now increasingly subject to sedimentation due to unceasing deforestation and hilly cultivation practices (e.g., jhum).

The major rivers of this region are: Karnafuli and its tributaries (e.g., Rainkhiang, Kasalong, Halda, Ichamati etc); Bakkhali, Sangu, Matamuhuri, Naf, and Feni. The Karnafuli, principal river originates in the Lushai Hills of Mizoram (India), flows through Rangamati and the port city of Chittagong and discharges into the Bay of Bengal near Patenga. Several streams flow upstream of Rangamati. The streams are: one originating near Thekamukh in Mizoram-Bangladesh border flowing through Harina, barkal and Sublong; one originating at Marishwa through Myanmukh and Langadu till reaching Subhalong; one flowing through Dangumura to Myanmukh; and one flowing through Mahalchhari to Rangamati. The streams meet near Rangamati and their combined flow is known as Karnafuli. The river is flashy and its length is about 131 km. Rainkhiang, Sublong, Thega, Kasalong, Ichamati and Halda are its main tributaries. Its major distributaries are Saylok' and Boalkhali.

The only hydropower station of the country was built by constructing a dam on this river at Kaptai. The Karnafuli is navigable at Barkal and Kaptai but above Barkal it is shallow. With the construction of the Kaptai dam, this river has been blocked, and a large artificial lake has

been created, and the bed of the river has also been much widened. This man-made lake provides a network of all-weather navigable routes in the area. Downstream of the dam the Karnafuli receives very little water in the dry season. The opening of the sluice gates of the dam creates water movement from the lake downstream. The river finally discharges into the Bay of Bengal. The port city of Chittagong is situated at the mouth of the river. Bangladesh water development board (BWDB) collects water level data through its 3 hydrometric stations located at Kodala, Chittagong and Patenga.

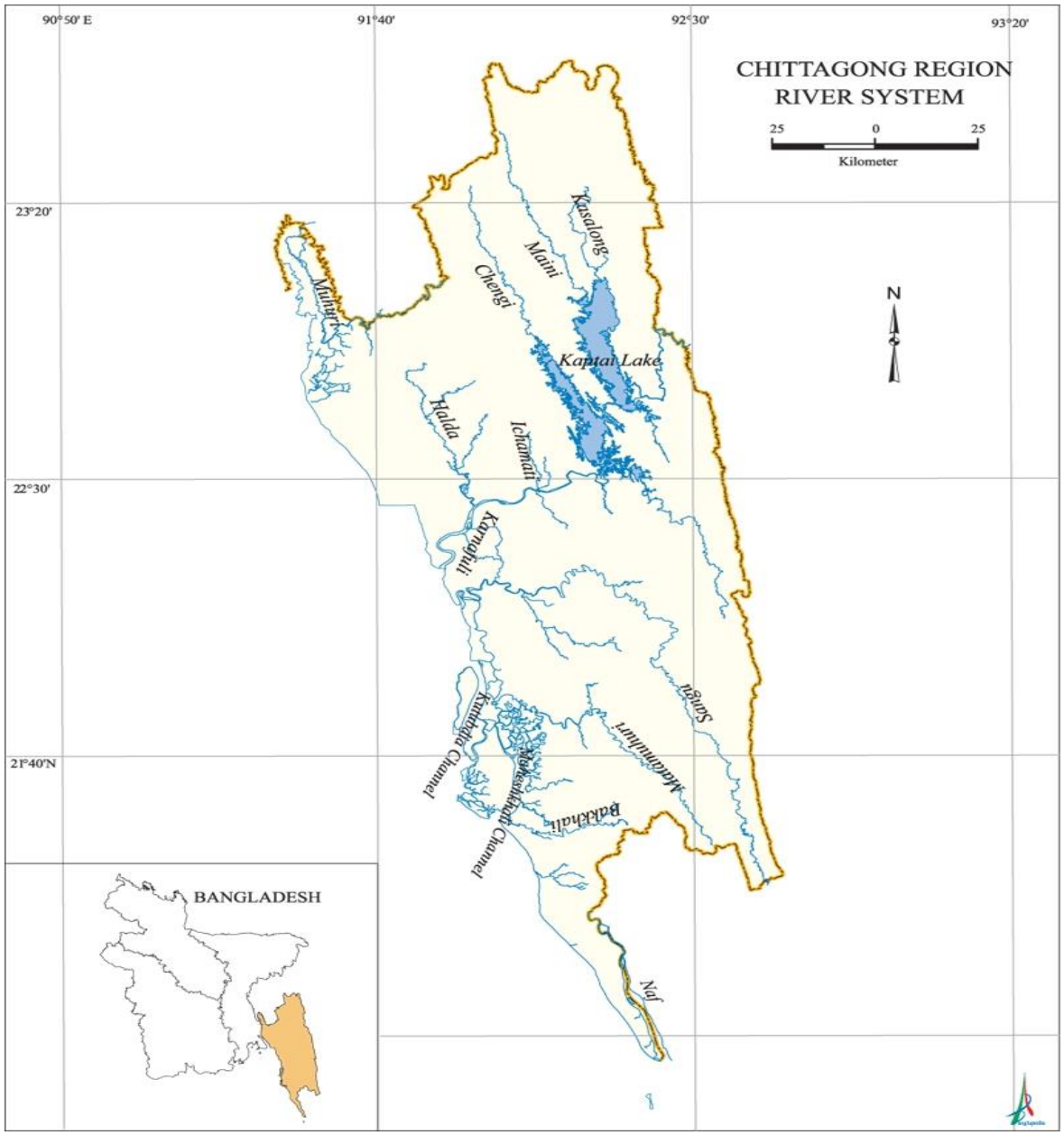


*Fig. 5.5: River network of Chattogram district.*

### 5.4.2 Water resource

A rhythm in the annual water cycle dominates life in Bangladesh: excessive water during

the monsoon causing flood and insufficient water during the dry season creating drought situation. The major sources of water in Bangladesh rainfall, river and ground water are closely related. Much of Bangladesh, nearly 60 percent in fact, is less than six meters above sea level, and is located within the flood plains of the three great rivers, the Ganges, the Brahmaputra and the Meghna (Hofer and Messerli 1997). Bangladesh is crisscrossed by over 200 rivers which form a complex and ever-changing pattern. These rivers cover some seven percent of the land area (Haggart e t a l 1994). These river systems drain a total catchment area of about 1.72 million square kilometers laying in India, China, Nepal, Bhutan and finally Bangladesh, of which, only eight percent of the catchment area lies within the country itself (Ahmed et al, 1994). As a result, huge inflows of water enter the country during the rainy season (July - September) on their way to the Bay of Bengal. About 90 percent annual rainfall also occurs in period (Chowdhury and Azizul 1990)

During this period, two thirds of Bangladesh is vulnerable to flood and almost every year between one third to one fourth of the country goes under water (Nishat 1990). The depth and impact of these inundation's varies, with rural production and life well adapted to, and to a large measure dependent upon, some level of inundation, but vulnerable to flooding that is too deep or occurs at the wrong time. The processes involved are not simple and are a consequence of a series of factors that singularly or in combination create flood conditions in Bangladesh: huge monsoon inflows of water from upstream, heavy monsoon rainfall over Bangladesh, low floodplain gradient, and congested drainage channels found in many areas, and, in coastal areas, tide and storm surges which can have devastating impacts.

Effective management of these water resources could control floods, prevent droughts, provide energy, create jobs and enhance environmental quality in each riparian country. However, badly or ineffectively managed such hydrological extremes linked to anthropogenic induced factors can lead to immense suffering through direct loss of life, or through a decline in the populations livelihood system as a result of crop and livestock loss, infrastructure damage and water borne diseases.

The Karnaphuli River, which is one of the major rivers in Bangladesh, flows through the Sitakunda-Mirsarai Upazila. The river provides water for irrigation, fishing, and transportation. There are also several canals and ponds in the area, which are used for irrigation and fish cultivation. In case of drinking water, the residents of Chattogram city areas in Bangladesh use drinking water from three sources, namely CWASA (Chattogram Water supply and Sewerage Authority), groundwater (tube-well), and commercial jar.

### 5.4.3 River morphology

The base line information study by JICA (JICA 2000) is the only account which describes the morphological changes in the rivers surrounding Chattogram. As part of the JICA study, additional cross section surveys were carried out, and historical satellite images retrieved and analysed. With this information the study determined the changes in top width and bank line changes of the river system. The JICA study (JICA 2000) reports that even though limited data have been available for the study, the following indications have been obtained:

- The river system is not highly morphologically dynamic.
- The rivers are more or less stable.
- The bank line and top width changes are not high.
- The rivers are more or less straight.
- Sediment concentrations are not very high.
- Bed sediment of most of the rivers is non-cohesive in nature and the rivers are not braided.

## 5.5 Environmental quality

### 5.5.1 Air quality

At present, secondary information's are available on local air quality from government and published articles. Population density within the project area of the Chattogram is high, although there are many motor vehicles operating on the project roads and other roads within the Chattogram division. However, it is expected that the subproject will not cause significant deterioration of air quality in the area. In view of above consideration, prior to construction activities, project contractors will conduct air quality measurements as baseline. During construction, contractors will be required to conduct air quality measurements and ensure that the subproject does not cause deterioration of ambient air quality. This is included in the environmental management plan hereof.

Chittagong is one of the largest cities in Bangladesh, and air pollution is a major environmental issue in the area. The Copernicus Atmosphere Monitoring Service (CAMS) provides real-time data on air quality around the world, including Chittagong. Based on the CAMS station datasets, the air quality in Chittagong is poor, and there are several pollutants that exceed safe levels.

According to the CAMS data, Chittagong experiences high levels of particulate matter (PM2.5 and PM10), nitrogen dioxide ($NO_2$), and sulfur dioxide ($SO_2$). PM2.5 is a type of fine particulate matter that is less than 2.5 micrometers in diameter and can penetrate deep into the lungs. PM10 is another type of particulate matter that is less than 10 micrometers in diameter and can cause respiratory problems. $NO_2$ and $SO_2$ are both gaseous pollutants that can cause respiratory problems and contribute to the formation of acid rain. The CAMS station data for Chittagong shows that the levels of PM2.5, PM10, $NO_2$, and $SO_2$ are often above safe levels recommended by the World Health Organization (WHO) and Department of Environment (DoE). The data also shows that the air quality in Chittagong is worse during the winter months, when there is less wind and increased use of heating sources such as coal and wood.

The poor air quality in Chittagong has significant health impacts on the local population, including respiratory problems, heart disease, and cancer. It also has economic impacts, as it can reduce productivity and increase healthcare costs. Efforts to improve air quality in Chittagong include increasing the use of cleaner fuels, promoting public transportation, and enforcing regulations on industrial and vehicular emissions. However, these efforts require continued commitment and resources from local authorities and the community. In conclusion,

the CAMS station datasets indicate that the air quality in Chittagong is poor and has significant health and economic impacts. Addressing air pollution in the city requires a sustained effort from all stakeholders to reduce emissions and improve public health. The following Table 5.8 depicts the air quality in Chattogram:

*Table 5.8: Air quality of Chattogram district*

| | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|
| PM2.5 | 68.9 | 47.1 | 56.39 | 64.26 |
| PM10 | 137.12 | 107.24 | 113.18 | 103.2 |
| $SO_2$ (ppb) | 20.92 | 12.26 | 5.37 | 6.83 |
| $NO_2$ (ppb) | 24.24 | 2.41 | 5.27 | 5.16 |
| CO (ppm) | 1.27 | 0.98 | 1.11 | 4.4 |
| O3 (ppb) | 4.63 | 6.52 | 11.91 | 12.15 |

The main air pollutants generated at the project area include gaseous emission (carbon monoxide, nitrogen oxides, ground-level ozone, sulfur oxides, lead) and particle pollution known as particulate matter, for example – mold spores, bacteria, dust, smoke and airborne viral particles. With the aim of measuring, the impact of the emission of particulate matter (PM2.5, PM10) and gaseous pollutants ($SO_2$, NOX, CO and Lead) concentration in the ambient air at project area, are considered as the major parameters of monitoring. Ambient air samples were collected in Tedlar bags and Summa canisters passively by relying on the evacuated canister. Respirable Dust Sampler (Model- Ecotech India AAS-217 NL) and Fine Particulate Sampler (Model-Ecotech India AAS-127) are used to collect the air sample. The PM2.5 and PM10, are tested by gravimetric method. The concentration of $SO_2$ is tested by TCM UV method. The $NO_2$ is tested by NEDA- Visible at 540 nm NEDA- Visible at 540 nm method. Likewise, the CO is tested by CO Meter (Iodine pentaoxide Method), and lead is tested by AAS method. The measured air quality parameters are PM2.5 (65.30), PM10 (89.34), $SO_2$ (7.21 ppb), $NO_2$ (8.50 ppb), CO (5.9 ppm), and Lead (0.02 µg/$m^3$).

*Fig. 5.6: Air sample and quality measurement at project area.*

### 5.5.2 Noise level

At present, secondary information's are available on local noise quality from government and published articles. Prior to construction activities, subproject contractors will conduct noise level measurements as baseline. During construction, contractors will be required to conduct noise level measurements and ensure that the subproject does not cause deterioration of noise level beyond the standards. This is included in the environmental management plan hereof. The principle sources of noise are recognized in the study area which details are given in the Table 5.9.

*Table 5.9: Principal sources of noise in the Study Area*

| Source | Particulars |
|---|---|
| General community noise | Noise from the market area (Dolar Dargah), advertising via rickshaw mounted loud speakers, prayer calls, church bells, etc. |
| Road traffic | Noise from the main roads and some secondary roads released from engines and originated from the frequent use of signal-hor |
| Commercial operations | Noise from minor industries and handicraft business. |
| Pumps | Most pumps are housed but often operate during night time, what may result in increased noise levels during the night time. |
| Noise arising from natural sources | Insects (in particular various types of crickets) and birds (as observed near forest area), wind and heavy rain may contribute to elevated noise levels. |

Noise levels are measured in Decibel (dB). The Decibel scale is presented in Table 5.10.

*Table 5.10: Noise characterization*

| Noise level, dB | Characterisation / examples for sources of noise |
|---|---|
| 0 | Threshold of hearing |
| 20 | Background noise in quite countryside or silent study room |
| 40 | Noise level in a living room |
| 60 | Conversational speech |
| 80 | Busy road traffic or freight train |
| 100 | Pneumatic hammer, construction site |
| 110 | Rock music concert |
| 120 | Threshold of discomfort |
| 140 | Threshold of pain |

*Source: compiled from www.osha.gov/SLTC/noisehearingconservation/loud.html, retrieved May 15, 2019 and other sources*

Noise levels standards are set by the Environment Conservation Rules 1997 for different types of land use;

**Silent Area:** The category "silent area" relates to 100 m zones around hospitals and other sensitive land uses as established by the government. In the absence of any regional planning documents describing the spatial distribution of commercial, residential, and other land uses based on the field observation.

- **Residential Area:** "Residential" zones are assigned to the sampling points located in rural, urban household areas with no business activities.
- **Commercial Area:** The area represents the business complex area.
- **Industrial Area:** The area represents the industrial complex including manufacturing, processing packaging units establish in area like economic zones etc.
- **Mixed area:** the area represents combined residential, commercial as well as industrial area.

Both, GoB and IFC guidelines provide noise limits for day and night time. While night time in Bangladesh is defined as the time interval between 9 PM and 6 AM, IFC considers night time from 10 PM to 7 AM Table 5.11. Considering the specifics of the country 9 PM and 6 AM night time is applied for all evaluations.

*Table 5.11: Bangladesh Government Noise standards*

| Standards | Zone | Day, dB | Night, dB |
|---|---|---|---|
| GoB Noise Standard | Silent area | 50 | 40 |
| | Residential Area | 55 | 45 |
| | Mixed Area | 60 | 50 |
| | Commercial | 70 | 60 |
| | Industrial | 75 | 70 |
| IFC EHS Guidelines (Leq) over 1 hour | Residential, institutional, educational | 55 | 45 |
| | Industrial, commercial | 70 | 70 |

In the absence of national standards describing the noise measurement methodology, the IFC guidelines shall be used as a minimum: "*Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as*

*established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation."* According to IFC Guidelines noise impacts shall not exceed the levels below or not increase the (background) noise levels more than 3 dB at the nearest receptors. Noise pollution studies conducted in Bangladesh focus on the capital where noise levels vary from 68 to more than 100 dB and few other major cities.

A portable noise measurement meter was used for measuring the noise level at the project location area. The manufacturer guidelines were used to measure noise level from the project area. The monitored noise level in the project area is ranged to 50–53 dB, 60–65 dB, and 70–75 dB at residential, commercial, and industrial areas, respectively at daytime while it is 35–40 dB, 45–55 dB, and 50–60 dB, respectively at nighttime.

*Fig. 5.7: Noise level measurement at project area.*

### 5.5.3 Water quality

There are secondary information's available on local water quality from government and published articles. A preliminary water quality measurement is conducted based one available as baseline data. During construction, contractors will be required to conduct water quality level measurements and ensure that the subproject does not cause deterioration of water quality beyond the standards. This is included in the environmental management plan hereof.

Water-quality measurement is usually performed to inform the decision makers about the current, ongoing, and emerging problems; to determine compliance with surface water standards, and to protect other beneficial uses of water. Water quality measurement was carried out at 4 locations for surface water adjacent to the working site during construction phase. The measurement covered the major 10 parameters (pH, DO, TDS, BOD, arsenic, iron, EC, COD, salinity, temperature) for surface water quality. All these parameters are tested in the laboratory of IIS Testing BD Pvt. Ltd.

Monitoring of water quality directly depends on selection of water quality parameters, sampling points, sampling frequency, evaluation criteria, etc. There are several ways of water quality monitoring and standard practices were followed for measuring of water quality in this study. This study intended for calculating surface water quality parameters to reveal the present water quality status in the surroundings of construction site. The measurement results are not only presented but also compared with the national standards in order to establish a strong baseline. The water samples collection is shown in Fig. 5.8 (below).

*Fig. 5.8: Water sample collection from project location areas.*

***Surface water***

The surface water quality of Sitakunda Mirsarai region is now severely affected by the ship breaking and recycling industry across the coast of Bay of Bengal. Laterally, the salinity is high in some areas due to close proximity to the Bay of Bengal. The following table has represented the surface water quality data of Sitakunda upazila.

*Table 5.12: Surface water quality of Sitakunda-Mirsarai upazila*

| Parameters | Highest value | Lowest value | Average value | Standards of ECR, 1997 |
|---|---|---|---|---|
| DO (mg/l) | 7.43 | 7.17 | 7.28 | 5.0 or more |
| BOD (mg/l) | 2.77 | 1.40 | 1.90 | 10 or less |
| COD (mg/L) | 69.00 | 16.00 | 42.50 | 200.0 |
| $P^H$ | 8.04 | 8.02 | 8.03 | 6.5–8.5 |
| EC (µS/cm) | 3590.50 | 1069.75 | 2330.13 | 2250.0 |
| Temperature (ºC) | 27.60 | 26.8 | 27.10 | 20–30 |
| TDS (mg/l) | 1250.00 | 500.00 | 875.00 | 1000.0 |
| Arsenic (mg/L) | 0.02 | 0.01 | 0.015 | 0.2 |
| Iron (mg/L) | 0.29 | 0.07 | 0.18 | 2.0 |
| Salinity (mg/L) | 0.50 | 0.01 | 0.26 | – |

***Groundwater***

Ground water samples will be taken once during the study period from different locations surrounding the project area. Water samples will be collected as grab water sample in a pre-washed 5-litre plastic jerry can and 250 ml sterilized clean PET bottle for complete physio-chemical tests respectively. The samples will be analyzed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA. The ground water quality of Sitakunda-Mirsarai region is given below:

*Table 5.13: Ground water quality of study area*

| Parameters | Measured value | Standards of ECR, 1997 |
|---|---|---|
| DO (mg/l) | 1.75 | 5.0 or more |
| TDS (mg/l) | 787.00 | 1000.0 |
| $P^H$ | 7.38 | 6.5–8.5 |
| Temperature (ºC) | 27.15 | 20–30 |
| EC (µS/cm) | 2822.13 | 2250.0 |
| Arsenic | 0.01 | 0.05 |
| Iron | 0.05 | 2.0 |
| Salinity | 0.15 | – |

The quality of surface water is compared with the standards for Inland Surface Water, Environment Conservation Rules (ECR), 1997-Schedule 3 (a) whereas the groundwater is compared with the Drinking Water Standard ECR-Schedule-3 (b), 1997. The standards are presented along with the measured results of surface and groundwater for comparison.

### 5.5.4 Soil quality

Most of the soil contains less than 1.7% organic matter in Chattogram district. SRDI has stated that the nutrient deficiency of the Chattogram district's arable soil is acute. Soil quality measurement can support management authority identify whether soil quality is degrading over time and what factors that may be contributing to soil degradation. For this EIA report, soil samples are collected for the determination of physical properties, particle size, soil pH, total calcium carbonate, total nitrogen, and organic matter contents.

Land use, soil fertility/ nutrient status, and soil physical quality are the major monitoring indicators for soil resources under this EIA report. The two most used soil sampling methods are grid sampling and zone sampling. Soil samples are collected from 5 inches depth and soil sampling tube is used. Then the collected soil samples are properly labeled and sent to lab. The samples are collected in the month of February and March 2023 and results incorporated in this report. Adjacent area of the transmission lines construction sites is selected respectively for soil sample in order to monitor the land use, and soil fertility/ nutrient status. The following figure presents the collection of samples of some areas.

*Fig. 5.9: Soil sample collection from the project location areas.*

Soil fertility depends on the parameters considered for monitoring. Texture is indicated mesh size of the soil quality and small size of soil particles can retain water in between the soil. Organic matter, CaCO3, soil pH is the quality of soil for growing crops. Physical property of this soil sample is determined by visual inspection, soil texture, organic matter, CaCO3, soil pH, particle size and nitrogen content. These parameters are based on the soil fertility at the project location. The sieves usually 3 screen mesh sizes (#10µm, # 50µm, and # 120µm) with

4-digit electrical balance is used for the measurement. Soil texture is the relative proportions of sand, silt, and clay in the soil. Loamy soil is consisted with a balance of sand, silt and clay soil which combination can create ideal soil texture for plant growth and holds plenty of moisture but also drains well so that sufficient air can reach the roots. The texture of this soil is Loamy-silty. Organic matter, CaCO3, soil pH, particle size and nitrogen content are within the recommended level for each different location. The following tables present results of soil measured at or near the construction site.

*Table 5.14: Soil properties and quality of study area*

| **Soil properties** | | **Measured value** | | | **Standards of ECR, 1997** |
|---|---|---|---|---|---|
| | | Highest | Lowest | Average | |
| Types | | Sandy loam | | | |
| Color | | Grey yellow | | | |
| Size of soil particles (%) | >10µm | 65 | 35 | 50 | |
| | >50µm | 36 | 24 | 30 | |
| | >120µm | 27 | 13 | 20 | |
| pH | | 7.8 | 7.2 | 7.5 | 7.7–8.5 |
| Total CaCO3 (mg/kg) | | 12.6 | 5.2 | 8.9 | – |
| Total nitrogen (mg–N/kg) | | 27.9 | 15.2 | 21.55 | 25–50 |
| Organic Matter (%) | | 10.3 | 4.8 | 7.55 | – |

## 5.6 Land resources

### 5.6.1 Agro-ecological zones

An Agro-ecological Region is a zone which has unique combination of physiographic, soil, hydrological and agro-climatic characteristics. Thirty agro-ecological regions and 88 sub-regions and 535 units have been identified by adding successive layers of information on the physical environment which are relevant for land use and for accessing agricultural potential. These layers are:

- Physiography
- Soils
- Depth and duration of seasonal flooding
- Length of rainfed kharif and rabi growing periods
- Length of pre-kharif period of unreliable rainfall
- Length of cool winter period
- Frequency of occurrence of extremely high (> 40 degrees) summer temperature.

The physiographic unit of the project is: Young Brahmaputra and Jamuna Floodplain (AEZ# 29). The region comprises the area of Brahmaputra sediments. It has a complex relief of broad and narrow ridges, inter-ridge depressions, partially in filled cut-off channels and basin. This area is occupied by permeable silt loam to silty clay loam soils on the ridges and impermeable clays in the basins, neutral to slightly acid in reaction. General soil types include predominantly

grey floodplain soils. Organic matter content is low in ridges and moderate in basins. Soils are deficient in N, P, and S but the status of K and Zn are reasonable. General fertility level is medium.

### 5.6.2 Land use

Similar with other developing cities, the growth of Chattogram's land use has been changing since 1967. While the vegetation of area is almost fixed at 70,000 ha in the past 40 years, the current water body became a quarter since 1967, which is 5,520 ha in 2010 from 206,868 ha in 1967**.** Thus, the water body has been converted to built-up area. The lack of growth management and planned urbanization causes extensive urban poverty, recurrent episodes of flash flooding, substantial growth of slums, and exploitation of resources and the mismanagement of limited land resources.

In 1967 to 1989, the built-up area had increased gradually from 53,727ha to 55,921ha with 0.2% of the annual increase rate. After that period, the urbanization has been accelerated. The built-up area increased by about 5,000 ha in the period of 1989 to 1999 and by 7,500 ha in the period of 1999 to 2010, respectively.

### 5.6.3 Land type

The landforms of Bangladesh can be divided into three major classes:

A. The northern and eastern hills
B. The Holocene floodplains
C. The Pliestocene terraces

The sediments deposits of Bangladesh mainly consists of those laid down by the Ganges, Brahmaputra and Meghna (GBM) river systems. Holocene floodplain deposits cover most of the surface area of present-day Bangladesh. According to geographic and geomorphic distribution, the Holocene floodplains are divided in four classes:

A. Piedmont plains
B. Meander floodplains
C. Tidal floodplains
D. Estuarine floodplains

Land types are classified depending upon the depth of inundation during monsoon season due to normal flooding in an average year. SRDI has made the land type classification into five types;

A. High land (Above flood level),
B. Medium highland (Flooding depth 0-90 cm),
C. Medium lowland (Flooding depth 90-180 cm),
D. Lowland (Flooding depth 90-270 cm) and
E. Very lowland (Flooding depth >270 cm).

### 5.6.4 Soil texture

The soils of the area are Quaternary Holocene (recent) alluvial deposits. The area is situated on the right bank (south bank) of the Karnaphuli river. Alluvial deposits carried by Brahmaputra-Jamuna, Ganges-Padma and Meghna rivers and their numerous tributaries and distributaries formed a large part of Bangladesh. Alluvial deposits of Bangladesh have been defined into several units in the Geological Map of Bangladesh (1990). Alluvial deposits range from flood sand to over bank silt and pounded clay. The project area has overlapping alluvial sand deposit (asd), alluvial silt deposit (asl) and alluvial silt-clay deposit (asc). Alluvial sand unit (asd) is composed of light to brownish grey, coarse sand to fine silty sand and sand is generally sub-rounded. Alluvial silt unit (asl) is composed of light to medium-grey, fine sandy to clayey silt, commonly poorly stratified; average grain size decreases away from main channels; chiefly deposited in flood basins and inter-stream areas. Alluvial silt unit includes small back swamp deposits and varying amounts of thin, inter-stratified sand, deposited during episodic or unusually large floods. Included in this unit are thin veneers of sand spread by episodic floods over flood-plain silts.

Extensive areas throughout the flood plain are occupied by broad ridges on which rather yellowish, friable, silt loams and silty clay loams predominate. Some of those have dark grey topsoils which are acid when dry, but slightly alkaline when flooded; subsoils are moderately alkaline, but non-calcareous. In the southern half of Chattogram district there are extensive deep basins which have dark grey compact clays with moderately alkaline subsoils usually overlying a yellowish and loamy substratum Table 5.15. The soil types of Dhaka are presented in below table. Flooding depths are mainly less than 5 feet in the east but increases to 10 feet in west.

*Table 5.15: Soil Texture of the Study Area*

| Soil Type | Description |
|---|---|
| Non-calcareous | Raw sandy and silty alluvial deposits, usually stratified either from the surface or below the cultivated topsoil in the active floodplain areas (young char lands) or massive in the older flood plain areas |
| Non-calcareous grey floodplain soils | Prismatic and/ or blocky structured predominantly grey sandy loams to silty clay loams on young floodplain ridges and silty clay loams to clays in basins. Slightly acid to neutral. They become saline in dry season in the coastal areas. |
| Non-calcareous dark grey flood plain soils | Structured dark grey loamy soils on old flood plain ridges and clay in basins. Slightly acid to somewhat alkaline in reaction. The basin clays have heavy consistence |

Soils on the settlement formations mostly followed the sand and silty sand. Two types of soil may be found in the Chattogram one is sand and silty sand, other is clay and silty clay. Physical

properties of soil may be categorized into 4 groups. The characteristics of each group are as follows.

- **Group-A:** Dominantly silty clay and clay, low permeability, high water holding capacity, high compressibility, poor drainage, level to depressed relief, medium to high plasticity.
- **Group-B:** Dominantly sand, high permeability, low water holding capacity, low compressibility, good drainage, low plasticity, low ridge and depressed relief.
- **Group-C:** Dominantly clay silt and sand, moderate permeability and drainage, moderate water holding capacity, low to moderate compressibility, level relief with local ridge, high shear strength that report.

## 5.7 Ecological resources

Sitakunda-Mirsarai Upazila is home to a diverse range of flora and fauna. The area has a significant number of mangrove forests, which serve as a habitat for a variety of aquatic and terrestrial species. The Sundarbans, which is the largest mangrove forest in the world, is located in the southern part of the area. The hills in this region are also home to a variety of plant species, including medicinal plants.

The biodiversity component of the study focused on biological components like flora, birds, reptiles, amphibians and mammals. Field work has been conducted in the proposed site. A multidisciplinary team related to ecology (terrestrial & aquatic) has been engaged to conduct the study with primary observation and secondary data.

### 5.7.1 Bio-ecological zones

Twenty-five bio-ecological zones have been delineated within Bangladesh by the IUCN. Six parameters were used to determine the areas including: physiography, soil, rainfall and temperature, floral distribution, faunal distribution and flood depth (IUCN 2002). The project location site falls in coastal and marine water bio-ecological zone Figure 5.10.

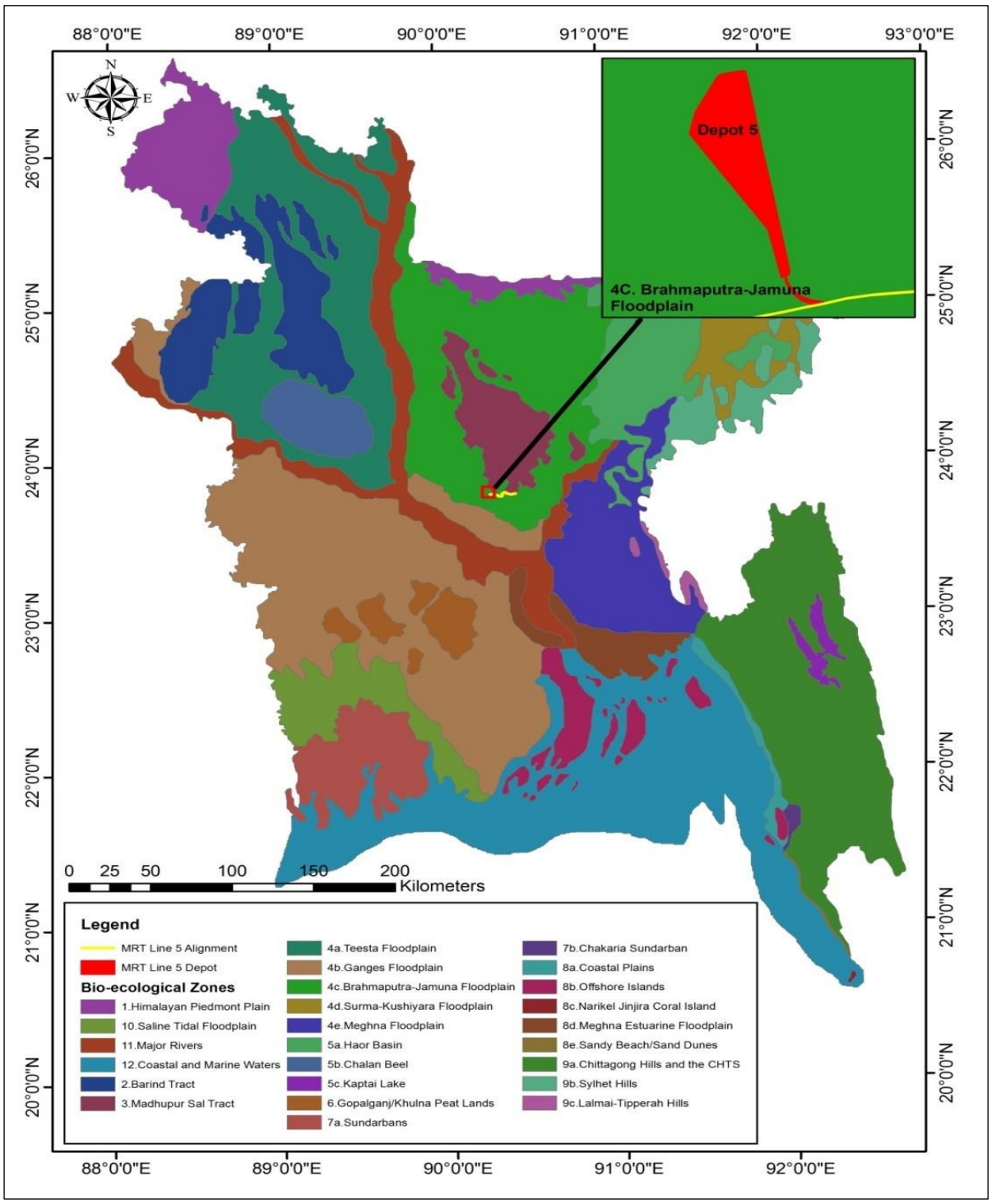


*Fig. 5.10: Location in Bio-ecological Zones of Bangladesh (*Source: IUCN 2002*)*

The Brahmaputra-Jamuna floodplain possesses a unique variety of plants, medicinal herbs, fruits bearing trees, hundreds of jungle shrubs, creepers and climbers, flowering trees, etc., many of which yield valuable products. Some of floral species which are valued as timber products are: the Banyan (*Ficus bengalensis*), Tamarind (*Tamarindus indica*), Sada koroi (*Albiza Procera*), Shimul (*Bombax ceiba*), and Ashwath (*Ficus religiosa*). The prominent fruit

bearing trees of this zone are: The Mango (*Mangifera indica*), Jackfruits (*Artocarpus heterophylus*), and Litchi (*Litchi chinensis*). Bushes of reeds and canes are also found here. This zone is similarly increased with orchids. The Rasna (*vanda roxburghii*) is commonly found in this zone (Khan, 1991).

Like the floral diversity this zone equally enjoys riches of faunal verity. According to Hunters (1875), Leopards were frequently sited in this zone. A few species of deer, such as Samber (*Cervus unicolor*), Hog deer (*Axis Procinus*), Swamp deer (*Cervus duvauceli*), and Barking deer (*Muntiacus muntjak*) were also once in around the everywhere in forest of this zone. Among the bird's species, small game birds such as common peafowl (*Pavo cristatus*), Red jungle fowl (*Gallus gallus*), partridges, and several verities of pheasants were commonly found. The Bangle florican (*Houbaropsis bengalensis*) and snipes are plentiful in the sandbanks and chars of this zone. On the other hand the most common poisonous snake is the Banded krait (*Bangarus fasciatus*) in this zone, which could easily be identified by its broad black and yellow bands.

### 5.7.2 Floral component

The team had conducted ecological survey on flora and fauna in the depot area. The team also collected secondary information from literature and FGD from the study area to understand the overall terrestrial ecosystem. No tree species found in the depot location during the study period. The floral habitat has been described below.

***Agricultural land vegetation***

Some land in the depot area is used for agricultural activities. Generally, paddy is cultivated in the agricultural land. Vegetable and mustard have been cultivated in the small patch of agricultural land.

***Fallow land vegetation***

Three fallow land quadrates (each of size 2 m x 2 m) have been studied and out of 3 quadrates, a total of 12 species belonging 12 families. Among the 12 species 75% are medicinal plants, 17% vegetables and 8% cattle fodder.

Fallow lands were dominated by herb species of Taro *(Colocasia esculenta)* Shame plant (*Mimusa pudica),* Scutchgrass (*cynodon dactylon*), Black nightshade (*Solanum nigrum*), spiny amaranth (*Amaranthus spinos*), Hill glory bower (*Aleroden dronviscosum*), Nut Grass (*Cyperus rotundus*), Ironweed (*Vernonia cinerea*), Yellow fruit nightshade (*Solanum xanthocarpum*), Caesarweed (*Eurena lobata*), Rattlebox Plant (*Crotalaria pallida*), diamond burbark (*Triumfetta rhomboidea).*

***Grass land vegetation***

Three quadrates of grass land (each of size 1 m x 1 m) were studied and 7 families have been recorded with 11 different species and Cyperraceae family has been found three times among those species. The second dominating family was Poaceae and Compositae which found twice during the survey tenure. Among the common grasses species *Cyperus rotundus*, *Cynodon*

*doctylon, Amaranthus philoveroides, Alternanthera sessilis, Alerodendron viscosum* and *Eurena loba were notable.*

***Aquatic vegetation***

The ecology team has been considered the depressed area for aquatic vegetation survey. A visual observation study has been carried out for the aquatic vegetation survey in this area. Total of 16 aquatic species belonging 12 families were found whereas Lemnaceae and Polygonaceae family has been found maximum three times. List of aquatic vegetation is shown in the following Table 5.16.

*Table 5.16: List of aquatic vegetation observed during field survey*

| S.N. | Common Name | Family name | Scientific name | Types | Uses | Red data book of |
|---|---|---|---|---|---|---|
| 1 | Alligator Weed | Amaranthaceae | *Alternanthera philoxeroides* | Herb | Medicine | Not Evaluated |
| 2 | Coco Yam | Araceae | *Colocasia esculenta* | Herb | Medicine | Not Evaluated |
| 3 | Flatsedge | Cyperaceae | *Cyperus sp.* | Herb | Medicine | Not Evaluated |
| 4 | Common Water Hyacinth | Pontaderiaceae | *Eichhornia crassipes* | Herb | Medicine | Not Evaluated |
| 5 | Helencha | Cyperaceae | *Fluctuans enhydra* | Herb | Medicine | Not Evaluated |
| 6 | Swamp Morning-Glory | Convolvulaceae | *Ipomoea aquatica* | Herb | Vegetable | Not Evaluated |
| 7 | Four Leaf Clover | Mersileaceae | *Marsilea quadrifolia* | Herb | Vegetable | Not Evaluated |
| 8 | Pondweed Arrow Leaf | Pontaderiaceae | *Monochoria hatata* | Herb | Fertilizer | Not Evaluated |

### 5.7.3 Faunal component

***Birds (Avifauna)***

Common bird species has been found in the depot area during the survey period. During the survey tenure, a total of 22 species belongings of 15 families have been observed in the study area during survey. The highest number of families has been found four times of Sturnidae and second highest has been found in Alcedinidae family. The depressed and grass lands are the feeding and roosting ground of wild birds. All species are Least Concern (LC) according to IUCN Red List 2015. A detail of bird's species checklist is presented in Table 5.17.

*Table 5.17: List of birds identified during field survey*

| S.N. | Local Name | Common Name | Scientific name | Family | IUCN |
|---|---|---|---|---|---|
| 1 | Doyel | Oriental Magpie Robin | *Copsychus saularis* | Muscicapidae | LC |
| 2 | Deshi Kanibok | Indian Pond Heron | *Ardeola grayii* | Ardeidae | LC |
| 3 | Chhoto pankouri | Little Cormorant | *Microcarbo niger* | Phalacrocoracidae | LC |
| 4 | Kala Fingey | Black Drongo | *Dicrurus macrocercus* | Dicruridae | LC |
| 5 | Gash pakhi | Striated Grass bird | *Megalurus palustris* | Locustellidae | LC |
| 6 | Pati Chorui | House Sparrow | *Passer domesticus* | Passeridae | LC |
| 7 | Telia Ghughu | Spotted Dove | *Spilopelia chinensis* | Columbidae | LC |
| 8 | Pati Hoodhood | Common Hoopoe | *Upupa epops* | Upupidae | LC |
| 9 | Pakra Shalik | Asian Pied Starling | *Gracupica contra* | Sturnidae | LC |
| 10 | Dhan salik | Common Myna | *Acridotheres tristis* | Sturnidae | LC |
| 11 | Pati Maachranga | Common Kingfiher | *Alcedo atthis* | Alcedinidae | LC |
| 12 | Pati Kak | House Crow | *Corvus splendens* | Corvidae | LC |
| 13 | Bulbuli | Red-vented Bulbul | *Pycnonotus cafer* | Pycnonotidae | LC |
| 14 | Sada Bok | Little Egret | *Egretta garzetta* | Ardeidae | LC |
| 15 | Dar Kak | Jungle Crow | *Corvus levaillantii* | Corvidae | LC |
| 16 | Moutusi | Sun bird | *Nectarinia asiatica* | Nectariniidae | LC |
| 17 | Dholagola Maachranga | White-throated Kingfisher | *Halcyon smyrnensis* | Alcedinidae | LC |
| 18 | Metepith Latora | Grey-backed Shrike | *Lanius tephronotus* | Laniidae | LC |
| 19 | Pati Fotikjol, Towfi | Common Iora | *Egithina tiphia* | Aegithinidae | LC |
| 20 | Bon salik | Jungle Myna | *Acridotheres fuscus* | Sturnidae | LC |
| 21 | Kath Shalik | Chestnut-tailed Starling | *Sturnus malabaricus* | Sturnidae | LC |
| 22 | Lenja Latora | Long tailed shrike | *Lanius schach* | Lanidae | LC |

***Amphibians and reptiles***

During field investigation, a total 5 species belonging same number of families has been found in the depot area. Bengal Monitor (*Varanus bengalensis),* Long-tailed Lizard *(Takydromous khasiensis),* Asian Common Toad *(Duttaphrynus melanostictus),* Common House Gecko *(Hemidactylus frenatus)* are found in the depot area. Bengal Monitor (*Varanus*

*bengalensis)* has been found Near Threatened according to the IUCN red list status 2015 whereas rest of the species is Least Concern. A detail species list has been provided in Table 5.18.

*Table 5.18: List of amphibians and reptiles in study area*

| S.N. | Local Name | *English Name* | Scientific Name | Family | IUCN Red List Status |
|---|---|---|---|---|---|
| 1 | Anjon | Common | *Eutropis carinata* | Scincidae | LC |
| 2 | Gui shap Lamba Leiz | Bengal Monitor | *Varanus bengalensis* | Varanidae | NT |
| 3 | Roktochusa | Long-tailed Lizard | *Takydromous khasiensis* | Lacertidae | LC |
| 4 | Kono bang | Asian Common Toad | Duttaphrynus melanostictus | Bufonidae | LC |
| 5 | Tiktiki | Gecko | *Hemidactylus frenatus* | Gekkonidae | LC |

Note: *LC-Least Concern, NT-Near Threatened*

***Mammals***

It has been recorded 4 mammal"s species belonging three families in the study area. Mammals that were found within the project area are Small Asian Mongoose (*Herpestes auropunctatus*), Golden Jackal (*Canis aureu*), Little Indian field mouse (*Mus booduga*), and House mouse (*Mus musculus*). According to the IUCN red list status 2015, all species are least concern.

***Fisheries***

Bangladesh is blessed with vast and rich aquatic resources with 9,318,608 hectare (ha) of inland open water and 795,841ha of inland closed water Department of Fisheries,2017 (DoF, 2017). Bangladesh is one of the world's leading fish producing countries with a total production of 3.87 million metric ton (MT), where inland open water (capture) contributes 27.03 percent (1.04 million MT) and inland closed water (culture) contributes 56.82 percent (2.20 million MT) of total production of the country (including open sea fish catches, DoF, 2017). According to Food and Agricultural Organisation (FAO) statistics 2018, Bangladesh is ranked 5$^{th}$ in world aquaculture production. This sector is contributing significantly in food security through providing safe and quality animal protein. Fish supplements to about 60% of Bangladeshi people's daily animal protein uptake. Fisheries sector contributes 3.65% to Gross domestic products (GDP) and 23.81% to agricultural GDP. More than 11 percent (%) of total population of Bangladesh is engaged with this sector on full time and part time basis for their livelihoods. This sector also has high potential for the perspective of economic development of the country. Bangladesh earns a considerable amount of foreign currencies by exporting fish, shrimps and other fisheries product. On the other hand, Bangladesh is enriched with wider range of aquatic diversity, comprising 253 species of freshwater fishes and 64 species of prawn and shrimps International Union on Conservation of Nature 2015 (IUCN, 2015).

Data were collected by the direct observation of fishing, personal interview of the fishermen, fish farmers and local people as well as Focus group discussions (FGD). Collected data are cross-checked with interview of the Upazila Fisheries Officer (UFO). Direct observation was carried out at randomly selected sites of both natural and manmade water bodies within the study area. Identification of species is based on keys used by Bhuiyan (1964), Talwar and Jhingaran (1991), Shafi and Quddus (2001) and Rahman (2005), Siddiqui *et al.* (2007), IUCN (2015a) and IUCN (2015b)

According to the fisheries officer and local people total 15 fish species belongings to 10 families are found in the depot area. Cyprinidae family has been found eight times among this species. All species are least concern status according to the IUCN red list status 2015. The checklist of the fish species in the depot area has been provided in Table 5.19.

*Table 5.19: List of fish in the study area*

| S. N | Local Name | English Name | Scientific Name | Family | IUCN Red List Status Banglades |
|---|---|---|---|---|---|
| 1 | Guchi Baim | Striped spinyeel | *Macrognathus pancalus* | Mastacembelidae | LC |
| 2 | Khailsha | Giant gourami | *Colisa fasciata* | Osphronemidae | LC |
| 3 | Lal Khalisha | Red gourami | *Colisa lalia* | Osphronemidae | LC |
| 4 | Koi | Climbing perch | *Anabas testudineus* | Anabantidae | LC |
| 5 | Bele | Tank goby | *Glossogobius giuris* | Gobiidae | LC |
| 6 | Shol | Striped snakehead | *Channa striatus* | Channidae | LC |
| 7 | Taki | Spotted Snakehead | *Channa punctatus* | Channidae | LC |
| 8 | Shing | Stinging catfish | *Heteropneustes fossilis* | Heteropneustidae | LC |
| 9 | Magur | Air breathing Catfish | *Clarias batrachus* | Clariidae | LC |
| 10 | Gutum | Cross fish | *Lepidocephalichthys guntea* | Cobitidae | LC |
| 11 | Rui | Rohu | *Labeo rohita* | Cprinidae | LC |
| 12 | Catla | Catla | *Catla catla* | Cyprinidae | LC |
| 13 | Chola Punti | Swamp barb | *Puntius chola* | Cyprinidae | LC |
| 14 | Jat punti | Pool barb | *Puntius stigma* | Cyprinidae | LC |
| 15 | Mola | Mola carplet | *Amblypharyngodon mola* | Cyprinidae | LC |

## 5.8 Socio-economic condition

The Sitakunda-Mirsarai Upazila is an industrial hub of Bangladesh, with a number of large-scale industries such as steel, cement, and fertilizer production. The rapid industrialization in this area has had a significant impact on the physical environment, particularly on the air and water quality.

In conclusion, the physical environment of Sitakunda-Mirsarai Upazila is diverse and complex, shaped by both natural and human factors. The area's climate, geology, water resources, and biodiversity have contributed to the development of the region, while industrialization has had both positive and negative impacts on the environment. It is important to continue monitoring the physical environment in this area and take appropriate measures to mitigate any adverse effects of industrialization on the natural environment.

The present socio-economic conditions of the people of the project or study area will provide sound reference and assess probable socio-economic impact of the proposed interventions. This will enable us to compare the changes and impacts of the project interventions in future. The socio-economic baseline scenario describes the socio-economic characteristics of project area based on primary and secondary data. The socio-economic characteristics include administrative area, demographic, household size, education, occupation, housing, employment opportunity, health, housing, access to water and sanitation status, etc.

### 5.8.1 Administrative bounding

Sitakunda and Mirsarai Upazila are situated in Chattogram district. The administrative boundary of Sitakunda Upazila is demarcated by the boundary line of Mirsarai, Fatikchhari, Hathazari Upazila and Sandwip channel of Bay of Bengal (details in Fig. 5.11).

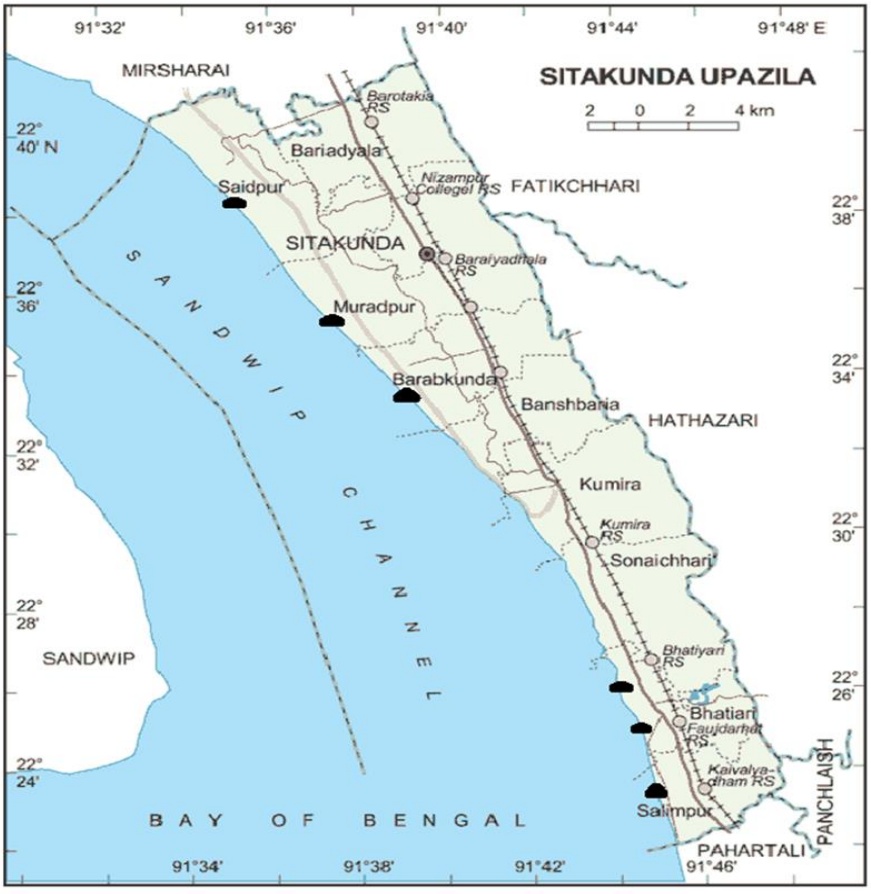


*Fig. 5.11: Administrative boundary of Sitakunda Upazila (Source: LGED)*

In the northern part of Sitakunda Upazila is adjacent to the Mirsarai Upazila, the North-east part is demarcated by Fatikchhari Upazila boundary, the east side of Sitakunda has boundary with Hathazari Upazila and the west part is demarcated by Sandwip channel of Bay of Bengal. In addition, Sitakunda has is a Municipality, so its development is very fast.

The administrative boundary of Mirsarai Upazila is demarcated by the boundary line of three upzilas of Feni District, Fatikchhari and Sitakunda Upazilas and Sandwip channel from the western side. Chagolnaiya, Feni Sadar and Sonagazi Upazilas of Feni District from the north and west part, Companiganj Upazila of Noakhali district from west part, Fatikchhari and Sitakunda Upazila of Chattogram District from east and south side and Sandwip channel of Bay of Bengal. The details of Mirsarai Upazila map are shown in Fig. 5.12 (below). Mirsarai Upazila is located at 22.7722°N 91.5750°E.

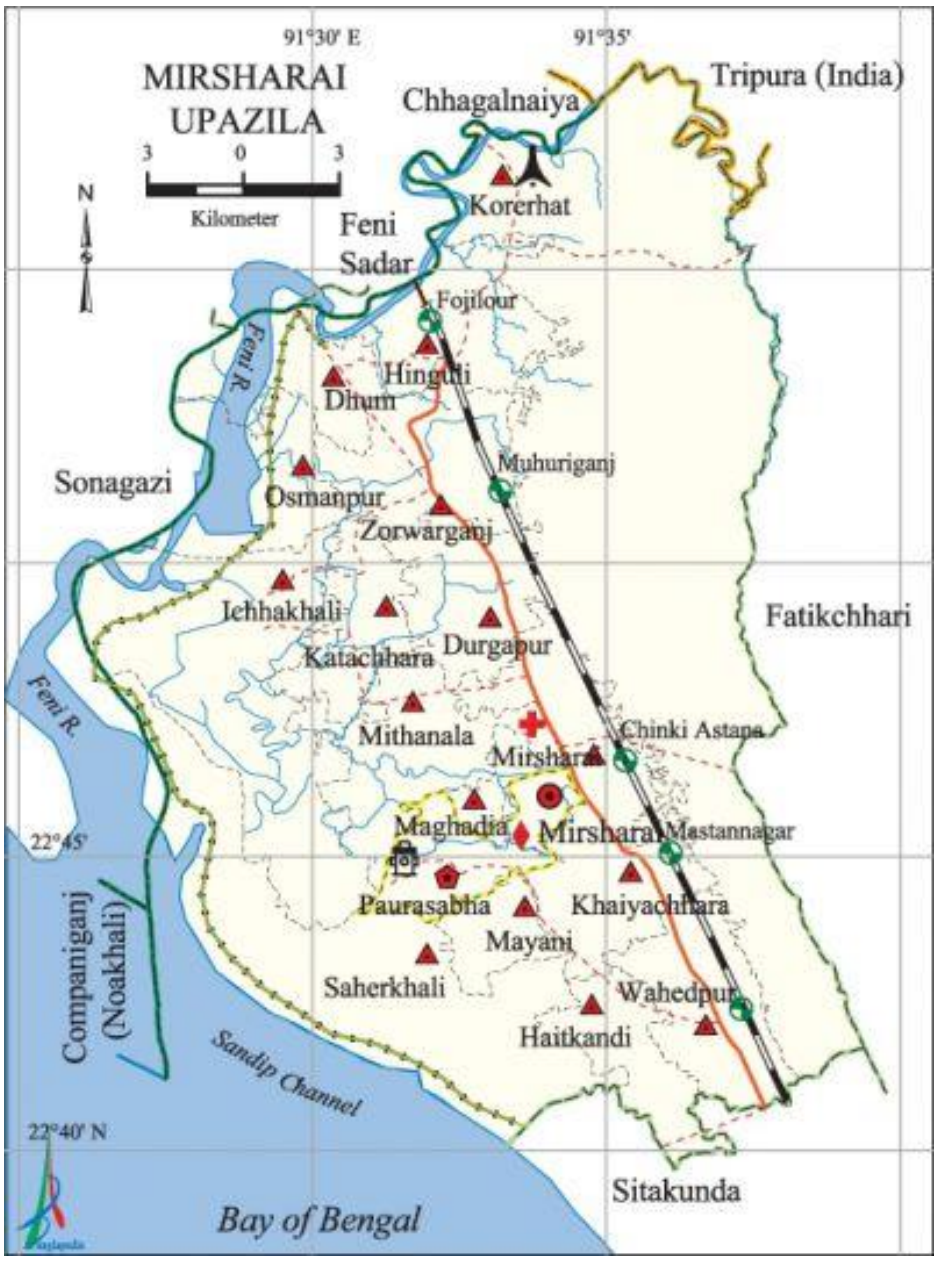


*Fig. 5.12: Map of Mirsarai Upazila (Source: Banglapedia)*

### 5.8.2 Demography

Demographical data analysis of any area is a crucial part of any plan preparation process of any area. Any planning decisions have been taken based on the population and economy of any area. Population is also necessary to calculate the demand and future need of the city. This section is attempts to analyze the population to calculate future population based on socio-economic data.

### 5.8.3 Households size

According to Construction Type, about 40.54% residential structures are katcha and 35.82% structures are semi-pucca while 23.18% are katcha of Chattogram area. Most of the residential structures are located in Block 3, 4 and 6.

According to population and housing census (2022), the household size of Chattogram District is 4.4. In rural area, it is 4.5 and in urban area it is 4.3. the proposed project is mostly located in rural area. According to Chattogram District statistics (2021) from BBS, the number of households in Sitakunda Upazilla is 77279 and in Mirsarai is 79545. The average household size in Sitakunda and Mirsarai Upazilla are 4.9 and 5.0, respectively. On the other hand, the population density of these two Upazilla are 801 and 826 for Sitakunda and Mirsarai Upazilla respectively.

According to population census (2011), total household of the study area is 356409. Predominant structure of this study area is Pucka (45%) followed by Semi-pucka (39%), Kutcha (12%) and Jhupri (4%). Housing tenancy of the study area is owned by (24.1%), rented (73.1%) and Rent free (2.8%). According to Construction Type, about 40.54% residential structures are katcha and 35.82% structures are semi-pucca while 23.18% are katcha of Chattogram area.

### 5.8.4 Age structure

The majority percent of population in the project areas falls within 0–29 years old, and very low percent of people are old than 70–80 years. The age structure of Sitakunda Upazilla are given in Table 5.20 (below). This table has described the age distribution of Sitakunda upazilla according to the Population Census (2011). This study has collected data both from the population and housing census (2022) and (2011). Because the most updated population and housing census (2022) is not available fully.

*Table 5.20: Age distribution of Sitakunda Upazilla*

| **Age Distribution (C 2011)** | |
|---|---|
| Age Structure | Number of People |
| 0-9 years | 78,302 |
| 10-19 years | 87,607 |
| 20-29 years | 82,324 |

| | |
|---|---|
| 30-39 years | 54,244 |
| 40-49 years | 37,911 |
| 50-59 years | 22,372 |
| 60-69 years | 14,171 |
| 70-79 years | 6,947 |
| 80+ years | 3,954 |

The age structure of Mirsharai upazilla has given in Table 5.21 (below). This table has represented the age distribution of Mirsharai Upazilla according to the population census (2011). Similar to Sitakunda Upazila, the majority percent of population in the project areas falls within 0–29 years old, and very low percent of people are old than 80 years.

*Table 5.21: Age distribution of Mirsharai Upazilla*

| **Age Distribution (C 2011)** | |
|---|---|
| Age Class | Number of People |
| 0-9 years | 88,008 |
| 10-19 years | 91,687 |
| 20-29 years | 70,838 |
| 30-39 years | 49,020 |
| 40-49 years | 38,029 |
| 50-59 years | 25,910 |
| 60-69 years | 19,076 |
| 70-79 years | 10,170 |
| 80+ years | 5,978 |

### 5.8.5 Education

According to the 2011 Population Census of Bangladesh, the literacy rate of Sitakunda Upazila was 54.4%. The male literacy rate was 58.5% and the female literacy rate was 50.1%.

According to the 2011 Population Census of Bangladesh, the literacy rate of Mirsarai Upazila was 53.5%. The male literacy rate was 58.6% and the female literacy rate was 48.2%.

### 5.8.6 Employment and occupation

According to the 2011 Population Census of Bangladesh, the main occupations in Sitakunda Upazila were agriculture (26.72%), fishing (7.37%), industry (17.72%), service holders

(22.06%) and others (21.53%). The unemployment rate in Sitakunda Upazila was 4.60%, which is slightly lower than the national average of 4.70%.

Sitakunda and Mirsarai are same electoral areas, so they have almost similar employment facilities and education rate. According to the 2011 Population Census of Bangladesh, the main occupations in Mirsarai Upazila were agriculture (28.54%), fishing (6.67%), industry (20.23%), service holders (25.78%), and others (14.07%). The unemployment rate in Mirsarai Upazila was 4.71%, which is slightly higher than the national average of 4.70%.

### 4.8.7 Historical, cultural and archeological sites

The study area is rich in historical, cultural, and archaeological sites, which reflect the area's diverse past and heritage. Archaeological heritage and relics Chandranath Mandir, Baskunda at Sitakunda Sadar, Bara Aulia Dargah Sharif at Sonaichhari, Harmadia Jami Mosque at Kumira.

History of the War of Liberation an encounter was held between the freedom fighters and the Pak army at Kumira of Sitakunda with heavy causality on the side of the Pak army. Besides, two freedom fighters were killed in an encounter with the Pak army at a place near the Barabkunda Chemical Bridge. On 19 April 1971 the Pak army killed 10 innocent persons of the Sitakunda Upazila.

Religious institutions - Mosque 292, temple 50, tomb 8, Buddhist math 3. Noted religious institutions: Sonaichhari Central Jami Mosque, Dal Chal Shah Mosque, Salimpur Jami Mosque, tomb of Bara Aulia, Kalu Shah Mazar, Fakir Hat Mazar, Pasthishala Buddhist Vihara, Sitakunda Shankar Math, Labanakhya Mandir, Chandranath Mandir, Bashbaria, Kumira, Guliakhali etc.

Here is the description of some of the notable sites:

***Chandranath Temple***

Chandranath Temple is a famous Hindu temple located on top of the Chandranath Hill in Sitakunda. The temple is dedicated to Lord Shiva and is believed to be more than 1,500 years old. The temple attracts a large number of devotees and tourists from all over the country.

***Sitakunda Botanical Garden and Eco Park***

Sitakunda Botanical Garden and Eco Park is a popular tourist attraction located in Sitakunda. The park is home to a wide variety of plant species, including some rare and endangered species. The park also has a large lake and a picnic area, making it a popular spot for families.

***Mirsarai Fort***

Mirsarai Fort is a historical fort located in Mirsarai Upazila of Chittagong District, which is just adjacent to Sitakunda. The fort was built during the Mughal period and played a significant role in the defense against British and Portuguese attacks.

***Sitakunda Hill Fort***

Sitakunda Hill Fort is a historic fort located in Sitakunda, which was built during the 17th century by the Mughal Emperor Aurangzeb. The fort is situated on top of a hill and provides a panoramic view of the surrounding area.

***Sonaichhari Hill***

Sonaichhari Hill is a hill located in Sitakunda, which has several archaeological sites including a temple and a mosque. The hill is believed to have been a center of Buddhist activity during ancient times.

***Srimat Swarupananda Math***

Srimat Swarupananda Math is a famous Hindu monastery located in Sitakunda, which was established in the early 20th century. The math has a large temple complex and hosts several cultural and religious events throughout the year.

***Bashbaria, Kumira and Guliakhali***

These three tourist spots are located along the coast of the Bay of Bengal. Nowadays, these are the most popular tourist spots of Sitakunda Upazila.

These historical, cultural, and archaeological sites are not only important for their heritage value but also attract many tourists from both inside and outside the country, contributing to the development of the local economy.

# Chapter Six
# Impact Prediction and Evaluation

## 6.1 Introduction

Every development activity has some potential impacts on major component of environment like air, water, soil, ecosystem, sound level, temperature, aquatic flora & fauna etc. The different stage of development activities for ex: pre-construction, construction & operation stages have different level of impacts. In this chapter impacts of the development activates have been identified, assessed & presented and also proposes appropriate mitigation measures to avoid, reduce, or compensate these Impacts.

## 6.2 Impact assessment methodology and Approach

Environmental impact assessment will start scoping the issues which are identified as consequence of various activities of the project related with environmental concerns.

Mainly impact assessment done in 3 steps

1. impact identification
2. Impact prediction
3. Impact evaluation

## 6.3 Identification of potential impact

The potential impacts have been identified in a systematic process whereas the activities (both planned & unplanned) associated with the project have been considered with respect to their potential to intermingle with environmental & social resources.

The interaction matrix shown in the below table a methodical identification of potential activities which are interacted with project activities may have influence (positive or negative)

## 6.4 Construction stage impact

The major actions in the construction period will be as follows:

- Procurement of Material
- Preparation of ROW by excavation of soil.
- Transportation and hauling of pipes
- Temporary Storage in Stockyard –pipe fittings & other material
- Stringing of line pipe
- Field bends to 8D radius using hydraulic pipe bending machine
- Equipment and Vehicle Mobilization
- External cleaning of pipe
- Manpower Engagement
- Build Main working camp & Field camp for workers

- Preparation of Pipeline route and working areas
- Welding
- Cleaning of weld area of mainline pipe by send blasting
- NDT like Radiography
- Grading
- Installation of Coating of Pipeline or Catholic protection
- Trenching
- Lowering in Gas Pipe Laying
- Tying-up
- Back Filling
- Re-instatement and Clean-up
- Aerial Marker
- Commissioning
- Road & rail crossing by thrust boring
- Land filling for Pig launching, valve, construction of market post and other permanent structures
- Metering Station Pig, valve, city gate station and Other Permanent Above-ground Facilities

Impact of the above activities in the construction phase are described in the following sections.

***Potential impact on air quality***

The construction of gas pipelines can contribute to air pollution, particularly through the emissions of pollutants from construction equipment and others. Here are some of the ways of project can contribute to air pollution:

**Dust and particulate matter:** During the construction phase of the pipeline, earth-moving equipment and other construction machinery can generate dust and particulate matter. The road side will be trenched to attain the required depth to install the gas pipes. These activities would enhance the emission of dust particles, particulate matters and air polluting gases from the vehicles and excavators and can be harmful to human health, particularly for people with respiratory issues.

**Emissions from construction vehicle**: Gas pipeline construction requires a lot of truck traffic and motorized excavators will be used to shorten the duration of excavation. Which can lead to increased emissions of pollutants such as nitrogen oxides, carbon monoxide, and particulate matter.

**Flaring:** During the testing phase of the pipeline, gas may need to be flared (burned off) to ensure that it is flowing properly. This flaring can release pollutants such as nitrogen oxides, sulfur dioxide, and carbon monoxide into the air.

***Impact on sound level***

This project can cause noise pollution during the construction phases. Here are some of the ways in which construction of these project can cause noise pollution:

**Heavy equipment:** The construction of gas pipelines requires the use of heavy machinery and equipment, which can generate loud noise levels that can be disruptive to nearby communities.

**Truck traffic:** The transportation of materials, equipment, and personnel to and from the construction site can result in increased truck traffic, which can generate noise pollution.

### *Potential Impacts on water quality*

During the construction phase of gas pipeline setup and upgradation project can have various impacts on water quality. Here are some ways that gas pipeline setup project can cause water pollution:

**Turbid water due to soil erosion and sedimentation:** During construction, soil can be disturbed, leading to erosion and sedimentation in nearby streams, rivers, ditches, ponds and other water bodies. This can cause water to become cloudy or murky, reducing visibility, increase turbidity and negatively impacting aquatic life.

**Contamination of surface water bodies due to spills and leaks:** Accidental spills or leaks of fuel, oil, or other chemicals used during the construction of pipelines can contaminate nearby water bodies. Spills can also occur during truck transport of materials, leading to accidental release of pollutants into waterways.

**Disruption of aquatic habitats:** Construction of pipeline and associated infrastructure can lead to changes in water temperature, flow rates, and chemistry, which can disrupt aquatic habitats and negatively impact fish and other aquatic life.

**Groundwater contamination:** To setup gas pipeline often require drilling and excavation, which can disrupt and contaminate groundwater sources. This can have significant impacts on local water supplies and ecosystems.

### *Potential impact on soil*

This project can cause soil pollution in various ways, particularly during the construction phase. Here are some of the ways that gas pipeline setup & upgradation project can cause soil pollution:

**Soil disturbance and compaction:** Pipeline construction often involves the excavation of large trenches, which can lead to soil compaction and disturbance of soil structure. This can make it harder for plants to grow and can lead to soil erosion and degradation.

**Soil contamination:** Construction materials and equipment can leak or spill fuel, oil, or other chemicals onto the ground, contaminating the soil. Chemicals used during construction can also leach into the soil and impact the soil's chemical composition, which can make it difficult for plants to grow.

**Loss of topsoil:** Excavation of soil for gas pipeline placing can result in the loss of topsoil, which is the most nutrient-rich layer of soil. Topsoil contains organic matter and nutrients necessary for plant growth. Losing topsoil can result in reduced plant growth and increased soil erosion.

**Disruption of soil ecosystems:** Pipeline construction work can disrupt soil ecosystems, including microorganisms and invertebrates that are essential for maintaining healthy soil.

### *Impacts due to construction & other waste management*

Gas pipeline setup project can generate various types of waste, including construction waste, hazardous waste, and domestic waste. Here are some of the ways that gas pipeline setup project can generate waste:

**Construction waste:** Pipeline construction generates a significant amount of waste, including excess concrete, rock, and soil. This waste can be difficult to dispose of and can contribute to soil pollution and erosion.

**Hazardous waste**: Gas pipeline project can generate hazardous waste such as oil, lubricants, solvents, and chemicals used for pipe coating and maintenance. These materials can pose a risk to human health and the environment if not handled properly.

**Domestic waste:** labor shed at different locations of construction sites will also generate significant amount of kitchen and other household wastes. The surrounding environment would be contaminated if the wastes are not properly placed/disposed.

### *Impact on ecosystem*

This gas pipeline setup and up gradation project can have various impacts on ecosystems, including:

**Habitat fragmentation and loss:** Pipeline construction can fragment and destroy habitats, leading to loss of biodiversity and reduced ecosystem services. Fragmentation can also increase the risk of invasive species invasion, altering the composition of ecosystems.

If plants (trees, shrubs and shrubs) appear inside the proposed gas pipeline, they need to be cleaned or cut before starting construction work. On the other hand, herbs, shrubs and undergrowth vegetation were also observed in this site. Vegetation clearing or damage along the proposed alignment will affect wild animals (e.g. reptiles, birds, mammals). Hopefully they will be able to survive in nearer surrounding areas and homestead bushes as the ecological parameter and vegetation composition is more or less similar. Some birds, reptiles (e.g, lizard and snakes) will leave the place due to removal of vegetation. Additionally, generation of noise due to construction activities and labor movement will create disturbance to the surrounding wildlife community.

The aquatic flora will be temporarily damaged when gas pipeline crossing the water body. At the proposed site, aquatic floras like Water hyacinth, Water velvet, etc. will have to be cleaned when the new pipe will be installed. In addition, existing bank side marshy vegetation will be damaged by labor and equipment movement due to new gas pipe installation. In that case, water depended fauna will be also temporary relocated/affected.

**Water pollution:** As mentioned earlier, pipeline construction can lead to water pollution due to soil erosion, sedimentation, and chemical contamination. This pollution can harm aquatic ecosystems, including fish populations.

**Soil and air pollution:** Aforesaid, pipeline construction can also lead to soil and air pollution, which can harm soil and air quality and impact the health of plants and animals.
**Noise pollution:** previously mentioned that pipeline construction can generate noise pollution, which can disrupt wildlife behavior and affect sensitive species, including birds and mammals.

### *Impact on fisheries resource*

Gas pipeline setup project can have significant impacts on fisheries resources, particularly if the pipeline crosses or runs near water bodies that support fish populations. Here are some of the ways that gas pipeline setup project can impact fisheries resources:
**Habitat destruction**: Pipeline construction can destroy or degrade the habitats of fish, including spawning and rearing areas. This can lead to reduced fish populations and loss of biodiversity. The Rivers are perennial in nature. Naturally the fishes spawn in rainy season due to suitable temperature, turbidity, water current, Dissolved Oxygen etc. The small fishes spawn in the pre-monsoon, but the matured fishes spawn in the monsoon season. The spawns are spread over upstream and downstream in the River through water current. It is expected that River fish habitat might have negative impact on recruitment of fish and other aquatic organisms due to gas pipe line transmission through River. This may hamper fish recruitment and production at least for one year after completion of construction activities.
**Decrease the fish production due to Water pollution:** As mentioned earlier, pipeline construction can lead to water pollution due to soil erosion, sedimentation, and chemical contamination. This pollution can harm aquatic ecosystems, including fish populations.
**Disruption of fish migration:** Pipeline construction can disrupt fish migration patterns by various activities like trenching, lowering in gas pipe laying, filling and blocking access to important spawning and feeding areas etc. So, the water movement may hamper the longitudinal and lateral migration of migratory fishes. The impacts, thus, on fish migration are likely to be negative.
**Reduce fish diversity & species richness:** During construction period some fishes may shift from the construction area because of mixing the suspended sediment, incremental water turbidity, sound etc. Moreover, fish eggs, fry, larvae and juveniles can be disrupted/destroyed in adjacent area. The consequences of construction activities, fish diversity and composition would be decreased temporarily at the construction and adjacent area.
**Effect on fish behavior Noise pollution:** Pipeline construction can generate noise pollution, which can disrupt fish behavior, including spawning and feeding.

### *Impact on biodiversity*

Gas pipeline construction project can have significant impacts on biodiversity, particularly if the pipeline crosses or runs near areas with high levels of biodiversity. Here are some of the ways that gas pipeline construction project can impact biodiversity:
**Habitat loss:** Pipeline construction can destroy or fragment habitats due to various types of works like grading, soil excavation and others, leading to the loss of biodiversity and reduced

ecosystem services. Species that rely on these habitats may be displaced or forced to adapt to new, less suitable habitats.

**Disruption of ecological processes:** In the project area, pipeline construction can disrupt ecological processes such as nutrient cycling, pollination, and seed dispersal. These disruptions can affect biodiversity by altering the composition of ecosystems and reducing the availability of resources for species.

**Introduction of invasive species:** Pipeline construction can create new pathways for the introduction of invasive species, which can outcompete native species and reduce biodiversity.

**Effects on biodiversity because of soil and water pollution:** As mentioned earlier, pipeline construction can lead to soil and water pollution, which can harm plant and animal species and reduce biodiversity.

### *Impact agricultural resource and activity*

Gas pipeline construction project can have important impacts on agricultural activity. Here are some of the ways that gas pipeline construction project can impact on agriculture:

**Destruction of agricultural land and reduce crop production:** If the pipeline crosses or runs near areas of cultivated land, both rice and non-rice-based crops are grown in this land would be damaged due to excavation work during construction period. The standing crop would be affected along the Right of Way (RoW). Certain amount of crop production might be lost due to install the gas transmission pipe line.

**Hamper the irrigation system**: Farmers grow crops by using irrigation water. The irrigation water is generally provided from ground water through the irrigation canals. During the construction phase, these canals would be cut off and temporary roads will be built up across these existing irrigation canals, thereby the supplying of irrigation water would be disturbed.

### *Impact on human safety and security*

Gas pipeline setup project can have significant impacts on human safety and security, particularly during the construction of the pipeline. Here are some of the ways that gas pipeline setup project can impact human safety and security:

**Construction accidents:** Pipeline construction involves heavy machinery and potentially hazardous materials, which can lead to accidents and injuries. Accidents can also occur during the transportation and storage of pipeline materials.

**Pipeline leaks and explosions:** Pipeline leaks and explosions can pose a significant risk to human safety and security. Leaks can release hazardous materials into the environment and cause fires or explosions that can harm nearby communities.

**Disruption of local communities:** Pipeline construction can disrupt local communities by disrupting transportation and infrastructure, creating noise and air pollution, and impacting local economies. This disruption can lead to social unrest and potential security issues.

***Employment opportunities***

Gas pipeline setup project can provide significant employment opportunities for local communities. Here are some of the ways that cited project can be created jobs:

**Construction jobs:** Pipeline construction requires a range of skilled and unskilled labor, including welders, equipment operators, and general laborers. These jobs can provide opportunities for local workers, including those with limited education or work experience.

**Support jobs:** In addition to construction jobs, gas pipeline setup project can create support jobs in areas such as transportation, logistics, and supply chain management. These jobs can provide opportunities for workers with a range of skills and experience.

**Maintenance jobs:** Once the pipeline is operational, it will require ongoing maintenance and repair. This can create opportunities for workers in fields such as engineering, maintenance, and operations.

**Economic benefits:** In addition to direct employment opportunities, this project can provide indirect economic benefits to local communities, such as increased demand for goods and services and increased tax revenues. Extension of industry will provide extra employment opportunities for the local people. Transportation, loading and unloading of goods/ materials will also create employment opportunities for the people.

To maximize the employment opportunities created by gas pipeline setup project, companies can implement measures such as hiring locally, providing training and development opportunities for workers, and working with local community organizations to identify potential job candidates. Additionally, companies can work with local governments and economic development organizations to maximize the economic benefits of the project for the community. Finally, companies can implement best practices to ensure that workers are safe and treated fairly throughout the construction and operation of the pipeline.

## 6.5 Operation stage impact

The basic activities in the operation and maintenance phase are described as follows:

- Pipeline Operation and Maintenance
- Station Operation
- Waste and Disposal activities

Gas pipeline operation and maintenance can also have significant environmental impacts. Here are some of the ways that gas pipeline operation and maintenance can impact the environmental parameter:

***Air pollution***

Air pollution: Gas pipelines can emit pollutants such as volatile organic compounds (VOCs), nitrogen oxides (NOx), and particulate matter (PM) during operation and maintenance activities such as pipeline pigging. These pollutants can contribute to air pollution and have negative impacts on human health and the environment.

### *Water pollution*

Gas pipelines can also have impacts on water quality. Leaks or spills during operation and maintenance activities can release contaminants into nearby waterways, which can harm aquatic life and impact water quality.

### *Land use and soil pollution*

Gas pipeline operation and maintenance can require the use of large areas of land for compressor stations, valve sites, and other facilities. This can lead to habitat destruction and fragmentation, which can have negative impacts on biodiversity. After construction period, the land remains fallow due to pipeline lying in the stipulated area. Because of this different spoil material are mixed with the soil. Land may be recovered immediately for future cultivation

### *Noise pollution*

The Off take valve station and other pipeline facilities can generate noise pollution, which can have negative impacts on nearby communities and wildlife.

### *Climate change*

Methane, the primary component of natural gas, is a potent greenhouse gas that contributes to climate change. Leaks and emissions of methane during pipeline operation and maintenance can contribute to climate change and impact the environment.

### *Waste Management*

Waste generation and disposal during the operation phase of gas pipelines can be a significant environmental issue. Here are some of the ways that waste can be generated during the operation phase of gas pipelines:

**Hazardous waste**: Gas pipelines can generate hazardous waste such as used oils, lubricants, solvents, and other chemicals during maintenance and repair activities.

**Operational waste:** Once the pipeline is operational, waste can be generated during routine maintenance activities. This waste can include materials such as filters, rags, and contaminated soil.

**Non-hazardous waste:** Gas pipelines can also generate non-hazardous waste such as scrap metal, used equipment, and general refuse during maintenance and repair activities.

**Pipeline pigging waste:** Pipeline pigging is a process used to clean and inspect pipelines. This process can generate waste such as debris, sediment, and other materials.

## 6. Accidental events

Accidental events during the gas pipeline setup project can have significant impacts on human safety, the environment, and the economy. Here are some of the potential accidental events that can occur during the gas pipeline setup project:

**Pipeline ruptures:** Pipeline ruptures can occur due to construction defects, damage from excavation equipment, or corrosion. Pipeline ruptures can result in gas leaks, fires, and

explosions, which can have significant impacts on human safety, the environment, and property.

**Equipment failures**: Equipment failures during construction, such as the failure of pressure control equipment or valves, can lead to gas leaks, fires, and explosions.

**Spills:** Spills can occur during construction when chemicals, fuels, or other materials are spilled on the ground or in waterways. Spills can contaminate soil, water, and air, and can have significant impacts on the environment and human health.

**Accidents involving construction vehicles**: Accidents involving construction vehicles such as trucks, cranes, and bulldozers can cause property damage, injuries, and fatalities.

***Fire & explosion due to gas pipeline setup project***

Fire and explosion are potential hazards that can occur during the gas pipeline setup project, and they can have significant impacts on human safety, the environment, and property. Here are some of the factors that can contribute to fire and explosion during the gas pipeline setup & upgradation project:

**Gas leaks**: Gas leaks can occur due to construction defects, damage from excavation equipment, or corrosion. Gas leaks can lead to the accumulation of gas, which can ignite and cause a fire or explosion.

**Hot work:** Hot work, such as welding and cutting, can generate sparks and heat, which can ignite gas leaks and other flammable materials.

**Electrical equipment:** Electrical equipment used during construction can generate sparks and heat, which can ignite gas leaks and other flammable materials.

**Human error:** Human error, such as improper use of equipment or failure to follow safety procedures, can contribute to the risk of fire and explosion.

# Chapter Seven
# Mitigation Measures

## 7.1 Introduction

This chapter has been prepared in line with the significant impacts for the activities as identified in the concerned section of preceding chapter on identification & evaluation of potential impacts. Initiatives have been made to include the mitigation measures with implementation plan in the designated part of this chapter accordingly.

Each aspect of the project activities has a potential impact on the environment. Most potential adverse impacts can be reduced or even eliminated if appropriate mitigation measures are implemented. Potential impacts have been identified and assessed in the previous chapter and potential positive and negative impacts are further assessed in this chapter to describe appropriate measures to mitigate or avoid potential negative impacts arising from the construction and operation phases of the project.

By appropriate application of mitigation measures (Table 7.1) and best management practices, most, if not all, potential impacts can be eliminated or mitigated to negligible levels.

*Table 7.1: Hierarchy of environmental mitigations for due Environmental Management:*

| Mitigation Method | Definition | Remarks |
|---|---|---|
| **Avoid the impact** | This step involves avoiding or preventing environmental impacts from occurring in the first place. This can be achieved by carefully selecting project sites or by avoiding activities that may cause environmental impacts such as changing some aspects of design, construction or operations so that the impacts no longer occur. | |
| **Reduce the impact** | If impacts cannot be avoided, the next step is to reduce the severity or magnitude of the impact. This can be achieved by implementing measures that will lower the level of impact in an acceptable limit, such as implementing pollution control technologies or reducing water usage or ensuring that construction equipment meets sound level standards. | |
| **Rectify the impact** | If environmental impacts do occur, the next step is to rectify the impacts rehabilitate the environment to a level where by the impact is within acceptable limit. This can involve restoring ecosystems or remediating contaminated sites. | |
| **Compensate for the impact** | If it is not possible to fully rectify the damage caused by environmental impacts, the next step is to compensate for the damage. This can involve providing non- monetary compensation (first priority) or financial compensation (second priority) to affected parties or undertaking | |

| | | |
|---|---|---|
| | environmental enhancement measures elsewhere to offset the harm caused. | |

It represents a set of proposed mitigation actions that are considered most appropriate, singly or in combination with other proposed mitigation measures, to address the range of suitable environmental conditions encountered in the field. The project developer will exercise judgment and choose among them to design a mitigation program that reduces the impacts to the desired level. The project developer may be required to implement one or all of the proposed mitigation measures. The conditions will be determined during the construction and operation of the project which will be implemented.

## 7.2 Environmental management procedure

## 7.3 Summary of Mitigation measure

- During construction
- During operation

## 7.4 Suggested mitigation measures for specific parameters

### 7.4.1 Mitigation plan for air quality deterioration.

**Construction phase:**

During construction, the principle air quality impacts will arise from dust generation due to soil excavation, pipe lying and vehicle movements. The measures listed below should be taken into account during construction to mitigate environmental impacts.

- Low emission fuel should be used for operating all kinds of engines.
- Selecting short & direct routes of all traffics.
- Incineration of any waste must be avoided.
- Dust Suppression Mechanism like water spraying should be done at least twice in day time
- Maintain generator engine & other heavy duty engines in good repair, to reduce exhaust emission
- Materials in the stockyard should be covered properly to suppress emission of dust.
- Regular inspection and maintenance of the Project vehicles should be carried out.
- No unfit vehicle, and equipment should be allowed to move.
- Regular monitoring of the concentration of air pollutants should be done.
- Use non-toxic paints, solvents and other hazardous materials for construction, wherever possible
- Low sulphur diesel oil should be used in all vehicle and equipment engines
- Green belt along the boundary can be developed by planting trees.

- Earth, excavated from the trench should be stacked properly and cover it to avoid emission of dust in the air.

**Operation phase:**

- Check leakage regularly & reduce fugitive emission of gas from the pipeline system.
- Leak detection systems can be installed along the pipeline to quickly identify and address any leaks that may occur
- Emergency response plans should be developed and implemented to respond to any potential accidents or incidents that may occur during pipeline operations.
- Exercise careful & minimum venting & purging of gas
- Maintain generator & other machine and equipment in good condition to operate with low exhaust particularly in the off-take valve station.
- All personnel involved in the operation of the pipeline should be trained on the importance of protecting the environment during operations and how to implement mitigation measures.

### 7.4.2 Mitigation plan for water pollution

During the set up & operation of gas pipe line, the major water quality impacts will arise from soil erosion & sedimentation during excavation, spill & leak of oil & chemical, drilling etc. The measures listed below should be taken into account during construction to mitigate environmental impacts.

**Construction Phase:**

- Oil Spillage should be controlled and minimized.
- Monitoring water quality during and after construction and ensure the discharge water quality conformance with Bangladesh standards.
- Location of labor shed, sanitary facilities should be far away from water bodies.
- Release of untreated wastes in surface water should be prohibited.
- Camp site must be equipped with proper latrine like Ventilated Improved Latrine (VIP) which should be filled up by earth after finishing the construction work.
- Bottom of the pit of latrine should be at least 2m above groundwater table at wet season and should be 10m away from tube well location.
- Construction material, debris, and excavated soil/silt should not be allowed to enter into the water bodies.
- Using sediment and erosion control measures during construction.
- Solid wastes should be properly collected and dumped at designated Place
- Surface drained will adequately grade, kept debris free & will be routed in a suitable location so as to prevent silting & flooding etc.
- installing secondary containment systems to prevent spills and leaks
- Prepare a suitable waste management plan to reduce open dumping of waste in water.
- Companies can also use alternative technologies, such as trenchless pipeline construction methods, that have less impact on water resources.

**Operation Phase:**

- The dispose materials should be well protected. So that the materials cannot enter the water body.
- Oil & any other chemical like coating chemical etc. spillage should be controlled and minimized
- Drainage surface shall be adequately graded, kept free of debris and routed at suitable locations to prevent siltation and flooding etc.
- Emergency response plans should be developed and implemented to respond to any potential accidents or incidents that may occur during pipeline operations.
- Regular monitoring and reporting of environmental impacts can help to identify any issues that arise and to develop appropriate mitigation measures.
- All personnel involved in the operation of the pipeline should be trained on the importance of protecting the environment during operations and how to implement mitigation measures.

### 7.4.3 Mitigation plan for sound pollution

During this project, the sound pollution will arise from movement of heavy vehicle and equipment, labor movement by vehicle, excavation work and pipe line maintenance activities, including pigging and flushing etc. The measures listed below should be taken into account during construction to mitigate environmental impacts.

**Construction phase:**

- Using sound barriers and mufflers on equipment and vehicles
- Scheduling maintenance activities during off-peak hours
- Avoiding construction activities in sensitive areas such as residential neighborhoods
- Construction activity should not take place at nighttime. If this is absolutely unavoidable, the authority should consult with local community leaders.
- Generator use with Canopy system.
- Taking maximum advantageous of shielding provided by onsite structure & offsite nature feature (tree etc.) to minimize at sound level at offsite receptor location.

**Operation phase**

- Scheduling maintenance activities during off-peak hours
- Noise abatement measures, such as noise barriers or sound-proofing equipment, can be installed to minimize the impact of noise pollution on nearby communities.
- Ensure the sound level around the project comply with Bangladesh standard.
- Regular monitoring and reporting of environmental impacts can help to identify any issues that arise and to develop appropriate mitigation measures.
- All personnel involved in the operation of the pipeline should be trained on the importance of protecting the environment during operations and how to implement mitigation measures.

### 7.4.4 Mitigation plan for Soil contamination, agricultural activity & fertility control plan

During the gas pipeline construction & operation phase, the soil pollution and fertility problem will arise due to the excavation of large trenches, leak or spill fuel, oil, or other chemicals onto the ground, pipeline construction etc. The measures listed below should be taken into account during construction to mitigate environmental impacts.

**Construction phase:**

- The contractor should carefully dig the hole for laying the gas pipeline.
- The excavated soil materials should be properly stacked in requisitioned strips in a sequence i.e. topsoil - subsoil – sub stratum.
- Avoid earth excavation work during rainy season, as appropriate
- Using erosion control measures during construction.
- Using equipment with low soil compaction
- Implementing spill prevention and response plans
- Grading shall be limited as much as possible to minimize the disturbing vegetated area and subjects them potential erosion.
- avoiding construction in areas with high-value soils or environmentally sensitive areas
- The excavated soils should be properly stacked for refilling the trench with soil by maintaining the sequence of the profile (i.e. Substratum – Subsoil – Topsoil).
- The loosened topsoil's must be compacted well so that no erosion can take place.
- The mobilization and construction work of the project should be carried out carefully, so that standing crop would not be damaged.
- Tranches shall be backfilled as soon as possible to minimize erosion potential.
- Leak detection systems can be installed along the pipeline to quickly identify and address any leaks that may occur
- The project work might be delayed for allowing the farmers to harvest their standing crop. The work should not be continued through the crop fields.
- If any irrigation canals are damaged or disrupted due to project work, immediately the canals should be repaired or re-established.
- Clearing operation shall not interfere or obstruct natural watercourse & man-made drainage system
- Loss of existing source of irrigation should be replaced by another source**.**

**Operation phase:**

- Hazardous liquid and solid pollutants should not be spread over the project site.
- Leak detection systems can be installed along the pipeline to quickly identify and address any leaks that may occur.
- Emergency response plans should be developed and implemented to respond to any potential accidents or incidents that may occur during pipeline operations.
- Regular monitoring and reporting of environmental impacts can help to identify any issues that arise and to develop appropriate mitigation measures.

- All personnel involved in the operation of the pipeline should be trained on the importance of protecting the environment during operations and how to implement mitigation measures.

### 7.4.5 Solid waste Management

The environment is significantly affected by this project due to the generation of waste during the construction and operation phases. Waste can be construction waste, hazardous waste, and operational waste or others. The following measures should be taken into account during construction & operation phase to mitigate environmental because of waste management.

**Construction phase:**

- Implement the 3R (reduce, reuse, recycle) waste disposal method to reduce environmental impacts.
- Using more efficient construction methods, and properly disposing of hazardous waste in accordance with local regulations.
- The responsible authority should implement waste management plans that address the entire life cycle of the pipeline, from construction to operation and eventual decommissioning.

**Operation Phase:**

- Waste reduction: Companies can implement measures to reduce waste generation, such as using more efficient equipment, recycling materials, and using environmentally friendly products.
- Waste segregation: Companies can segregate hazardous and non-hazardous waste and store them separately to ensure proper disposal.
- Proper disposal: Companies can ensure that waste is properly disposed of, either by contracting with waste disposal companies or by disposing of the waste at approved facilities.
- Spill response plans: Companies can develop and implement spill response plans to minimize the impact of spills and leaks on the environment.
- Regulatory compliance: Companies can comply with all relevant regulations regarding waste management and disposal.
- Emergency response plans should be developed and implemented to respond to any potential accidents or incidents that may occur during pipeline operations.
- Regular monitoring and reporting of environmental impacts can help to identify any issues that arise and to develop appropriate mitigation measures.

### 7.4.6 Mitigation plan to protect biodiversity

The project has significant impacts on biodiversity, especially if the pipeline runs close to areas with high levels of biodiversity, surrounding area effected by high level of water & soil pollution, sound pollution etc. The measures listed below should be taken into account during construction & operation to mitigate the impacts on biodiversity.

**Construction phase:**

- Avoid vegetation damage as much as possible or vegetation clearance should be minimized to select sites for labor shed and material stock by using nearer fallow land or barren homestead yards
- Fuel wood should be collected from local market.
- Limit vehicle and labor movements to avoid disturbance to the existing nearby wildlife habitat.
- The work should be completed within scheduled time
- Labor should be made aware about local faunal species.
- Make early notification to the proper authorities (i.e. Concern tree owner and concern UPZ officials) about tree felling.
- The owners of the trees will have to be paid proper compensation if the trees are cut or damaged especially for fruit yielding tree.
- Plantation program with local ornamental and medicinal tree should be implemented.
- Trees should be planted where the fallow land are available. It is be to noted, trees should not be planted closer than 25 feet from any natural gas transmission line)
- Do not run construction activities at night to avoid disturbance of wildlife habitat;
- Awareness program on plant and wild life conservation
- As much as possible all canals (selected or temporary impacted in this project) should be used for construction activities in mainly dry season (From May to August)
- Use minimum land to the extent possible for labor and equipment movement
- implement best management practices during construction and operation to reduce impacts on air, water, and soil quality and minimize habitat destruction
- The site will be fenced and site excess will be controlled strictly

**Operation phase:**

- Use advanced technology, such as pipeline pigging and smart sensors, can be used to improve pipeline efficiency and safety, as well as to minimize environmental impacts.
- Emergency response plans should be developed and implemented to respond to any potential accidents or incidents that may occur during pipeline operations.
- Regular monitoring and reporting of environmental impacts can help to identify any issues that arise and to develop appropriate mitigation measures.
- All personnel involved in the operation of the pipeline should be trained on the importance of protecting the environment during operations and how to implement mitigation measures.

### 7.4.7 Mitigation plan for fish resource

This gas pipeline setup project has significant impacts on fisheries, particularly if the pipeline crosses or runs near water bodies that support fish populations, leak or spill fuel, oil, or other chemicals into the water bodies, sound pollution etc. The measures listed below should be taken into account during construction & operation to mitigate the impacts on fisheries resources.

**Construction Phase:**

- Construction machineries should be taken care during construction so that oil or grease do not spill to adjacent water bodies or in the river water.
- The vehicles related to construction activities should be carefully driven for avoiding accident in the vicinity of the water bodies or in the river.
- Avoid the spawning period for construction in the month of May-July. If not possible, activities should be conducted carefully during spawning and migration period.
- Aware the construction staff about time of fish spawning and work carefully.
- The construction authority should work with local fisheries experts to identify and avoid sensitive areas and implement best management practices during construction and operation to minimize impacts on water quality.

**Operation phase:**

- The dispose materials should be well protected. So that the materials cannot enter the water body.
- Emergency response plans should be developed and implemented to respond to any potential accidents or incidents that may occur during pipeline operations.
- Regular monitoring and reporting of environmental impacts can help to identify any issues that arise and to develop appropriate mitigation measures.
- All personnel involved in the operation of the pipeline should be trained on the importance of protecting the environment during operations and how to implement mitigation measures.

## 7.5 Analysis & Description of mitigation measures

## 7.6 Identification of immitigable impact & environmental mitigation proposal.

I. **Potential impact on natural phenomenon.**
II. **Residual noise within limit.**
III. **Residual discharge within limit.**
IV. **Residual impact on air quality**

## 7.7 Analysis of impact & Development of a comprehensive management plan

# Chapter Eight
# Environmental Management Plan

## 8.1 Introduction

The gas pipeline construction activities involve earth works, trenching, welding, laying, special crossings, pigging, purging, testing and commissioning. These activities have both positive and negative impacts on various components of the environment and socio-economic conditions. The Environmental Management Plan (EMP) has been prepared to suggest mitigation measures for minimizing the effect of the negative impacts, compensation measures for impacts that cannot be mitigated, enhancement measures for increasing the benefit of the positive impacts. It provides essential link between predicted impacts and mitigation measures during implementation and operational activities. EMP outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or mitigate adverse environmental impacts, and the actions needed to implement these measures. The likely impacts on various components of environment due to the project during developmental activities have been identified and measures for their mitigation are suggested. The EMP lists all the requirements to ensure effective mitigation of every potential biophysical and socio-economic impact identified in the EIA. For each attribute, or operation, which could otherwise give rise to impact, the following information is presented:

- A comprehensive listing of the mitigation measures.
- Parameters that will be monitored to ensure effective implementation of the action.
- Timing for implementation of the action to ensure that the objectives of mitigation are fully achieved.
- The EMP comprises a series of components covering direct mitigation and environmental
  monitoring, an outline waste management plan and a project site restoration plan.

## 8.2 Environmental Policy Statement of KGDCL

KGDCL is committed to the protection of the environment and will conduct its operations in compliance with all relevant local, national and international environmental legislation and standards. KGDCLwill Endeavour to ensure the protection of human health and the environment by complying with the letter and spirit of the national environmental policy, environmental legislation, and promulgate (Gazette) environmental rules and regulations of the GOB and international treaties and conventions accepted by the government.

*Table 8.1: Management action and Responsibilities*

**Pre-construction Phase**

| Potential impact | Mitigation measure | Management actions | Authority |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1) Pre-construction activities for the gas transmission lines and facilities will have temporary blockage at some road crossings which are used by local people.<br>2) Occasional road blockage due to survey and vehicular movements etc.<br>3) Dust & emission from such movement of traffic will also have impact on the local people.<br>4) Such disturbance will continue up to commencement of preliminary works for construction of the pipeline in route marking, grading and construction of site camps and approach roads etc. | ➢ Alternate path ways for the road blocks and controlled movement of vehicles including sprinkling water would be necessary to minimize the sufferings of the affected local people. | ➢ Arrangement of alternate path ways for the road blocks and controlled movement of vehicles including sprinkling water would be made by KGDCL/ Study team / Contractor. This has to be supervised and monitored by the KGDCL. | KGDCL |
| 5) Improper selection of camp site. | ➢ Currently disturbed areas such as nearby schools or mosques should be considered in preference. | ➢ After consultation with local administration like upazilla Chairman, the camp site should be selected. | KGDCL |
| 6) Potential impacts of field camps on surface and groundwater is the concern of contamination of surface and groundwater with sanitary waste. | ➢ They should conform, as far as is practicable, to ecological sanitation methods. | | KGDCL |
| 7) Inappropriate locations of toilets and the sanitary waste if not treated properly; there are the potential that water sources used by neighboring villages will be affected. | ➢ Toilets pits in the field camp area should be dug in an area away from food preparation and living areas. | The KGDCL shall monitor such measures as well as any odors as a routine procedure to ensure impacts on adjacent properties are not significant. | KGDCL |

| Potential impact | Enhancement or mitigation measure | Management actions | Authority |
|---|---|---|---|
| 8) The project activities will produce a variety of waste products, the vast majority of which will be produced at the field camps. | ➢ As there are no facilities within the project sites which allow disposal of wastes in accordance with international best practice requirements, a Waste Management Plan will be formulated in accordance with sustainable development principles and the Government of Bangladesh's legislative requirements. It will aim to reduce the use of resources and the discharge of wastes. | ➢ The minimum mitigation measures shall be implemented as part of this Waste Management Plan and will be regularly monitored by KGDCL. | KGDCL |
| 9) Maintenance of worker safety standards is an important aspect of camp site management before starting construction. | ➢ During the pre- project activities, there is the potential for health and safety problems to occur. Measures will however be implemented to minimize any illness or injury to staff or the general public. These include: Necessary preventive and precautionary arrangements should be made to guard against any accidents.<br>➢ Site camps should be well protected and sufficient numbers of portable fire extinguishers should be placed in accessible places in the camp as preventive measure.<br>➢ If possible the camp should be located near surface water storage for pumping during emergency. | ➢ Proper training and supervision arrangements should be implemented by the project management and contractor and the residents should be under strict instruction to follow all relevant health and safety procedures to avoid any potential injury or mishap.<br>➢ Adequate fire safety in camps should be monitored at all times. | KGDCL |

## Construction phase

| Potential impact | Mitigation measure | Management actions | Authority |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1) Impacts due to movement of heavy vehicles, equipment and hauling of line pipe & other construction materials causing occasional road blockage, spreading of dust & damaging the public roads having impact on local environment and the people. | ➢ Contractors to follow the terms of the contract on mitigation measures and act in an environmentally responsive manner through providing alternative pathways for the passersby and local traffic sprinkling water on the roads, promptly reinstating the road damages if any. | ➢ Description of the works to indicate that environmental matters to be of considerable importance and that the contract will be administered accordingly.<br>➢ Briefing of appointed contractors/supervisory officials on mobilization, regarding sensitive environmental matters. | Contractor |
| 2) Erosion of pipeline / Valve Station site borrow pit leading to deterioration of the surrounding land with long- term adverse effects on economic benefits. | ➢ Earthworks specifications to include provision for placing grass turfs on all earthworks slopes, and refilling the borrow pit, if any as soon as possible after the work is completed. | ➢ Sensitive sites to be identified; options for protection measures to be investigated and suitable measures to be incorporated in project designs and construction specifications with inclusion in the contract. | Contractor |
| 3) Pollution of land, groundwater and surface water arising from sanitary and other wastes and spillages. | ➢ Contractors to prepare for approval detailed site environmental plans for the base camps and other work sites, which make adequate provision for safe disposal of all wastes, and prevention of spillages, leakage of polluting materials etc. Also to cleanup & reclaim the land and pay due compensation to the affected ones. | ➢ Inclusion of appropriate clauses in construction contracts.<br>➢ Contractor to act accordingly.<br>➢ Monitoring of compliance during construction and appropriate administration of contracts. | Contractor |

| Potential impact | Enhancement or mitigation measure | Management actions | Authority |
|---|---|---|---|
| 4) Sensitive sites to be identified; options for protection measures to be investigated and suitable measures to be incorporated in project designs and construction specifications with inclusion in the contract. | ➢ Monitoring of compliance during construction. | ➢ Inclusion of appropriate clause in agreement for provision of medical and other service facilities.<br>➢ External workers should have medical checkups prior to commencing work to minimize the potential of communicable disease to the local area. | Contractor |
| 5) The vast majority of waste products will be produced at the base & field camps during field operations. Non- hazardous wastes produced during the field operations are likely to include: Oils and grease; Machinery parts and tires; Sewage, Food: and Paper and plastic. | ➢ Project staff shall not throw away any waste product, solid, liquid or otherwise, whilst en route during operations.<br>➢ All waste products (solid, liquid and wooden stakes) shall be carried out by the crew during project activities and disposed of appropriately at the field camp or other suitable waste receptacle.<br>➢ Consequently food waste must not be disposed of on the site, but should be held inappropriate containers for correct disposal at a later time. | ➢ Contract would contain guide line & specification for this and the EPC contractor is to follow accordingly.<br>➢ Due supervision & monitoring will be exercised to minimize the impact. | Contractor |

| | | | |
|---|---|---|---|
| 6) Noise, vibration & emission of smoke resulting from operation of the welding generators, side booms, Trenchers Bending Machines and Trailers etc will have impact on local environment. | ➢ Due caution is to be exercised in selecting more environment friendly machineries & equipment's and keeping them in good operating condition. | ➢ Such indications should be included in the contract and the contractor is to follow meticulously. Proper supervision & monitoring would minimize these impacts. | Contractor |

*Table 8.2: Comprehensive Management Action Plan*

| **Air quality Management Plan** | |
|---|---|
| **Objectives** | To construct the gas fields in a manner that has minimal impact to the qualities of the air environment that are conducive to:<br>➢ Protecting the health and biodiversity of ecosystems,<br>➢ Human health and wellbeing ,<br>➢ Protecting the aesthetics of the environment, including the appearance of buildings, structures and other property ,<br>➢ Protecting agricultural use of the environment. |
| **When** | **a) Construction Phase:**<br>Air quality impact from combustion sources during construction phase should minimized through routine inspection and maintenance of combustion emissions sources such as generators, diesel engines etc. maintenance will ensure that equipment is operating efficiently and not producing excessive emissions.<br>**b) Operation phase**<br>The only emissions during operation phase are fugitive from pipeline's valves, flanges and intermittent venting from the sectionalizing valves provided along with the pipeline. Engineering design approach shall avoid/minimize emissions to the atmosphere from fugitive emission sources by applying good engineering practice by selecting suitable valve packing, seal. |
| **Required Actions** | 1. Construction activities must be planned and undertaken to minimize generation of dust resulting from adverse weather conditions including:<br>a) scheduling dust generating activities to avoid adverse weather conditions such as extreme wind,<br>b) Modifying activities during windy weather to minimize dust generation.<br>c) Implementing additional dust mitigation measures when dust-generating weather is forecast.<br>2. Requirements for dust management must be communicated to all onsite personnel including that all site personnel have responsibility for monitoring work areas continually for dust emissions and reporting excessive dust generation, particularly in the vicinity of sensitive receptors.<br>3. No on-site burning of vegetation or waste materials is permitted. |

| | |
|---|---|
| | Works undertaken around identified contaminated sites or live sewerage systems to be undertaken in a manner to ensure risk of odour impact on community and workforce is mitigated. |

| **Noise and Vibration Management Plan** | |
|---|---|
| Objectives | To construct the gas fields in a manner that has minimal impact to the qualities of the air environment that are conducive to:<br>Protecting biodiversity of ecosystems<br>Human health and wellbeing.<br>Reduction of sound pollution . |
| When | **a) Construction Phase**<br>On a construction site, nearly everything can generate potentially dangerous levels of noise. A jackhammer, often used for breaking through concrete or stone, generates 100 A-weighted decibels (dBA) of noise. A chainsaw clocks in at 110 dBA and a hammer drill at 115 dBA.<br>Understanding decibel levels is only part of the equation. Construction workers and employers also need to understand when a noise becomes a health and safety hazard. Everything listed above would be considered a safety hazard on a construction site. |
| Required actions | The Contractor must comply with all relevant requirements to reduce noise pollution and must incorporate construction noise management measures into the work order.<br>1) Operating noisy equipment when fewer people are present.<br>2) Limiting the amount of time that a worker is exposed to noisy areas.<br>3) Establishing tranquil spaces where staff can rest during breaks.<br>4) Enhancing noise attenuation measures on plant and equipment • Use of noise attenuation barriers<br>5) Choosing low-noise machinery.<br>6) Maintaining and lubricating equipment and machinery.<br>7) Utilizing noise barriers and other noise suppression equipment. |

| **Water Management Plan** | |
|---|---|
| Objectives | a) Protecting the health and biodiversity of aquatic ecosystems,<br>b) Protecting the stability and function of watercourses,<br>c) Human health and wellbeing,<br>d) Sustaining the economic environment associated with watercourses,<br>e) To construct the gas distribution pipe line in a manner that minimizes the potential impacts on to surrounding landowners.<br>f) Minimal disturbance to riparian vegetation especially the removal of large canopy trees, |

<table>
<tr><td>Targets</td><td>a) Minimal disturbance to riparian vegetation especially the removal of large canopy trees,<br>b) No failure of erosion and sediment control devices leading to unacceptable soil erosion and transport of sediment outside of construction extents,<br>c) No barriers to fish passage,<br>d) No introduction or spread of weed species.</td></tr>
<tr><td>Required actions</td><td>a. The Contractor must comply with all relevant requirements to reduce water pollution and must incorporate construction water management measures into the work order.<br>b. Road crossings and other traffic areas will be located and constructed to minimize the concentration or diversion of water in drainage lines.<br>c. Where practical, surface cover will be maintained in these areas. During backfilling, soil in the pipeline trench will be compacted and the material graded off such that surface water flow will not be impeded/diverted.<br>d. Disturbed natural drainage lines will be restored to their original level/contours and access tracks and any borrow pits will be constructed and aligned.<br>e. Stormwater runoff must be diverted around disturbed areas. This includes any runoff from areas upslope of the works site.<br>f. Chemicals and hazardous substances are not permitted to be stored within 100m of any wetland, waterway or watercourse.<br>g. Works must not occur within a wetland of high ecological significance nor cause a negative impact on a wetland of high ecological significance.</td></tr>
<tr><td>Water quality</td><td><table>
<tr><th>Parameter</th><th>Existing value</th><th>Standard Limit</th></tr>
<tr><td>TDS</td><td>875</td><td>1000</td></tr>
<tr><td>TSS</td><td>95</td><td>150</td></tr>
<tr><td>pH</td><td>8.03</td><td>6.5–8.5</td></tr>
<tr><td>Temp</td><td>27.01</td><td>20–30</td></tr>
<tr><td>EC</td><td>2330.13</td><td>2250</td></tr>
<tr><td>Salinity</td><td>0.26</td><td>–</td></tr>
<tr><td>DO</td><td>7.28</td><td>5.0 or more</td></tr>
</table></td></tr>
</table>

<table>
<tr><th colspan="2">Waste Management Plan</th></tr>
<tr><td>Objectives</td><td>a. Maximize waste recycling and reuse.<br>b. Minimize contamination of the site.<br>c. Appropriately manage waste generated on-site<br>d. Avoid wastes entering the site.<br>e. Minimize waste generated from the site.</td></tr>
<tr><td>Targets</td><td>Documentation and clarify waste management procedures, including waste minimization, waste identification and segregation, collection, handling and storage, waste transfer/transportation, reuse and recycling and disposal of wastes applied across the Project sites.</td></tr>
<tr><td>Required actions</td><td>Detailed waste management plan should be developed and implemented for the construction phase of the proposed project including the following:</td></tr>
</table>

| | |
|---|---|
| | ➢ Waste storage, transfer and handling.<br>➢ The requirements for consignment notes.<br>➢ Inspection and auditing<br><br>Additionally, all personnel employed for the construction phases of the proposed project should receive formal waste management awareness training, particularly regarding the correct waste segregation, storage and labeling procedures and potential recycling of wastes if possible.<br>1. Aqueous waste (comprising hydrotest water, drainage water, untreated sewage water);<br>2. Non-hazardous waste ; solid and liquid (domestic refuse, industrial refuse, sewage sludge);<br>3. Gaseous wastes (vents, exhausts, fire-fighting agents, refrigerants). |

*Table 8.3: Safety Hazard Control Mitigation Measures*

| Sl. | Event | Prevention, Control and Mitigation measures. |
|---|---|---|
| 1. | General Instruction for Workers | a. Personal and continuous visual supervision of the worker who is not competent to perform the job.<br>b. Workers to be conversant on the general safety procedures.<br>c. Workers must be confident that they have adequate training on handling unsafe or hazardous material. |
| 2. | Maintenance of Equipment | a. Employer shall ensure that all equipment used on a work site is maintained in standard condition.<br>b. Will perform the function for which it is intended or was designed.<br>c. Is of adequate strength for that purpose.<br>d. Is free from potential defects. |
| 3. | Traffic Hazard | Where there is a danger to workers from traffic, KGDCL shall take appropriate measures to ensure that the workers are protected from traffic hazards. |
| 4. | Illumination | a. Ensure that illumination at a work site is sufficient to enable work to be done safely.<br>b. Where failure of the normal lighting system would endanger workers, the employer shall ensure that emergency lighting is available that will generate sufficient dependable illumination to enable the workers to:<br>➢ Leave the work site in safety;<br>➢ Initiate emergency shutdown procedures; and<br>➢ Restore normal lighting. |
| 5. | Housekeeping | a. Ensure that each work site is clean and free from stepping and tripping hazards.<br>b. Waste and other debris or materials do not accumulate around equipment, endangering workers. |

| | | |
|---|---|---|
| 6. | Falling Hazards | Ensure that where it is possible for a worker to fall through a vertical distance, the worker is protected from the falling by:<br>➢ A guard rail around the work area;<br>➢ A safety net; or<br>➢ A fall arresting device. |
| 7. | Sanitary Facilities & Drinking Water | a. Ensure that an adequate supply of drinking fluids is available at the work site.<br>b. Ensure that work site is provided with toilet facilities in accordance with the requirement of general health protection guidelines. |
| 8 | wearing and clothing's | Ensure that where there is a possibility that a worker or worker's clothing might come in to contact with moving parts of machinery, the worker:<br>➢ Wears close-fitting clothing;<br>➢ Confines or cuts short his head and facial hair; and<br>➢ Avoids wearing jewellery or other similar items. |
| 9. | Trenching | a. Ensure that proper shoring, stringers and bracing are used.<br>b. Dewatering if water seeps or accumulates in the trench.<br>c. Heavy equipment to be kept at a safe distance so that the trench does not collapse. |

## 8.3 Disaster Management Plan

The early response in a disaster is a incident that is critical step in the overall emergency response. The responders mainly have minimal information and must make rapid decisions to ensure safety of the public and the response teams them. As a general rule the initial response is guided by three priorities, these are: People, Property and Environment. Keeping these priorities in mind, six steps described below constitute most of the emergency response phases. It is important to realize that although the six discrete steps have been identified where, several of the steps may be activated simultaneously.

The emergency procedures identify who does what and when in the event of an emergency. Responsibility for who is in charge and their coordination of emergency actions shall be identified. The following are important events that require emergency procedures at any given time or may be occurring all at once. It is also important to remember that emergency response must be adapted to individual circumstances and may requires inventive, adaptive or creative solutions to difficult problems with very little time for planning or debate. Further, to improve the response capabilities, cooperative arrangements and organizations must be established for providing the appropriate equipment and expertise.

| Disaster Type | Disasters |
|---|---|
| Emergency | ➢ Fire,<br>➢ Blow-out / Explosion,<br>➢ Medical emergency, |

| | |
|---|---|
| | ➢ Leaks and other releases of hazardous substances,<br>➢ Spillage of toxic chemical, and electrocution |
| Natural Disasters | ➢ Flood,<br>➢ Earthquake/ cyclone,<br>➢ Storm/ typhoon/ tornados, and<br>➢ Cloud burst lightning |
| External Factors | ➢ Food poisoning/water poisoning,<br>➢ Sabotage, and<br>➢ War |

## 8.4 Six Steps in Emergency Response

| Steps | Work plan |
|---|---|
| Step-1 | a) Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.<br>b) Determine potential hazards stemming from local conditions such as inclement weather water bodies etc and ensure that the initial response team is aware of these conditions. |
| Step-2: | Determine the source/ cause of the event resulting to the emergency and prevent<br>further losses |
| Step-3: | Conduct an assessment of the incident site for any further information on hazards or remedies. |
| Step-4 : | Initiate redress procedures. |
| Step-5. | Report the incidence its nature cause impact applied redress procedures and any<br>further assistance required etc. to the : appropriate company, government and/or land owner. |
| Step-6 : | Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment. |

## 8.5 Environmental Monitoring Plan

Environmental monitoring programs for this project shall be implemented to address all activities that have been identified to have potentially significant impacts on the environment

during normal operations and upset conditions. Environmental monitoring activities shall be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the proposed gas pipeline project. Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored. Monitoring shall be conducted by trained individuals following monitoring and record- keeping procedures and using properly calibrated and maintained equipment. Monitoring data shall be analysed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. The overall objective of (performance) monitoring shall be to identify any unanticipated changes to the biophysical, health and social environment brought about by the proposed gas pipeline and associated facilities Project. Baseline information against which development and post development impacts and mitigation measures can be measured and compared has been established.

KGDCL shall ensure that deviations from the baseline beyond reasonable limits shall trigger corrective actions so that monitoring becomes a dynamic activity as opposed to passive collection of data. This Environmental Monitoring Plan has been formulated with the aim of ensuring that all the identified significant impacts from the project are mitigated to as low as reasonably possible and that key performance indicators are monitored periodically to track how effectively mitigation measures are implemented. It specifies the mitigation measures, monitoring requirements, duration and frequency of the monitoring, and the action parties to manage the biophysical, social and health environment at the various phases of the project.

*Table 8.4: Key Monitoring Parameters*

| Sl | Impact Parameter | Impact Indicator | Sampling Location | Sampling Method | Sampling Frequency | Monitoring Party |
|---|---|---|---|---|---|---|
| 1 | Air Quality | ➢ $CO_X$<br>➢ $NO_X$<br>➢ $VO_C$ | Along pipeline route | In situ gas monitors | Weekly during excavation, monthly thereafter | KGDCL |
| 2 | Soil Quality | ➢ pH<br>➢ OrganicCarbon<br>➢ THC<br>➢ Oil & Grease<br>➢ Heavy Metals | Pipeline Route | pH Meter UV Spec, AAS | Quarterly after construction | KGDCL |
| 3 | Water Quality (surface) | ➢ pH<br>➢ BOD<br>➢ COD<br>➢ THC<br>➢ Heavy Metals | Pipeline Route | pH Meter UV Spec, AAS | Monthly (during construction); Annually thereafter | KGDCL |
| 4 | Ground Water | ➢ pH<br>➢ BOD<br>➢ COD<br>➢ THC<br>➢ Heavy Metals1 | Existing monitoring borehole | pH Meter UV Spec, AAS | Monthly (during construction); Annually thereafter | KGDCL |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | Vegetation | ➢ Morphology<br>➢ Floristic<br>➢ Composition<br>➢ Pathology<br>➢ Species density | Work site<br>Base Camp<br>Line Cuttings | Field assessment<br>Culturing & Identification | monthly | KGDCL |

# Chapter Nine
# Risk Management

## 9.1 Introduction

Methane is the major component of natural gas, while tiny quantities like ethane, propane, and butane gases are also exist. Natural gas has been reported as a clean and eco-friendly nonrenewable fuel source. Now, the use of natural gas is increasing by leaps and bounds in all sectors, specifically in power generation, which might be due to its cost-effectiveness and eco -friendly behavior compared to other renewable/non-renewable fuels. It is known to us that natural gas consumption has been increased by 8% than previous years.

Gas leakage due to pipeline damage or poor management practices result in fire and explosions. This badly affects any country's economy regarding property loss, serious health problems, casualties in site workers, and significant environmental degradation. Natural gas is very reactive due to its high oxidizing ability and presence of halogen compounds. It is highly flammable when combined with air and ignition compounds.

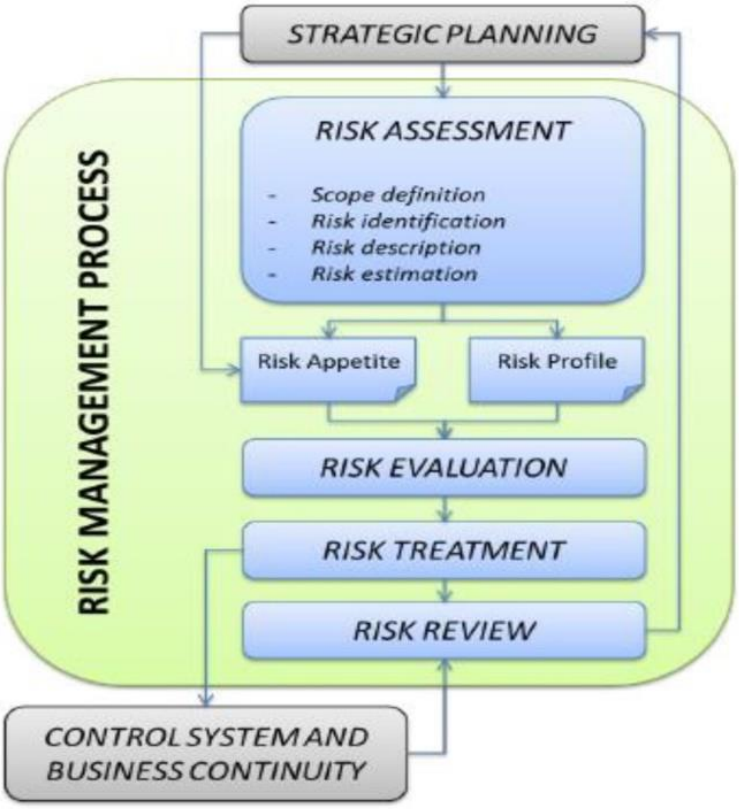


*Figure 9.1 Flow chart of Risk management*

The following issues were taken into consideration in averting any risk and hazard during different phases of construction and operation of the project.

1. Review existing information and historical databases to arrive at possible likelihood of such risk scenarios;
2. predict the consequences of such potential risk scenarios and if consequences are observed to be high, establish the same through application of quantitative simulations;
3. Impacts on ecosystem at pipeline transmission site;
4. Recommend feasible preventive and risk mitigation measures as well as provide inputs.

## 9.2 Risk Assessment

The principal approach to risk assessment is obviously based on the postulation of a certain probability of major accidents occurring at a specific site and an estimate of potential damage to the population and the environment around the site. Probability of risk within any identification framework for various reasons of chemical emergency during pipeline operation is usually derived from statistical data. The probability of a major accident largely depends on the failure ratio of technical installations, the frequency of hazardous goods transports etc. The damage assessment depends on various factors like amounts of chemicals stored or transported, dispersion distances for different chemical substances, toxic properties of chemical substances, population density, etc.

## 9.3 Frequency Analysis

To assess the probability throughout the project life cycle, frequency analyses of the risks highlighted concerning the proposed project have been done. Risk frequencies were assessed based on the study of historical accident frequency data and professionally evaluated in respect to the proposed project. The following frequency categories and criteria were created based on the range of possibilities for distinct possible dangers during pipeline operations related to the proposed project.

*Table 9.1: Severity Category and Criteria*

| Consequence | Ranking | Criteria Definition |
|---|---|---|
| **Catastrophic** | 5 | • Multiple fatalities/permanent total disability to more than 50 persons<br>• More than 5 years for natural recovery<br>• Net negative financial impact > 10 crores<br>• Long term impact on ecologically sensitive areas<br>• International media coverage<br>• Loss of corporate image and reputation |
| **Major** | 4 | • Single fatality/permanent total disability to one or more persons<br>• 2–5 years for natural recovery<br>• Net negative financial impact of 5–10 crores<br>• Significant impact on endangered and threatened floral-fauna species<br>• National stakeholder concern and media coverage. |

| | | |
|---|---|---|
| **Moderate** | 3 | • Short term hospitalization and rehabilitation leading to recovery<br>• 1–2 years for natural recovery<br>• Net negative financial impact of 1–5 crores<br>• Short term impact on protected natural habitats |
| **Minor** | 2 | • Medical treatment injuries<br>• 1 year for natural recovery<br>• Net negative financial impact of 0.5 1 crore<br>• Temporary and mitigable environmental impacts<br>• Local stakeholder concern and public attention |
| **Insignificant** | 1 | • First Aid treatment<br>• Natural recovery < 1 year<br>• Net negative financial impact < 0.5 crores.<br>• No significant impact on environmental components<br>• No media coverage |

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. The significance of the risk is expressed as the product of likelihood and the consequence of the risk event, expressed as follows:

***Significance = Likelihood x Consequences***

The below illustrates all possible product results for the five likelihood and consequence categories while the assigns risk significance criteria in three regions that identify the limit of risk acceptability. Depending on the position of the intersection of a column with a row in the risk matrix, hazard prone activities have been classified as low, medium and high thereby qualifying for a set of risk reduction / mitigation strategies.

*Table 9.2: shows all conceivable product outcomes for the five categories of probability and consequences.*

| Consequences | | Likelihood: Frequent | Probable | Remote | Not Likely | Improbable |
|---|---|---|---|---|---|---|
| Catastrophic | 5 | 25 | 20 | 15 | 10 | 5 |
| Major | 4 | 20 | 16 | 12 | 8 | 4 |
| Moderate | 3 | 15 | 12 | 9 | 6 | 3 |
| Minor | 2 | 10 | 8 | 6 | 4 | 2 |
| Insignificant | 1 | 5 | 4 | 3 | 2 | 1 |

*Table 9.3: Risk evaluation requirement criteria and requirement*

| **Risk Significance** | **Criteria Definition & Action Requirement** |
|---|---|
| High (16–25) | **"Risk requires attention"** __ Project Management need to ensure that necessary mitigation are adopted to ensure that possible risk remains within acceptable limits |
| Medium (10–15) | **"Risk is tolerable"** __ Project Management needs to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementations of all practicable controls. |
| Low (5–9) | **"Risk is acceptable"** __Project related risks are managed by well-established controls and routine processes/procedures. Implementation of additional controls can be considered |

## 9.4 Risk Evaluation

Environmental risks and potential hazards for various scenarios of emergency during pipeline operation generates from inappropriate handling, use, transportation, storage and disposal of hazardous chemicals. Hazardous materials are classified as those that present an excessive risk to property, the environment or human health due to their physical and or chemical characteristics. The materials classified as Hazardous include:

- Explosives;
- Compressed gases, including toxic or flammable gases;
- Flammable solids;
- Oxidizing substances;
- Radioactive material;
- Toxic and infectious substances; and
- Corrosive substances etc.

Each detected risk was assessed in the light of its probability of occurrence and its degree of effects based on the ranking of probability and frequency. The relevance of this risk is stated as the product of probability and as the result of the risk event:

*Meaning = Probability × Consciousness*

*Table 9.4*

| No | Group of technological tasks | No. of low risks | No. of moderate risks | No. of high risks | No. of risks per a technological activity | Percentage share in total |
|---|---|---|---|---|---|---|
| 1 | Trenching of soil | 0 | 5 | 0 | **5** | **2.31%** |
| 2 | Traffic congestion | 0 | 5 | 0 | **5** | **2.10%** |
| 3 | Explosion during transmission | 4 | 0 | 0 | **4** | **3.45%** |
| 4 | Leakage | 5 | 2 | 0 | **7** | **6.03%** |
| 5 | Contamination with air | 3 | 0 | 0 | **3** | **2.59%** |
| 6 | Vegetation coverage | 6 | 6 | 6 | **18** | **15.52%** |
| 7 | Local markets | 1 | 1 | 7 | **9** | **7.76%** |
| 8 | Land Acquisition | 0 | 3 | 2 | **5** | **4.31%** |
| 9 | Placing of a pipeline | 0 | 2 | 4 | **6** | **5.17%** |
| 10 | Burying of the pipeline and land reconstruction | 1 | 1 | 4 | **6** | **5.17%** |
| 11 | Connections in trenchless technology | 1 | 1 | 8 | **10** | **8.62%** |
| 12 | Pressure tests | 1 | 3 | 0 | **4** | **3.45%** |
| 13 | Installation of cathode protection | 0 | 5 | 1 | **6** | **5.17%** |
| 14 | Technological facilities – gas units | 7 | 11 | 4 | **22** | **18.97%** |
| 15 | Technical acceptance | 0 | 0 | 3 | **3** | **2.59%** |
| 16 | Filing with gas and start-up | 0 | 0 | 2 | **2** | **1.72%** |
| 17 | Final acceptance and handover for operation | 2 | 0 | 4 | **6** | **5.17%** |
| **Total** | | **31** | **40** | **45** | **116** | **100%** |
| **Percentage share in the risk group** | | **26.72%** | **34.9%** | **38.79%** | **100%** | |
| | | | | | | |

## 9.5 Risk analysis for F-S-M Gas Distribution Network Up-gradation Project

The analysis of risk factors, determination of preventive actions, the assignment of personal responsibility and the scheduling of periodic or continuous monitoring of both the formerly identified and the new risks, may help us find the right directions for actions, mitigate these risks and protect our operations from the consequences of such undesirable events.

The study identifies 30 risks which are specific to the construction of gas supply pipelines . The risk factors, which have been established, are ranked according to the weights assigned to them. The weights has been estimated as the normalized (between 0 and 1) result of multiplication of the probability of occurrence (from the historical data) and the cost. This gives an overall picture of what risks may be considered critical, i.e. which risks are expected to have the biggest impact on the construction process failure or success.

*Table 9.5: Risk factor assessment*

| **Sl. no** | **Risk factor** | **Frequency** | **Risk weight** |
|---|---|---|---|
| **1** | Collision of a boring with an underground infrastructure | 4 | **4** |
| 2 | Leaks in insulation layers of fittings | 4 | **4** |
| 3 | Dirt inside the pipeline | 1 | **1** |
| 4 | Failure to achieve the required resistance of a connection or jacking pipe after drawing | 3 | **3** |
| 5 | Failure to meet insulation parameters of joints | 3 | **3** |
| 6 | Leaving blocks, debris, stones, roots etc. in a trench | 1 | **1** |
| 7 | Incorrect insulation of protective pipe terminals in a pipeline | 5 | **5** |
| 8 | HDD boring – diversion from a planned route | 2 | **2** |
| 9 | Incompliant quality documentation (for acceptance tests) | 2 | **2** |
| 10 | Failure to restore the land to its original condition | 3 | **3** |
| 11 | Defective joints, exceeding the limit specified in the tender | 4 | **4** |
| 12 | Welders and/or welding equipment operators without required authorizations | 4 | **4** |
| 13 | Welding conducted by the Ordering Party’s unauthorised welders and operators | 5 | **5** |
| 14 | No sand bedding | 3 | **3** |
| 15 | No sand shading | 3 | **3** |

| | | | |
|---|---|---|---|
| 16 | No sand backfill | 3 | **3** |
| 17 | Failure to meet insulation requirements for fittings | 3 | **3** |
| 18 | Failure to perform (or incorrect performance) of insulation testing for joints using a defectoscope | 3 | **3** |
| 19 | Failure to perform (or incorrect performance) of pipe tightness tests | 4 | **4** |
| 20 | Failure to perform (or incorrect performance) of an insulation tightness | 4 | **4** |
| 21 | Failure to repair damaged insulation | 5 | **5** |
| 22 | Failure to perform (or incorrect performance) of insulation testing on separated (zero defect) sections | 3 | **3** |
| 23 | Incorrect Control and Testing Plan (if required) | 2 | **2** |
| 24 | Incorrect Health and Safety Scheme | 3 | **3** |
| 25 | Incorrect Environmental Protection Scheme | 4 | **4** |
| 26 | Filling trenches with blocks, debris, stones, roots etc. | 3 | **3** |
| 27 | HDD boring – a supply pipeline stuck under the ground | 3 | **3** |
| 28 | Inaccurate tightening of screws on a flange | 4 | **4** |
| 29 | Pressure drop in tightness or fatigue testing | 5 | **5** |
| 30 | Failure to introduce changes to design documents | 4 | **4** |

*Table 9.6: Summary of Risk and Risk management plan*

| **Sl** | **Risk description** | **Assessment** | **Risk Management Plan** |
|---|---|---|---|
| 01 | Trenching of soil | Medium | 1) Operational procedures should be laid down and followed to ensure safety, optimum operation and economy.<br>2) Regular preventive maintenance and inspection procedures must be implemented and regular certification of high pressure equipment should be obtained. Avoid geo-hazards along pipeline route.<br>3) Ensure that the pump or compressor is sized correctly. |
| 02 | Traffic congestion | Medium | |
| 03 | Explosion during transmission | High | |
| 04 | Leakage | Medium | |
| 05 | Contamination with air | Low | |
| 06 | Vegetation coverage | Low | |

| | | | |
|---|---|---|---|
| 07 | Local markets | low | 4) Ensure that surge suppression equipment is sized correctly.<br>5) Minimum removal of herbs/shrubs during placing the pipe.<br>6) A handsome compensation should be provided to the local shop keeper and businessmen.<br>7) No need of public land acquisition in this project.<br>8) Regular documentation should be carry on from very beginning of the project.<br>9) Regular preventive maintenance and inspection procedures must be implemented and regular certification of high pressure equipment should be obtained.<br>10) Disaster may affect persons working in and around moving machinery, other plant and various sites which have been mentioned as potential hazard areas.<br>11) A safety audit should be undertaken periodically in conjunction with a training program.<br>12) During the operational phase access to work sites should be denied to unauthorized persons. |
| 08 | Land Acquisition | low | |
| 09 | Preparing quality documentation | Medium | |
| 10 | Purchase of materials | Medium | |
| 12 | Cold bending of steel tubes | Medium | |
| 13 | Welding | High | |
| 14 | Insulation | Medium | |
| 15 | Digging of trenches | Low | |
| 16 | Placing of a pipeline | Medium | |
| 17 | Burying of the pipeline and land reconstruction | Medium | |
| 18 | Connections in trenchless technology | High | |
| 19 | Pressure tests | Low | |
| 20 | Installation of cathode protection | Low | |
| 21 | Technological facilities – gas units | High | |
| 22 | Technical acceptance | Low | |
| 23 | Filing with gas and start-up | low | |

## 9.6 Emergency response planning

The main objective of the Emergency Response Plan (ERP) is to ensure that activities are carried out to the following priorities:

- Safeguard lives;
- Protect the environment;
- provide response to emergency situations using an effective communication network and organized procedures;
- Protect the company or Third Party assets
- Maintain the company image/reputation
- Resume normal activities

## 9.7 Emergency response team

In case of serious emergencies the three will be a team assisting the authority in the following areas:

1. Handle communication both Internal/External;
2. Devise strategies to control the emergency situation-plan,
3. Read drawings, issue guidelines to incident controller,
4. Arrange logistics; identify potential needs, suppliers of service, material. Secure agreements, resource hiring etc.;
5. Food, transport, replacement of site personnel, alternate duty roster in case of prolonged emergencies;
6. Handling of journalists, media, public

Implement the plan jointly as supporting team, external aid arrangements;

# Chapter Ten
# Environmental Monitoring Programme

## 10.1 Introduction

The purpose of an Environmental Monitoring Program is to identify problem areas where potentially harmful microorganisms and toxic pollutants may be harboring, becoming a source of contamination, and verifying the effectiveness of sanitation programs. Environmental monitoring enables construction and infrastructure projects to ensure compliance with environmental plans, permits and other regulations, while mitigating and minimizing environmental impact.

## 10.2 Technical Aspects

Technical aspects include monitoring parameters, measurement methods, place or area covered, and frequency and duration of monitoring. The parameters & selected indicators must cover the possible impacts in this study. The methods chosen for monitoring parameters should be standard statistical, analytical or relevant cost-effective methods for measuring their impact. The location, duration and frequency of measurements should be such that the data obtained are representative and adequate to draw a certain conclusion about the extent and trend of impacts.

## 10.3 Environmental monitoring program

The environmental monitoring program has been prepared with the following objectives:

- To assess the effectiveness of the anticipated mitigation measures and protection of the adjacent environment as per the suggestion/standards for the project.
- To identify the need for improvements in the management plans
- To verify compliance with statutory & community obligations.
- To allow comparison with baseline conditions & assess the changes in environmental quality in the project area.

Prediction of impacts can be made only based on knowledge of the baseline environmental parameters at the location of project. Table 10.1 gives the baseline measurements made which were based on the requirement of prediction.

*Table 10.1: Environmental parameters against activity*

| Activity | Environmental parameter | | | | | | |
|---|---|---|---|---|---|---|---|
| | Air | Water | Sound | Land | Sediment | Ecology/biodiversity | Socio - economic |
| Construction material handling | | | | | | | |
| Construction activity | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Building worker camp | | | | | | | |
| Land excavation | | | | | | | |
| Land reclamation | | | | | | | |
| Laying of pipeline | | | | | | | |
| Construction of Off-take valve | | | | | | | |
| Installation of Coating of Pipeline or Catholic protection | | | | | | | |
| Transportation of pipeline | | | | | | | |
| NDT like Radiography | | | | | | | |
| Trenching | | | | | | | |
| Back Filling | | | | | | | |

## 10.4 Waste Management

Through of the project, the emphasis will follow the principle of waste minimization in order to reduce the potential for waste impacts on the local & non-local environment.

### 10.4.1 Waste disposal plan

Used oil & spilled oil shall be collected and recycled. Contaminated soil, paints, solvents & other chemicals etc. shall be collected & disposed of in an approved waste disposal site by an approved waste disposal contactor. Solid waste shall be collected & disposed of in an approved solid waste facility.

Sanitary latrines shall be provided at each construction camp and waste dispose of through designing & constructing an appropriate septic tank.

Similarly appropriate waste disposal plan has to be drawn & implemented for this gas distribution up gradation project.

To create a waste disposal plan for this project, it is important to consider the potential sources of waste generated during the project's construction and operation phases. Here are some steps to follow:

Identify potential sources of waste: The construction and operation of a gas pipeline can generate various types of waste, including construction waste, hazardous waste, and non-hazardous waste. Identify the sources of waste and categorize them based on their type and potential environmental impact.

Develop a waste management plan: Develop a waste management plan that outlines the procedures for handling and disposing of waste generated during the project. The plan should

identify waste handling and disposal requirements, such as proper storage, transportation, and disposal methods, and assign responsibilities to project team members.

Consider local regulations: Research local regulations and laws related to waste disposal and incorporate them into the waste management plan. Ensure that the plan complies with local regulations and obtain any necessary permits for waste disposal.

Use sustainable waste management practices: Use sustainable waste management practices to reduce the environmental impact of waste generated during the project. This can include recycling, reusing materials, and minimizing waste generation.

Monitor waste disposal: Monitor the waste disposal process throughout the project to ensure that waste is properly handled and disposed of. This can include inspections, tracking waste volumes, and auditing waste disposal facilities.

Train project team members: Provide training to project team members on proper waste disposal procedures and the importance of following the waste management plan. This can help ensure that everyone involved in the project is aware of their responsibilities and follows best practices for waste disposal.

## 10.5 Health, environment & safety management plan

A Health, Environment, and Safety Management Plan (HESMP) is an important component of this project. The HESMP ensures that the project is conducted in a manner that minimizes risks to the health and safety of workers and the nearby public and the environment. Below listed initiatives to be followed to develop an operative HESMP for this project.

**Identify potential hazards:** Identify potential hazards associated with the construction and operation of the gas pipeline. This may include hazardous materials, equipment, and activities such as excavation, welding, and transportation.

**Conduct risk assessments:** Conduct risk assessments to determine the likelihood and potential severity of the identified hazards. This will help determine the appropriate measures to mitigate the risks.

**Develop mitigation measures:** Develop mitigation measures for the identified hazards. This may include implementing engineering controls, administrative controls, and personal protective equipment (PPE) requirements.

**Develop emergency response plans:** Develop emergency response plans for potential incidents such as leaks, spills, fires, and explosions. The plan should include procedures for reporting incidents, evacuating personnel, and coordinating with emergency responders.

**Establish monitoring and reporting requirements:** Establish monitoring and reporting requirements to ensure that potential hazards and incidents are detected and reported in a timely manner.

**Train personnel:** Train personnel on the HESMP, including hazard identification, risk assessment, mitigation measures, emergency response, and reporting requirements.

**Monitor and evaluate the HESMP:** Monitor and evaluate the HESMP to ensure that it remains effective throughout the project's duration. This may include conducting audits, inspections, and incident investigations.

## 10.6 Erosion

## 10.7 Air quality monitoring

It was earlier identified that the negative impact on air quality would be mostly due to soil excavation, dust emissions from heavy vehicle movement and gaseous emissions during operations. Dust load on the nearby homestead & vegetation is an indicator of dust pollution in the air. The previously proposed mitigation measures will successfully offset these negative impacts. Monitoring suspended particles load & gaseous emission in the atmosphere of the project area should be measured frequently to comply with the air quality standard.

## 10.8 Noise monitoring

There shall be no use of high noise making equipment or process except the excavation work by excavator, welding machine, connection with TBS point, use small generator for power production & movement of vehicle. Placement of power generator units inside a sound prof room and regulating the use of hydraulic horns should be monitored for compliance.

## 10.9 Monitoring of water quality

Nearby ground water & surface water such as ponds, river, khals, ditches quality monitoring should be done at regular basis.

## 10.10 Monitoring implementation schedule

## 10.11 Monitoring parameters & schedule

## 10.12 Financial aspects of environmental monitoring system

## 10.13 Training of environmental professionals

# Chapter Eleven
# Beneficial Impacts

## 11.1 Introduction

The present economy of Bangladesh is very fast growing. The country is expected to be graduated from the Least Developed Countries (LDCs) in 2026. The country is also aiming for its vision-2041 when it expects to be a developed and prosperous country. Therefore, in focusing on vision-2041, its target is sustainable rapid industrialization. But in achieving the targeted industrialization the primary requirement is energy security. The development and implementation of gas distribution pipelines have had numerous beneficial impacts on society, ranging from providing a reliable source of energy to promoting economic development and environmental sustainability. With a steady supply of natural gas, households, businesses, and industries have access to an affordable and cleaner-burning energy source that can improve air quality, reduce energy costs, and promote job growth. Additionally, the construction and operation of gas distribution pipelines create jobs and boost the local economy, while strict safety measures ensure that the pipelines are secure and efficient. In this way, gas distribution pipelines have become a vital component of modern society, providing a range of benefits that positively impact our daily lives.

## 11.2 Positive impacts of the project

Gas distribution pipelines can have several positive impacts, including:

1. **Industrialization:** Industrialization of an area always needs secure energy supply. This gas distribution pipeline will assist in fulfilling the demand of gas supply to any industrial unit.
2. **Reliable Energy Supply:** Gas distribution pipelines provide a reliable source of energy to homes, businesses, and industries. With a steady supply of natural gas, individuals and businesses can depend on uninterrupted energy supply for heating, cooking, and other uses.
3. **Energy Cost Savings:** Natural gas is often less expensive than other energy sources such as electricity or oil. By providing access to natural gas, pipelines can help reduce energy costs for consumers, making it an affordable option for heating homes and businesses.
4. **Environmental Benefits:** Natural gas is considered to be a cleaner-burning fuel than other fossil fuels such as coal or oil, resulting in fewer emissions of greenhouse gases and other pollutants. Therefore, the use of natural gas can help to reduce air pollution, contributing to improved air quality.
5. **Economic Benefits:** The construction of gas distribution pipelines creates jobs and boosts the local economy. Additionally, the availability of natural gas can attract businesses to the area, leading to increased economic development.

6. **Safety Benefits:** Natural gas pipelines are designed with safety features to prevent leaks and other potential hazards. Pipelines are monitored 24/7 and inspected regularly to ensure that they meet strict safety standards, reducing the risk of accidents and injuries.
7. **Employment Generation:** This natural gas distribution pipeline needs manpower at construction and operational level. Thus, many people will get to work in this project.
8. **Social development:** Living quality of the people in proximity to this gas distribution pipeline will be improved with the help of secured energy supply. Educational and employment generation institutions will be benefitted from this project. The cultural and archaeological sites of the area proximity to the pipeline will have special opportunity to grow a little further. The tourism sector will also be flourished with the assistance of this gas supply in some way.

Overall, gas distribution pipelines can provide a reliable, affordable, and clean source of energy that can have significant economic, environmental, and safety benefits.

# Chapter Twelve
# Public Consultation

## 12.1 Introduction

Stakeholders mean individual or group who may have a direct or indirect "stake" in the project – anyone who can be affected by it, or who can have an effect on the actions or decisions of the company, organization or government. The people who are simply interested in the matter, but more often they are potential beneficiaries. They can be internal people or external, such as community members or groups, investors, suppliers, consumers, policy makers, etc.

Any organized consultation with parties and persons interested in or affected by project activities, forms an important part of best practice project planning and environmental impact assessment. Early and participative engagement of stakeholders in any project planning phase increases the likelihood of approval by regulatory authorities and the implementation of project activities. Feedback from the consultation process has an important role in understanding the apprehensions and expectations from members of the public in general and stakeholders in particular. Such contribution from them helps development of a clear picture of the socio-economic and environmental baseline survey of the project area. The importance of stakeholder engagement has also been recognized by the Bangladesh Department of Environment in its guidelines ECA '95 and ECR '97 of DOE and thus stipulated the requirement for consultation activities to be integrated into project planning and implementation phases, including during EIA of planned projects. Further, as a matter of fact, such consultation and FGD are now considered an essential pre-requisite for RAP as well.

Stakeholders contribute significantly to the decision-making and problem-solving processes as well. Moreover,

They can understand the context, issues and potential impacts more fully determine their focus, scope, and objectives for solutions establish whether further research is needed into the problem.

The basic communications skills are applied in stakeholder consolation include the following strategy:

1. **Effective Writing**: The consultation was written carefully during the conversations instantly in the field.
2. **Visual Rhetoric**: to understand or make clear all technical terms to the audience, words and graphics and poster papers were used during the consultation to make complex issues understandable to a general audience.
3. **Public Speaking/Presenting**: Local language was used while conversation with the stakeholders. Consultation with local people with their local language make the discussion more effectively.

4. **Interpersonal and intercultural skills:** The people were set in face-to-face situations, to make them feel comfortable and secure, and to be mindful of cultural factors that may affect interest level, accessibility, impact, values, or opinions.
5. **Active listening:** speakers and listeners were kept active and motivated during consultation. This strategy helped find out highest output from the stakeholders.

## 12.2 Methodology and Output

The process of public consultation was initiated and conducted in two stages. This was done during February-March 2023 through focus group discussion (FGD) at and around different locations of the transmission pipeline right of way and at valve station block land sites. The consultant arranged 5 such consultation meetings with the local stakeholders for information dissemination and community participation with the concerned NGO, and probable affected persons. The consultant and investigators investigated all the relevant matters.

Representative(s) of KGDCL, SETS and local government were also present in these meetings to understand the people's views and suggestions. An open discussion was made on the proposed project and its positive and negative impacts, and then people's perceptions were written by the SETS representatives for record and reference.

The details of the FGD meeting in stage-I records have been incorporated in the report in a summary format and presented in Table- for reference. These meetings were held at 5 different places in Dhaka-Chittagong highway. Participants in these consultation meetings included elected representatives, local leaders, women groups, representatives of professional groups like agriculturist, businessmen, farmers, school-teachers, religious leaders, public representatives as well as members and chairman of the Union Councils and the consultant has carefully studied all types of impacts in the locality of the proposed gas pipeline. Some of the arranged public consultation meetings are shown in Fig. 12.1 (below).

*Fig. 12.1: Photos of public consultation meeting in the project areas.*

In addition, a number of Key Informant Interviews were also carried out with selected key individuals. For uniformity and clarity in conducting the public consultation meetings, a checklist was devised by the consultants and was used to enable the participants to comprehend the issues easily. This has helped them so much so that they could effectively participate in the discussions and express their opinions from objective points of views.

**Consultants Checklist:**

| Sl.No | Questions | Answers |
|---|---|---|
| **01** | Location of consultation | |
| **02** | Name and occupation of the participants | |
| **03** | Awareness of the participants about the Project | |
| **04** | Description of the Project | |
| **05** | Benefits of the Project | |
| **06** | impacts of the Project on social and environmental components | |
| **07** | Concerns about the Project | |
| **08** | Expectations from the Project | |
| **09** | Suggestions about the Project | |

During the public consultations with local stakeholders, social, environmental as well as cross-cutting issues were discussed in detail. In addition, such discussions also included the potential impacts of the project activities on environmental and social parameters, identification of sensitive issues, risks, potential threats, public concerns and expectations from the project.

| Question / Comment | Answer |
|---|---|
| 1. What are the legal framework and the criteria according to which the EIA was made? | The EIA was undertaken according to the Criteria of Law 4/94 and the EEAA guidelines for EIA in the oil and gas sector; and in line with the principles of the European Communities Directives 97/11/EC guidelines. |

| | |
|---|---|
| 2. Is the design of pipeline considering earthquakes? | The proposed pipeline designed based on the intensity of the highest earthquake happened in the area. |
| 3. Why not to test the pipeline by compressed air instead of water? | Technically and according our experiencehydro testing is more efficient than air. |
| 4. What are safety precautions used for pipeline construction / installation | Safety general manager of KGDCL explained material of pipes, types of codes and construction/installation practices to achieve the safest pipeline operation. |
| 5. Is the route of pipeline be marked clearly? | Yes, Safety general manager said, the pipeline route will be marked with clear signs according to the international standards. |

## 12.3 Findings from Focus Group Discussion

Though they have, appreciated laying of pipeline as a development work of the country and in their opinion, it will help setting up industries Economic zone, generate employment and its nature of impact is usually temporary. But the work should be done carefully to avoid any accident in future and reinstatement along the alignment has to be done properly and promptly after completing the pipe laying works. Participants in these consultation meetings were the shop keepers, local businessman and house owners and available local people along the project site.

As reported, the following major issues among others were raised in the public consultation meetings.

- Local small shops and tea stalls may be affected. Due compensation should be paid on the spot to the affected shop keepers.
- Gathering of people during project activities may damage crops and other trees.
- Noise/dust pollution from vehicles and equipment at the project sites may cause disturbance to human being and wild life.
- There will be enhanced soil erosion particularly above the khals, which should be addressed
  properly.
- Water pollution of the natural water bodies may be aggravated and should be taken care of as
  this water is used for agriculture and domestic purposes.
- Movement of vehicles may affect movement of people, especially women, children and disabled
  persons from one place to another.
- Air pollution due to dust and gaseous emission should be controlled.
- Explosion and leakage during transmission may bring great environmental havoc.
- Environmental pollution through sanitation and waste materials as well as other social nuisance should be controlled.

## 12.4 Expectations of the People

The following expectations of the local people were evidenced during the consultations:

- Local personnel should be employed in different activities of the project on a priority basis.
- Preference should be given to engage local businessmen/ contractors in different phases of the project for construction and development depending in their suitability for such engagements.
- Compensation payment, in whatever form it may be, should be properly and promptly distributed so that the actual affected person gets his full share and in right time.
- Supply of gas would help improving their socio-economic conditions and therefore gas should be made available in the areas through which gas line would be passing through.

# Chapter Thirteen
# Conclusion and Recommendation

## 13.1 Conclusion

In accordance with the scope of the works as defined in the Terms of References (ToR) of the contract agreement between KGDCL and SETS, about 57 km Fouzderhat-Sitakunda-Mirsarai Gas Distribution Network Upgradation Project, Chattogram has been carried out in this EIA study. The study proceeded following the Environmental Impact Assessment Guideline of DoE (Department of Environment) that include multi-disciplinary team having appropriate capacity and also tools and techniques of Physical, Biological and Socio-economic investigations.

The consensuses on key environmental sensitivities of the gas pipeline on the project intervention area in terms of natural environment, socio-economic or cultural were identified and impacts were preliminary assessed based on qualitative assessment. The project shall be under all conditions, strictly enforce the implementation of the proposed environmental measures designed for the construction and operation phases in order to avoid or minimize both environmental and social impacts on the surrounding communities and general public.

There is no protected and ecologically sensitive areas located within the project area according to the impact assessment in this EIA study. In addition, the study suggests that the overall impacts associated with the proposed KGDCL gas pipeline project can be managed within reasonable and acceptable limits by applying all identified mitigation measures including suggested monitoring plan described within this report. The benefits which are expected due to the implementation of the proposed Karnaphuli gas pipeline upgradation project is potentially significant and the identified negatives impacts are non-significant.

## 13.2 Recommendation

Based on the findings of this EIA study, the following stated impact mitigation measures are suggested:

- The EIA fulfills the requirements of the procedures specified in the ECR (1997);
- The potential impacts that are associated with the project based on impact assessment, can be effectively mitigated;
- The selected RoW of the proposed project does not fall in any protected area and is not expected to affect any habitat of threatened species;
- The project will have potential positive (beneficial) impacts having national interest of Bangladesh;
- The Site Clearance Certificate (SCC) for the proposed project is accordingly requested in favor of the proponent;
- This EIA recommends appropriate abatement and control/mitigation measures to be applied as required and also to implement effective environmental monitoring under an Environmental Cell having appropriate monitoring budget, and
- Continuous stakeholder engagement and complain register to be ensured;

This Environmental Impact Assessment study reveals that most of the negative impacts will be temporary in nature and their magnitude can be brought down to acceptable limit. Long term impacts would be mostly positive in nature in consideration of which Site Clearance Certificate may kindly be issued.

# Appendix