

Environmental & Social Impact Assessment (ESIA)

OF

Reliance Meghnaghat 750 Combined Cycle Power Plant

A Project by

Reliance Bangladesh LNG & Power Ltd.

Prepared By:

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ISO 9001:2015 Certified

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January 2017

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ABBREVIATION

AAQS	-	Ambient Air Quality Standards
AAQM	-	Ambient Air Quality Monitoring
ADB	-	Asian Development Bank

AECL	-	Adroit Environment Consultants Ltd
AGI	-	Above Ground Installation
AGP	-	Advanced Gas Path
AoI	-	Area of Influence
APM	-	Architecture & Project Management
ASTM	-	American Society for Testing of Material
BBS	-	Bangladesh Bureau of Statistics
BCSIR	-	Bangladesh Council 0f Scientific and Industrial Research
BDT	-	Bangladeshi Taka
BMD	-	Bangladesh Meteorological Department
BNAAQS	-	Bangladesh National Ambient Air Quality Standard
BNBC	-	Bangladesh National Building Code
BOD	-	Biochemical Oxygen Demand
BPDB	-	Bangladesh Power Development Board
BRTA	-	Bangladesh Road Transport Authority
BUET	-	Bangladesh University of Engineering & Technology
BWDB	-	Bangladesh Water Development Board
CAMS	-	Continuous Air Monitoring Station
CCCW	-	Closed Cycle Cooling Water
CCPP	-	Combined Cycle Power Plant
CD	-	Conservation Dependent
CMB	-	Chemical Mass Balance
CMSWMF	-	Common Municipal Solid Waste Management Facility
CO	-	Carbon Monoxide
CO_2	-	Carbon-Di-Oxide
COD	-	Chemical Oxygen Demand
CR	-	Critically Endangered
CSR	-	Corporate Social Responsibility
CTG	-	Combined Turbine Generator
dB (A)	-	A-weighted Decibel
DEPC	-	Department of Environmental pollution Control
DEM	-	Digital Elevation Model
DIFE	-	Department of Inspection for Factories and Establishments
DLN	-	Dry Low NOx
DM plant	-	Demineralization Plant
DMC	-	District Management Committee
DO	-	Dissolve Oxygen

DOE	-	Department of Environment
DPHE	-	Directorate of Public Health Engineering
ECA95	`-	Environment Conservation Act, 1995
EA	-	Environmental Assessment
ECO	-	Emergency Control Organisation
ECC	-	Emergency Control Centre
ECR97	-	Environment Conservation Rules 1997
ED	-	Energy Division
EHS	-	Environment Health & Safety
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EMS	-	Environmental Management System
EN	-	Endangered
EPC	-	Engineering, Procurement, and Construction
EQS	-	Environmental Quality Standards
ESIA	-	Environmental Social Impact Assessment
ESMP	-	Environmental and Social Management Plan
ETP	-	Environmental Treatment Plant
EWP	-	Elevated Work Platform
FGD	-	Focused Group Discussions
FRP	-	Fibre Reinforced Plastic
FSRU	-	Floating Storage and Re-gasification Unit
GDP	-	Gross Domestic Product
GE	-	General Electric
GoB	-	Government of Bangladesh
GPS	-	Global Positioning System
GRC	-	Grievance Redress Committee
GRM	-	Grievance Redress Mechanism
GSB	-	Geological Survey of Bangladesh
GTCL	-	Gas Transportation Company Limited
GTG	-	Gas Turbine Generator
HFO	-	Heavy Fuel Oil
HFL	-	High Flood Level
HFT	-	Himalayan Frontal Thrust
HRSG	-	Heat Recovery Steam Generation
IBAT	-	Integrated Biodiversity Assessment Tool
IEE	-	Initial Environmental Examination

IFC	-	International Finance Corporation
IP	-	Intermediate Pressure
IPD	-	Infrastructure Planning & Design
ISO	-	Indian Standard Organisation
IUCN	-	International Union for Conservation of Nature
IPP	-	Independent Power Producers
LC	-	Least Concern
LILO	-	Loop In Loop Out
LNG	-	Liquefied Natural Gas
LNGT	-	Liquefied Natural Gas Terminal
LP	-	Two-flow low pressure
MBT	-	Main Boundary Thrust
MCT	-	Main Central Thrust
MoEF	-	Ministry of Environment and Forest
MPN	-	Most Probable Number
MSDS	-	Material Safety Data Sheet
MSL	-	Mean Sea Level
MW	-	Megawatt
NABET	-	National Accrediation Board for Education & Training
NCBI	-	National Center for Biotechnology Information
NEAMP	-	National Environmental Management Action Plan
NG	-	Natural Gas
NGO	-	Non-Government Organization
NO_x	-	Oxides of Nitrogen
NOC	-	No Objection Certificate
NT	-	Near Threatened
NTU	-	Nephelometric Turbidity Unit
ODS	-	Ozone Depleting Substances
O&M	-	Operation & Maintenance
OPML	-	Orion Power Meghnaghat Ltd
OSHA	-	Occupational Safety & Health Administration
PCB	-	Poly-Chlorinated Biphenyls
PCU	-	Passenger Car Unit
PGCB	-	Power Grid Company of Bangladesh
PLF	-	Plant Load Factor
PM_{10}	-	Particulate Matter
$PM_{2.5}$	-	Particulate Matter

PMU	-	Project Implementation unit
PPP	-	Public-Private Partnership
PS	-	Performance Standard
PSMP	-	Power Sector Master Plan
PUC	-	Pollution Under Control
PVC	-	Polyvinyl Chloride
PWD	-	Public Works Datum
QCI	-	Quality Council of India
RBLPL	-	Reliance Bangladesh LNG and Power Limited
REA	-	Rapid Environmental Assessment
RID	-	Rail Infrastructure Division
RIL	-	Reliance Infrastructure Limited
RPL	-	Reliance Power Limited
SCHM	-	Suggestion and Complaint Handling Mechanism
SEI	-	Significant Environmental Impacts
SO_2	-	Sulphur dioxide
SMPCL	-	Summit Meghnaghat Power Company Limited
SPL	-	Sound Pressure Level
SPM	-	Suspended Particulate Matter
SPS	-	Safeguard Policy Statement
STG	-	Steam Turbine Generator
TDS	-	Total Dissolve Solid
TOC	-	Total Organic Carbon
TOR	-	Terms of Reference
TPS	-	Thermal Power Station
TRB	-	Transportation, Roads & Bridges
TSS	-	Total Suspended Solid
UGI	-	Underground Installation
UNCED	-	United Nations Conference on the Environment and Development
UNEP	-	United Nations Environment Programme
USEPA	-	United States Environmental Protection Act
VSPL	-	Voyants Solutions Pvt. Ltd.
VU	-	Vulnerable Category
WB	-	World Bank
WHO	-	World Health Organization
WSD	-	Water Sanitation Department
WWTP	-	Waste Water Treatment Plant

GLOSSARY

Adverse impact: An impact that is considered undesirable.

Ambient air: Surrounding air.

Aquatic: Growing or living in or near water.

Bangla: Bengali language.

Baseline (or existing) conditions: The 'baseline' essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the project, i.e. the 'No-development Option'.

Bazar: Market.

Beel: A 'back swamp' or depression can be either perennial or seasonal.

Beneficial impacts: Impacts, which are considered to be desirable and useful.

Biological diversity: The variety of life forms, the different plants, animals and microorganisms, genes they contain and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecological diversity.

Char: Newly accreted land: Land, sometimes islands, within main river channels and nearby mainland or in the estuary, subject to erosion and accretion.

Ecosystem: A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit.

Emission: The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source.

Endangered species: Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among those are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from immediate danger of extinction.

Environmental effects: The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity.

Environmental Impact: An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors.

Environment Management Plan (EMP): A Plan to undertake an array of follow-up activities which provide for the sound environmental management of a project/ intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured.

Environmental Management: Managing the productive use of natural resources without reducing their productivity and quality.

Erosion: Process in which wind and water removes materials from their original place; for instance, soil washed away from an agricultural field.

Evaluation: The process of looking back at what has been really done or accomplished.

Fauna: A collective term denoting the animals occurring in a particular region or period.

Field Reconnaissance: A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal.

Flora: All of the plants found in a given area.

Habitat: The natural home or environment for a plant or animal.

Household: A household is identified as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit having separate cooking arrangements constitute separate household.

Important Environmental Component (IEC): These are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment.

Khal: Small Channel, canal.

Land use: Types include agriculture, horticulture, settlement, pisciculture and industries.

Mauza: A Bangla word for the smallest government administrative area corresponding to village revenue unit.

Mitigation: An action, which may prevent or minimize adverse impacts and enhance beneficial impacts.

Negative Impact: Negative change from the existing situation due to the project.

Public involvement / Public consultation: A range of techniques that can be used to inform, consult or interact with stakeholders' affected / to be affected by a proposal.

Reversible impact: An environmental impact that recovers either through natural process or with human assistance (e.g. cutting off fish migration by an embankment might be reversible at a later stage if a proper regulator is built).

Stakeholders: Those who may be potentially affected by a proposal, e.g. Local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the project or to take an interest in it.

Taka: Unit of Bangladeshi currency.

Terrestrial: Living on land.

Thana: Sub-district level of government administration, comprising several unions under district.

Union: Smallest unit of local self-government comprising several villages.

Upazila: Sub-district name. Upazila introduced in 1982.

Zila: Bengali word for district.

EXECUTIVE SUMMERY

1. Introduction

Reliance Bangladesh LNG and Power Limited (herein after referred as 'RBLPL,' or 'proponent') proposes for development of a 750 Megawatt (MW) gas based combined cycle power plant (CCPP) projectat Village Meghnaghat, sub-district Sonargaon, District Narayanganj, Bangladesh. Bangladesh is a one of the fastest growing economy in south Asia. As per the estimates only around 72% of the total population of Bangladesh had access to electricity but reliable and quality supply of power is still a faraway. The demand for electricity is steadily increasing in Bangladesh as per Ministry of Power and Mineral Resources.

To meet the existing power shortage and the demand-growth in future years the Government of Bangladesh (GoB) is planning for power generation target of 39,000 MW by 2030. The Bangladesh government has taken several steps to initiate the augmentation of electricity gap by placing Power Sector Master Plan (PSMP) 2010. In order to achieve the said target, the Government of Bangladesh (GoB) planning to develop power sector projects through public private partnership. Therefore, the development of the proposed 750MW Combined Cycle Power Project at Meghnaghat will aid in securing both current as well as future electricity demand of Bangladesh. The present project is in line with Ministry of Power, Energy and Mineral Resources provided an in-principle approval to the project. The proposed project also has obtained the site clearance vide letter Memo No. 22.07.67700.140.72.064. 16-18 dated 15. 01. 2017

In Bangladesh, natural gas is the most important indigenous source of energy that accounts for 73% of the commercial energy of the country. To provide access to affordable and reliable electricity to all by 2021 as well as to comply with the policy of Government of Bangladesh (GoB) RBLPL intends to construct a new 750 MWCCPP in the Government allotted land.The proposed area of the plant is located at Meghnaghat inside the vicinity of BPDB's allocated 35 acres government land.

The Reliance Meghnaghat 750 MW CCPPproject will be implemented by RBLPL and financed by Asian Development Bank (ADB) and other lenders. The objective of this study is to provide an examination and assessment of the major environmental and social impacts arising due to the proposed project activity during its construction and operation phase. The study will also focus on suggesting the possible mitigation measures for any adverse impacts.A management and monitoring plan to evaluate the effectiveness of the mitigation measures will be suggest as a part of Environment Management Plan.

This Environment and Social Impact Assessment (ESIA) report is prepared in accordance with the ADB's safeguard policy statement SPS 2009 and IFC Performance Standards as well as EIA guideline in Bangladesh which are set out in "Rules and Regulations under the 1995 Environmental Protection Acts".

2. The Project

RBLPL, proposes for development of a 750 Megawatt (MW) gas based combined cycle power plant (CCPP) project at Village Meghnaghat, sub district Sonargaon, District Narayanganj, Bangladesh. Fuel requirement of Liquidified Natural Gas (LNG) for the project shall be supplied through a proposed 24 inches Gas Pipeline from Kutumbpur to Meghnaghat being set up by

GTCL (Gas Transportation Company Limited). Electricity generated from the power plant will be evacuatedat Power Grid Company of Bangladesh (PGCB) 400 kV transmission network available at Meghnaghat. The salient feature of the project is highlighted below

Name of the Project	Reliance Meghnaghat 750 MW Combined Cycle Power Plant
Location of the Project	
Village	Meghnaghat
Sub district	Sonargaon
District	Narayanganj
Latitude and Longitude	23° 36’29” N & 90° 35’ 39” E
Project Proponent	Reliance Bangladesh LNG & Power Ltd.
General Climatic Conditions	
Monthly Mean Maximum Temperature	37.0° C
Monthly Mean Minimum Temperature	5.3° C
Relative Humidity	52-84%
Annual Rainfall	2347 mm
Accessibility	
Road Connectivity	National Road No1(Dhaka-Chittagong Highway) 2 km
Airport	Dhaka Airport 45 km
Historical/Important Places within 5 km study area	
Archaeological Site	None
Historically Important Site	Domed Mosque by Jalaluddin Fatheh Shah in Panam Nagar, Tomb of Sultan, Goaldi Mosque
Sensitive Places	None
Sanctuaries/National Parks	None
Nearest Industries	Summit Meghnaghat Power Company Ltd, Pendekar Meghnaghat Power Plant Unique Power Plant Ltd.
Interstate Boundary	None
Seismic zone	Zone II
Type of Project	Combined Cycle power plant
Total Area of Land	35 acres
Fuel Requirement	RLNG/Natural Gas: 130mmscfd @ 100% load
Water Requirement & Source of Water	1076 m^3/h; Source: Meghna River
Quantity of Discharge Water	206 m^3/hr

The project will comprise of "Closed Loop Cooling" system for steam condensation which will decrease the amount of water discharge significantly.

Relocated Temporary Jetty detail

A temporary jetty will be constructed during the construction phase of the project to ensure convenient and efficient transportation of the construction material and the component of the actual power plant. Previously it was planned to construct the proposed temporary jetty on the western bank of the River Meghna or on the southeast corner of the project site which was extending in the main river stream flow area, as per the previously approved EIA of Reliance Meghnaghat 750 MW Combined Cycle Power Plant. As the adjoining land has been allocated to another project by BPDB, the temporary jetty location has been changed from the proposed location to the north-west corner of Meghnaghat Power Hub which is approximately 600 meters from the previous planned location. Now, the proposed temporary jetty will be constructed on the northwest corner of Reliance Meghnaghat 750 MW Combined Cycle Power Plant and it'll be demolished after the completion of the power plant project. This location is far from the main stream flow area of Meghna River and the Environmental and Social impact is much lesser as compared to the previous location.

The total area of the Temporary jetty is 2,250 sq m. Temporary jetty of LOLO 30m x 15m, and RORO 15m X 10m in dimension. Approximately 500 Sqm wooden log Pilling required for shore & Temporary Jetty protection. The approach road os approximately 400m long.

Required river draft for Temporary jetty operation is 3.0m in the main channel and 2.0m near the Temporary Jetty. Highest flood level of the project area is 2.5m. Height of the Temporary Jetty from river bed is 4.0m from river bed. Up to 1.2 m Excavation needed for Temporary jetty construction under river bed and filling needed 2~3m.

3. Policy and Legal Considerations

This ESIA report has been prepared by following the methodology prescribed in the EIA guidelines for industries of DOE, ECA95 and ECR97, that are the main legislative documents relating to environment protection in Bangladesh. The report is also compliant with ADB‘s Environmental Safeguard Framework. Steps to consult potentially affected people by the project and to disclose the ESIA report to the public have been taken for compliance with the Bank‘s policies of the ESIA preparation, although these are non-mandatory as per national legislations. The environmental classifications for industrial projects in Bangladesh are based on "inclusion lists" given in the ECR97 with "RED" being the highest category. Power Plant is listed in the "Red Category" in ECR97 (i.e., serial no.6 in the ECR97 Red list in Schedule-1.). According to ADB environmental classification, the project falls under Category-A.

4. Baseline Environment

Baseline environment is concerned with existing physical, chemical and biological conditions of the area where the plant is going to be set up. The surface water, ground water, ambient air quality and noise level have been analyzed to evaluate the primary baseline of the area. The partial data from the monthly monitoring data of proposed Reliance Meghnaghat 750 MW CCPP have also been used to evaluate the monthly concentrations of PM2.5 and PM10 in the project area.

In the vicinity of the plant, the main surface water body is the river Meghna is adjacent to the site. The quality of the river water from a previous study from another project (secondary data) has been analyzed and found satisfactory. Ground water level exists at a moderate (Generally below 8.0 m) depth in the area. Water from underground source is assumed to be available as because most of the period of the year the area remains under water. That means the recharge capacity of the ground water level seems to be adequate.

In common with other peri-urban or rural areas; birds like Crow, Salik, Chorui, doel, ghughu, Kokil, etc are seen at times at the project site. There are no wildlife, natural forest and vegetation, endangered species of present in and around the plant site. Although the plant site is mostly barren, there are a number of different types of trees like jack fruit, mehogoni, krisnochura etc. along with few other shrubs around the plant site.

The climate of the region is of tropical monsoon type. According to Bangladesh Meteorological Department, the maximum temperature of 2013 at project site is 37.0° C in June & July and minimum temperature is 5.3 °C in January. Mean relative humidity for an average year (2013) is recorded as 73% and on a monthly basis; it ranges from 54% in March to 81% in August. At normal times, the maximum and minimum wind speeds at Dhaka (no meteorological station in Narayanganj) are 3.2 Knots/hr and 2.1 Knots/hr respectively in 2013. The rainfall is mostly confined in the monsoon season i.e., between May to October. Maximum and minimum rainfall in May 2015 is 623 mm and 0 mm in Nov respectively.

The data from the DOE CAMS (continuous air quality monitoring stations) is not available near the project area. So, to establish a realistic baseline air quality, AECL is undertaking a 24 hours air monitoring for one day and seven weeks of study on air monitoring has already been carried out for Reliance Meghnaghat 750MW CCPP. The baseline levels for other criteria pollutant i.e., CO, NO2 and SO2 are compliant with DoE and World bank/IFC standard. Baseline noise levels measured in a previous study near the plant site were never found to be above 70dBA and the maximum value is 65.6 (secondary data). Although, there are two existing natural gas and an HFO engine based power plants located adjacent to the project, there are no significant noise pollution yet. Since there is no homestead within the 100m radius of the proposed project, so, the noise emission from the project or anywhere nearby would not create any harm to the neighboring community.

Relocated Temporary Jetty

During the ESIA study of power plant (including previous Temporary Jetty) a 5km radius study area has been considered. But the temporary jetty location has been changed from the proposed location to the north-west corner of Meghnaghat Power Hub which is approximately 600 meters from the previous planned location. So, separate baseline study is not required.

5. Potential Impacts of the Proposed Project

The purpose of impact evaluation is to assign relative significance to the predicted impacts associated with the project, and thus determine the order in which impacts are to be avoided or mitigated. It should be noted that impact evaluation are somewhat subjective as the impacts can't always be quantified before the event. The following are the main objectives of impact evaluation: (i) Distinguish between impacts that are of most concern (need to be avoided/ mitigated) and those that are considered to be less important; (ii) Organize measures of significance in a way that allows a comparison of alternative project proposals; and (iii) Facilitate the communication of results to the concerned public and to decision makers. Key elements for assessing impact significance are: (i) Scientific and professional judgment; (ii) Disturbance/disruption of valued ecological systems; (iii) Degree of negative impact on social values and quality of life; and (iv) Public perception versus the scientific/professional opinion of the risks/benefits involved.

Identification of potential impacts due to the plant location, construction and operation of the plant has been done using a checklist. The checklist contains the environmental effects and impacts designated to stimulate the analysis and to consider broadly the possible consequence of contemplated actions. The significant impacts in different phases i.e., (i) due project location and design, (ii) construction phase and (ii) operation phase have been identified using the process. As the land development of the project has started now, there are some impacts for air quality, surface water quality and drainage pattern are concern. The impacts due to operation are most important, which are: (i) Air Emissions especially NO2 (ii) Noise, (iii) Water pollution, (iv) Occupational health, and (v) Emergency/disaster impact.

6. Prediction and Evaluation of Impacts

As the proposed power plant will utilize Natural gas as fuel, the pollutants of potential concern will only Oxides of Nitrogen (NOx) during the operation period of the project. This pollutant has been examined to ensure the Bangladesh emission limit standard as well as IFC/WB, where appropriate, the required emission control techniques would be incorporated into the mitigation measures. The ground concentration of NOx emission have been determined by air emission dispersion modeling by using USEPA approved AERMOD model up to a distance of 5km radius to the project site.

As explained above, the main potential environmental impacts, which may arise as a result of construction of the power plant, can be grouped as follows: (i) Atmospheric emissions and Air quality, (ii) Noise generation, and (iii) Water pollution and waste water disposal. These aspects have been examined and the findings are summarized below.

Atmospheric Emission and Air Quality: Emission of Nitrogen Oxides is the major concern of air pollution for the project. The Heat recovery Steam Generation (HRSG) system which produces steam by using the waste heat from the Gas turbine will reduce the exhaust heat temperature to 3650C. To evaluate the ground concentration of the above emissions to the surrounding environment, an emission dispersion modeling (USEPA approved AERMOD 8.9.9 model) has been done and the result shows that all the criteria pollutants will be within the Bangladesh NAAQS and Bank group's (i.e. IFC).

Noise: The gas turbine and the steam turbine will have internal noise level of around 85 dBA which will be minimized by sophisticated acoustic power house building design so as to minimize the noise up to standard. The heat recovery steam generator stack will emit a noise level of 85 dBA after providing the silencer. To reduce the effect, most costlier and effective Critical Type Silencer will be used in the stack. In particular, significant noisy components such as the gas turbine sets are enclosed in buildings acoustically designed, providing Styrofoam filler of 50 mm width in between 300 mm thick brick walls around the power house building. Moreover, thick doors are provided and holes which may create sound pollution are sealed with sound proof materials. Vibration pad will also be used at the bed of all power generation units to prevent the vibration. The stack noise emission dispersion has been predicted by means of noise impact modeling. It is observed from the noise emission modeling that the max noise level within the 50m radius is 32.16 dBA.

The resultant noise calculation with the ambient noise level shows that the noise level after 300m from the power plant will not affect the ambient noise level of the area, so, there would not create any noise problem due to the power plant to the nearest settlement.

Liquid Discharge: The estimated water consumption is 1100 m3/hr and discharge will be 196 m^3/hr in the proposed Reliance Meghnaghat 750 MW CCPP project. The low amount of water discharge is due to the use of "Closed Circuit Cooling System". Owing to the low amount of discharge and use of closed circuit cooling, rise in river temperature will have no impact on river water temperature considering the amount of discharge from the other power plants near the project premise. The domestic liquid wastes would be disposed through a septic tank system. It has been planned that the surface drainage network would be connected with an interceptor prior to discharge to surface drainage system. All other surface water coming from cooling tower blow down, DM plant rejects and service water will be taken to wastewater treatment plant prior to discharge to natural water.

Relocated Temporary Jetty

A temporary jetty will be built adjacent to the project site to transport the construction material and heavy equipment during the construction period of the power project. Required river draft for temporary jetty operation is 3.0m in the main channel and 2.0m at the Jetty. The excavation activities and pilling work in the riverbed for construction of the jetty will generate fine sediments and will also result in resuspension of sediments in water. The leakage and spillage of oil and lubricants from machineries and equipment can cause adverse impact on surface water quality.

The construction materials to be used will involve raw materials which are non-hazardous in nature such as steel, cement, gravel, rock etc. Cutting and filling should be avoided during jetty construction at the river bank to avoid the river erosion. Construction of permanent structure will be avoided. Resuspension of the sediments will happen for a very short period of time as the constructional period consists of only 3 months. However, strict supervision should be maintained so that the impact remains within the project area.

Moreover, the current location is far from the main stream river flow area and fishing hamlet. So, the Environmental and Social impact is less. As the location is far from the regular navigation route of Meghna river so it will not create obstruction or trouble to regular navigation due to loading unloading vessels in the jetty. Proper sign, signal and strict supervision should be maintained for navigation of the vessels to avoid accidents. Addition to that, the adjacent channel to the current location of Jetty is not used for regular fishing so it will not have much impact on the fishing around the area.

7. Environmental Management Plan (EMP)

In the context of a project, Environmental Management Plan (EMP) is concerned with the implementation of the measures necessary to minimize and offset the adverse impacts and to enhance beneficial impacts. Unless the mitigation and benefit enhancement measures are identified in ESIA and fully implemented, the prime function of the ESIA cannot be achieved. Thus, the objectives of EMP for the present project are: (i) Identification of Monitoring requirements and Monitoring indicators; (ii) Mitigation measures to reduce or eliminate negative impacts; and (iii) Enhancement measures to maximize positive impacts. Environmental management plan has to be considered as part of the plant's overall management and it would be part of the plant operational manual.

Monitoring of the performance of a plant is very important and sometimes vital. Industrial units in Bangladesh generally do not monitor the environmental parameters related to plant operation, thereby neglecting the environment. For surveillance of the environmental performance of an industry, and monitoring of the quality of the local environment, environment in the work-zone and the general impact zone have to be performed on a regular basis. A management set up has to be created for the environmental monitoring program which can ensure compliance with national environmental standards. To this end a committee (Environmental Management and Safety Committee) will be created with plant manager as head and with 2-4 other members. The committee must meet at least once in a quarter and discuss about the environmental status of the plant. The main emission from the plants (i.e., air emissions, noise and any other) are to be analyzed as per monitoring plan. The "the quarterly and annual environmental monitoring reports will be submitted to DOE, ADB and will also be placed on the company website for public scrutiny.

The cost of the Environmental Management Plan (EMP) is divided into several parts to reflect the different phases of the project and the requirements of each phase. The cost of EMP must include the costs of the capacity building, public consultation and the quality control requirements for a period of 5 years of operation. An allocation will be made for EMP every year in budget estimated for the project.

EMP for Relocated Temporary Jetty

For the Power plant we have considered a 5km bounding impact area and the location has been shifted only 600m. So, the impact area and Monitoring will be same as the Power plant. Monitoring suggested for the power plant will be enough for inspecting the impacts due to the temporary Jetty. The monitoring of Power plant will reflect the impacts due to the temporary Jetty.An ESMP for the proposed Temporary Jetty is given in Table 7.5.

8. Emergency Response and Occupational Health & Safety

Under the supervision of the 'Environment Management and Safety Committee', all plant personnel will have responsibilities assigned to them during emergency. The documented responsibility will be included in a program manual which can constitute a part of the plants operation manual. Compliance with the responsibilities should be monitored and if these are not carried out for any reason, corrective measures should be taken.

The plant management will prepare an occupational health safety policy manual which should be updated from time to time. The policy should be signed and dated by the Chief Safety Officer who may be the Plant Manager. The policy should be discussed with all the plant personnel. The Chief Safety Officer should periodically review the policy and re-issue the policy.

9. Alternative Analysis

After understanding the resource limitation of Bangladesh, it is evident that the best possible technology for power generation is combined cycle technology. So, no other power generation technology is recommended.

After the analysis of air quality modeling, it is evident that the air quality of the project site is satisfactory and the air quality parameters are all within limit. Better air environment is not easily found in an industrial area like Narayanganj district.

As the project site is far from locality and in a power hub, the power plant will not affect the nearby people. Also, the power plant technology will contribute very little NOx to the existing ambient air and very little CO2 will be contributed overall. The power plant will use the first ever closed loop cooling system in Bangladesh. The proposed power plant site is an empty government acquired land and no further land acquisition was required. As there is no relocation needed, no alternative is required for the proposed project site.

After analysis of various possible alternatives, this ESIA finds the plant's environmental impacts at the selected site are acceptable if the management procedures delineated are properly implemented. Therefore, the site has been considered suitable for the plant.

10. Stakeholder Consultation and disclosure

Stakeholder consultations are very important and sensitive issues for setting up a new industry in any area of Bangladesh. The process was initiated with an open objective to ensure people's participation right from the planning stage of the project. Furthermore, this was aimed at improving the study taking into account opinions from the people of the impacted area. Meetings with stakeholders consisted of community consultation meetings, focus group discussions, and in-depth interviews with men and limited focus-group discussions with women.

In recognition of the diversity of views within any community, it is very important to obtain a clear understanding of the different stakeholders and to analyze their capacity and willingness to be involved in some or all of the project and its planning process. It is important to be aware of how different power relations can distort participation. It is also important to examine how community skills, resources, and 'local knowledge' can be applied to improve project design and implementation. All of this can be achieved by careful use of the various tools of Stakeholder Consultation.

In the series of informal profess of consultation various stakeholders have been consulted e.g. local communities, men, women and local elders, local government representatives, NGOs, local fishermen and their family, local cow owners etc. The most important consultation was the consultation of local fishermen and cow owners.

A formal public consultation has been conducted on 28th August 2017 at the Sonargaon Upazilla complex. There were Member of the Parliament, representatives of the Local Chairman, UNO of Sonargaon Upazilla, representatives of Local NGOs, headmasters of local schools, local political & religious leaders and member of the publics were present in the consultation. All the speakers and guests were very positive about the project and discussed about various issues related to construction and operation of the project.

Consultation of local fishermen

The fishing village, Char Balaki, has roughly 200 families living there nearly for many years. Most of the households depend on the fishing for their livelihood. On the aspect of livelihood currently their greatest needs are lack of safe landing station for travelers, commodities and goods, no proper communication means to reach from mainland to the char, lack of variety of fish nets, seasonal variation of number of fishes found.

Fishermen in the village do fishing within 5-6 kilometers around the char including 40-50 meters from the outfall. Some fishermen do fishing in other areas sometimes. Each fishermen consisting of two members can catch 5-10 kg fish per day in rainy season and 1.5 - 2 kg per day in winter season. Per kg of fish is sold ranging from BDT 500 to BDT 700.

The participants including men and women were noticed from the local people about installation of Reliance Meghnaghat 750 MW CCPP and they reportedly mentioned that do not find any negative impact on their livelihood/fishing. Instead they welcome the power generation activities for the betterment of the country, but they reportedly regret being deprived of electricity till days. In the past, they didn't find the activities of the power plants detrimental to the fishing activity.

Consultation of Cow Owners

There are no formal cattle farms near the project area but some people living near the project area used to graze some of their domestic cows on the project land since the land is unprotected and has no fencing. The number of cows is merely 25-30 and there are plenty of green fields in the vicinity of the project area where they could find alternative grass land for the grazing of their cows. They are aware of the project and they informed that they will drive their cows elsewhere once the proposed land is occupied.

The stakeholders' consultation process will be continued in the operation phase of the plant as well, so that issues of public concern can be addressed.

According to the cow owners, the Project site is not the only place they use for grazing their cows. They graze their cows wherever they can manage an empty piece of land covered with grass. The project will not occupy the entire land; therefore, the remaining land can be used as a grazing ground.

The ESIA report will be uploaded in the Company's website and a copy of ESIA is kept at the plant for public review. The executive summary will be translated into Bangla and will also be made available to the public.

11. Grievance Redress Mechanism

The Project Management has established a procedure to answer to project-related queries and address complaints and grievances about any irregularities in application of the guidelines adopted for assessment and mitigation of environmental safeguards impacts. The complaints related to plant operation that may create inconveniences to agency/individual should be addressed based on consensus; the procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time- consuming legal actions.

To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRC will record the details of the complaints and the reasons that led to acceptance or rejection of the particular cases. The GRC will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by appropriate authority, WB and any organizations known to be working with urban development issues. However, it should be noted that the GRC process will not pre-empt and aggrieved person's right to seek redress in the courts of law.

12. Conclusion and Recommendations

The present ESIA report finds that though there are certain environmental impacts associated with the industrial unit under consideration, these are manageable.

The project is indispensable in view of the current energy shortage scenario in Bangladesh. The impact on the social environment is positive given the employment and business opportunities created for local residents from the project. The project will help in the industrialization, accelerating socioeconomic growth, and improving quality of life. One of the most critical issues for the project is safety. This has been adequately addressed through compliance with national building code (BNBC) in the construction to ensure safety during natural disasters like earthquake and cyclone.

The project has been designed to comply with the country's environmental laws and regulations, especially on air emissions, ambient air quality, wastewater effluent, and noise. The project management has taken steps to ensure that the plant meets the DOE/World Bank/ADB's environmental standards. Given the management measures and monitoring commitments by the RPL for the project, environmental impact of the project will be manageable.

No development can be expected without any adverse impact on the environment. The beneficial impacts on the nation as well as human beings would only be meaningful and sustainable development would only be possible if adverse impacts are minimized through strict maintenance and control measures as mentioned for this project. All this would need vigilant care and cost money, and the project authority should take these into considerations. However, the following are the recommendations should be followed by the RBLPL during the construction and operation of the project:

The Environmental Monitoring Plan should be followed properly and review of the EMP should be done as per plan.

Continuation of the baseline air monitoring study: Since the baseline air monitoring study has been conducted from September-December, a follow up baseline air quality monitoring should be conducted at July-August and January-February so that the proper monsoon and dry season data would be reflected.

Continuation of the Stakeholder Consultation: To evaluate the true consequences of the project, the Stakeholder consultations should be continued during the Construction and operation of the project in a regular interval.

Post Environmental Impact Assessment: A post ESIA should be conducted after the implementation of the project to compare the ESIA mitigation measure that suggested are logical and working properly.

Given the proponent's commitments, actions undertaken for further measures to be adopted in due course of time as required, the Reliance Meghnaghat 750 MW CCPPproject is going to be a nationally important and environmentally sustainable industrial venture.

Chapter-1

INTRODUCTION

1.1 PROJECT BACKGROUND

Electricity, the most usable form of energy, is one of the most important issue for the economic development of a country. Electricity is a vital ingredient to upgrade the socio-economic condition and to alleviate poverty. The supply of electricity has a great impact on the national economy. Proper and enough reliable electricity supply have a great positive impact on the country's GDP. Therefore, use of electrical energy is increasing day by day with rise of GDP growth. Human civilization has tremendously been advanced by the versatile uses of electricity and demand for electricity is integrated with all aspects of development.

Bangladesh is still at a very low level of Electrification. The government of Bangladesh has declared its vision 2021 to provide electricity for all. Power Sector Master Plan 2010 (PSMP-2010) has been undertaken to accommodate the govt.'s vision 2021. According to the study the total demand would reach 34,000 MW assuming a 7% GDP growth over the time period while according to plan, the generation capacity would be about 40,000 MW. The aggregated investments for the development of the generation, transmission and related facilities are found to be at Taka 4.8 trillion (US$ 69.5 billion). The annual average of the investment amounts to Tk. 241 billion (US$ 3.5 billion).

According to Bangladesh Power Development Board (BPDB) presently the installed generation capacity as on October 2016 in the power sector is 13,280.00 MW. The per capita electricity consumption in Bangladesh remains one of the lowest in the Asian region, At present, only about 68% of the total population (including renewable energy) has access to electricity and per capita generation is 348 kWH, which is very low compared to other developing countries. To alleviate poverty in the face of resource limitations and high population density, Bangladesh requires an economic growth rate of more than 7% p. a. In order to achieve this growth rate, electricity growth needs to be achieved by 10%. So, the generation of electricity should be increased for the following years to fulfill the upcoming increasing demands. Now the biggest challenge for Bangladesh's economic growth is to ensure uninterrupted electricity supply to reduce the demand- supply gap for the growing industrial, agricultural and household needs.

Because of the critical nature, the Government of Bangladesh has given highest priority to the power sector to enhance the generation capacity. BPDB has come up with a comprehensive plan to meet the surging demand in power. Accordingly, the government plans to eliminate the demand supply gap and achieve the ultimate goal of providing "electricity to all" by 2021 by having generation capacity of 20,000 MW.

To ensure overall and balanced development of the sector government has devised immediate, short term, medium term and long term generation plans. The plans have been developed based on a techno-economic analysis and least cost options.

However, the timely implementation of above plans is a concern as there are issues with regards to availability of finance, competency of project sponsors and inherent bureaucracies and other bottlenecks in the system. Further, the demand estimates for power may also be understated to some extent. Strategies have been made to meet the investment requirement by involving private sector with Government through Public Private Partnership (PPP) initiatives. A successful IPP model has been designed with a lot of comforts and protection to investors.

Responding to the need of the country, now the **Reliance Bangladesh LNG & Power Limited** (the Company), part of the Reliance Group and one of the India's largest private power generation company, has proposed to set up gas based combined cycle power plant project named **Reliance Meghnaghat 750 MW CCPP** at Meghnaghat, Sonargaon, Narayanganj. Due to the scarcity of the natural gas resources in Bangladesh, Reliance Power Limited has aimed to establish FSRU in Bangladesh for this power project so that to give a proper solution by not enforcing the present gas scarcity.

1.2 POWER GENERATION PLAN OF THE GOVERNMENT

In spite of financial constraints and gas supply shortages, the government designed a strategy to overcome the crisis and at the same time meet the ever increasing demand for power. It launched immediate, short, medium and long term programs to increase power supply through introduction of fuel mix (gas, coal, liquid fuel, nuclear energy and renewable), demand side management, energy efficiency and conservation. After assessing the latest demand, the government has revised its targets for increasing power generation. The year-wise details of the additional power generation programs, both in public and private, are listed below:

Table 1.1 Plants Commissioned During 2012- 2016 in MW

YEAR	2012	2013	2014	2015	2016	TOTAL
Public	632	1467	1600	1410	750	5919
Private	1354	1872	1637	772	1600	7235
Total	1986	3339	3297	2182	2350	13154

(Source: Bangladesh Power Development Board)

Natural gas is the major source of fuel used for power generation (60.15%) with furnace oil being the next (20.21%). Although coal is available in Bangladesh, due to the huge cost of extraction and processing, use of coal in power generation has not yet been more widespread **(Table 1.2).**

Table 1.2 Power Generation Units (Fuel Type Wise)

Installed Capacity of BPDB Power Plants as on October 2016		
Fuel Type	Capacity(Unit)	Total (%)

	0.00	MW	0 %
Coal	250.00	MW	1.88 %
Gas	7988.00	MW	60.15 %
HFO	2684.00	MW	20.21 %
HSD	1528.00	MW	11.51 %
Hydro	230.00	MW	1.73 %
Imported	600.00	MW	4.52 %
Total	13280.00	MW	100 %

Derated Capacity of BPDB Power Plants as on October 2016			
Fuel Type	Capacity(Unit)		Total (%)
	0.00	MW	0 %
Coal	200.00	MW	1.58 %
Gas	7529.00	MW	59.35 %
HFO	2627.00	MW	20.71 %
HSD	1499.00	MW	11.82 %
Hydro	230.00	MW	1.81 %
Imported	600.00	MW	4.73 %
Total	12685.00	MW	100 %

(Source: BPDB, 2016)

Bangladesh is facing a major electrical power shortage for the last one decade. The shortfall aggravated during recent years and the scenario in the power sector has become a cause for great concern. The unbalanced supply-demand situation in this sector will significantly hamper the development in all sectors of life including those in agricultural, industrial, commercial and domestic sectors.

There is no alternative than to add more power generating units to the existing power system of Bangladesh within the shortest possible time frame. The urgency is not only because of the ever-increasing demand for electricity but also due to the fact that many our existing power generating units are nearing the end of their life cycle. The proposed 750 MW combined cycle power plant at Meghnaghat, Narayanganj would certainly help improving power demand situation to a considerable extent.

1.3 Natural Gas reserve and Necessity of LNG import in Bangladesh

Bangladesh is the seventh-largest producer of natural gas in Asia. Gas supplies meet 56% of domestic energy demand. As of 2015, the natural gas reserves of Bangladesh are 14.16 trillion cubic feet. The country has an average daily natural gas production of around 2,700 million cubic feet. According to Table-1.2 around 60.15% power generation in Bangladesh is done by natural gas.

The demand for natural gas has been increasing day by day for its diversified use. On the contrary the existing reserve is depleting. As a consequence, we are being experiencing severe gas crisis especially to ensure gas supply to the power plants. However, to alleviate gas reserve constraint government and private sector stakeholders are exploring the import of LNG as well as natural gas through pipeline from the neighboring countries.

Present government has accorded high priority to meet the increasing gas demand of the country and to ensure uninterrupted gas supply to the national grid by importing LNG and injecting it to the national gas grid pipeline. Government is also considering import of gas either through pipeline from neighboring countries.

1.4 FSRU Unit by Reliance Power Limited

Indications that indigenous gas resources are falling below sustainable economic operational levels and eventually may run out in the short- to medium-term have resulted in the need for supplementary feedstock in form of importing liquefied natural gas (LNG). Keeping this is view; Reliance Power plans to establish a Liquefied Natural Gas (LNG) storage and re-gasification facility/Terminal of up to 5 MMTPA capacities. The Terminal may be a Land based LNG terminal or a Floating storage & Regasification unit (FSRU) in the range of 3.5 - 5 MMTPA (about 750 mmscfd peak load) with a storage capacity of 125,000 to 180,000 m3 located offshore of Kutubdia island in Chittagong region of Bangladesh. Subsea and overland pipelines would transport the gas from FSRU to the nearest gas grid pipeline.

1.5 OBJECTIVES OF ESIA STUDY

This report presents the finding of an Environmental & Social Impact Assessment (ESIA) of the project proposed by Reliance Bangladesh LNG & Power Ltd., a 750 MW gas based CCPP. The proposed plant is located at Meghnaghat, Sonargaon, Narayanganj. The objective of the study is to provide an examination and assessment of the principal environmental impacts of the proposed plant. The outline of an environmental management plan also suggested with an indication of the extent of work to be done to keep the development and environment compatible. In this context, it should be noted that the term “environment” and its derivatives have been used in a wide sense, which covers not only physical and chemical aspect, but also the human dimension. The specific objectives of this ESIA are to:

- Present a brief discussion on the ESIA process and its role in the planning and implementation of development projects;
- Present a general description of the project and the process;
- Present a description of the pre-project environment;
- Delineate the significant environmental issues found and believed to be involved;

- Identify the environmental impacts of the project and quantify them to the extent possible;
- Suggest the plan for management of the environment, during the implementation and operation of the plant.

1.6 STUDY METHODOLOGY

Based on the above Scope of Work, the following steps were followed during the ESIA process:

- Undertaking a field survey towards collection of primary Baseline Social and Environmental information and data pertaining to the project area;
- Collection of Secondary data;
- Understanding the technical aspects of the proposed power plants
- Conducting modeling exercise to analyze environmental impact;
- Undertaking identification of potential environmental impacts (along with residual impacts and cumulative impacts, if any) and evaluation of socio- economic consequences of such impacts.

Identification of impacts was done using Checklists method. All the relevant social and environmental risks and potential impacts have been taken due care of as part of the assessment in compliance of the Performance Standards set by the Asian Development Bank (ADB) following the guidelines set forth by DOE.

1.7 THE ESIA TEAM

Adroit Environment Consultants Ltd. (AECL) has prepared this report under the guidance and supervision of Dr. Nasir Uddin Khan. The total team composition and their expertise have been given in the table below:

Table 1.3: The EIA team

Professional	Name	Expected Expertise
ESIA & Emission Modeling Expert	Dr. Nasir Uddin Khan	Highly experienced on conducting ESIA of various nature in home and abroad. Have vast experience on identifying different environmental impacts and suggesting mitigation measures for any project. Experienced on emission and noise modeling of various projects. Experienced on Project stakeholder engagement - Public consultation and Disclosure Plans.
Legal, Policy, Health & Safety Professional	Md. Zahedur Rahman	Highly experienced in identifying different environmental impacts and suggesting mitigation measures.
Power Plant Engineer	Md. Abdul Matin	Understanding the power plant configurations for environmental issues.
Socio-economist	Md. Humayun Kabir	Experienced on Social baseline studies, community needs assessment, Social and Community Health Impact Studies/Assessments etc.
Ecological Survey Specialist	Dr. Abdur Jabber	Experienced in aquatic flora and fauna analysis for different power projects
Project Liaison Officer	Md Hasanul Islam	Experienced on conducting ESIA of various nature. Involved in baseline environmental study, identifying different environmental impacts, suggesting mitigation measures and environmental management plan for any project.
	Nuvia Noorain Rashid	Make Liaison with all field staff and Consultants; allocate staff & resources to different places when necessary. Background of organizing site visits, surveys, liaison with community, public and govt. organizations, etc.
	Md. Hadiuzzaman	Make Liaison with all field staff and Consultants; allocate staff & resources to different places when necessary. Background of organizing site visits, surveys, liaison with community, public and govt. organizations, etc.
	Syed Hosnee Jahab	Base line data collection, sample collection from site, sample preservation and laboratory analysis.
Field Investigator/ co-	Md. Murad Hossain	Base line data collection, secondary data collection, sample collection and site

Professional	Name	Expected Expertise
coordinator		survey
	Nigar Shultana	Base line data collection, sample collection from site, sample preservation and laboratory analysis.

Services performed by the consultant are conducted in a manner consistent with that level of care and skill generally exercised by members of the engineering and consulting profession. The report may not exhaustively cover an investigation of all possible circumstances that may exist. However, an effort is made to discover all meaningful areas under the stipulated time available. In evaluating subject site, consultant relies in good faith on information provided by client's management or employees. The Consultant assume that the information provided is factual, accurate and accepts no responsibility for any deficiency, misstatement or inaccuracies contained in this report as a result of omission or misrepresentation of any person interviewed or contacted. However, the consultant notifies the contradictions and errors in the data, where it seems appropriate.

It should be recognized that the information given in the report is time specific and with the passage of time the relevancy of data and analysis may suffer. Specific circumstances and condition of site can change due to which conclusion and opinions may also change.

1.8 ACKNOWLEDGEMENT

The ESIA Report has been prepared basically with the support from **Reliance Bangladesh LNG & Power Limited** and also from various government agencies and NGOs including Bangladesh Power Development Board (BPDB), Bangladesh Meteorological Department (BMD), Soil Resource Development Institute (SRDI), Bangladesh Bureau of Statistics (BBS), Bangladesh Water Development Board (BWDB), Department of Environment (DOE) and Department of Agriculture Extension (DAE), etc. We would like to say thanks to each organization and its employees for their contribution in conducting the study.

1.9 REPORT STRUCTURE

The ESIA report has been structured to provide primarily the information content of ADB guideline and review requirement of TOR in a logical sequence. The issue and the Corresponding section of the report where it has been addressed is summarized in the following table **(Table 1.3)**

Table - 1.4 Issues and corresponding section of the report where these are addressed

Sl. No	ESIA Review Issues	Sections where addressed
1	Introduction	Chapter-1
2	The Project	Chapter-2
3	Policy and Legal Consideration	Chapter-3
4	Baseline Existing Environment	Chapter-4
5	Identification of Project Impact	Chapter-5
6	Evaluation of Project Impacts and Mitigation Measures	Chapter-6
7	Environmental Management Plan (EMP)	Chapter-7
8	Disaster Management Plan	Chapter-8
9	Alternative Site	Chapter-9
10	Stakeholder Consultation	Chapter-10
11	Grievance Redress Mechanism	Chapter-11
12	Conclusion	Chapter-12

Chapter-2

THE PROJECT

2.1 PROJECT DESCRIPTION

Reliance Meghnaghat 750 MW CCPP project is a natural gas base combined cycle power plant with rated capacity of 750 MW. In order to develop the Bangladesh power sector & to bridge the electricity demand-supply gap, the Government of Bangladesh had put in place a Power Sector Master Plan (PSMP) 2010. The PSMP 2010 include an optimum power development plan and identification of the potential power plant sites based on the fuel diversification study. The development of the proposed 750 MW Combined Cycle power project at Meghnaghat will aid in securing current as well as future electricity demand for the country.

The proposed power plant will consist of heavy duty, advanced class (F-Class) gas turbines, matching heat recovery steam generator (HRSG), steam turbine generator with all integral auxiliary equipment. The preferred unit configuration for the project shall consist of a power block of 750 MW with two numbers of advanced turbines with AGP, two numbers of HRSGs and one Steam turbine.

2.2 PROJECT CATEGORY

Under the criteria of DoE as per The Environment Conservation Rules, 1997, the power generation process plant operation fall under Red Category that requires Environmental & Social Impact Assessment (ESIA). As per the ESIA Guidelines of DoE, it is mandatory to carry out Initial Environmental Examination (IEE) for Red Category projects prior to conducting ESIA. The IEE report should be submitted to get environmental site clearance. The basic data of the project are furnished in **Table-2.1.**

Table-2.1: Basic data on Reliance Meghnaghat 750 MW Combined Cycle Power Plant

Item	Description
1. Name of the Project	Reliance Meghnaghat 750 MW Combined Cycle Power Plant
2. Executing Agency	Reliance Bangladesh LNG & Power Ltd.
3. Project Location	Meghnaghat, Sonargaon, Narayanganj, Bangladesh.
4. Location of the Proposed Plant	23°36'25.56"N, 90°35'32.16"E
5. Type of Project	Combined Cycle power plant
6. Raw Materials	The main raw material of the project is natural gas.
7. By-product, if any	None
8. Net Plant Capacity	750 MW of Electric Power
12. Total Area of Land	35 Acres
14. Fuel Requirement	RLNG/Natural Gas: 130mmscfd @ 100% load

Item	Description
15. Water Requirement & Source of Water	1100 m^3/hr, Source: Meghna River.
16. Quantity of Discharge Water	196 m^3/hr

2.3 SITE DESCRIPTION

2.3.1 Location

The proposed power plant will be set up at Meghnaghat, Sonargaon, Narayanganj, Bangladesh. It is situated approximately 36 kilometers southeast of Dhaka, near the Meghna Road Bridge on the Dhaka-Chittagong Highway and is at around 2 km west from Dhaka-Chittagong highway, at the bank of the river Meghna. The environmental setting of the site is given in **Table 2-2.**

The aerial distances of nearby important cities and places of interest from the proposed project site are given below in the **Table: 2.3.**

Table 2 2: Environmental Setting of the site

Sr. No.	Particulars	Details	
1	Plant Location	Meghnaghat, Sonargaon, Narayanganj.	
2	Plant Site Coordinates	Latitude	Longitude
		23°36'25.56"N	90°35'32.16"E
3	General Elevation	7 m above MSL	
4	Plant Site Topography	Generally plain	
5	Present land use at the site	Empty BPDB land allotted for power plant	
6	Nearest Highway	Dhaka-Chittagong Highway- 2km E	
7	Nearest Railway Station	Narayanganj Railway Junction (8.94-km W)	
8	Nearest Airport	Hazrat Shahjalal International Airport- 45 km N	
9	Nearest Seaport	Chittagong Port- 190 km S	
10	Nearest Major Water Bodies	The River Meghna- Adjacent to project site	
11	Nearest Town/City	Narayanganj- 9 km West [Population as per 2011 Census: 1,323,600]	
12	Nearest Village	Char Balaki (1 km, W)	

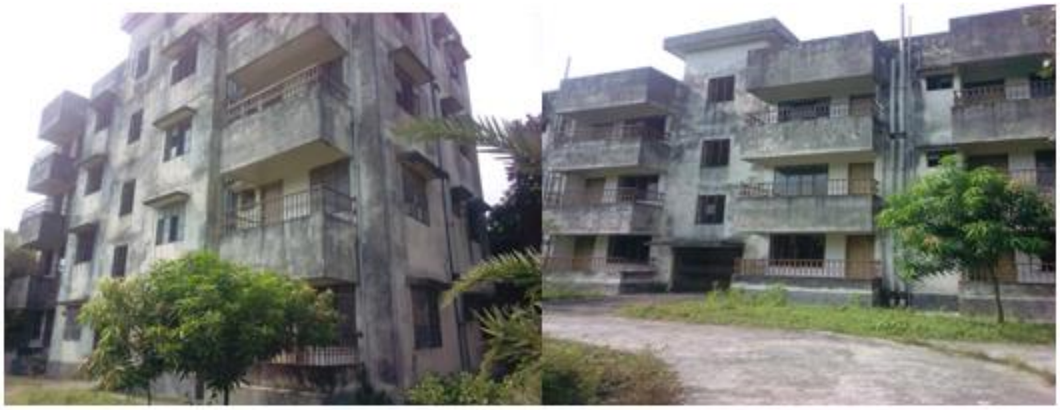
Sr. No.	Particulars	Details
13	Hills/Valleys	No hills and valleys within 5 km radius
14	Archaeologically important places	No important site within 5 km Radius
15	Protected areas	None within 10 km radius
16	Reserved/ Protected Forests	None within 10 km radius
17	Seismicity	Seismic Zone-II as per Geological Survey of Bangladesh (GSB)
18	Defence Installations	None within 10 km radius area

Table 2.3: Aerial distances from the site

Location	Distance (Km)
Dhaka City	36
Old Dhaka City	28
Sonargaon Upazilla Sadar HQ	4
Dhaka Airport	45
The crossing of National road No. 1 (Dhaka –Chittagong) and the approach road	4

The site is situated to the west of a box- shaped island formed due to meandering of River Meghna from its main course. The site is surrounded by Meghna River in the north, west and south direction. The major factors considered during the evaluation of sites include accessibility, land type and use, proximity to FSRU based LNG terminal planned and interconnection with national gas grid network, feasibility of power evacuation, sensitivity of the location(s) with respect to environmental & ecological aspects. The existing land that has been identified for the proposed power plant project is a government Khas Land. The land is currently empty and has been leased out by the Bangladesh Power Development Board (BPDB), Government of Bangladesh. There is no locality within the two kilometers radius of this project site. This part of Meghnaghat is mainly used for industrial land use. There are few industries in this area including 3 other power plants adjacent to the proposed Reliance Meghnaghat 750 MW CCPP. The location of the project location and its immediate surrounding is shown in **Figure 2-1.** Satellite imagery of the project location is shown in **Figure 2-2.**

Though the nearest settlement is around 1 KM away at Charbalaki village. There are some residential building of GTCL located around 500m north-east to the project site but there are no residents in those buildings and become abundant now. The following are some pics of GTCL empty building who shows the buildings are empty locked and broken glass.



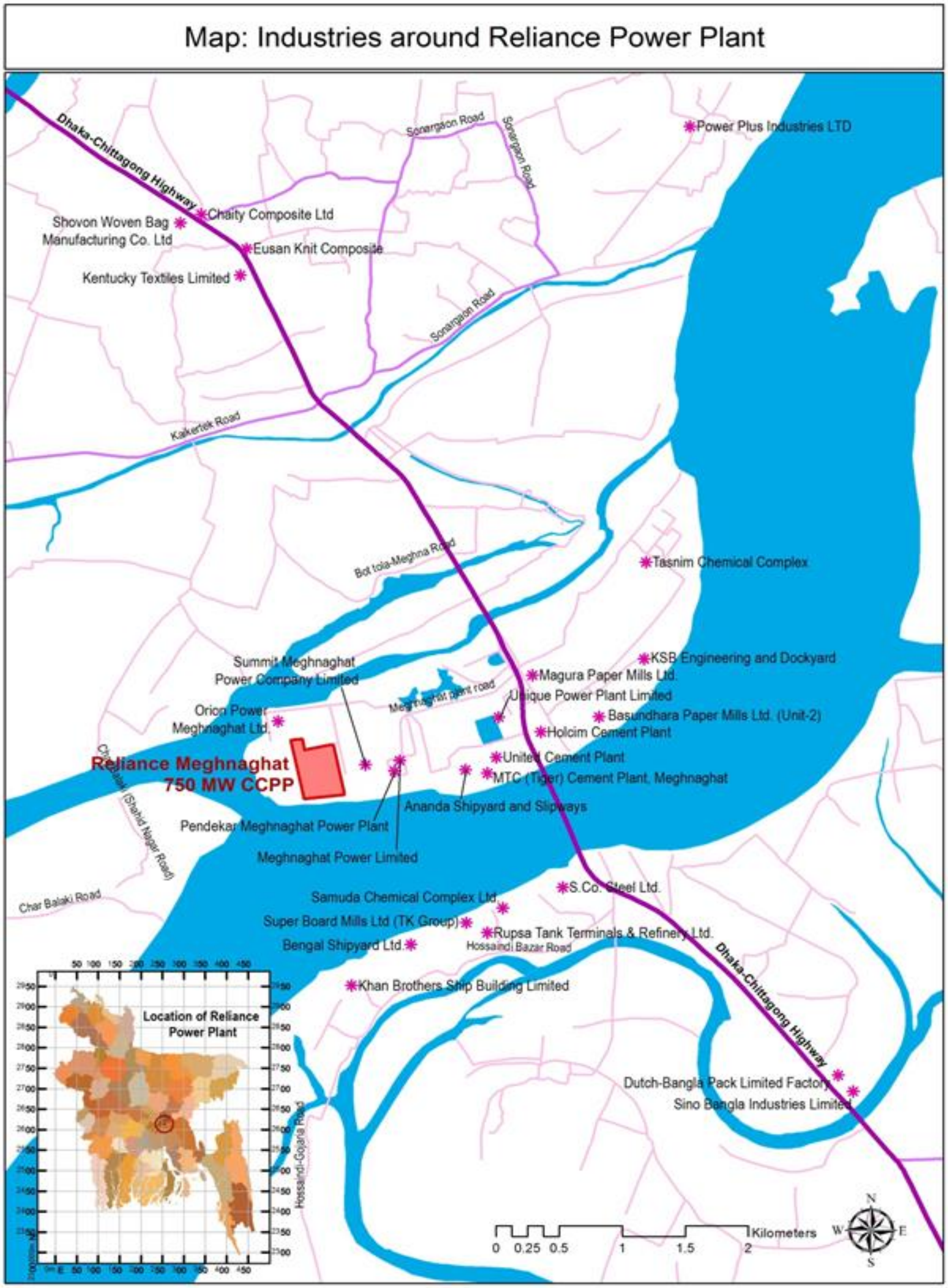


Figure 2.1: Location of the proposed power Plant

Figure 2.2: Satellite imagery of the project location

2.3.2 Plant Layout

2.3.2.1 Existing Power Plants

Meghnaghat is an area consisting of several power plants situated in the Sonargaon Upazila of the District of Narayanganj. Meghnaghat Power Limited, with capacity of 450 MW CCPP, Summit Meghnaghat Power Company Limited (SMPCL), a dual fuel (Natural Gas/ liquid Fuel Oil) fired combined cycle power plant with capacity of 350 MW and Orion Power Meghnaghat Power Plant (OPML), a 100 MW HFO fired power project under the government policy QRPP are situated at Power village, Meghnaghat, Sonargaon, Narayanganj, near the bank of the Meghna River which is adjacent to the proposed project. Around 65 acres of fallow land is still available in that area under the supervision of Bangladesh Power Development Board (BPDB).

2.3.2.2 Existing Industries

Apart from power plants, being in an industrial zone, there are numerous numbers of factories near and across the project site. In the inventory of the industries, there includes ship yards, cement plants, packaging industries, chemical industries and so many more. An inventory of the surrounding industries has been shown in **Figure 2-3** anddetailed in **Table 2-4.**

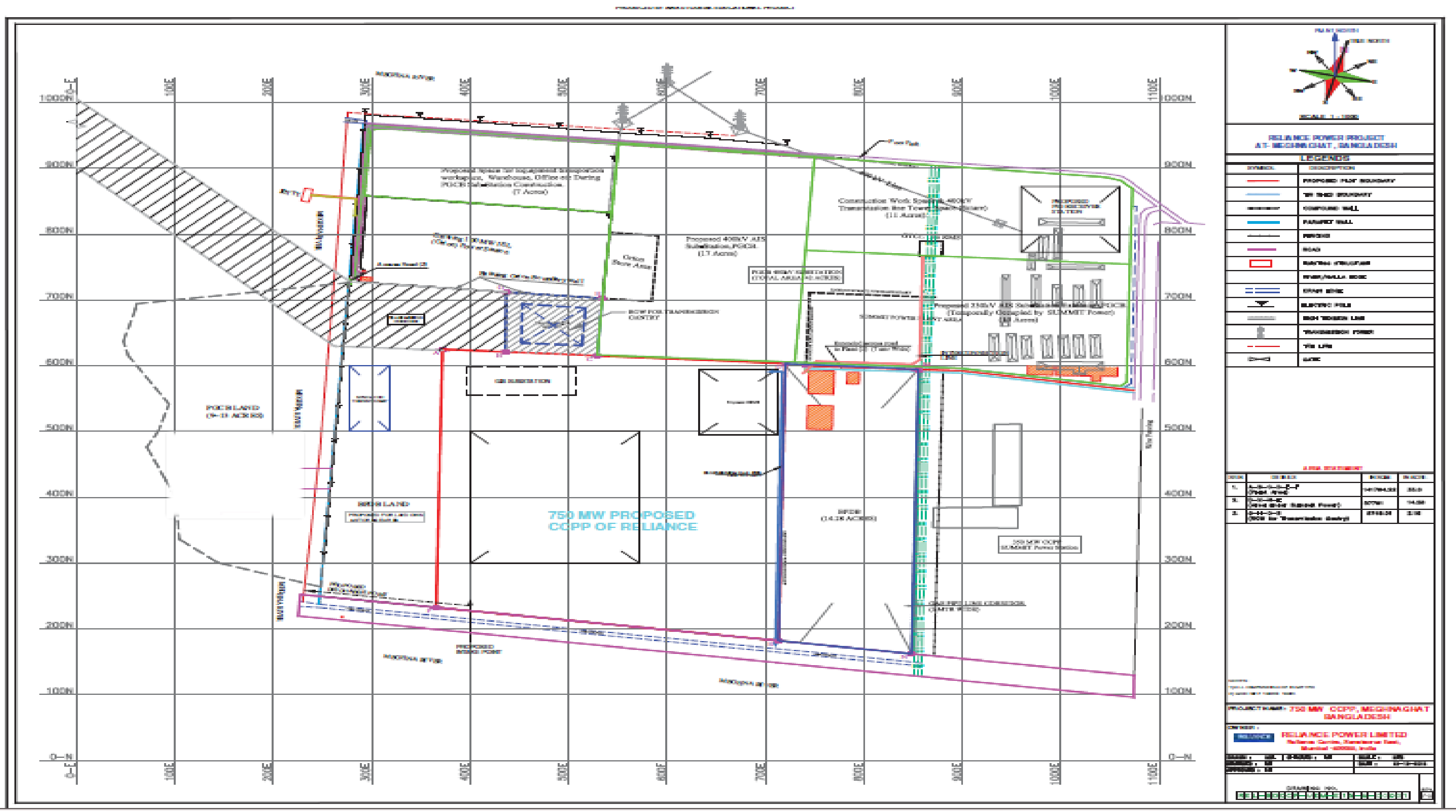


Figure 2.3: Existing industries near the project site

Table 2 4: Existing Industries near the Project Site

Name of the Existing Industry	Distance from the Project Site (km)
Orion Power Meghnaghat Limited	0.4
Summit Meghnaghat Power Company Limited	0.75
Meghnaghat Power Company Limited	0.95
Anandya Shipyard Limited	1.3
MTC Tiger Cement Plant	1.46
United Cement Plant	1.54
Unique Power Plant	1.81
Fresh Cement Factory	1.97
Holcim Cement Factory	2.15
Magura Paper Mills Ltd.	2.25
Bashundhara Paper Mills Ltd.	2.6
KSB Engineering Dockyard	3.1
Tasnim Chemical Complex	3.4
Khan Brothers Ship Building Limited	1.76
Bengal Shipyard Limited	1.6
Super Board Mills Limited	1.9
Rupsha Tank Terminals and Refinary Limited	2.05
Samuda Chemical Complex Limited	2.02
S.Co. Steel Limited	2.35

2.3.2.3 Environmental and Social Management in Industrial Area

Department of Environment, GoB is the nodal agency for Environment related matters. There are few other industries in the Meghnaghat Area. Though there are many industries in the Meghnaghat area as such there is no declaration or management as separate industrial estate. Individual industries follow Environmental and social guideline as per the applicable rules and regulations applicable for the project.

2.3.3 Power Generation Technology

The thermal system is based on combined cycle process. Combined Cycle Power Plant Module will consist of 750 MW Power block. A Module consists of Two (2) Gas Turbine each having capacity of 242 MW along with Electrical Generators, two (2) Heat Recovery Steam Generators and One (1) Steam Turbine Generator having capacity of 269 MW. The Combined Cycle Power Plant is based on the latest state-of-the art heavy duty industrial type Gas Turbines GE 9FA, which is suitable for base load and cyclic load operation inboth simple (open) cycle and combined cycle mode

The main advantages of the above selected configuration include:

- High part load efficiency.
- Higher reliability.
- More operational flexibility.
- Lesser time for installation.
- Can be used for peaking Duty.
- It is proven equipment globally with reference conditions

Each Module of Power block has two (2) Gas Turbines, two (2) HRSGs & one (1) Steam Turbine and associated Auxiliaries with GT water wash skid, Electrical & Instrument with dedicated control Package, Lube oil systems, vacuum pumps, control fluid equipment, heat exchangers & pumps for closed cycle DM cooling water system, Seal oil equipment for the generator, flash tanks etc. GTG and STG Building are separately located in the Power Block. The STG Building has two floors -Operating & Mezzanine. Boiler Feed Pumps (BFP) and Steam / Water sampling system are located near the HRSG. Condensate extraction pumps are located in the pit adjacent to Steam turbine condenser.Figure 2-4 shows the plot plan of the proposed plant.

2.3.3.1 Combined Cycle Process Description

A combined-cycle facility consists of four main components: control, auxiliary components, gas turbine, and generator. Combined steam-gas cycle has some advantages:

i. Energy generation is clean— i.e. it is the most acceptable technology from an ecological standpoint
ii. High efficiency factor, more than 50%.
iii. Minimal land requirement
iv. Minimal water requirements

v. Fast operations: The station starts and shuts down quickly, so it is possible to operate the facility both for base and peak load.

The thermal system is based on GE 9FA combined cycle, including: two sets of Gas Turbines, two sets of HRSGs and one Steam Turbine (2+2+1).The description of the cycle is given below: Air is compressed by the axial compressor which is on the same shaft with the Gas Turbine, then it enters the combustion chamber and mixes with the natural gas, the high temperatureflue gas produced from combustion of the mixture of gases drives the Gas Turbine. The flue gas from the Gas Turbine goes to the HRSG for the heat exchange and then passes through the stack to atmosphere. The high temperature flue gas also can pass through a bypass stack to atmosphere to meet the rapid start-up requirement. The Gas Turbine is coupled at the Compressor air inlet end via a Load coupling to the Generator Rotor. Mechanical Energy is converted to electrical energy in the Hydrogen cooled generator. The Generator Step up transformer raises the voltage from 15.75 KV to 400 KV. The Generator Circuit breaker connects the Generator to the 400 KV GIS. 400 KV GIS has a line breaker and connecting isolators and earth switches as a standard. The GIS 400 KV is connected to the AIS 400 KV Quad Moose line for transmission of power to the electrical grid. Exhaust gas from the Gas Turbine is routed to the HRSG through insulated ductwork, where it passes through the super heater, re heater, evaporator and economizer sections of the HRSG.Steam is generated in the HRSG by heat transfer from flue gas (casing side) to the water /steam flowing inside the tubes. Flue gas then enters the stack and it is exhausted to the atmosphere. Steam turbine with its HP / IP and dual Flow LP stage converts the Heat Energy to Mechanical Energy and the turbine shaft is coupled to the Hydrogen Cooled Generator rotor. The Mechanical Energy is converted to electrical energy at the generator. The Transformers at Step-up the voltage from 15.75 KV to 400 KV and the Steam turbine Generator is connected via the400 KV GIS line breaker to the Electrical grid. The 400 KV GIS is connected to 400 KV AIS and connects the Station to the Electrical grid

2.3.3.2 Gas Turbine Description

The Gas Turbine for the Plant is General Electric (GE) PG 9351(FA) (9FA), equipped with a hydrogen cooled generator. GE Frame 9FA Gas Turbine delivers reliable, highly efficient, power output, while maintaining best-in-class NOx and CO emission levels. It has Dry Low NOx DLN 2+systems that maintain low NOx level by premixing the Fuel and Air prior to combustion.

The axial flow compressor has 18 stages with modulating inlet guide vanes. Interstage air extraction is used for cooling and sealing air for turbine nozzles, wheel spaces, and bearings, and for surge control during start up. The compressor discharge casing contains 13th through17th stage compressor stators and one row of exit guide vanes. It also provides an inner support for the first-stage turbine nozzle assembly and supports the combustion components. In the three-stage turbine section, energy from hot pressurized gas produced by the compressor and combustion section is converted to mechanical energy. The turbine section is comprised of the turbine rotor, turbine shell, exhaust frame, exhaust diffuser, nozzles and diaphragms, stationary shrouds, and aft (number 2) bearing assembly. The combustion systemuses a reverse flow, multi-chamber (can annular) design in which combustion chambers are arranged around the periphery of the compressor discharge casing. The evaporative cooler issued in applications where significant operation occurs in the hot months and where low relative humidity is common. With evaporative cooling, water is added to the inlet air and, as the water evaporates, the air is cooled.

Table 2 5: Gas Turbine Main Parameters

Gas Turbine Make	GE USA
Frame	9FA.03
Combustion	Dry Low NOx DLN 2.0+
Fuel	Natural Gas
Ambient	29 Deg C / 70% RH / 1.0103 bar a
Turbine Exhaust Temperature	610 Deg C at Base Load
Compressor/ Turbine Stage	18 / 3
RPM	3000
Generator Model	GE make Model : 324
Generator	15.75 KV / 50 Hz/ 0.95 PF
Exciter	Static Excitation
Starting	Means Load Commutated Inverter (LCI2100)

The exhaust system arrangement includes the exhaust diffuser and expansion joint. After exiting the last turbine stage, the exhaust gases enter the exhaust diffuser section in which a portion of the dynamic pressure is recovered as the gas expands. The gas then flows axially into the exhaust system. A bypass stack at the exhaust of the Gas Turbine is provided. The construction is steel structure based. The detail of the Gas Turbine Exhaust Gas Composition is given in **Table 2-6.**

Table 2 6: Gas Turbine Exhaust Gas Composition

Gas	Composition (% Molar)
Nitrogen	66-78
Oxygen	10-18
Water Vapor	3-12
Carbon Dioxide	2-5
Argon	0.7-0.9
Pollutants	PPMV
NO_x	25 (DRY @15% O_2)

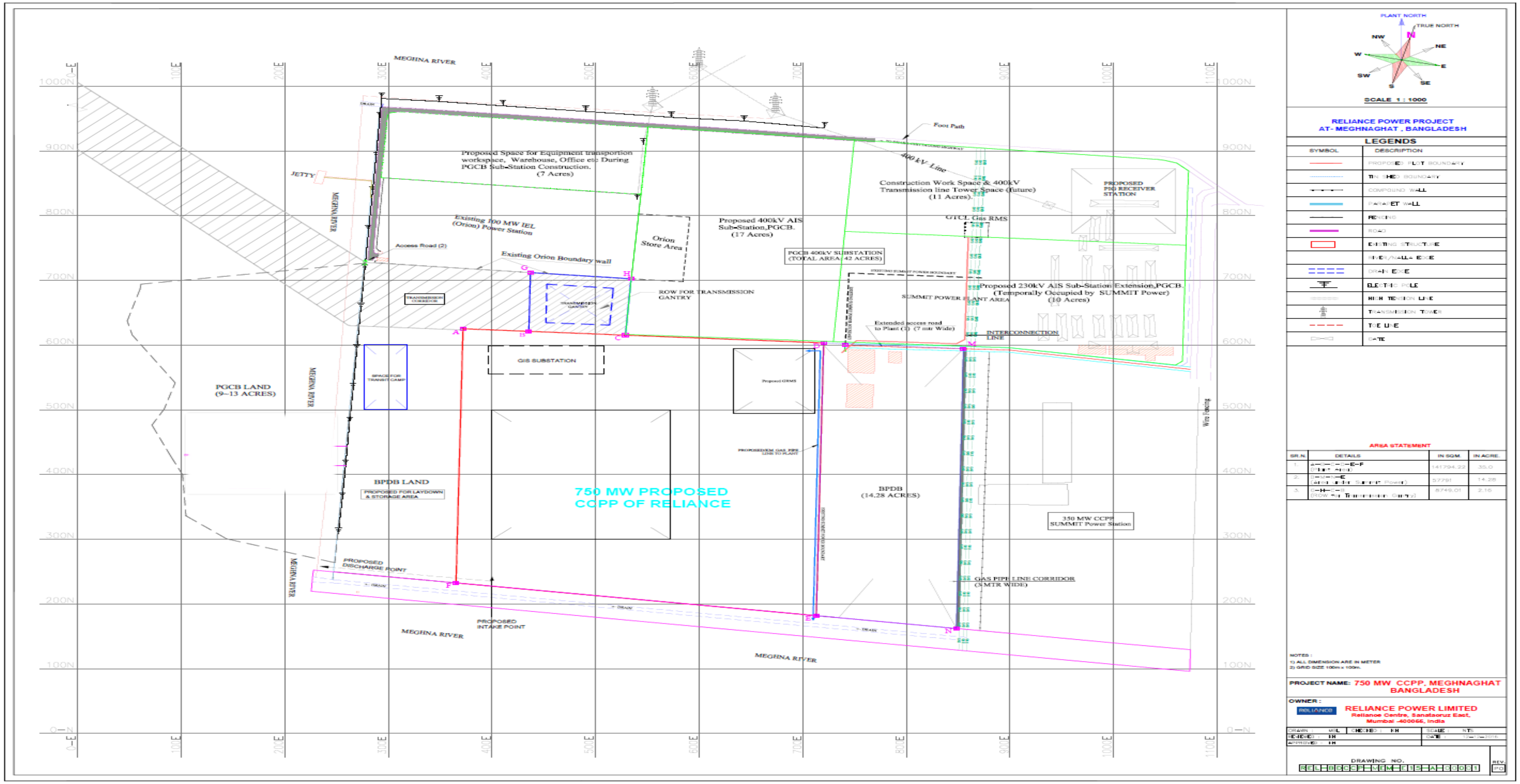


Figure 2.4: Plot Plan of the Proposed Plant

2.3.3.3 Heat Recovery Steam Generator

Gas turbine will be provided with triple pressure, reheat, natural circulation type, unfired, outdoor type heat recovery steam generator (HRSG) located adjacent to the gas turbine. The steam conditions will be suitable for desired net output of combined cycle plant as discussed earlier. Gas flow and pressure will be matching with the exhaust temperature and pressure of the connected gas turbine.

HRSGs will consist of a casing that houses super heaters (HP, IP and LP), evaporators (HP, IP and LP), economizers (HP, IP and LP), reheater sections, mounted steam drums (HP, IP and LP) and internal insulation and lagging. Gas flow leaving the gas turbine passes through diffuser and transition duct to the HRSG where the available energy converts water to superheated steam. The relatively cool gases leaving the HRSG pass through the outlet duct, stack breeching and exhaust stack to the atmosphere. Deaerated feed water enters the HRSG unit via the inlet header in the economizer sections. The economizers, consisting of fin tubes, add heat to the feed water prior to entering the steam drum. Sufficient heat is absorbed in the steam drum to raise the incoming feed water temperature to essentially saturated temperature at the steam drum pressure. Saturated water is drawn from the steam drum by natural circulation to the evaporator sections. The water and steam formed in the evaporators is then returned to the steam drum for separation. It is the function of the super heater to take the saturated steam formed in the drum and raise its temperature level as required to meet the operating conditions. The reheater utilizes the available energy to raise the steam temperature to the level required to meet the operating conditions.

2.3.3.4 Steam Turbine

The steam turbine will receive the steam supply through HP, IP and LP emergency stop valves and governing valves.

The steam turbine shall be two casing design with a single shell, opposed flow combined high (HP) and intermediate pressure (IP) section and a two-flow low pressure(LP) section. The HP and IP sections are on one rotor, supported by two journal bearings, and utilizes impulse staging. The Generator is on the LP end of the turbine. The steam turbine has a down flow exhaust. Single shell construction is used for the combined HP/IP section. The shell is horizontally split with bolted joint flanges, and the diaphragms are directly supported in the outer shell. The HP end is supported by the front standard and the LP section rests on and is keyed to the foundation. The nozzle plate bolted in the shell and diaphragms are centerline supported. The LP section includes a fabricated, carbon steel (similar to ASTM A36) hood with centreline supported carbon steel inner casing. The low pressure diaphragms are centreline supported in the inner casings. Atmospheric relief diaphragms are located on the upper half to prevent over pressurization of the LP section and condenser.

Gas flow leaving the gas turbine passes through diffuser and transition duct to the HRSG where the available energy converts water to superheated steam. The relatively cool gases leaving the HRSG pass through the outlet duct, stack breeching and exhaust stack to the atmosphere.

The salient features of steam turbine are described below:

1	Make	:	GE
2	Model	:	D11
3	Type	:	TC-Down flow
4	Rated Load	:	266520
5	Rated Speed	:	3000 rpm

Steam Parameters

A	HP steam pressure admission	:	119.83 bar
B	HP steam temperature admission	:	565.6 °C
C	HP steam flow admission	:	541.77 t/hr
D	IP steam pressure admission	:	25.242 bar
E	IP steam temperature admission	:	565.6 °C
F	IP steam flow admission	:	613.69 t/hr
G	LP admission pressure	:	4.6912 bar
H	LP admission temperature	:	318.8 °C
I	LP admission flow	:	706.85 t/hr
J	Exhaust pressure	:	0.092354 bar

2.3.3.5 Condenser and Vacuum Equipment

The condenser shall receive exhaust from the steam turbine. The condensate formed shall be extracted from the hot well by condensate extraction pumps. The exhaust steam in the condenser shall be cooled by clarified water with closed recirculation cooling system. Heat rejection for a combined cycle in this project is accomplished by circulating cooling water through the condenser. The condenser air removal system creates and maintains vacuum in the shell side of the main condenser by removing air and non-condensable gases. Non condensable will be removed and condenser vacuum will be maintained using liquid ring vacuum pump.

2.3.4 POWER EVACUATION

At present the spread of 400 kV transmission lines in Bangladesh is limited to only Dhaka region. Part of Dhaka ring is at 400 kV and another 400 kV two double circuit line connects Indian grid substation of Baharampur to Bheramara grid substation of Western Bangladesh which is used for power import from India. The other 400 kV network extends from Meghnaghat – Aminbazar to evacuate power from existing Meghnaghat Power station & reliable power to western part of the Dhaka.

Govt. of Bangladesh shall facilitate firm power evacuation for the Project. For the plant capacity of 750 MW, 400 kV two double circuit lines will be used for the evacuation of power. It is proposed to connect plant substation to the 400 kV lines connecting Aminbazar using a LILO as a temporary measure. Further, it will be connected to PGCB 400 kV AIS at Meghnaghat in future once it is ready. The temporary facility for power evacuation will again be built in the existing land of the BPDB where absolutely no land acquisition is needed and therefore, no resettlement is necessary.

The evacuation of electric power generated by the Facility, will be through the existing 400 kVcircuits connecting nearby 230/132 kV existing substations at Meghnaghat and Aminbazar ownedby PGCB. The connection to the Facility will be though LILO (230 KV to be Upgraded to 400KV).The Company shall construct and own 400 kV switchyard for evacuation of power. The switchyard, line breaker, current transformer, potential transformer and other necessary equipment and associated relays, controls, protection, communication and instrument system willbe operated and maintained by the Company. Once the Meghnaghat 400 kV substation is in place and operation, the connection to the Facilitywill be at Meghnaghat 400kV switchyard. The power evacuation line and the facilities at theremote end (PGCB Substation) shall be constructed, owned and operated by PGCB. TheCompany shall build a 400 kV connecting lines (U/G or O/H) from the Facility's switchyard to the upcoming Meghnaghat 400 kV switchyard and extend required no’s of 400 kV bays for connection. Length of the Transmission Line from the power generating facility to the LILO point is 567+Mts. This is an Industrial Zone and no community’s nearby.The power evacuation plan has been shown in **Figure 2-5.**

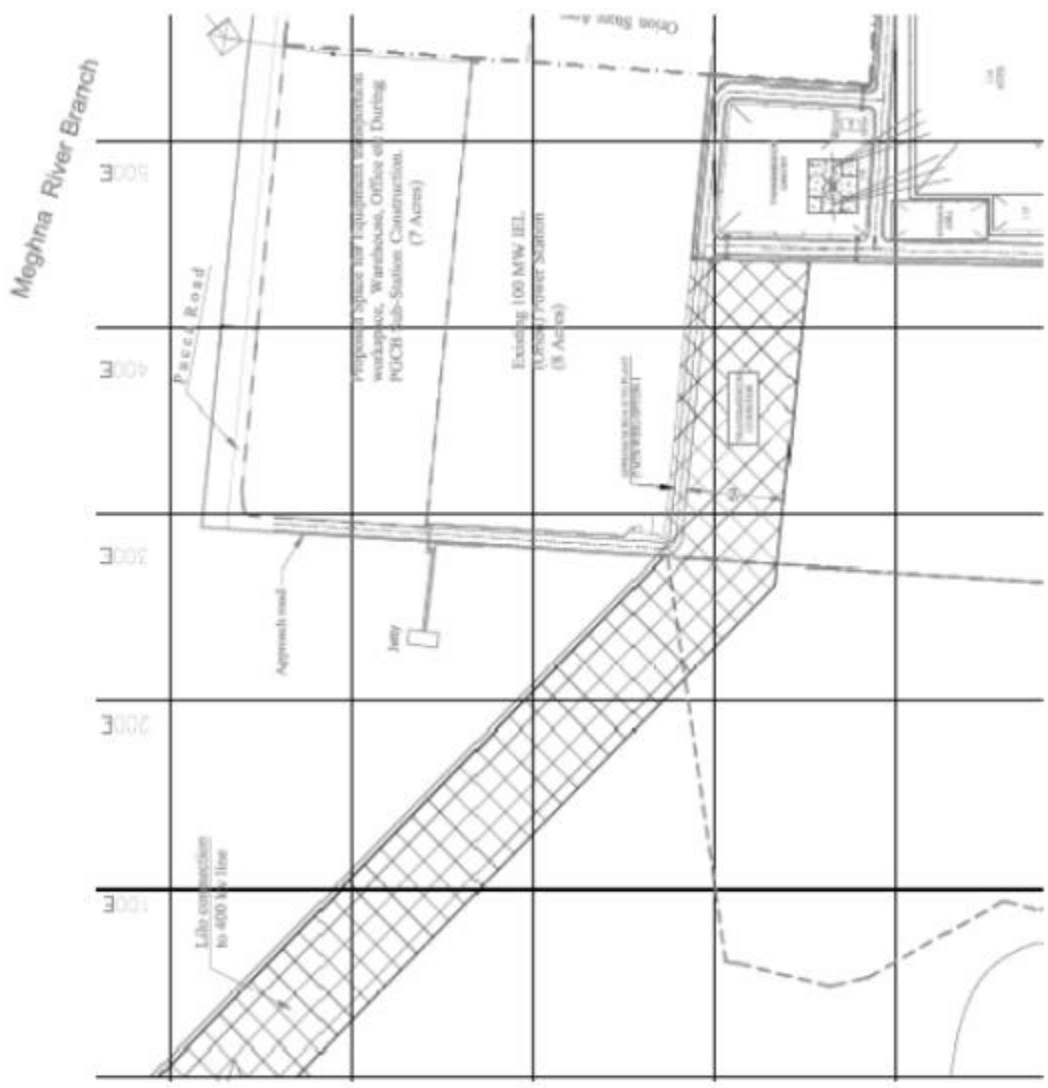


Figure 2.5: Transmission Line Network from GIS to LILO Point

2.4 INFRASTRUCTURE REQUIREMENTS

2.4.1 Land

About 35 acres of land is available for the proposed plant. The plot is slightly irregular in shape but power block and switchyard facilities can be accommodated for siting of the proposed CCPP. The proposed project is going to use existing land at Meghnaghat; BPDB has agreed to lease the land to the developer at Meghnaghat site for setting up of the Project. The proposed site has no homesteads land. The adjacent land has been formerly used for various power plants.

2.4.1.1 Land for the LILO Facility

National Survey Organization has conducted survey on the location for suitable LILO attachment facility and proposed Three Transmission Towers. The temporary facility for LILO attachment will be built in the existing Govt. land where absolutely no land acquisition is needed and therefore, no resettlement is necessary. But local people use the land for one crop cultivation. If those lands are used, they need to be paid for the crop 2-3 times from market price.

The coordinate of the proposed towers and their distances from the transmission gantry is given below:

Table 2.7: Coordinate of the proposed towers and their distances from the transmission gantry

Tower Name & Location	Co-ordinate	Distance from Transmission Gantry
Tower I	X= 254173.03 Y= 2613146.07	203 m
Tower II	X= 253658.45 Y= 2613275.80	733 m
Tower III	X= 253353.46 Y= 2613161.05	1058 m

The alignment and details of the tower has been given in Figure 2-6.

2.4.2 Fuel

The fuel proposed for this project is primarily Natural gas and RLNG, since advanced class machines are adopted for reliable and efficient operation. The gas requirement for 750 MWCCPP is about 130 mmscfd at 100% load & 110 mmscfd at 85% load respectively. In Bangladesh, natural gas is the most important indigenous source of energy that accounts for 73% of the commercial energy of the country. The gas quality analysis is enclosed wherein there is no sulphur and 85% is methane. The existing natural gas is mainly used in electricity, fertilizer, industry, transport and housing sectors.

The proposed power plant will be run by natural gas which will be supplied by a GTCL national gas pipeline coming from Kutumbpur, Comilla. On the other hand Reliance Power is working to set up a LNG terminal where they will supply gas to national grid through 36 inch Gas Pipeline from Kutubdia to Napura at GTCL national gas grid. Anew pipeline will be built by GTCL to deliver gas from Kutumbpur, Comilla to the site, RBLPL shall construct a pipleline of ~400mts length as a part of its project activity from it's noundary over the land of existing BPDP land to get the supply connected. The route of pipeline, once confirmed from GTCL / BPDP, shall be depicted over layout for clear understanding of the alignment of and updated in to updated ESIA along with two season data. The pipeline project of GTCL is considered as an associated facility of the project.

Gas Specification:

1. **Chemical Composition of Gas to be delivered to the Facility**

Constituent	Minimum Percent by Volume	Maximum Percent by Volume
Methane (CH_4)	85.0	100.00
Ethane (C_2H_6)	0	6.00
Propane (C_3H_8)	0	5.00
Butane (C_3H_8)	0	3.00
Pentane (C_5H_{12}) and higher	0	2.00
Hydrogen Sulphide (H_2S)	0	0
Carbon dioxide (CO_2)	0	2.00
Nitrogen	0	3.00
Oxygen (O_2)	0	1.0
Inert (the total combined Nitrogen, Oxygen, Carbon dioxide and any other inert compound)	0	5.00

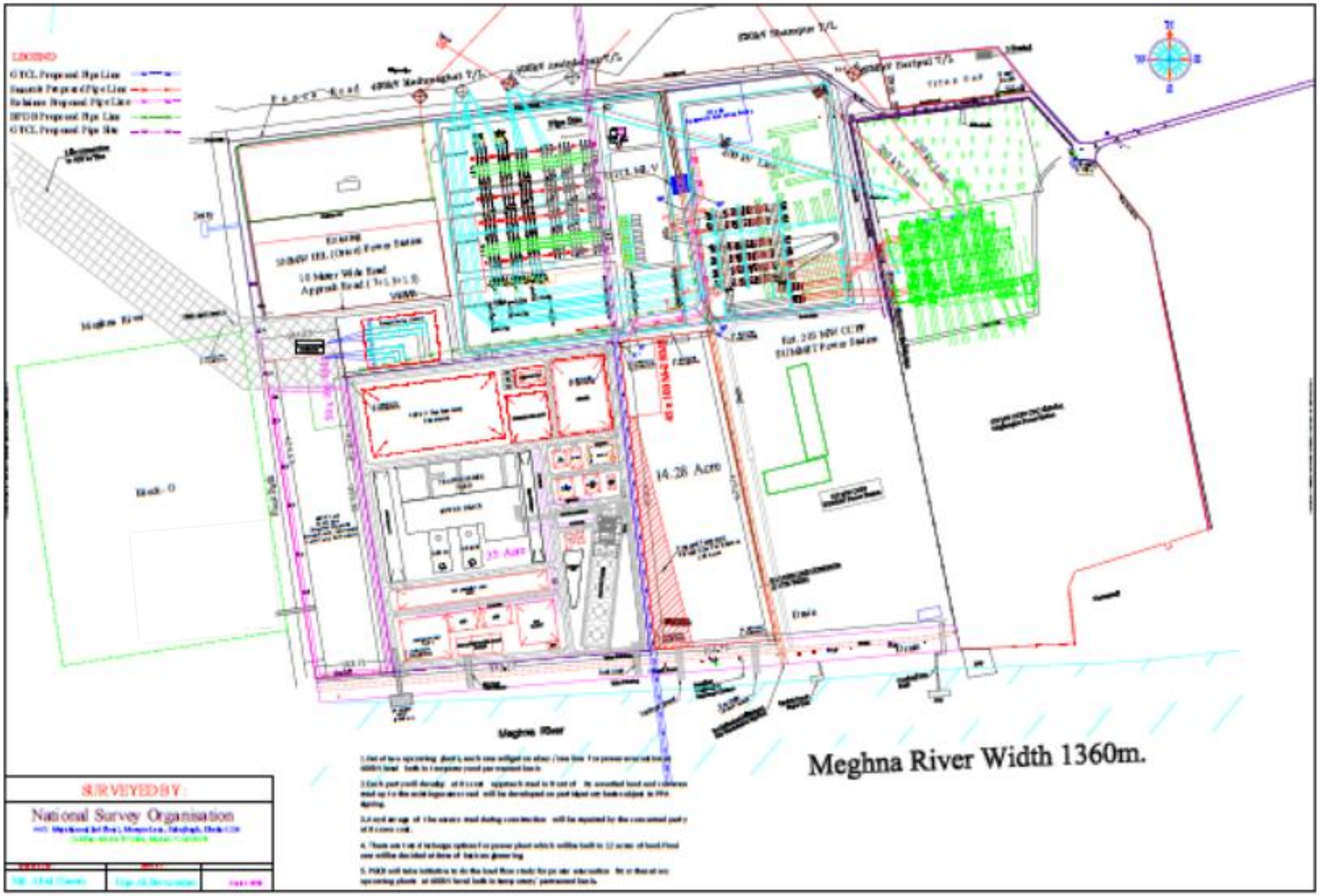


Figure 2.6: Alignment Details of the Transmission Line

2.4.3 Water

It was calculated that about 1076 cubic meters of water per hour flow is required as the makeup water for the close circuit cooling system and other uses. Major source of water required in the CCPP are:

i. Cooling water for steam condenser is the part of heat sink for the thermodynamic cycle. This system in a power station is the largest consumer of water.
ii. Cooling water for STG and HRSG auxiliaries, compressors, A.C. System etc.
iii. Cooling of Gas Turbine auxiliary equipment.
iv. Make-up water for power cycle (HRSG make-up).
v. Other auxiliaries like service and make up water.

The water requirement calculation is detailed in **Table 2.8.**

Table 2 8: Water Requirement Calculation

Sl. No.	Parameter	Value (m^3/hr)
1	Water Consumptive Requirement for cooling	990
2	Demineralized water	25
3	Service Water	40
4	Plant Potable	10
5	Others	33
	Total	**1098**

The fresh water requirement envisaged for the project is around 1076 cum/hr with closed cooling water system.The source of water for the project site is Meghna River which is considered to be perennial. The project area is located right along the bank of the river upper Meghna. The upper Meghna river basin is one of the rainiest regions in the world and has an annual rainfall of up to 5,800 mm. Total catchment area of the Meghna is about 82,000 sqkm of which 47,000sqkm lies in India and 35,000 sqkm lies in Bangladesh. As the location of the plant is at the bank of the river Meghna, so, to fulfil the requirement of the cooling water a new pump station could be constructed at bank of the Meghna River.

As closed loop cooling system with cooling towers will be adopted in this project, major portion of the water will be recirculating for further use by adopting COC 5. About 206 cum/hour of water is expected to discharged from the plant to the river after treatment. The detailed water balance diagram is shown in Figure 2-7.

2.4.3.1 Circulating Water System

The estimated cooling water requirement for the condenser and auxiliary cooling system is 990 m3/hr. closed cycle recirculating type CW system is envisaged for the CCPP with an adequately sized multicell induced draft cooling tower. Make-up to the cooling tower is 990 m3/hr to compensate for the evaporation loss and blow down requirements.

2.4.3.2 Power Cycle Make-up

The concentration of dissolved solids in the HRSG drum water gradually gets increased due to the evaporation process. To control the 'carry over' by steam, this concentration level has to be maintained by 'blow down' of drum water. Power cycle make-up is mainly for making up the HRSG (20 m3/hr) back wash and others.

2.4.3.3 Service and Potable Water System

For miscellaneous plant services including washing and cleaning needs as well as drinking water requirement of the plant personnel, the water requirement is estimated to be around 10 m3/hr.

2.4.3.4 Fire Protection System

Hydrant fire water protection system covering different plant areas and spray water for the transformers oil tanks and cable galleries are proposed to be met by the dedicated fire protection system comprising a set of fire water pumps installed in the pump house and water requirement will be drawn from the soft water reservoir. The fire protection system will be complete with pipe work, valves, specialties such as hydrants, spray nozzles, detectors, cabling etc.

The sustainability of water source for the project is related to the availability of water in the Meghna River. The available discharge in Meghna River near the project site has beenanalyzed based on the SWAT model developed in a recent study (PKSF, 2014). Based onthe SWAT model results for 1981-2012, dependable flow analysis has been carried out. **Table 2-9** shows the dependable flow amount near the power plant site for 75%, 90% and 95% dependability.

Table 2 9: Available dependable flow in the Meghna River

Dependability	Monthly Average Flow (m^3/s)
75%	90
90%	23
95%	10

The water requirement for the proposed project is 0.305 m3/s which is well covered in 75%, 90% and 95% dependability levels after meeting the existing water use in the area.

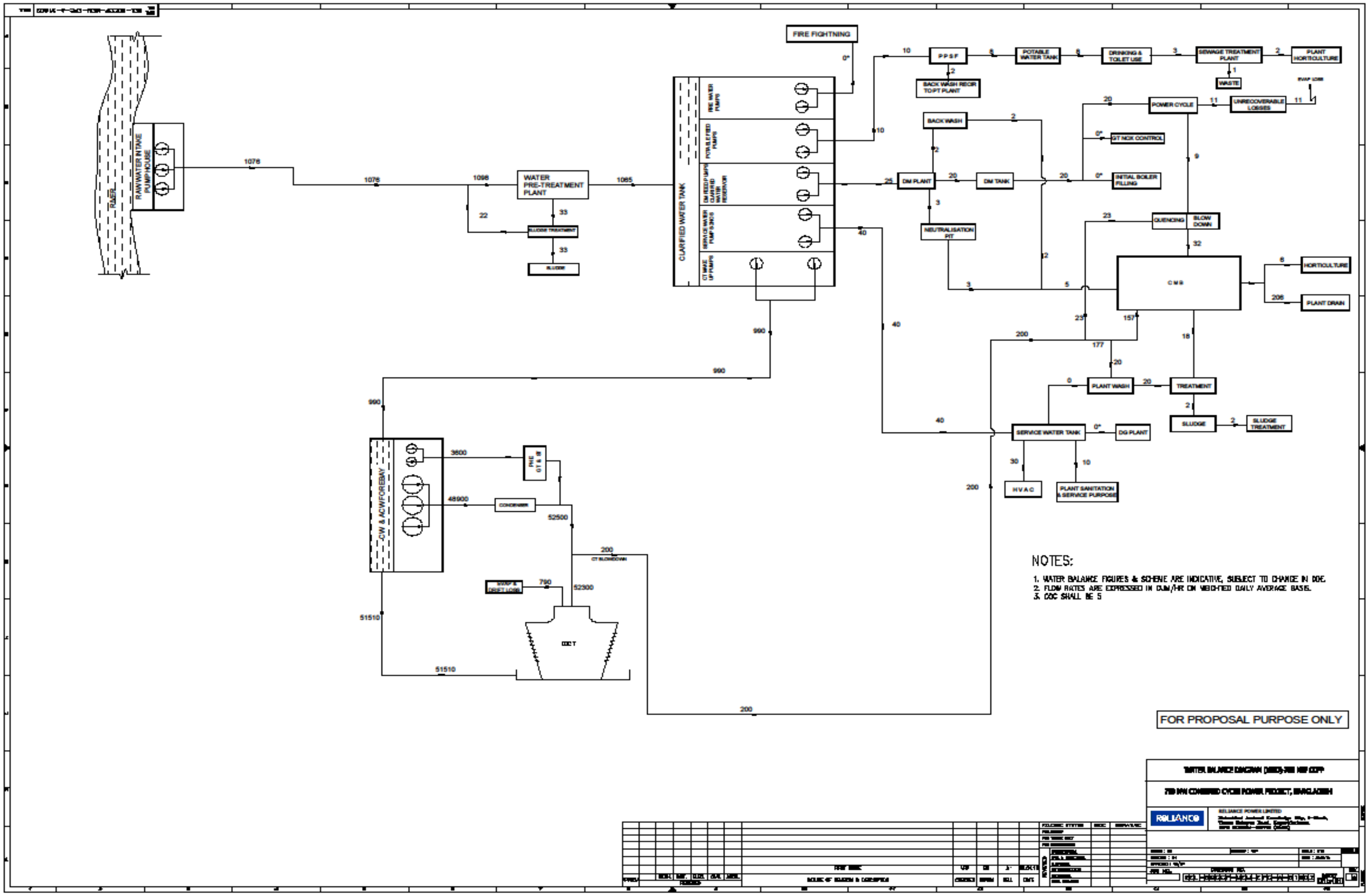


Figure 2.7: Proposed Water Balance Diagram

2.4.4 Outside Plant Boundary Facility: Temporary Jetty

A temporary jetty will be constructed during the construction phase of the project to ensure convenient and efficient transportation of the construction material and the component of the actual power plant. Previously it was planned to construct the proposed temporary jetty on the western bank of the River Meghna or on the southeast corner of the project site which was extending in the main river stream flow area, as per the previously approved EIA of Reliance Meghnaghat 750 MW Combined Cycle Power Plant. As the adjoining land has been allocated to another project by BPDB, the temporary jetty location has been changed from the proposed location to the north-west corner of Meghnaghat Power Hub which is approximately 600 meters from the previous planned location. Now, the proposed temporary jetty will be constructed on the northwest corner of Reliance Meghnaghat 750 MW Combined Cycle Power Plant and it'll be demolished after the completion of the power plant project. This location is far from the main stream flow area of Meghna River and the Environmental and Social impact is much lesser as compared to the previous location.

The total area of the Temporary jetty is 2,250 sq m. Temporary jetty of LOLO 30m x 15m, and RORO 15m X 10m in dimension. Approximately 500 Sqm wooden log Pilling required for shore & Temporary Jetty protection. The approach road os approximately 400m long.

Required river draft for Temporary jetty operation is 3.0m in the main channel and 2.0m near the Temporary Jetty. Highest flood level of the project area is 2.5m. Height of the Temporary Jetty from river bed is 4.0m from river bed. Up to 1.2 m Excavation needed for Temporary jetty construction under river bed and filling needed 2~3m. Location of the proposed temporary Jetty is shown in the **figure (2.8)** below:

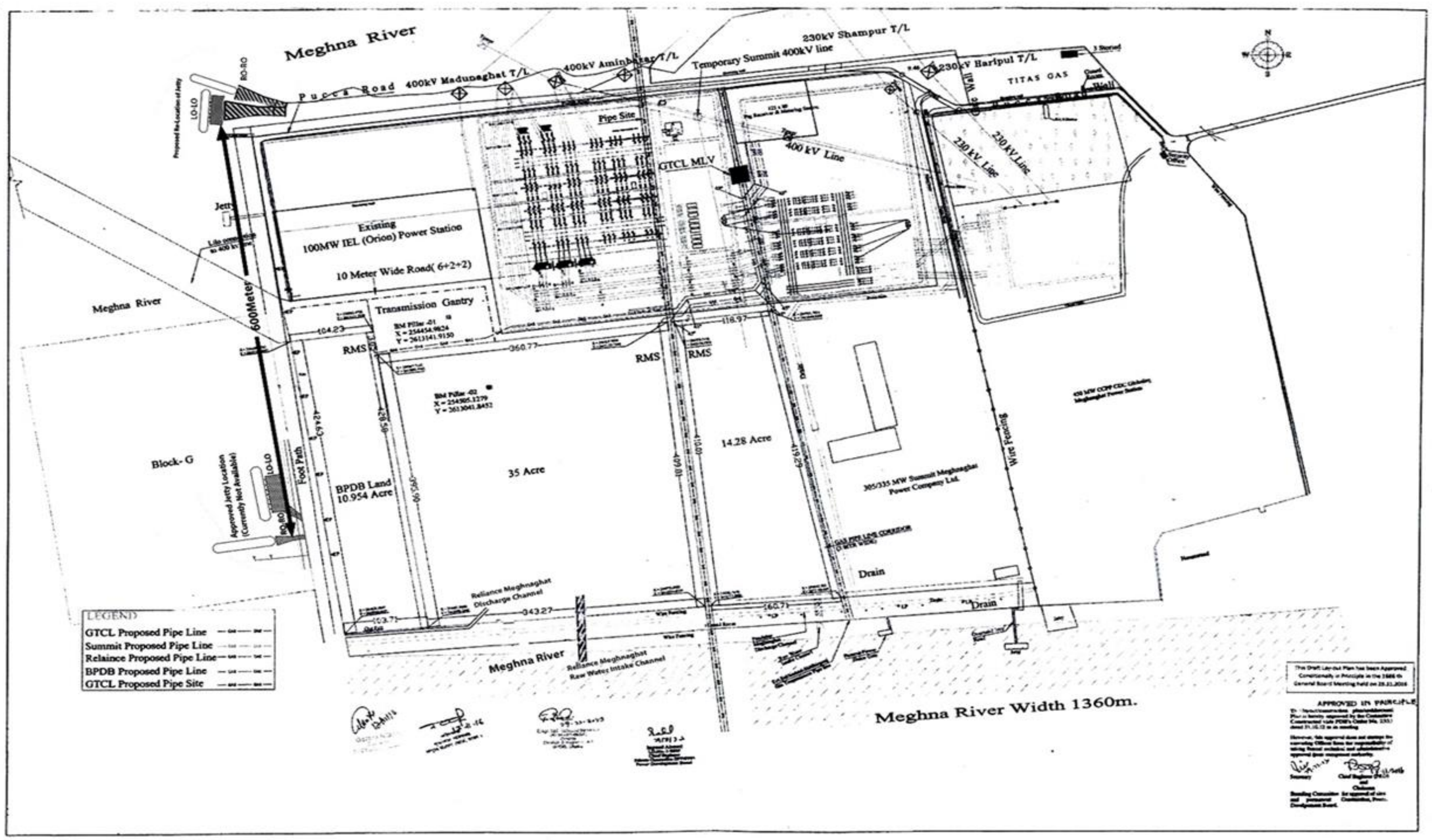


Figure 2.8 Location of the proposed temporary Jetty

2.4.4.1 Dimensions and Construction Materials

The proposed dimension of the temporary jetty is 90 m in length with a walkway of 25m width. The structural diagrams of the temporary jetty are presented in Figure 3.3 (a), 3.3 (b). The construction materials which will be used for construction of the temporary Jetty include cement, steel bars and aggregates.

The structure is a simple retaining wall using 20ft / 40ft containers filled with lean Concrete (1:2:4) bags or some concrete blocks & sandbags with boulder foundation at base. Sal or bamboo Balli piling will be used for the toe protection for the retaining wall and the balli piling will not be done to take any vertical load.

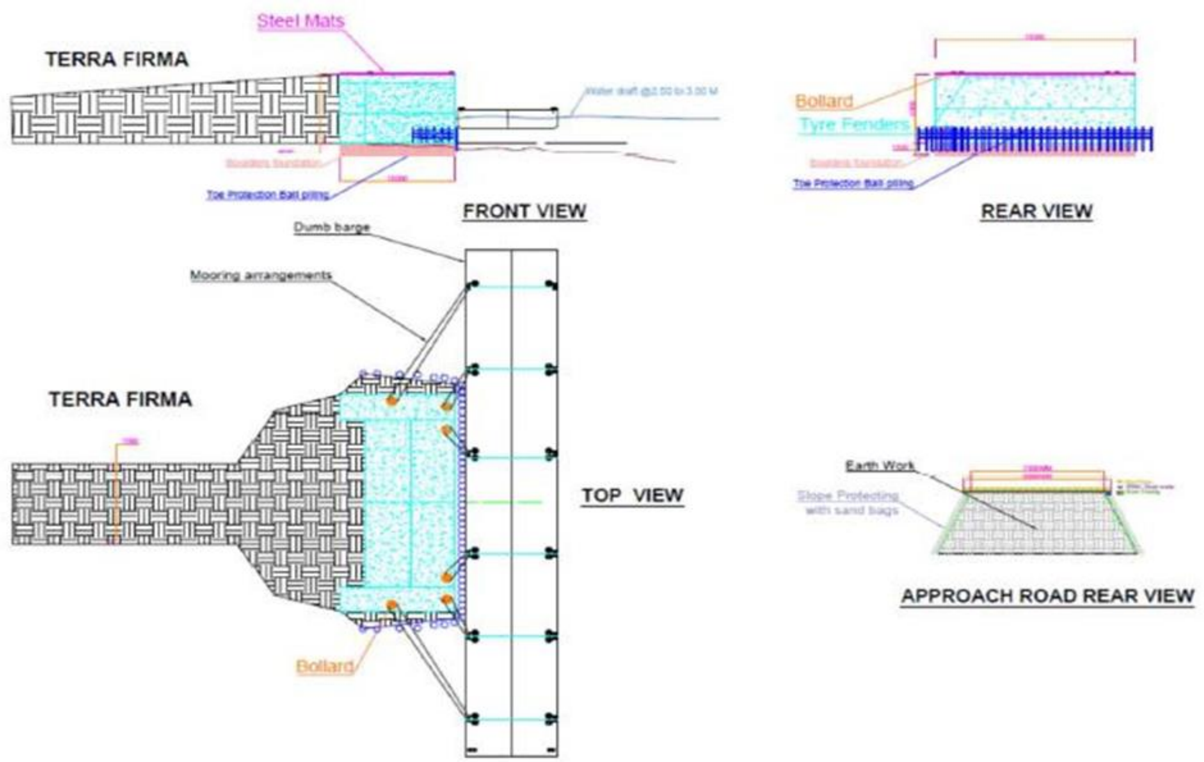


Fig 2.9(a): Temporary Lo Lo Jetty

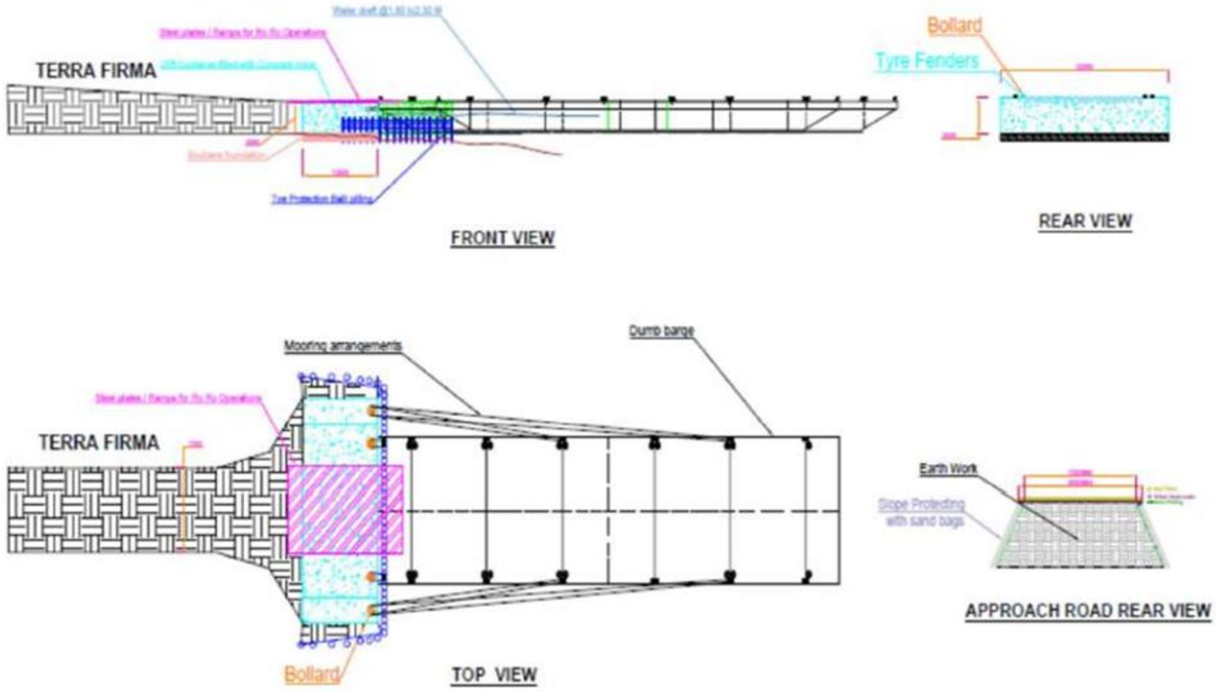


Fig 2.9 (b): Temporary Ro Ro Jetty

Foundation type

Temporary Ro Ro Jetty (For Shallow Foundation)

FOR PIER
Depth of foundation level from bed Level = 3.000 M
Width of foundation base, B = 10.00 M
Length of foundation base, L = 15.00 M

Temporary Lo Lo Jetty (For Shallow Foundation)

FOR PIER
Depth of foundation level from bed Level = 3.000 M
Width of foundation base, B = 15.00 M.
Length of foundation base, L = 30.00 M.

2.4.4.2 Construction methodology of Temporary Jetty

The construction is to facilitate Lo-Lo / Ro-Ro operation of vessel unloading, carrying construction material and plant equipment during the construction period of Reliance Meghnaghat 718MW CCPP PJT is a temporary Jetty head structure is in the form of a retaining wall on the shore at Meghanaghat.

The retaining structure will be constructed by developing required height based on river drafts the riverbank in rigid Soil. Meghana riverbed nature presumed that the Soil Strata is silty sand (ML) with little clay. Bearing capacity corresponding to soil classification is approx. 1.9 to 2.0 Tons per square feet strength. With the proposed load which is arriving at max. 5 to 7 Tons per Square Meter on the retaining structure it is very feasible and safe. Here, it may be noted that the loading is of short-term nature (transient condition during ro ro operations).

The structure is a simple retaining wall using 20ft / 40ft containers filled with lean Concrete (1:2:4) bags or some concrete blocks & sandbags with boulder foundation at base. The sal or bamboo Balli will be used to protect the toe of the retaining wall and the Balli pilling will not be used to take any vertical load.

Considering project cargo weights / proposed loads which will arriving at max. 1.33 Tons per square feet on the retaining structure, it is very much feasible and safe

2.4.4.3 Construction Equipment

Table 2.10: Equipment will be used during the Construction Phase

SL No.	Equipment
1.	Dump truck
2.	Welding and cutter set
3.	Excavator
4.	Pilling Hammer
5.	Pay loaders
6.	Roller
7.	Diesel Generator Set

2.4.4.4 Waste Management

During Construction Phase

During the construction phase, this project will generate small amount of waste that will be reused. The main waste expected to be generated from the project include excavation materials, solid wastes of workers. The dredged and excavated soil will be reused during the construction of temporary jetty. The solid waste generated will be disposed of in a suitable place.

During operation phase

Some waste will be generated during the operation phase due to the influx of workers which is negligible. Proper sanitation system will be provided, proper and safe disposal of human waste will be ensured during the operation period. Other solid waste will be disposed off at the proper location.

2.4.4.5 Power and water

The power required by the project for various construction activities will be obtained from Generator. Specification of Generator is 10 KVA Diesel Generator, 8 KW, Air Cooling, Noise Level (dB) 75 dBA, Voltage 230 V, Frequency 50HZ. A 15m stack height will be used.

Water required for various construction activities will be obtained from water resources available in the Meghna River. Safe drinking water for workers will be provided by Reliance Bangladesh LNG & Power Ltd. No additional well or borehole will be dug to obtain water required for the project.

2.4.4.6 Sensitive Receptor

Sensitive receptor for the current location of the temporary jetty is same as the previous location. The added benefit for the current location is that, this current location is far from the regular navigation channel of Meghna river and this current location is situated near a pocket channel of Meghna river which is a dead channel and no longer used for fishing.

List of sensitive receptors are:

1. Orion Power Meghnaghat ltd.
2. Meghnaghat Power Limited
3. Summit Meghnaghat Company ltd.
4. Meghna Tea Company Ltd.
5. Power Grid Company of Bangladesh
6. Choto Korbanpur
7. Khaser Gao
8. Korbanpur
9. Dudghata
10. Char Shahidnagar

Figure 2.10: Location of Temporary Jetty and surrounding area

Figure 2.11: Navigation Route around the Temporary Jetty area

2.4.4.7 Land Use Pattern

The proposed site for construction of the temporary jetty is located at Meghnaghat, Sonargaon, Narayanganj, Bangladesh. This part of Meghnaghat is mainly used for industrial purpose. There are three large power plants near the project site i.e. Meghnaghat Power Limited, with capacity of 450 MW CCPP, Summit Meghnaghat Power Company Limited (SMPCL) with capacity of 350 MW and Orion Power Meghnaghat Power Plant (OPML) with capacity of 100 MW are situated at the southeast part of the project site. The area of Meghnaghat Power Hub is an isolated area and local people do not come to this place often for every day work. Only the people working here at different factories and offices come to this place. There is permanent Jetty and water discharge channel beside the proposed temporary Jetty location.

The nearest village is situated on the northwest side of the project at apprx. 300m distance on the opposite side of the Meghna River. They have different approach road for their regular use and normally they don’t use the access roas inside the Meghnaghat power hub.

The proposed jetty operations have been proposed at a considerable distance from the fishing hamlet. Shahid nagor & Char Balaki village is in the south-west direction of the project and apprx 1.5 km and 2km away from the Temporary Jetty location respectively. During Public consultation we found that most of the fishermen lives in these char areas.

2.4.4.8 Lifetime of the Temporary Jetty

The expected construction work duration of the temporary jetty is 3 months and it will be under operation for 24 months for the constructional work of the Reliance Meghnaghat 750MW CCPP project. After the completion of the constructional work of the Power plant the Temporary Jetty will be demolished.

2.5 POLLUTION CONTROL

2.5.1 Air Emission

The natural gas R-LNG do not contain any significant sulphur, therefore the plant does not warrant a tall chimney. The proposed height of the stacks will be 70 m above ground level as per DoE minimum height requirement.

The gas turbines will produce oxides of nitrogen (NOx) during combustion with natural gas / R-LNG firing. However, it is possible to reduce NOx emission by using dry low NOx burners. The plant will be designed to have NOx emissions not more than 25 ppm {(v/v), at 15% excess oxygen} which well below the prescribed norms of ministry of Environment and Forests for combined cycle plants of capacity more than 400 MW using natural gas/R-LNG as fuel.

Heat recovery steam generator (HRSG) will be utilizing about 80% of the heat content in the exhaust gases in producing steam for use in the steam turbine. Heat emission from the stack into atmosphere will not cause any significant increase in ambient temperature. According to

EHS guidelines,the stack height for all point sources of emissions, whether 'significant' or not, should be designed according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts".

As per the above since the clean fuel is used where in the SO2 emissions are Zero, We need to maintain minimum 30mt of Stack Height. However based on Annex. 1.1.3- Good international Industry Practice (GIIP) Stack Height (Based on United States 40 CFR, part 51.100 (). HG= H + 1.5L; where HG = GEP stack height measured from the ground level elevation at the base of the stak, H = Height of nearby structure (s) above the base of the stak. L = lesser dimension, height (h) or width (w), of nearby structures ("Nearby structures" =Structures withon/touching a radius of 5L but less than 800 m.) the below calculation is accrued out to determine Stack Height to be at 70 mtrs. The stack and emission details are provided in **Table 2-11.**

(The nearest stack height of the neighborhoos power station (Summit Meghnaghat Power Limited) understood to be 50 mts. And L = 6.25 mts, thus HG = H+1.5 (6.25 Dia of Stack) comes to H= 68.73 mts. Say, 70 mts.)

Table 2 11: Stack and Emissions

Parameter	Unit	Value
Stack Height	meter (m)	70
Diameter	m	6.3
Exit Gas Velocity	m/s	25
Exhaust Flow rate	m^3/s	615
Emission per Stack		
NO_x	ppm g/s	25 31.37

2.5.2 Noise Control

Noise generating equipment will be designed to limit the noise level of 70 dB (A) which will be maintained at 120 m from the main plant building.Noise generating sources and their abatement measures are provided in **Table 2-12.**

Table 2 .12: Noise Generating Sources and Abatement Measures

Source	Abatement Measures
Turbine Hall & Boiler House	Sound absorbing materials will be provided and sound

Source	Abatement Measures
	transmissions loss of wall and roof will be improved.
Fans	Mufflers will be provided
Leaks	Will be controlled by improved maintenance
Electric Motor	Installation of ventilation inlet and/or discharge muffler.

2.5.3 Effluent Characteristics, Treatment and Discharge

The plant will generate effluents from various systems. These include HRSG blow down, demineralization waste, cooling tower blow down and sanitary waste.

The wastewaters including cooling tower blow down will be discharged after complying with DoE stipulated discharge norms.

Cooling water Blow down and waste water does not contain any heavy metals such as Zn, Cr. Cooling system waste water treatment technology and methodology is pH adjustment by dosing Sulphuric Acid; Disinfection by the dozing of Chlorine and Environment Friendly commodity chemicals which does not have any heavy metals for avoiding the corrosion and scaling.

Salient characteristics of HRSG blow down water are: pH in the range of 9.5 to 10.3, negligible suspended solids and temperature of blow down water at about 1000C. The HRSG blow down water will be collected with other wastewaters in a common basin.

The DM plant effluent will be neutralized to safe and desirable pH value prior to discharge to a central monitoring basin.

Effluents from plant wash will betreated in ETP and will be taken to central monitoring basin.The capacity of the ETP would be around 20 m3/hour.

All floor drains and storm water drains will be routed to adequately sized storm water sump i.e. 24 hours holding capacity.

It has been estimated that about 212 m3/hour of waste water will be generated from different sections. All liquid effluents emerging out of the power plant from different sections shall be collected in central monitoring basin.About 6 m3/hour waste water will be treated in horticulture and rest i.e. 206 m3/hour will be discharged to plant drain.

The treated effluents shall also meet quality requirements mentioned in Ministry of Environment and Forests Gazette Notifications as well as IFC standards. All the waste water generated at the various sources will be collected at one point, as far as practicable and technically viable, before treatment and then treated to meet the statutory requirements. Treated effluents are equalized in Guard pond before reuse and recycling within the plant. Excess treated and equalized effluent will be disposed through plant's effluent outfall. This discharge will thus meet the permissible standards.

Table 2.13: Treated Water Quality

Parameters	Treated Water Quality
pH	6.0 – 9.0
Suspended solids	: <50 mg/l
Oil and grease	: <10 mg/
Ambient Temperature of Discharge water	Delta 3 ^{0}C of the ambient receiving water temperature in any season

The Effluent Treatment Plant conceived will handle effluent from the following facilities-

- Neutralized waste from DM plant
- Cooling tower blow down
- Boiler blow down
- Waste water from the plant wash

Neutralized waste from DM Plant, cooling tower blow down and Boiler blow down do not need any treatment except only dilution and retention of effluent in CMB is envisaged before discharging outside the plant boundary

For waste water from the plant wash, Treatment plant is envisaged with suitable capacity before discharging through CMB. The capacity envisaged is 20 cum/hr. The following treatment will be done in the ETP

- Collection tank
- Coagulation & Flocculation
- Solid separation by clarifier
- clean water to CMB
- Sludge thickening
- Sludge dewatering by centrifuge

Sludge generated from Pre Treatment plant shall be treated suitably and solid waste generated shall be disposed outside plant in consultation with local government authorities. The layout plan of the ETP is shown in **Figure 2-12.**

2.5.4 Water treatment Plant

The requirement of raw water for 750 MW CCPP would be 1076 m3/hr which will be pumped from the Meghna River to the plant. Hence raw water pump house/channel will be planned at off take point for the plant. The Meghna river water quality is highlighted in **Table 2.14.**

Table 2 14: Meghna river water quality for design raw water analysis

Sl No	Parameters	Unit	Values

Sl No	Parameters	Unit	Values
1	Aluminium (Al)	ppm	0.27
2	Biochemical Oxygen Demand (BOD)	ppm	5
3	Chemical Oxygen Demand (COD)	ppm	16
4	Chloride (Cl)	ppm	12
5	Colour	Hazen	3.3
6	Fluoride	ppm	<MDL
7	Manganese (Mn)	ppm	0.06
8	Nitrogen (Nitrate)	ppm	5
9	Nitrogen (Nitrite)	ppm	<MDL
10	pH	ppm	7.8
11	Phosphate	ppm	0.37
12	Potassium (K)	ppm	5
13	Sodium (Na)	ppm	20
14	Sulphate	ppm	2
15	Total Suspended Solid (TSS)	ppm	8
16	Turbidity	NTU	25*
17	Ammonia	ppm	0.6
18	Total Organic Carbon (TOC)	ppm	3.2
19	M – Alkalinity	ppm	35
20	P – Alkalinity	ppm	0
21	Ca - Hardness (as CaCO3)	ppm	20
22	Mg - Hardness (as CaCO3)	ppm	15
23	Iron (Fe)	ppm	0.6
24	Ferrous Iron (Fe2+)	ppm	0.01
27	Free Chlorine (Cl2)	ppm	0.03
28	Silica (SiO2), reactive	ppm	11
29	Silica (SiO2), colloidal	ppm	3.5

The scheme to be selected for water treatment depends upon the quality of raw water available, required quality of treated water and also economic considerations.

The Raw Water Treatment Plant needs to produce water of a quality that satisfies the requirements of suitable feed water to Secondary Treatment Systems. The required design quality of treated water from the Raw Water Treatment Plant is mentioned as below.

Table 2.15: Required design quality of treated water from the Raw Water Treatment Plant

Iron	:	Less than 0.3 ppm.
Turbidity	:	Less than 10 NTU at rated capacity of Clariflocculator and less than 15 NTU at 20% overloading condition
Organic matter	:	Less than 0.05 ppm

Pre-treatment plant shall be designed considering 500 NTU as inlet raw water turbidity. There are several treatment options in the plant to treat the raw water as per the requirement and consumption. The water first passes through clarification plant in which solid particles will be separated by coagulation and clarification. The proposed treatment plant envisages the aeration of raw water & for removal of organic matter, chlorination of raw water is envisaged. Clarification by tubesettler type Clarifier is established technique for removal of suspended solids from raw water and the same is envisaged in Raw Water Treatment Plant. To optimize the consumption of coagulant and to increase the efficiency of TSS removal, suitable provision for addition of coagulant aid shall also be provided in the Raw Water Treatment Plant. Around 990 cu.m/hour water will flow to close loop condensate cooling system as make up water.

Around 25 m3/hour water will be carried to DM plant to receive polish water to feed those to different precision cooling system in generator and NOx injection.

2.5.5 Cooling Water System Detail

Heat rejection for a combined cycle in this project is accomplished by circulating cooling water through the condenser. The circulating cooling water system envisaged for the plant is re-circulating type system with cooling towers. For the re-circulating type CW system, the clarified water will be pumped by CW Makeup pumps to the cold water channel. Water from cold water channel will enter the CW pump house through bar screens/trash racks at low velocity to filter out debris. Stop log Gates will be provided after the screens to facilitate the maintenance. For carrying circulating water from CW pump house to TG area and from TG area to cooling tower, steel lined concrete duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes shall be used. Induced Draft Cooling Tower for the module is envisaged. Cooling tower shall be with FRP Frame, PVC tower fill, fill supports, air inlet louvers, drift eliminators etc.

2.6 PROJECT SCHEDULE

2.6.1 Pre-Construction Period

The pre-construction period started with the principle approval from the GOB on March 27, 2016. The pre-construction period will be completed with the completion of site clearance which will indicate the end of all bureaucratic procedure.

2.6.2 Construction Period

The construction period will start in 1st November, 2017. The mechanical erection is expected to be started on 5th March, 2018. The construction period is expected to be finished by 30th April, 2019.

2.6.3 Operation Period

The operation period is expected to start after the erection of the plant has been completed and the test generation has been observed to be fully functional. The detail of the project schedule is shown in **Figure 2-13.**

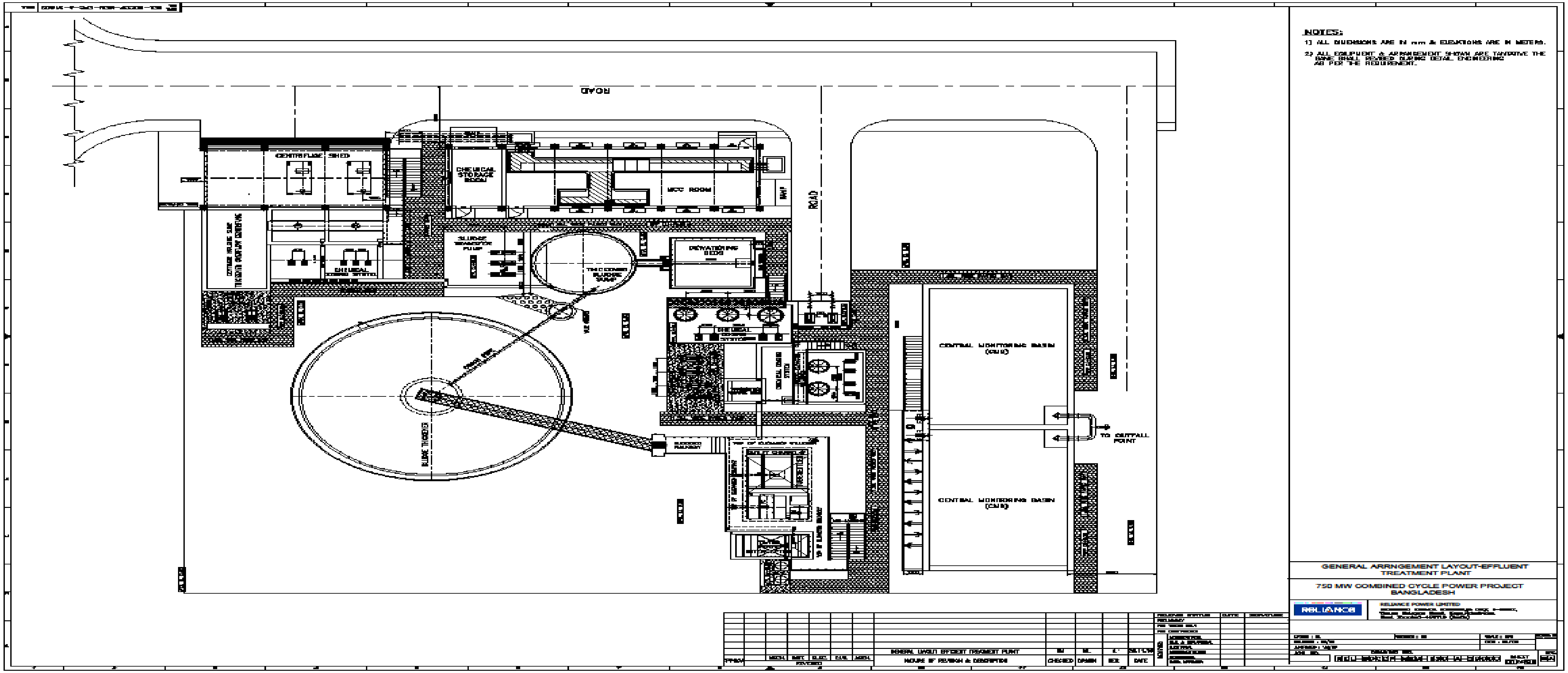


Figure 2.12: Schematic Diagram of ETP

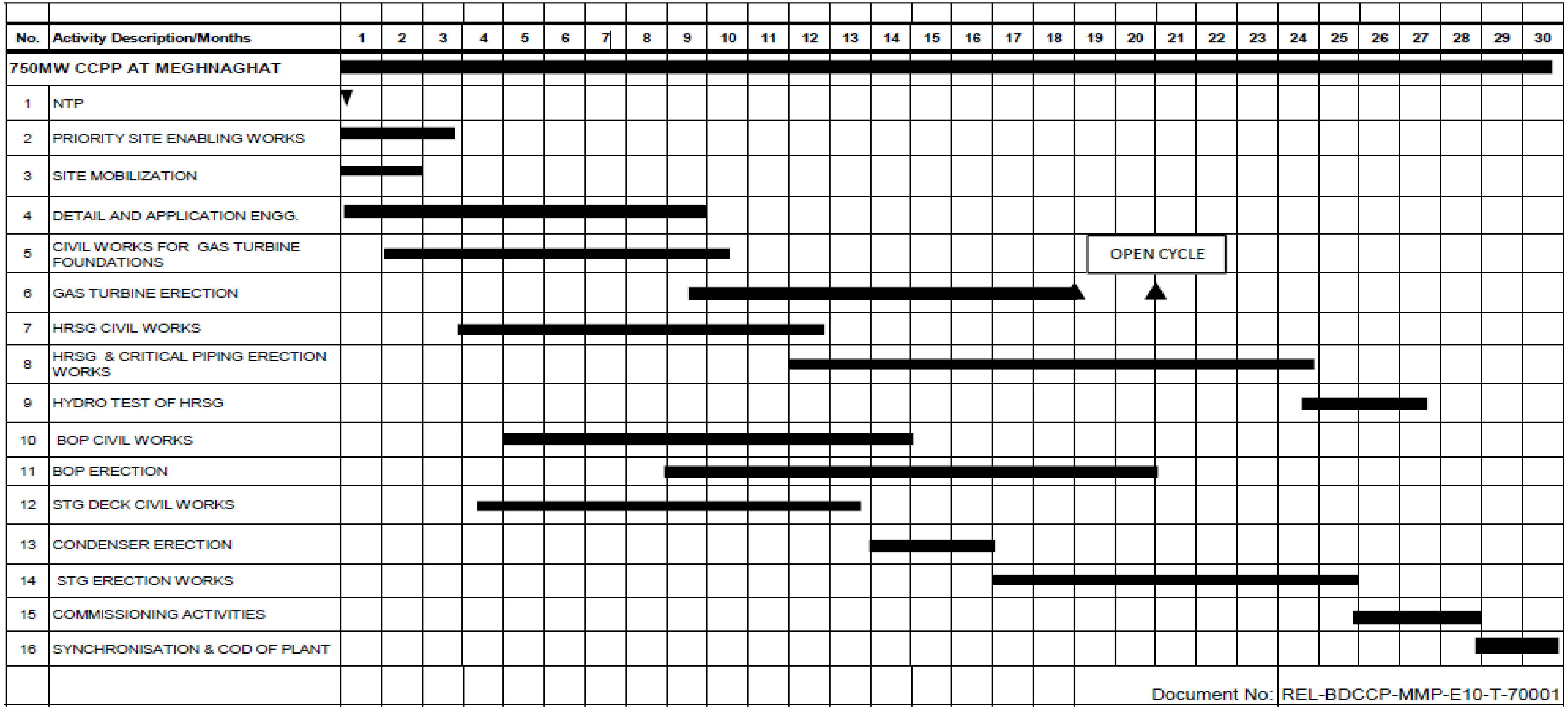


Figure 2.13: Project Schedule

Chapter-3

POLICY AND LEGAL CONSIDERATION

3.1 BACKGROUND

The emerging environmental scenario calls for attention on conservation and judicious use of natural resources. There is a need to integrate the environmental consequences of the development activities and for planning suitable measures in order to ensure sustainable development. The environmental considerations in any developmental process have become necessary for achieving sustainable development. To achieve such goals the basic principles to be adopted are:

- To enhance the quality of environment in and around the project area by adopting proper measures for conservation of natural resources;
- Prevention of adverse environmental and social impact to the maximum possible extent;
- To mitigate the possible adverse environmental and socio-economic impact on the project-affected areas.

The proposed Project is covered under several environmental Policies & legislations pertained with GOB, ADB Safeguard Policy Statement (SPS) 2009. All of the policies or legislation aimed at the conservation and protection of the environment. The existing policies and legislation, which are relevant to the environment, are described in the following sections.

3.2 POLICIES

3.2.1 Industrial Policy 1991

The Industrial policy of 1991 contains the following clauses in respect of environmental protection

- To conserve ecological balance and prevent pollution during industrialization
- To take effective steps for pollution control and conservation of environment during industrialization
- To ensure embodying of necessary pollution control and preventive measures by industrial investment project endangering environment.

3.2.2 National Environmental Policy 1992

Bangladesh National Environmental Policy (GoB, 1992) was approved in May 1992, and sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. Key elements of the policy are:

- Maintenance of the ecological balance and overall progress and development of the country through protection and improvement of the environment.
- Protection of the country against natural disasters.
- Identification the regulation of all types of activities which pollute and degrade the environment.
- Ensuring sustainable utilization of all natural resources.
- Active association with all environmentally-related international initiatives.

Environmental policy contains the following specific objectives with respect to the industrial sector:

- To adopt corrective measures in phases in industries that causes pollution.
- To conduct Environmental Impact Assessments for all new public & private industries.
- To ban the establishment of any industry that produces goods cause environmental pollution, closure of such existing industries in phases and discouragement of the use of such goods through the development and/or introduction of environmentally sound substitutes.
- To ensure sustainable use of raw materials in the industries to prevent their wastage.

3.2.3 National Conservation Strategy

National Conservation Strategy (GoB/IUCN, 1992) was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle; however the final approval of the document is yet to be made by the cabinet. It underwent a number of modifications over the last five years, and is waiting to be placed before the cabinet finally sometime in late September 1997. For sustainable development in industrial sector, the report offered various recommendations; some of those are as follows:

- Industries based on nonrenewable resources should be made to adopt technology which conserves raw materials, and existing industries should be given incentives to install technical fixes to reduce wastage rate.
- All industries, especially those based on imported raw materials, should be subjected to ESIA and adoption of pollution prevention/control technologies should be enforced.
- No hazardous or toxic materials/wastes should be imported for use as raw material.
- Import of appropriate and environmentally sound technology should be ensured.
- Complete dependence on imported technology & machinery for industrial development should gradually be reduced so that industrial development is sustainable with local skills and resources.

3.2.4 National Environmental Management Action Plan (NEMAP), 1995

National Environmental Management Action Plan, also referred to as NEMAP (GoB, 1995) is a wide-ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements during the period 1995 to 2005, and sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented.

NEMAP has the broad objectives of:

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

One of the key elements of NEMAP is that sectoral environmental concerns are identified. In outline, the environmental issues of the industrial sector include the following:

- Pollution arising from various industrial processes and plants throughout the country causing varying degrees of degradation of the receiving environment (Air, Water, and Land).
- There is a general absence of pollution abatement in terms of waste minimization and treatment.
- Low level of environmental awareness amongst industrialists and entrepreneurs.
- Lack of technology, appropriate to efficient use of resources and waste minimization leading to unnecessary pollution loading in the environment.
- Economic constraints on pollution abatement and waste minimization such as the cost of new technology, the competitiveness of labor, and intensive production methods as compared to more modern methods.
- Concentration of industry and hence pollution in specific areas which exacerbate localized environmental degradation and exceed the carrying capacity of the receiving bodies.
- Unplanned industrial development has resulted in several industries located within or close to residential areas, which adversely affects human health and quality of human environment.
- Establishment of industries at the cost of good agricultural lands and in the residential areas.
- Lack of incentives to industrialists to incorporate emission/discharge treatment plant in their industries.

3.3 NATIONAL LEGISLATION

3.3.1 Environment Conservation Act 1995 (ECA 1995)

Formal concern at the national level, for the state of environment in Bangladesh can be traced back to at least Independence and passing of the Water Pollution Control Act in 1973. Under this a small unit was established in the Directorate of Public Health Engineering (DPHE) to monitor pollution of ground water and surface water.

In order to expand the scope of environmental management and to strengthen the powers for achieving it, the Government issued the Environmental Pollution Control Ordinance in 1977. The ordinance provided for the establishment of an Environmental Pollution Control Board, which was charged with formulating policies and proposing measures for their implementation. In 1982, the board was renamed as Department of Environmental Pollution Control (DEPC). Four divisional offices were established in Dhaka, Chittagong, Khulna and Bogra. A special presidential order again renamed the DEPC to the Department of Environment (DOE) and placed under newly formed ministry of Environment and Forest (MoEF) in 1989.

The national environmental legislation known as Environmental Conservation Act, 1995 (ECA'95) is currently the main legislative document relating to environmental protection in Bangladesh, which repealed the earlier environment pollution control ordinance of 1997 and has been promulgated in 1995. The main objectives of ECA’95 are:

- Conservation and improvement of environment, and
- Control and mitigation of pollution of environment.

The main strategies of the act can be summarized as:

- Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas.
- Regulation in respect of vehicles emitting smoke harmful for the environment.
- Environmental clearance.
- Regulation of the industries and other development activities - discharge permit.
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes.
- Promulgation of standard limit for discharging and emitting waste.
- Formulation and declaration of environmental guidelines.

3.3.2 Environment Conservation Rules, 1997 (Subsequent Amendments in 2002 and 2003)

A set of the relevant rules to implement the ECA’ 95 has been promulgated (August 1997). The rules mainly consist of:

- The national Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of pollution activities of the existing or proposed industries/development projects/activities.
- Procedure for obtaining environmental clearance;
- Requirement for undertaking IEE and ESIA as well as formulating EMP according to categories of industries/development projects/activities;
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

The Rules incorporate "inclusion lists" of projects requiring varying degrees of environmental investigation.

Green: Industries/development projects/activities are considered relatively pollution- free and therefore, they do not require an environmental clearance certificate from the DOE and no environmental study.

Orange: Industries/development projects/activities fall into two categories. Orange “A” is less polluted and Orange “B” is moderately polluted required to submit general information, a process flow diagram and schematic diagrams of waste treatment facilities along with their application to DOE for obtaining environmental site clearance and environmental clearance.

Red: Industries/development projects/activities are those which may cause ‘significant adverse’ environmental impacts and are therefore required to submit an ESIA report. It should be noted that they might obtain an environmental site clearance on the basis of an IEE report, and subsequently submit an ESIA report for obtaining environmental clearance along with other necessary papers.

Environmental standards in operation in Bangladesh also Promulgated under the Environment Conservation Rules 1997. There are standards prescribed for varying water sources, ambient air, noise, odor, industrial effluent and emission discharges, vehicular emission etc.

The Bangladesh standards intend to impose restrictions on the volume and concentrations of wastewater/solid waste/gaseous emission etc. discharged into the environment. In addition a number of surrogate pollution parameters like Biochemical Oxygen Demand, or Chemical Oxygen Demand; Total Suspended Solids, etc. are specified in terms of concentration and/or total allowable quality discharged in case of waste water/solid waste. Additionally specific parameters depending on the manufacturing process are specified such as phenol, cyanide, copper, zinc, chromium etc. Air emission quality standards refer mostly to concentration of mass emission of various types of particulate, sulfur dioxide, and oxides of nitrogen and in some cases volatile organic compounds and other substances.

The Bangladesh standards in general are less stringent compared to the developed countries. This is in view to promote and encourage industrialization in the country. The Bangladesh standards are not for any specific period of time. There is no provision for partial compliance too.

The ambient standard of water quality, air quality and noise are presented in Table 3.1 to Table 3.5 in the following page. Standards refer to discharges to freshwater bodies with values in parentheses referring to direct discharges to agricultural land.

Table 3.1: Inland Surface Water Quality Standards for Waste from Industrial Units

Parameters	Unit	Inland Surface Water Quality Standards
Temperature	Centigrade	40
Biological Oxygen Demand (BOD_5) at 20^0 C	mg/l	50
Chemical Oxygen Demand (COD)	mg/l	200
Dissolve Oxygen (DO)	mg/l	4.5-8
Total Dissolved Solids (TDS)	mg/l	2,100
pH		6-9
Suspended Solid (SS)	mg/l	150
Nitrate	mg/l	10.0
Arsenic	mg/l	0.2
Lead	mg/l	0.1
Chloride	mg/l	600
Iron	mg/l	2
Manganese	mg/l	5
Copper	mg/l	0.5
Oil & Grease	mg/l	10

Source: ECR- Schedule 10

Table 3.2: Standards for Drinking Water

Parameters	Unit	DoE (Bangladesh) Standard for drinking water
pH		6.5-8.5
Hardness (as CaCO3)	mg/L	200-500
Iron	mg/L	0.3-1.0
Chloride	mg/L	150-600
Arsenic	mg/L	0.05
Residual chlorine	mg/L	0.2
Total Coliform	n/mL	0
Fecal Coliform	n/mL	0
Ammonia	mg/L	0.5
Nitrate	mg/L	10
Phosphate	mg/L	6

Source: ECR- Schedule 3

Table 3.3: Ambient Air Quality Standards

AIR POLLUTANT	STANDARDS	AVERAGE TIME
1	2	3
Carbon Monoxide (CO)	10 mg/m^3 (9 ppm) (Ka)	8-hour
	40 mg/m^3 (35 ppm) (Ka)	1-hour
Lead (Pb)	0.5 µg/m^3	Annual
Oxides of Nitrogen (NO_x)	100 µg/m^3 (0.053 ppm)	Annual
Suspended Particulate Matter (SPM)	200 µg/m^3	8-hour
PM_{10}	50 µg/m^3 (Kha)	Annual
	150 µg/m^3 (Ga)	24-hour
$PM_{2.5}$	15 µg/m^3	Annual
	65 µg/m^3	24-hour
Ozone (O_3)	235 µg/m^3 (0.12 ppm) (Gha)	1-hour
	157 µg/m^3 (0.08 ppm)	8-hour
Sulfur di Oxide (SO_2)	80 µg/m^3 (0.03 ppm)	Annual
	365 µg/m^3 (0.14 ppm) (Ka)	24-hour

Source: ECR- Schedule 2 (Amended in 2005) Abbreviation: ppm: Parts Per Million
Notes:
(Ka) Not to be exceeded more than once per year
(Kha) Annual average value will be less than or equal to 50 microgram/cubic meter (Ga) Average value of 24 hours will be less or equal to 150 microgram/cubic meter for one day each year.
(Gha) Maximum average value for every one hour each year will be equal or less than 0.12 ppm.

At national level, sensitive areas include national monuments, health resorts, hospitals, archaeological sites and educational establishments.

Table 3.4: Standards for Gaseous Emission from Industries

Parameters for power plant (<200 MW)	Standard present
Oxides of Nitrogen	40 ppm

Source: ECR- Schedule 11

Table 3.5: Ambient Noise Standards

Areas	Day Time dBa	Night Time dBa
Silence Zone: Zone A	50	40
Residential Area: Zone B	55	45
Mixed Activity Area: Zone C	60	50
Commercial Area: Zone D	70	60
Industrial Area	75	70

Source: ECR- Schedule 1 (Amendment in 2006)

The second column of limits values refer to day time (06.00 to 21:00) and the third column to night time (21.00 to 06.00). A silence zone is defined as an area within 100m, around hospitals or educational institutions.

3.4 OTHER LEGISLATIONS

3.4.1 ENVIRONMENTAL REQUIREMENTS OF THE ASIAN DEVELOPMENT BANK (ADB)

The ADB Safeguard Policy Statement 2009 sets out the requirements for ADB's operations to undertake an environmental assessment for projects funded by the bank. The environmental assessment requirements for projects depend on the significance of impacts on the environment by the project. Each proposed project is scrutinized as to its type; location; the sensitivity, scale, nature, and magnitude of its potential environmental impacts; and availability of cost-effective mitigation measures.

A project is classified as one of the environmental categories (A, B, C, or FI).

Category A: A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An ESIA is required.

Category B: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An IEE is required.

Category C: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

Category FI: A proposed project is classified as category FI if it involves investment of ADB funds to or through a FI.

Categorization based on the Most Environmentally Sensitive Component.

Categorization is to be based on the most environmentally sensitive component. This means that if one part of the project is with potential for significant adverse environmental impacts, then project is to be classified as Category A regardless of the potential environmental impact of other aspects of the project. Of course only those aspects of the project with potential for significant adverse environmental impacts need to be assessed in detail. The scoping for the ESIA and the TOR for the ESIA report should focus on the significant environmental issues.

Basic Environmental Assessment Requirements

Category A. ESIA is required to examine the project's potential impacts, and to recommend an environmentally sound project by comparing all possible alternatives. Public consultation must be undertaken at least twice during the ESIA process, once during the early stage of the ESIA field studies and after the draft ESIA report has been prepared. The ESIA should recommend mitigation measures for minimizing the adverse impacts and identify environmental monitoring requirements. The mitigation measures and proposed monitoring are to be incorporated into the EMP. An ESIA report must be prepared following the recommended format in Appendix 2. The SESIA shall be circulated to the Board at least 120 days prior the Board consideration. The ESIA and SESIA are to be made available for public (and published it on ADB's web-site). The Borrower should translate the SESIA into the local language.

Category B. An IEE is required for Category B projects to determine whether or not significant environmental impacts warranting an ESIA are likely. If an ESIA is not needed, the IEE is regarded as the final environmental assessment report. Public consultation must be undertaken during the IEE process. An IEE report is required to follow the recommended format. For Category B projects deemed environmentally sensitive, the SIEE should be submitted to the Board at least 120 days prior to the Board consideration. In addition to the SIEE, IEE will be made available to Board members upon request. The Bank may make the SIEE available to locally affected groups and NGOs, upon request, through the Board Member of the DMC concerned, or through the Bank's Depository Library program, except where confidentiality rules would be violated.

Category C. No ESIA or IEE is required but environmental implications of the project still need to be reviewed and mitigation measures if any should be directly integrated into the project design.

Category FI. Environmental Assessment of the financial intermediation and equity investments is required. A due diligence assessment of the financial intermediary and its environmental management system (EMS) is required, except in the where the subproject involves only small loans with insignificant impacts. In the cases where there will be on lending through credit lines, an environmental assessment and review procedures for subprojects are required. The environmental assessment and review procedures are similar to that for sector loans and the requirements for public involvement, information disclosure, and in some cases, clearances by ADB apply.

3.4.2 ENVIRONMENTAL AND SOCIAL GUIDELINES OF THE INTERNATIONAL FINANCE CORPORATION IFC/WB GROUP

As a member of the World Bank Group, the International Finance Corporation (IFC) has the environmental and social guidelines for projects funded by it following those of the World Bank. The World Bank procedures for EA study cover policies, guidelines and good practices. Such guidelines therefore follow the national best practices in undertaking any development project in Bangladesh. The environment safeguards policies applicable to the proposed project are the following:

- Environmental Assessment (EA) (OP 4.01/BP/GP 4.01): An Environmental Assessment is conducted to ensure that IFC-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any IFC-funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.

- Natural Habitats (OP/BP 4.04): Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under a sector investment or financial intermediary loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical (either legally or proposed to be protected or high ecological value) and non-critical natural habitats. World Bank's interpretation of "significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.

- Forestry (OP/GP 4.36): This policy is triggered by forest sector activities and World Bank sponsored other interventions, which have the potential to impact significantly upon forested areas. The World Bank does not finance commercial logging operations but aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty and encourage economic development.

- Cultural Property (OPN 4.11): Physical cultural resources are defined as movable

Or

immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The Bank seeks to assist countries to manage their physical cultural resources and to avoid or mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

- Policy on Disclosure of Information, 2002: There are disclosure requirements at every part of the project preparation and implementation process. Consultation with affected groups and local community should take place during scoping and before Terms of references (ToRs) are prepared; when the draft EA is prepared; and throughout project implementation as necessary. The Borrower makes the draft EA and any separate EA report available in country in a local language and at a public place accessible to project-affected groups and local community prior to appraisal. Besides, IFC has set out 8 (eight) performance standards in respect of various parameters pertaining to a proposed project. These eight performance standards of IFC with their corresponding parameters as under:

- Performance Standard 1: Social and Environmental Assessment and Management System
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of: (i) integrated assessment to identify the social and environmental impacts, risks and opportunities; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client’s management of social and environmental impacts throughout the life of the project. The rest seven of the performance standards, i.e., Performance Standards 2 through 8 seek to ascertain establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate

Table 3.6: WHO Ambient Air Quality Guidelines

	Averaging Period	Guideline value in $\mu g/m^3$
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Table 3.7: Noise Level Guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

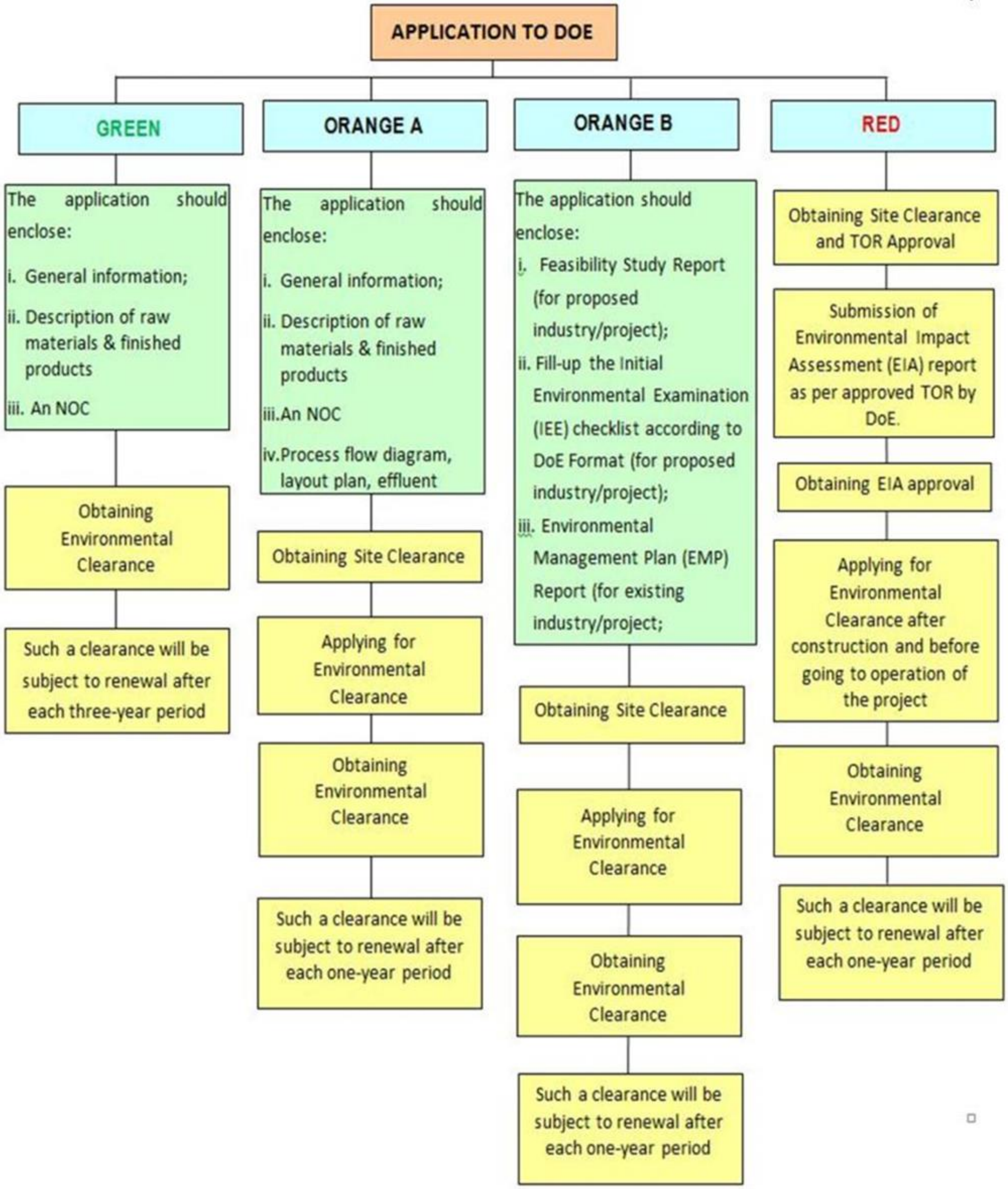
Table 3.8: Emission Guidelines for Combustion Turbines (in mg/Nm3)

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)	Dry Gas, Excess O_2 Content (%)
Combustion Turbine			NDA/DA		NDA/DA	
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%
Fuels other than Natural Gas (Unit > > 50MWth)	50	30	Use of 1% or less S fuel	Use of 0.5% or less S fuel	152 (74 ppm)[a]	15%

3.5 ENVIRONMENTAL CLEARANCE

Formal ESIA guidelines in Bangladesh are set out in “Rules and Regulations under the 1995 Environmental Protection Acts” as published in the official Gazette on August 27, 1997. Any proponent planning an industrial project is currently required under Paragraph 12 of the Environmental Protection Acts, 1995 to obtain “environmental clearance letter:” from the Department of Environment.

The first to obtain environmental clearance is for the project proponent to complete & submit an application form which may be obtained from the appropriate DoE regional offices as per the category. The application is accompanied by other supporting documents (i.e. project profile, lay-out plan, NOC from local authority, Govt fees etc.) reviewed by the divisional and district offices of DOE who has the authority to request supporting documents as applicable. The divisional office has the power to take decision on Green and Amber-A & B category projects and the Red category projects are forwarded to head office for approval. The proposed projects receive an environmental site clearance at the beginning and the environmental clearance subject to the implementation of the project activities and all mitigation measures suggested in the IEE report or in the application. In case of Red category, the client needs to submit an IEE report for site clearance and ESIA to obtain ESIA approval and environmental clearance.


APPLICATION TO DOE
GREEN
ORANGE A
ORANGE B
RED
The application should enclose:
i. General information;
ii. Description of raw materials & finished products
iii. An NOC
Obtaining Environmental Clearance
Such a clearance will be subject to renewal after each three-year period
The application should enclose:
i. General information;
ii. Description of raw materials & finished products
iii.An NOC
iv.Process flow diagram, layout plan, effluent
Obtaining Site Clearance
Applying for Environmental Clearance
Obtaining Environmental Clearance
Such a clearance will be subject to renewal after each one-year period
The application should enclose:
i. Feasibility Study Report (for proposed industry/project);
ii. Fill-up the Initial Environmental Examination (IEE) checklist according to DoE Format (for proposed industry/project);
iii. Environmental Management Plan (EMP) Report (for existing industry/project;
Obtaining Site Clearance
Applying for Environmental Clearance
Obtaining Environmental Clearance
Such a clearance will be subject to renewal after each one-year period
Obtaining Site Clearance and TOR Approval
Submission of Environmental Impact Assessment (EIA) report as per approved TOR by DoE.
Obtaining EIA approval
Applying for Environmental Clearance after construction and before going to operation of the project
Obtaining Environmental Clearance
Such a clearance will be subject to renewal after each one-year period

3.6 POWER SCENARIO AND MASTER PLAN IN BANGLADESH

Power and energy are vital factors that determine the growth path of a developing country like Bangladesh whereas; electricity is the major source of power for country's most of the economic activities. Consistent supply of power and energy can ensure development of the economy. Nonetheless the huge demand supply gap prevailing in the power sector has turned out to be a hurdle for the economic expansion of the nation.

The per capital electricity consumption in Bangladesh remains one of the lowest in the Asian region, At present, only about 47% of the total population of Bangladesh has access to electricity. Even though power has reached many urban areas, approximately 53,000 of the 68,000 villages are connected to power. Further, one million retail electricity connections are pending. The contribution of power sector to GDP ratio has been stagnant around 1.3% for last 5 years with the power generation being increased annually by 2.8% during this period. The majority of power produced in the country is used for commercial purposes. Hence, the electricity supply to households remains delicate which is also a politically sensitive issue. The demand for electricity in the rural areas has experienced significant growth over the years mainly driven by agriculture and small & medium enterprises.

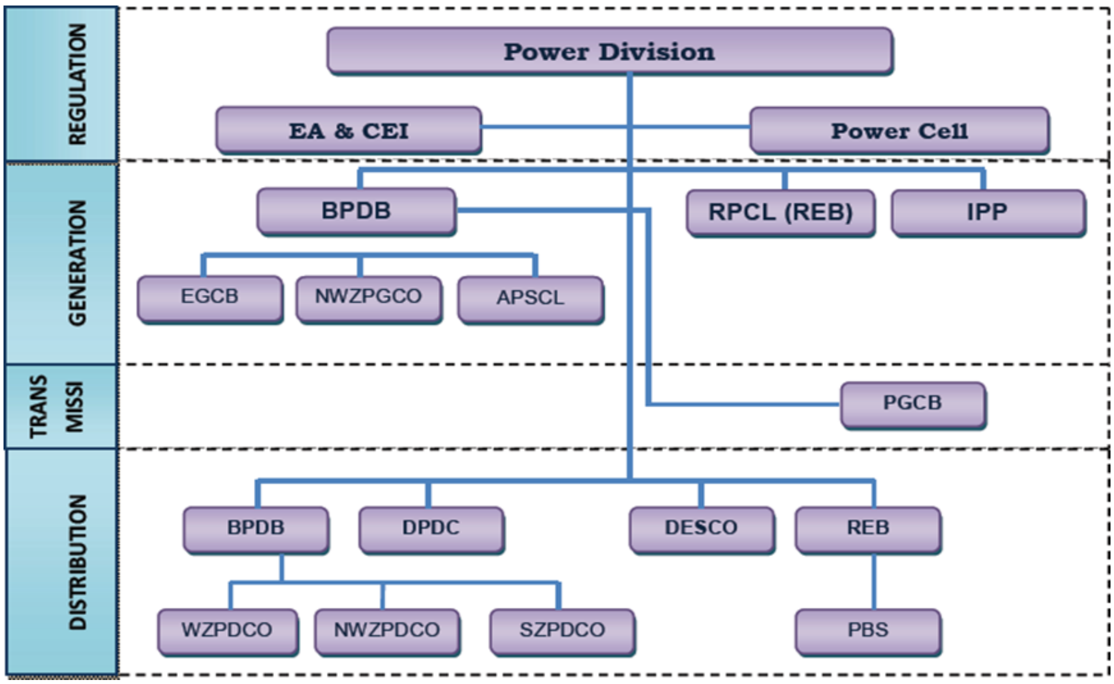
According to Bangladesh Power Development Board (BPDB) presently the installed capacity as on December 2013 in the power sector is 10,213.00 MW, whereas the derated generation capacity is 9,599.00 MW. According to a demand projection analysis, the peak electricity demand is 9,268 MW in 2014, 10,283 MW in 2015 and 11,405 MW in 2016. So, the generation of electricity should be increased for the following years to fulfill the upcoming increasing demands.

Because of the critical nature, the Government of Bangladesh has given highest priority to the power sector to enhance the generation capacity. BPDB has come up with a comprehensive plan to meet the surging demand in power. Accordingly, the government plans to eliminate the demand supply gap and achieve the ultimate goal of providing "electricity to all" by 2021 by having generation capacity of 20,000 MW. To ensure overall and balanced development of the sector government has devised immediate, short term, medium term and long term generation plans. The plans have been developed based on a techno-economic analysis and least cost options.

However, the timely implementation of above plans is a concern as there are issues with regards to availability of finance, competency of project sponsors and inherent bureaucracies and other bottlenecks in the system. Further, the demand estimates for power may also be understated to some extent. Strategies have been made to meet the investment requirement by involving private sector with Government through Public Private Partnership (PPP) initiatives. A successful IPP model has been designed with a lot of comforts and protection to investors.

3.7 INSTITUTIONAL STRUCTURE OF POWER SECTOR IN BANGLADESH

Power Division is responsible for formulating policy relating to power and supervise, control and monitor the developmental activities in the power sector of the country. To implement its mandate, the Power Division is supported by a number of organizations, related with generation, transmission and distribution. The overall organizational structure and linkage is shown below:



Chapter-4

BASELINE EXISTING ENVIRONMENT

4.1 GENERAL CONSIDERATION

Baseline condition of environment states the present status of different components of environment i.e. physical, biological, cultural, economic and social environmental characteristics in absence of the project. Environmental baseline study by examining the existing environment, serves as the basis of the project site against which potential impacts from development activities of the project both during implementation and in operation phases can be compared. Mainly there are two principal objectives in examining and defining the existing environment:

- To recognize potential environmental impacts of the project and enable mitigation measures to be identified.
- To provide a base line against which environmental conditions in the future project may be measured and to document conditions which were either existing or developing before the introduction of the project and not due to the project.

The baseline environmental quality is assessed through field studies within the impact zone for various components of the environment, viz. air, noise, water, and land and socio-economic.

4.2 BOUNDING THE IMPACT AREA

The study area covers the Reliance Meghnaghat CCPP and the immediate surrounding extended area of about 5 km radius, considered as “Area of Influence (AoI)”. The proposed power plant will be located at Meghnaghat, which has been acquired by Bangladesh Power Development board (BPDB) on the river bank of Meghna on Govt khas land. Sonargaon is located on the bank of the Meghna River about 36 kilometers southeast and is connected by highway with Dhaka. There also exists good waterways connection of the site with seaports of Chittagong and Mongla. The project locates in Meghnaghat mauza of Sonargaon Upazila. Dhaka- Chittagong highway is just 1km away from the project area. Primary and Secondary data has been generated and collected for conducting Baseline Study. Primary environment monitoring and secondary data collection were undertaken as detailed in **Table 4-1**. Area of 5 km radius from the project site has been considered as study area for the project, as shown in **Figure 4-1**

Table 4.1: Attributes of Environment Data

S. No.	Attributes	Parameters	Source and Frequency
1.	Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_X , CO , SPM	Twosampleperweekat Six (6)locationsfrom September to December
2.	Meteorology	Wind speed and direction, temperature, relative humidity and rainfall	a] Continuous hourly recording through setting up of site meteorological station; b] Data collected from secondary sources like Meteorological Station.
3.	Water quality	Physical, Chemical and Bacteriological parameters	Once during the study period at 6 locations (for 3 ground water and 3 surface water)
4.	Ecology	Existing terrestrial and aquatic flora and fauna within 10-Km radius circle.	Primary inventory through site survey and secondary data from forest office
5.	Noise levels	Noise levels in dB(A)	Once during study period continuously for 24 hours through field visits at 6 locations
6.	Soil Characteristics	Physical and Chemical parameters	Once at 4 locations during study period
7.	Land use	Existing land use for different categories	Based on BPDB information and satellite imagery
8.	Socio-Economic aspects	Socio-economic and demographic characteristics, worker characteristics	Based on data published in latest census
9.	Hydrology	Drainage area and pattern, nature of streams, aquifer characteristics, recharge and discharge areas	Based on data collected from secondary sources
10	Geology	Geological history	Based on data collected from secondary sources
11	Risk assessment, Disaster Management Plan and Occupational Health and Safety	Identify areas where disaster can occur and identify areas of occupational hazards	Based on assessment

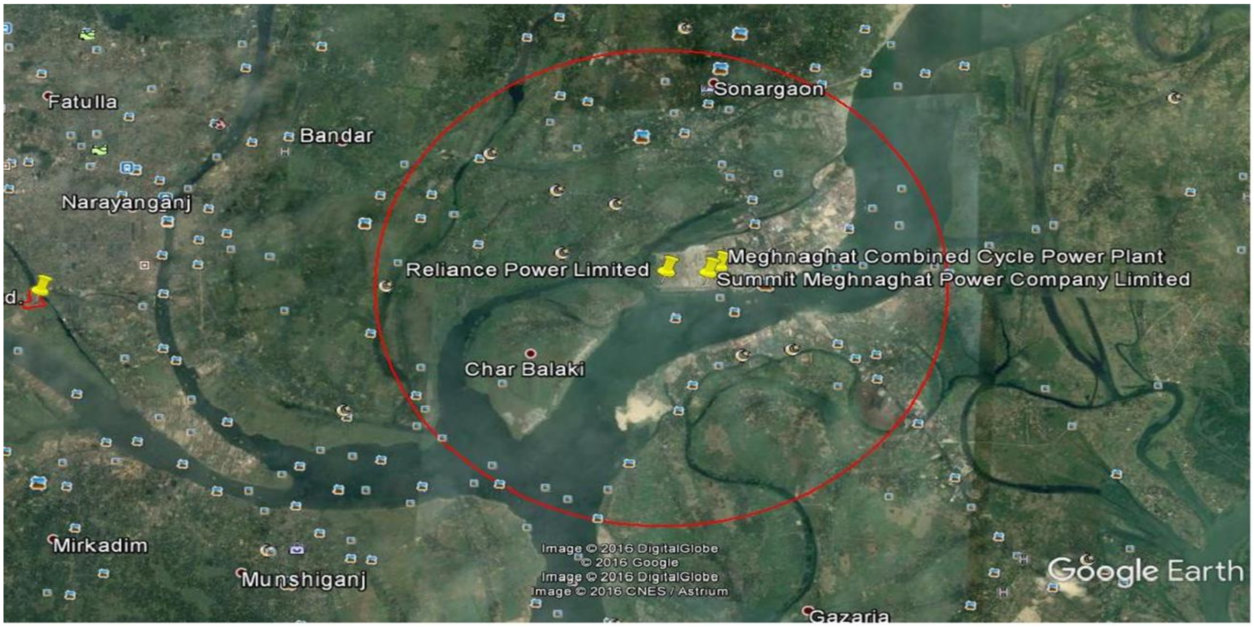


Fig 4.1: Area of Influence (AoI)

4.3 CLIMATE

The climate of this region is tropical, with monsoons, characterized by a change of four seasons: pre-monsoon (March to May), monsoon (June to September), post- monsoon (October to November) and dry season (December to February). High air temperature is observed all throughout the year; daily air temperature variations are insignificant; air humidity is high with abounding rains. Typical parameters of the weather elements, as recorded for the period of last few years of observations at Dhaka Meteorological Station are presented in Table below.

4.3.1 Rainfall

The annual rainfall is about 2347mm and approximately 80% of it occurs during the monsoon. Average monthly rainfall during monsoon period varies between 300mm to 450mm.

The rainfall follows the general climate pattern with the highest rainfall in the summer month of June to September and minimum rainfall in the cooler and drier months of November to March. It is evident that extreme rainfall events occurred during the monsoon (June-September). Average monthly rainfall values for Dhaka (As there is no Meteorological station in Narayanganj) area since 2001 are presented in **Table - 4.2** and shown in **Figure 4-2**

Table - 4.2 Monthly Average Rainfall in the project area (2001- 2015)

Year	Rainfall in mm											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2015	3	17	4	166	185	375	623	395	346	51	0	1
2014	0	12	10	80	147	342	212	391	156	49	0	0
2013	0	8	26	32	378	325	302	212	172	131	0	4
2012	10	1	37	269	137	175	226	282	81	38	68	5
2011	0	0	20	123	235	314	356	409	207	112	0	0
2010	0	48	22	37	177	308	167	340	169	174	0	81
2009	1	1	43	14	168	170	676	482	298	74	4	0
2008	23	56	45	91	205	577	563	319	279	227	0	0
2007	0	30	11	163	185	628	753	505	179	320	0	0
2006	0	0	0	181	185	326	331	167	663	61	5	0
2005	1	3	155	91	291	259	542	361	514	417	3	0
2004	0	0	9	167	162	496	295	191	839	208	0	0
2003	0	25	96	123	140	473	191	202	264	134	0	45
2002	22	4	51	111	272	373	446	272	156	52	36	0
2001	0	1	33	46	402	386	202	205	209	177	18	0

Source: BMD

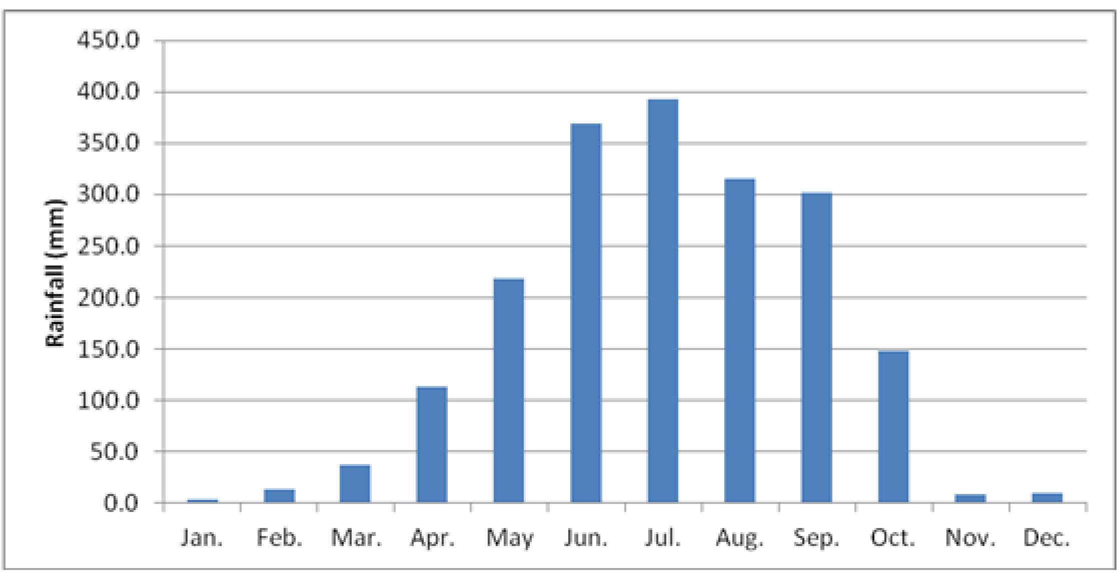


Figure 4.2: Distribution of Average Monthly Rainfall during 2001- 2015

4.3.2 Relative Humidity

As would be expected, relative humidity during the wet season is significantly higher than those occurring at other period of the year. This is well depicted by the data as shown in the **Table - 4.3** for relative humidity of Dhaka (As there is no Meteorological station in Narayanganj) during the period 2007 – 2015.

Table -4.3 Average Monthly Relative Humidity of the Project Area in years 2007-2013 (source: BMD)

Humidity in %	Monthly Mean Humidity											
Year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug	Sep	Oct.	Nov.	Dec	Annual
2007	68	68	54	69	70	81	84	80	80	78	77	69	73
2008	69	61	67	64	70	80	83	81	81	77	69	79	73
2009	72	55	53	66	72	74	80	82	81	73	66	69	70
2010	71	56	59	67	71	79	77	78	79	74	68	66	70
2011	69	54	57	64	76	80	79	82	77	73	67	73	70
2012	66	52	57	69	70	77	79	78	79	71	68	77	70
2013	65	55	55	63	78	76	77	80	81	78	66	72	70
2014	72	62	52	56	68	78	77	82	76	72	66	77	69
2015	70	63	52	68	71	77	81	79	78	73	69	68	70

Source: BMD

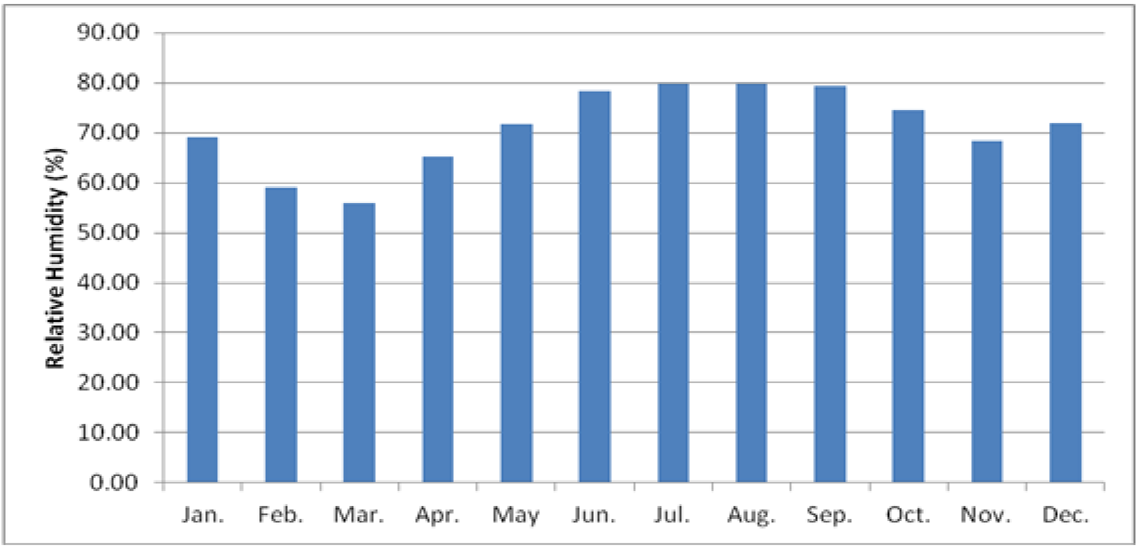


Figure 4.3: Distribution of Average Monthly Relative Humidity during 2006- 2015

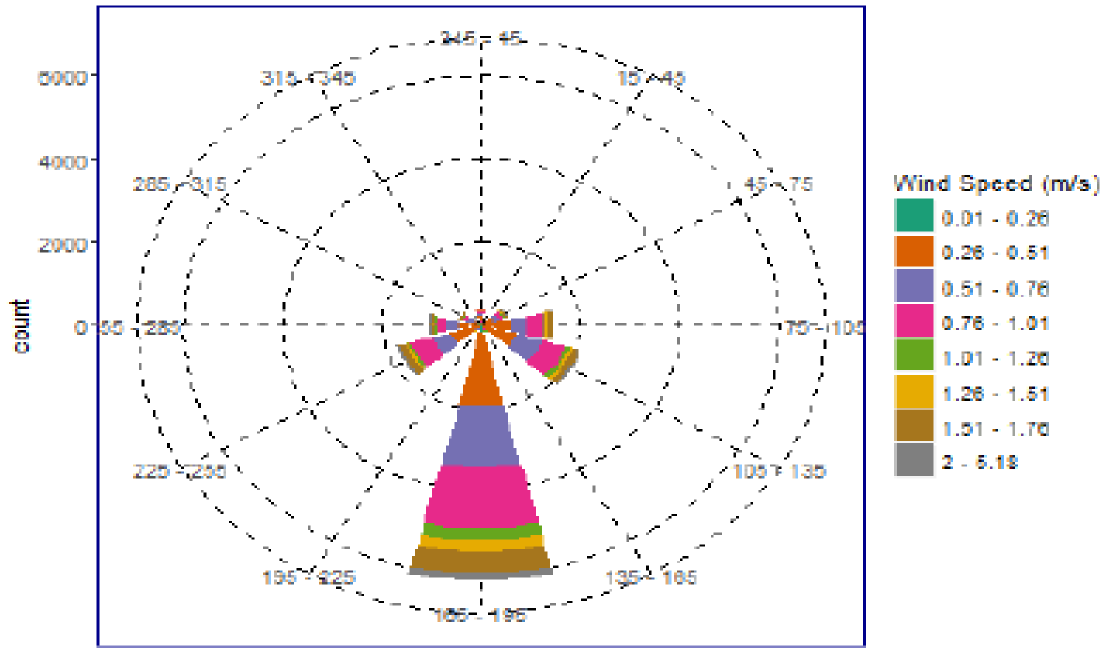
4.3.3 Wind Speed

Generally, calm to very light winds prevails throughout the year. According to Bangladesh Meteorological Department the average wind speed at Dhaka (As there is no Meteorological station in Narayanganj) varies from 2.4 knots to 3.4 knots. The maximum average wind speed in observed in the month of March. The season wise wind rose for the period of 1981-2010 as sketched for the BMD Station is shown as **Figure 4-4.**

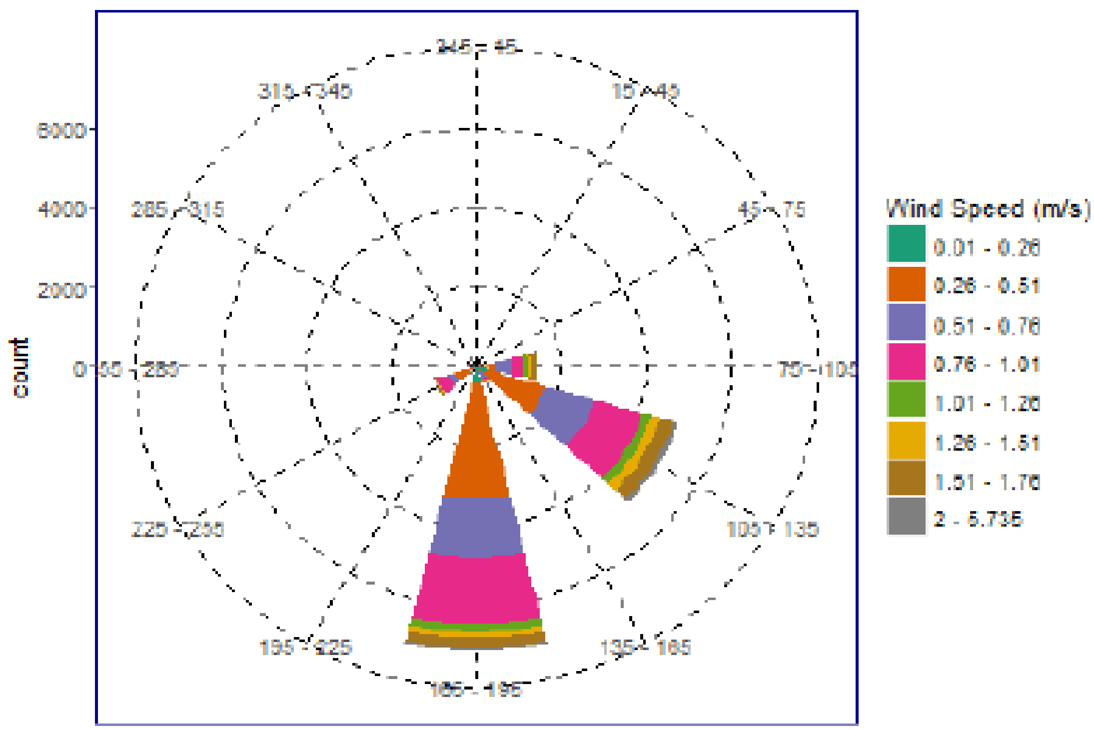
Table - 4.4 - Monthly Prevailing Wind Speed and Direction in Knots of Dhaka for the period of 2007-2015

Year	Jan.	Feb.	Mar	Apr	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2007	2.9N W	3.1N W	4.2N W	3.8S	3.5S	3.1S	3.1S	3.1S	3.2S	4.1NE	5.5N E	2.9NW
2008	3.6N	3.2N	3.8S	3.4S	3.4S	3.3S	3.4S	2.8S	2.8S	9.6NE	2.5N E	3.3W
2009	3.3W	4.1W	4.0 W	4.1S	3.8S	3.1 S	4.3SE	2.8S	4.2SE	2.3E	2.8N	2.4NW
2010	2.9N W	3.3W	3.8S	4.1S	3.7S	3.0S	2.4S	2.2S	2.6SE	2.0NE	2.9N	2.4N
2011	2.2W	2.4W	3.8S	2.4S	3.0S	2.7S E	2.4SE	2.4SE	2.6SE	2.0NW	2.3W	2.1NW
2012	2.4W	3.0W	2.5S	2.6S	2.5S	3.0S	2.7SE	2.5SE	2.2E	2.0S	2.2W	2.3W
2013	2.3W	2.2W	2.6 W	2.8S	3.2E	2.3S	2.7SE	2.7SE	2.2S	2.9SE	2.1N	2.3W
2014	2.5 W	2.5 W	2.4 NW	2.2 S	2.8 S	2.1 S	2.4 SE	2.4 SE	2.1 SE	2.1 W	2.1 W	2.2 W
2015	2.2 W	2.4 W	2.2 W	2.5 S	2.3 S	2.6 S	2.4 E	2.7 S	3.0 SE	1.9 S	2.5 N	2.1 W

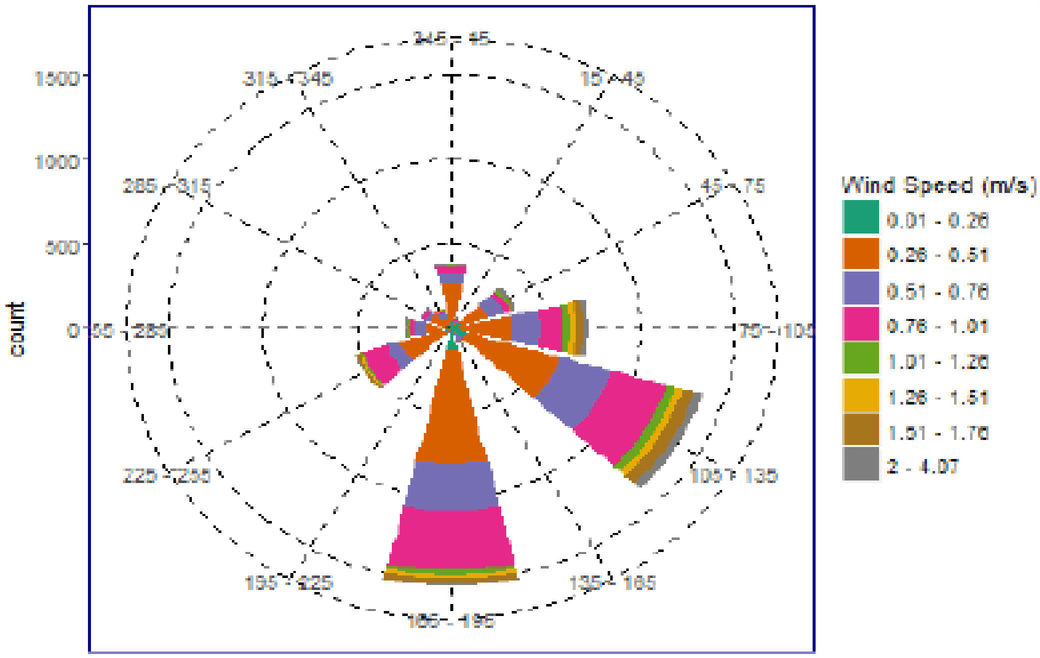
Pre-Monsoon



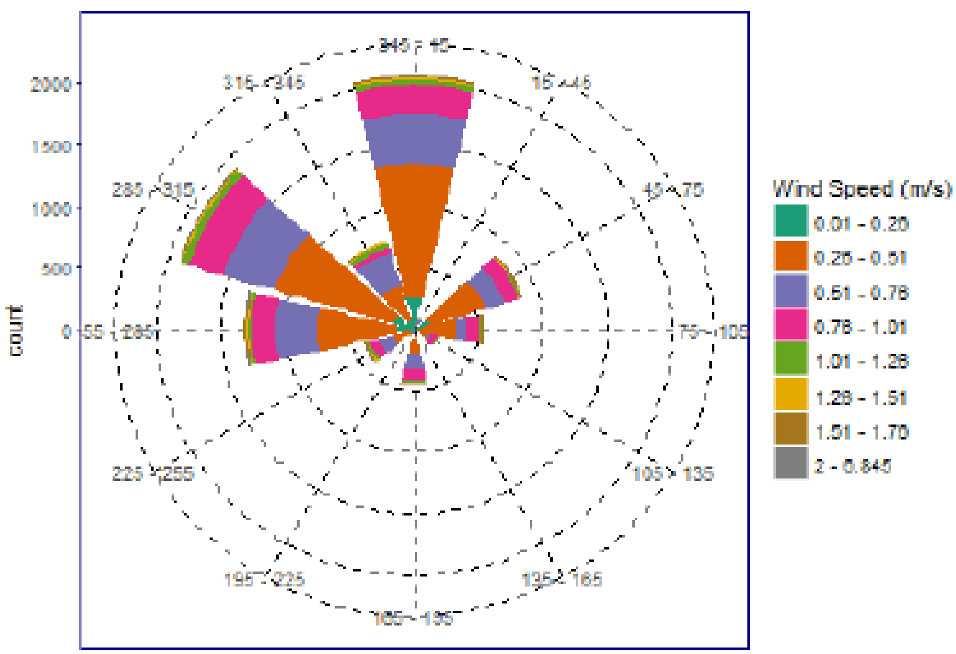
Monsoon



Post-Monsoon



Winter



Source: *BMD*

Figure 4.4: Wind rose Representation for the Period 1981-2010

4.3.4 Ambient Air Temperature

The temperature of the country has the relationship with the period of rainfall. In general cool seasons coincide with the period of lowest rainfall. **Table 4.5 – Table 4.11** respectively shows the monthly average maximum and minimum temperature at Dhaka (As there is no Meteorological station in Narayanganj) for the period 2007- 2013. **Table 4-12 and Table 4-13** respectively shows the monthly average minimum and maximum temperature at Dhaka (As there is no Meteorological station in Narayanganj) for the period 2007-2015. Dhaka enjoys a tropical climate with mean daily maximum temperature of 40° C in August while mean daily minimum temperature is 5° C in the month of January.

Table - 4.5 Monthly Ambient Temperature of the Project Area in 2007

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	18.0	28.8	9.6
Feb	21.5	30.8	12.6
March	25.4	36.7	15.0
April	28.1	35.9	18.1
May	30.0	37.5	22.5
June	28.7	35.9	22.0
July	28.2	34.8	23.4
Aug	29.1	35.9	24.2
Sep	28.7	34.9	24.5
Oct	27.1	35.6	19.5
Nov	23.9	31.8	16.8
Dec	19.8	28.2	11.3

Source: BMD

Table - 4.6 Monthly Ambient Temperature of the Project Area in 2008

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	19.0	29.0	10.5
Feb	20.3	30.6	10.8
March	26.6	34.6	16.5
April	29.2	36.9	19.6
May	29.3	36.7	20.3
June	28.7	35.4	22.5
July	28.5	34.0	24.6
Aug	28.8	36.0	23.6
Sep	28.9	34.8	24.4
Oct	27.1	34.8	18.0
Nov	23.7	32.3	16.3
Dec	20.4	29.0	13.0

Source: BMD

Table - 4.7 Monthly Ambient Temperature of the Project Area in 2009

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	19.7	28.1	9.8
Feb	23.3	33.9	11.2
March	27.0	36.0	15.6
April	30.1	39.6	19.0
May	29.1	37.8	19.8
June	30.2	36.5	23.2
July	29.0	35.7	23.8
Aug	28.9	34.3	23.7
Sep	28.8	35.3	23.0
Oct	27.6	35.8	19.8
Nov	24.6	33.9	13.2
Dec	20.0	29.7	8.7

Source: BMD

Table - 4.8 Monthly Ambient Temperature of the Project Area in 2010

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	17.6	29.0	9.6
Feb	22.3	31.2	12.0
March	28.2	37.3	18.4
April	30.4	37.9	20.8
May	29.7	36.9	21.3
June	29.3	35.8	23.2
July	29.7	35.1	25.3
Aug	29.5	35.1	25.0
Sep	28.9	34.0	24.8
Oct	28.3	35.7	21.5
Nov	24.9	33.2	16.6
Dec	20.1	29.7	11.0

Source: BMD

Table - 4.9 Monthly Ambient Temperature of the Project Area in 2011

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	17.3	27.8	8.2
Feb	22.5	31.0	13.0
March	26.4	34.5	16.0
April	28.0	35.8	20.2
May	28.4	35.3	21.3
June	29.1	36.0	23.2
July	29.2	35.4	23.9
Aug	28.5	35.0	24.5
Sep	29.1	36.2	23.7
Oct	28.1	34.5	22.0
Nov	23.9	32.4	17.2
Dec	19.3	30.0	11.0

Source: BMD

Table - 4.10 Monthly Ambient Temperature of the Project Area in 2012

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	18.9	28.5	9.0
Feb	22.1	33.0	9.8
March	27.1	37.3	16.2
April	28.1	37.1	17.6
May	30.1	36.2	20.5
June	29.7	36.7	22.2
July	29.1	34.3	24.8
Aug	29.2	34.5	24.0
Sep	29.0	36.5	24.5
Oct	27.9	34.4	19.2
Nov	23.5	32.4	12.9
Dec	18.4	28.5	8.8

Source: BMD

Table - 4.11 Monthly Ambient Temperature of the Project Area in 2013

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	17.6	28.1	5.3
Feb	22.8	32.4	12.9
March	27.5	36.0	15.2
April	29.0	37.0	19.2
May	28.0	37.1	19.2
June	30.1	36.4	23.8
July	29.3	34.6	24.8
Aug	28.7	35.0	24.6
Sep	28.9	35.7	24.0
Oct	27.2	35.2	20.7
Nov	23.8	32.1	15.1
Dec	20.2	30.5	10.2

Source: BMD

Table 4 12: Monthly Average Minimum Temperature

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2007	9.6	12.6	15	18.1	22.5	22	23.4	24.2	24.5	19.5	16.8	11.3
2008	10.5	10.8	16.5	19.6	20.3	22.5	24.6	23.6	24.4	18	16.3	13
2009	9.8	11.2	15.6	19	19.8	23.2	23.8	23.7	23	19.8	13.2	8.7
2010	9.6	12	18.4	20.8	21.3	23.2	25.3	25	24.8	21.5	16.6	11
2011	8.2	13	16	20.2	21.3	23.2	23.9	24.5	23.7	22	17.2	11
2012	9	9.8	16.2	17.6	20.5	22.2	24.8	24	24.5	19.2	12.9	8.8
2013	5.3	12.9	15.2	19.2	19.2	23.8	24.8	24.6	24	20.7	15.1	10.2
2014	10.3	11.6	16	18.9	21.1	23.2	24	24.3	24.2	19.5	15.4	12.3
2015	11.4	12.8	15	19.5	20.1	23.2	23.6	23.8	24	20.3	17.5	11.5
Avg.	5.3	9.8	15	17.6	19.2	22	23.4	23.6	23	18	12.9	8.7

Table 4 13: Monthly Average Maximum Temperature

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2007	28.8	30.8	36.7	35.9	37.5	35.9	34.8	35.9	34.9	35.6	31.8	28.2
2008	29	30.6	34.6	36.9	36.7	35.4	34	36	34.8	34.8	32.3	29
2009	28.1	33.9	36	39.6	37.8	36.5	35.7	34.3	35.3	35.8	33.9	29.7
2010	29	31.2	37.3	37.9	36.9	35.8	35.1	35.1	34	35.7	33.2	29.7
2011	27.8	31	34.5	35.8	35.3	36	35.4	35	36.2	34.5	32.4	30
2012	28.5	33	37.3	37.1	36.2	36.7	34.3	34.5	36.5	34.4	32.4	28.5
2013	28.1	32.4	36	37	37.1	36.4	34.6	35	35.7	35.2	32.1	30.5
2014	28.5	30.4	38	40.2	38	37	35.8	34.4	34.8	36	33.8	29.2
2015	29.9	32.2	36.4	35.5	36.4	36.5	35.5	34.7	36.5	35.5	32.9	30.3
Avg.	29.9	33.9	38	40.2	38	37	35.8	36	36.5	36	33.9	30.5

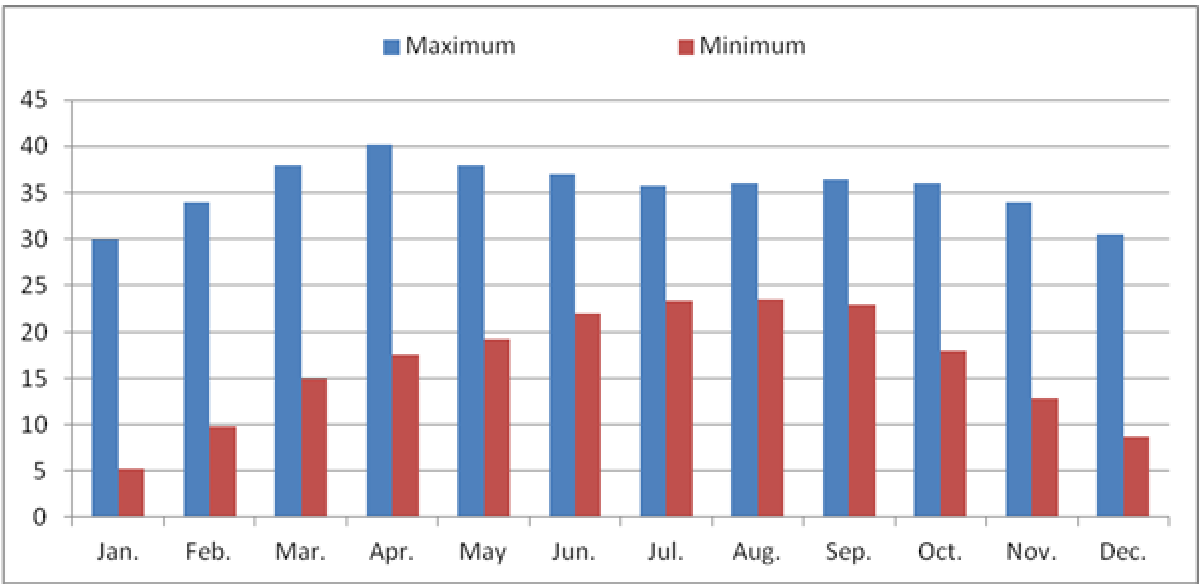


Figure 4.5: Distribution of Average Monthly Maximum and Minimum Temperature during 2007-2015

4.3.5 WEARTHER MONITORING REPORT

An ongoing weather monitoring is being conducted using Meteorological stations. So far, the weather data of two months (From 09/08/2016 to 09/10/2016) has been recorded. During this time, the rainfall has been significantly low (recorded maximum rainfall 4.6 mm) and therefore the weather is relatively dry.

4.3.6 Micro-Meteorology

The meteorological data recorded during the monitoring period is very useful for proper interpretation of the baseline information as well as for input prediction models for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region.

The year may broadly be divided into four seasons:

Winter season	:	December to February
Pre-monsoon season	:	March to May
Monsoon season	:	June to September
Post-monsoon season	:	October to November

4.3.6.1 Methodology

To get the synoptic view of micrometeorological condition occurring at site specific meteorological data was collected for the period September-December, 2016. A comprehensive weather monitoring has been conducted using Meteorological stations. The meteorological parameters were recorded on hourly basis during the study period and include parameters like wind speed, wind direction (from 0 to 360 degrees), temperature, relative humidity, atmospheric pressure, rainfall and cloud cover.

4.3.6.2 Weather Monitoring Data

The weather data from 09/08/2016 to 15/12/2016 has been recorded. During this time, the rainfall has been significantly low and therefore the weather is relatively dry. The summery of the weather report is given in **Table 4-14.**

Table 4 14: Summary ofMicrometeorological Condition at site

Month	Temperature (^{0}C)		Relative Humidity (%)		Maximum Daily Rainfall (mm)	Maximum Wind Speed (ms /sec)
	Max	Min	Max	Min		
September 2016	44.03	27.02	95.41	63.83	11.2	7.8
October 2016	35.66	24.96	95.95	65.43	5.8	10.4
November 2016	31.16	19.88	97.75	42.81	17.8	12.2

The monitoring data for wind from the time period September to December 2016 is shown in Figure 4-6. The predominant wind direction during the study period was observed to be from East direction followed by west-south-west. The average wind speed during study period was recorded as 0.9 m/s. About 47% of the time calm condition prevails (wind speed <0.5 m/s)

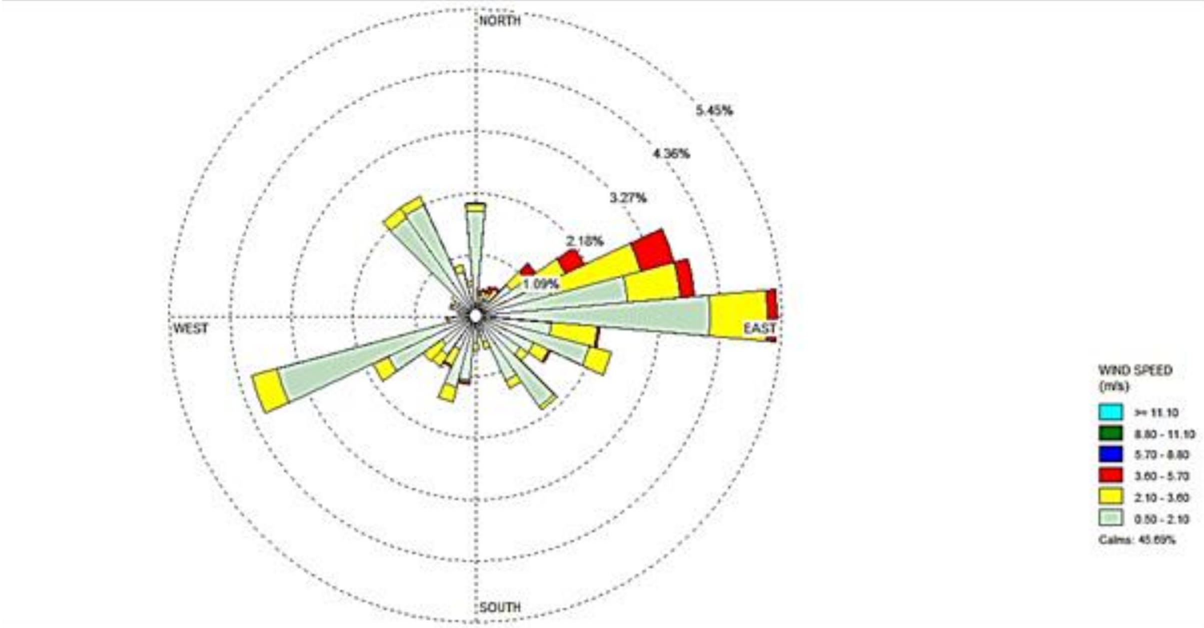


Figure 4.6: Wind Rose (September to December, 2016) near the Project Site of Reliance Meghnaghat 750 MW CCPP

4.4 PHYSICAL ENVIRONMENT

4.4.1 Physiography

There are three distinctive natural features in Bangladesh:

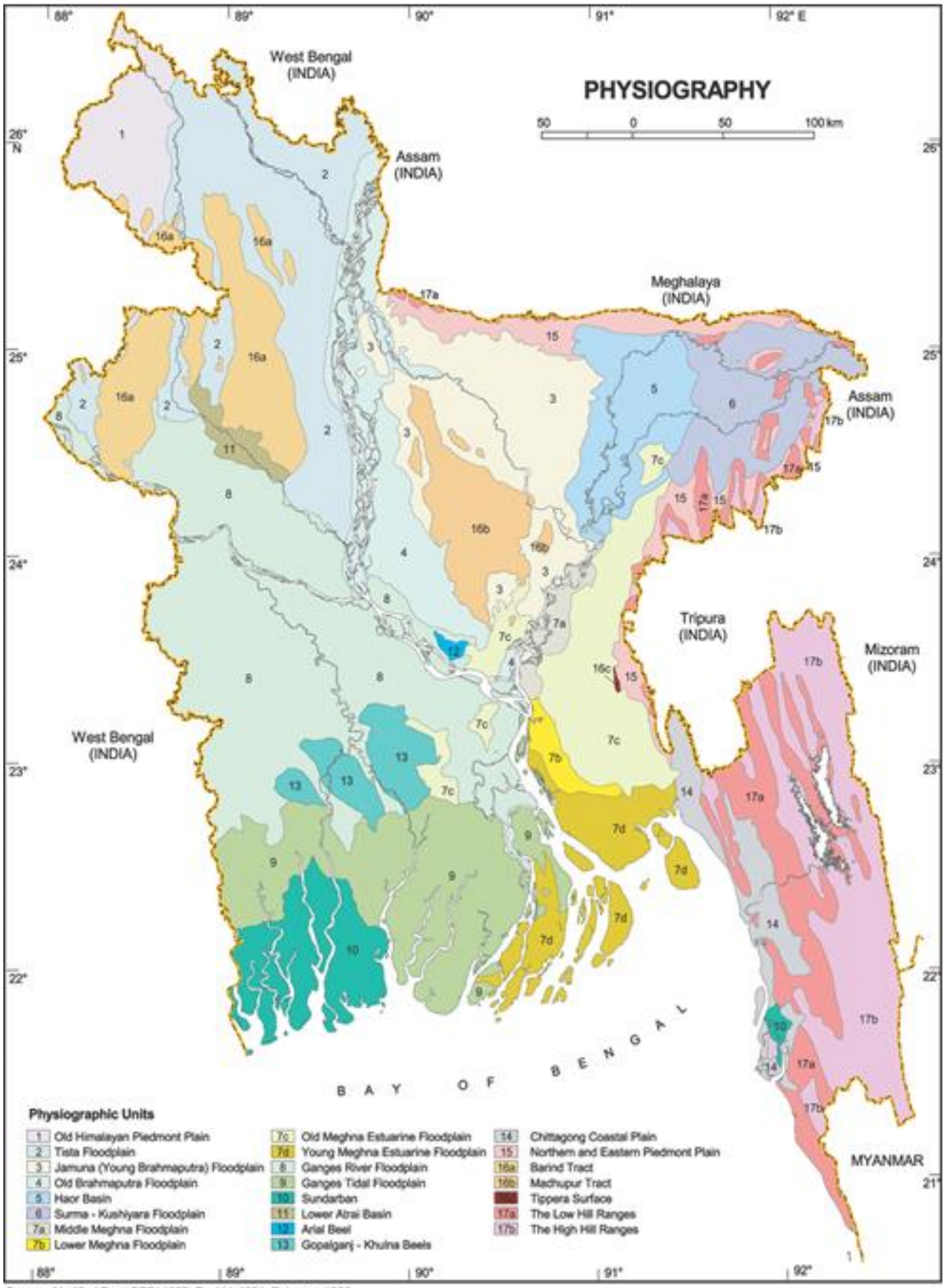
- a broad alluvial plain subject to frequent flooding;
- a slightly elevated relatively older plain;
- a small hill region drained by fast flowing rivers.

Most of the area of Bangladesh is a vast, low-lying alluvial plain, sloping gently to the south and southeast. According to Bangladesh Agricultural research council's Agro-Ecological Zoning map of Bangladesh, the proposed project area falls in the Old Meghna Estuarine Floodplain. This region occupies abandoned channel of the Brahmaputra River on the border between Bandar and Narayanganj Upazila. This region includes islands-former Brahmaputra chars within the Meghna River as well as adjoining parts of the mainland.

The area falls under the Old Meghna estuarine floodplain. In this floodplain, the landscape in this widespread region is quite different from that on river and tidal floodplains. The relief is almost plane, with minute difference in elevation between ridges and basins. Natural rivers and streams are far apart in the southern part, drainage is provided by a network of man-made canals. The sediments are primarily deep and silty, but a shallow layer of clay in some basin centres superimposes them. Seasonal flooding is mainly deep, but it is shallow in the southeast. Some basin centres stay wet throughout the dry season. Virtually everywhere, this flooding is by rainwater downpour the land when external rivers flow at high levels. The physiography of Bangladesh can be seen in the **Figure 4-7.**

4.4.2 Drainage

The Brahmaputra River, known locally as the Jamuna, unites with part of the Ganges to form the Padma, which, after its juncture with a third large river, the Meghna, flows into the Bay of Bengal. Offshoots of the Ganges-Padma, including the Burishwar, Garai, Kobadak, and Madhumati, also flow south to the Bay of Bengal. The rivers flow and its drainage is depicted in the **Figure 4-8.**



Source: Modified From *SRDI,1997; Rashid, 1991; Reimann, 1993*

Figure 4.7: Physiography of Bangladesh

Figure 4.8: Drainage map of the Region

4.5 AMBIENT AIR QUALITY

Air pollution can cause significant effects on the environment and subsequently on human, animals, vegetation and materials. In most cases, air pollution aggravates pre-existing diseases or degrades health status, making people easily susceptible to other infections and development of chronic respiratory and cardiovascular diseases. Further, environmental impacts from air pollution can include acidic deposition and reduction in visibility. The proposed project is a gas based combined cycle power plant project where NG/RLNG will be used as primary fuel. Burning of NG/RLNG produces NO2, SO2, CO and CO2. During construction phase, minor air pollution may occur due to site preparation, transportation and construction activities.

The ambient air quality status with respect to the study zone of 5 km radius from the center of the proposed power unit will form the baseline information having concentration already getting emitted by the existing industries over which the predicted impacts due to the development of project area can be superimposed to find out the net impacts on the air quality in the project impact area. The baseline ambient air quality can be assessed through a scientifically designed ambient air quality network. The design of monitoring network in the air quality surveillance program is based on the following considerations:

- Meteorological conditions on synoptic scale
- Topography of the study area.
- Representation of regional background levels.
- Representation of plant site.

A site–specific background of air quality monitoring program was conducted for the proposed project site during post monsoon season. Background data was collected for suspended particulate matter (SPM), Particulate Matter less than 10 µ (PM10), Particulate Matter less than 2.5 µ (PM2.5), Sulphur dioxide (SO2) Oxides of Nitrogen (NO2). Six sampling stations located within 5.0 km of the site was considered to provide the surrounding baseline air quality. Sampling network design took into consideration down wind, up wind cross wind as well as locations where maximum concentration is expected

4.5.1 Selection of the Station and Duration

For this particular project, air monitoring has been conducted at six different locations (24 Hour Basis) and twice a week following DoE protocol. The air monitoring study was carried out from 4th September, 2016 to 3rd December, 2016. The locations of the stations were selected in such manner so that the study points will surround the project area.

The abmient air quality monitoring will be continued further from Dec 2017 to April 2018 to assess the ambinet air quality around the project site during dry season which will be added to the ESIA report later.

4.5.2 Description of the Stations

Ambient Air Quality Monitoring (AAQM) stations were set-up at six locations from September 2016 to December 2016 covering post monsoon season of 2016. **Table 4-15** gives the location details of the selected AAQM stations with reference to the project site and shown in **Figure 4-9.**

Table 4 15: Description of the Air Monitoring Stations

Name of the Station	GPS Coordinate	Distance from the project site (km)	Direction from the project site
Pachani, MongolerGaon, Sonargaon, Narayanganj	N 23° 36' 29.81" E 90° 34' 35.21"	1.62	West
Mograpara, Sonargaon, Narayanganj	N 23° 38' 6.66" E 90° 35' 18.01"	3.12	North
Boiddarbazar, Sonargaon, Narayanganj	N 23° 39' 0.17" E 90° 37' 28.23"	5.68	North East
VatiBalaki, Hossaindi, Gazaria. Munshiganj	N 23° 35' 22.07" E 90° 34' 39.52"	2.70	South West
Jamaldi, Hossaindi, Gazaria, Munshiganj	N 23° 35' 44.03" E 90° 36' 54.72"	2.51	South East
Gowalgaon, Gazaria, Munshiganj	N 23° 34' 21.64" E 90° 35' 22.22"	3.82	South

4.5.3 Observations of Ambient Air Quality Data

The collection of data went on for of 12weeksnear and around the proposed plant site.The major air pollutants viz. Particulate Matter less than 10 µ (PM10), Particulate Matter less than 2.5 µ (PM2.5), Sulphur dioxide (SO2), Oxides of Nitrogen (NO2) representing the basic air pollutants in the region were monitored for ambient air quality. The summery of the ambient air quality have been provided in Table 4-9, where as the detailed monitoring is enclosed as Annexure 4.1. The concentration of PM2.5, PM10, SO2 and NO2 and CO of different monitoring locations are shown in **Figure 4-10 to 4.14**

Figure 4.9: Air Monitoring Locations near the Project

It shows that the ambient air quality of shows temporal as well as spatial deviation. Gaseous pollutants were within the national and international limits whereas particulate matter though observed to be complying with ECR, 2005 but it crosses the limits with respect to WHO IT-1. The pollutant levels (24 hourly averages) at these sampling stations reflect that the regional background, i.e. PM10 is 72.8- 125 µg/m3 and PM2.5 ranged between 33.3µg/m3and 47.5 µg/m3. The concentrations of SO2 are in the range of 7.1-8.8 µg/m3 and NO2 is in the range of 6.8- 9.4 µg/m3 respectively during the study period.

The NOx is the main concern to this power project and have been measured within a range of 6.8- 9.4 µg/m3in different locations throughout the monitoring period. The above ambient NO2 level is far below than the IFC/WB and Bangladesh standards for NO2 even after there are other 3 power projects in operation in the vicinity. Based on that we can conclude the air shed is as non-degraded nature as per IFC/WB definition.

Table 4 16: Summary of the Ambient Air Quality in the study area

Parameter (Maximum found in the study area)		September	October	November	December
$PM_{2.5}$	Pachani	21	41	46.1	43.2
	Mograpara	22.3	34.9	41.2	40.6
	Boiddarbazar	19.7	30.3	45.1	49.6
	Gowalgaon	18.3	33.5	49.8	31.7
	Jamaldi	17.0	23.6	90.2	58.4
	VatiBalaki	23.6	27.4	57.2	51.7
PM_{10}	Pachani	70.1	101.9	197	132
	Mograpara	41.7	105.3	122.9	106.9
	Boiddarbazar	63.2	72.6	94.5	118.7
	Gowalgaon	58.4	82.1	104.6	119.4
	Jamaldi	28.6	62.9	73.8	125.8
	VatiBalaki	31.8	34.5	88.2	155.4
SO_2	Pachani	7.2	13.1	9.5	4.8
	Mograpara	4.1	12.2	6.2	5.8
	Boiddarbazar	5.8	12.3	9.2	7.8
	Gowalgaon	5.6	10.1	8.7	4.8
	Jamaldi	6.8	9.0	8.6	5.4
	VatiBalaki	7.6	11.4	9.0	7.1
NO_2	Pachani	7	11.2	5.7	6.5
	Mograpara	6.2	9.4	6.3	8.2
	Boiddarbazar	6.6	15.7	7.5	7.8
	Gowalgaon	9.0	8.7	6.8	6.1
	Jamaldi	6.7	6.3	8.9	5.4
	VatiBalaki	4.8	5.1	11.9	6.3
CO	Pachani	185	177	154	172
	Mograpara	164	223	169	201
	Boiddarbazar	161	158	189	223
	Gowalgaon	181	179	164	197
	Jamaldi	175	162	196	159
	VatiBalaki	185	184	209	206

The above monitoring has been conducted for 24 hourly sampling basis which represents NO2as 24 hr basis. But Bangladesh National Ambient air quality standard NO2 level set for annual average. As the primary data is not available throughout the year to measure at an annual basis, DOE Continuous Air Monitoring Station (CAMS) secondary data available from Narayanganj CAMS station for annual average of NO2 for the following months:

Month	Annual average of NO_2
January, 2017	35.67
December, 2016	29.0
November, 2016	32.7
October, 2016	41.8
September, 2016	15.7
August, 2016	12.6
July, 2016	13.3

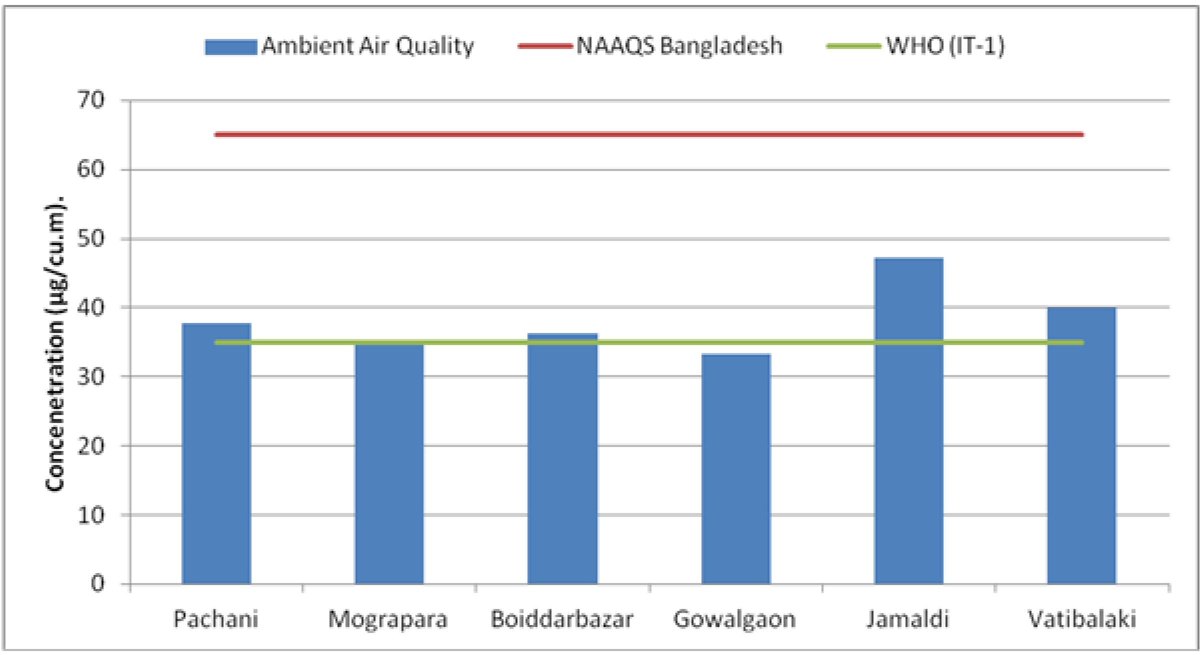


Figure 4.10 : PM2.5 Concentration at Different monitoring locations

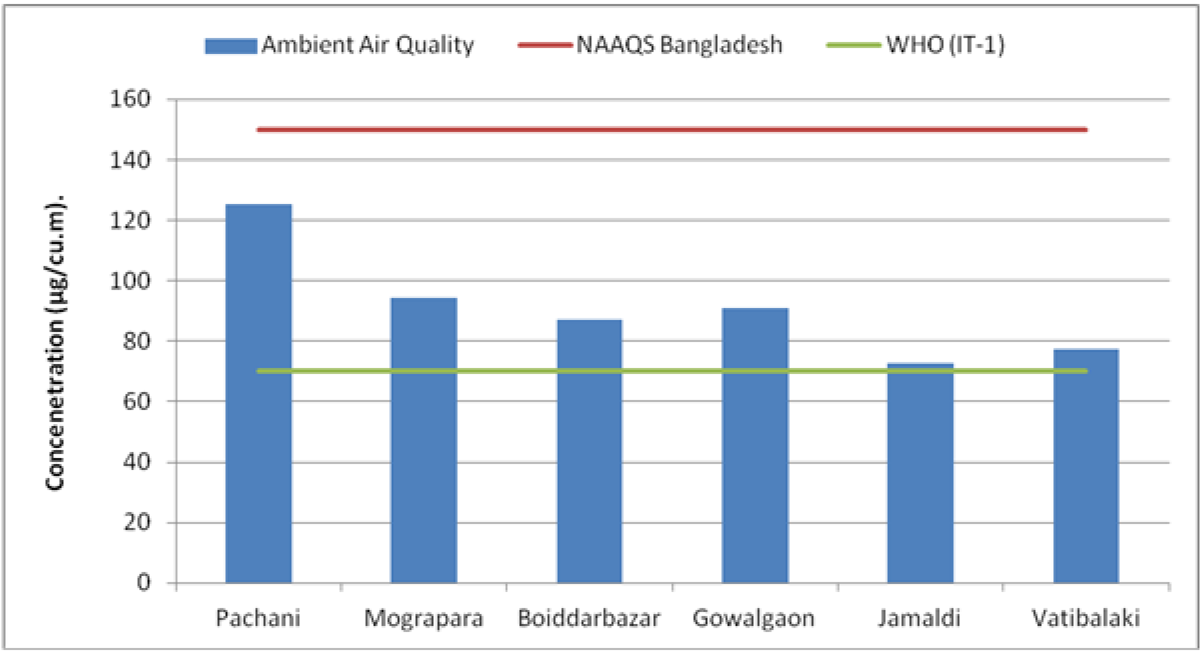


Figure 4.11: PM10 Concentration at Different monitoring locations

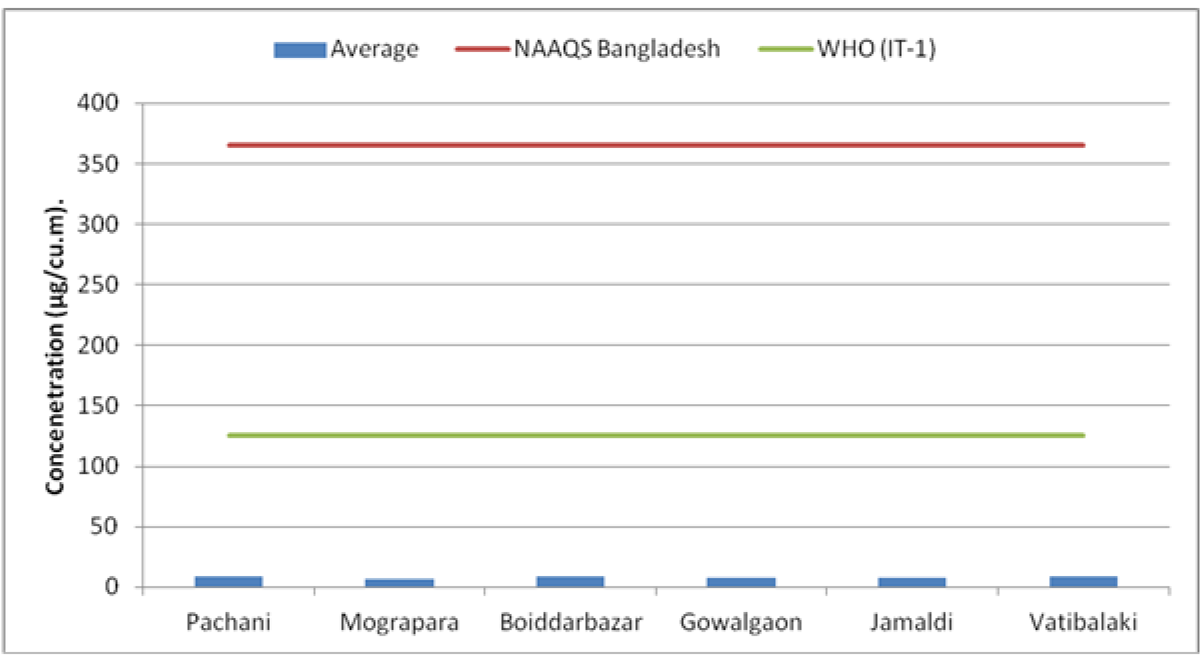


Figure 4.12: SO2 Concentration at Different monitoring locations

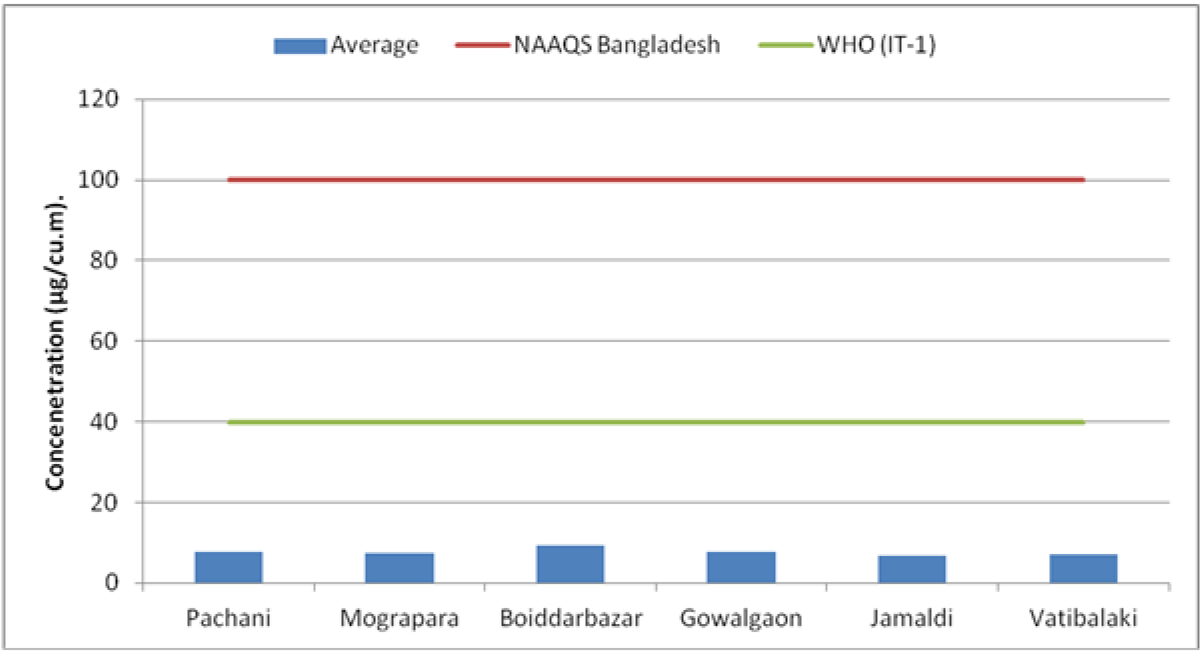


Figure 4.13: NO2 Concentration at Different monitoring locations

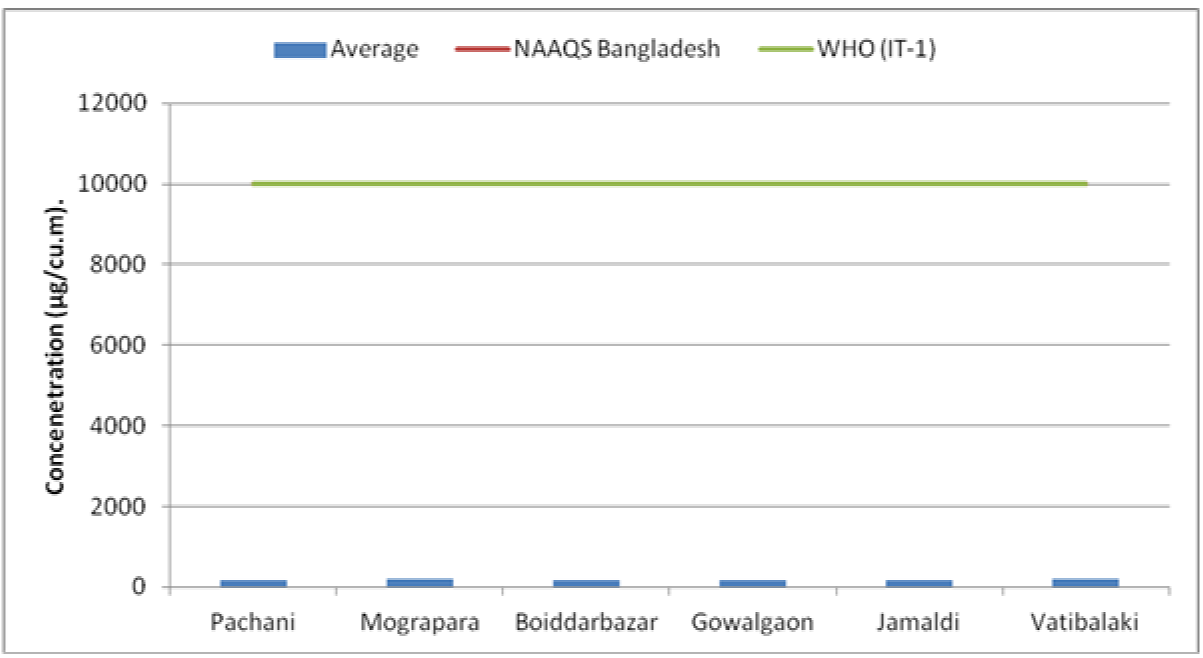


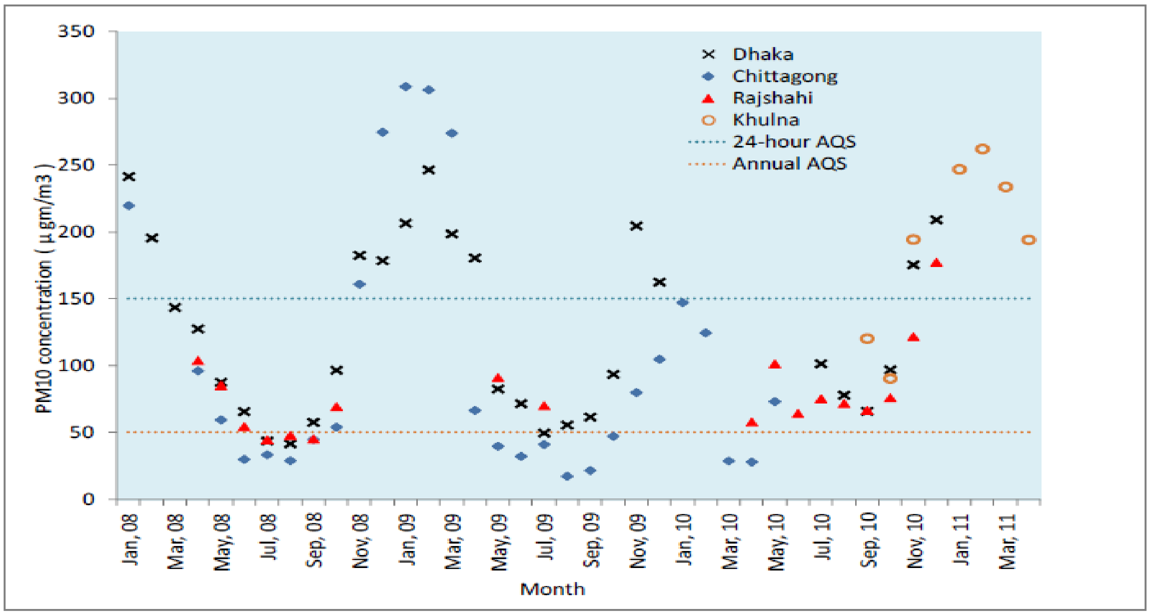
Figure 4.14: CO Concentration at Different monitoring locations

4.5.4 Regional Background Air Quality Data

Air pollution, especially in the large cities of Dhaka and Chittagong, is a major environmental hazard in Bangladesh. Governments of all developed countries have been very active in controlling air pollution in order to ensure a good quality of life for their citizens. Developing countries like Bangladesh have also taken note of the air pollution issues, and often guided by the multinational agencies like the World Bank (WB), Asian Development Bank (ADB), United

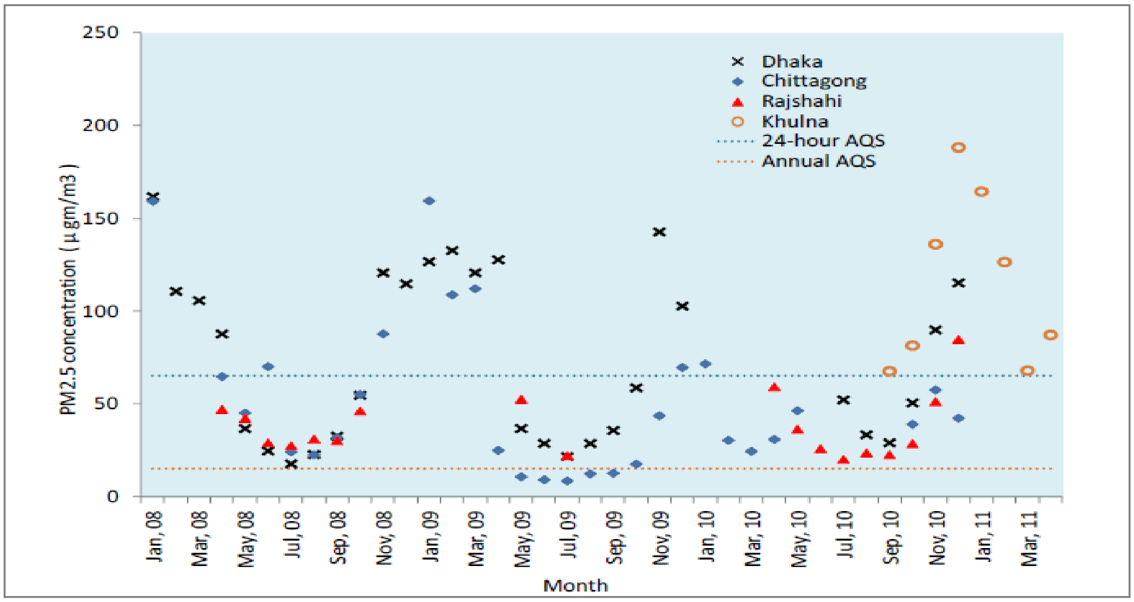
Nations Environment Programme (UNEP), have taken measures or have made plans to reduce and control air pollution

In the absence of site specific data we studied air long term air quality data of Dhaka city which is about 30 km from the project site. Though meteorological factors, land use as well as air pollution generating sources all contribute to spatial distribution of air quality but in the absence of site specific data, air quality of Dhaka city may be considered as gross approximation of the long term air quality of project area. Seasonal variation of air quality at Dhaka city is shown in **Figure 4-15 to Figure 4-19.**



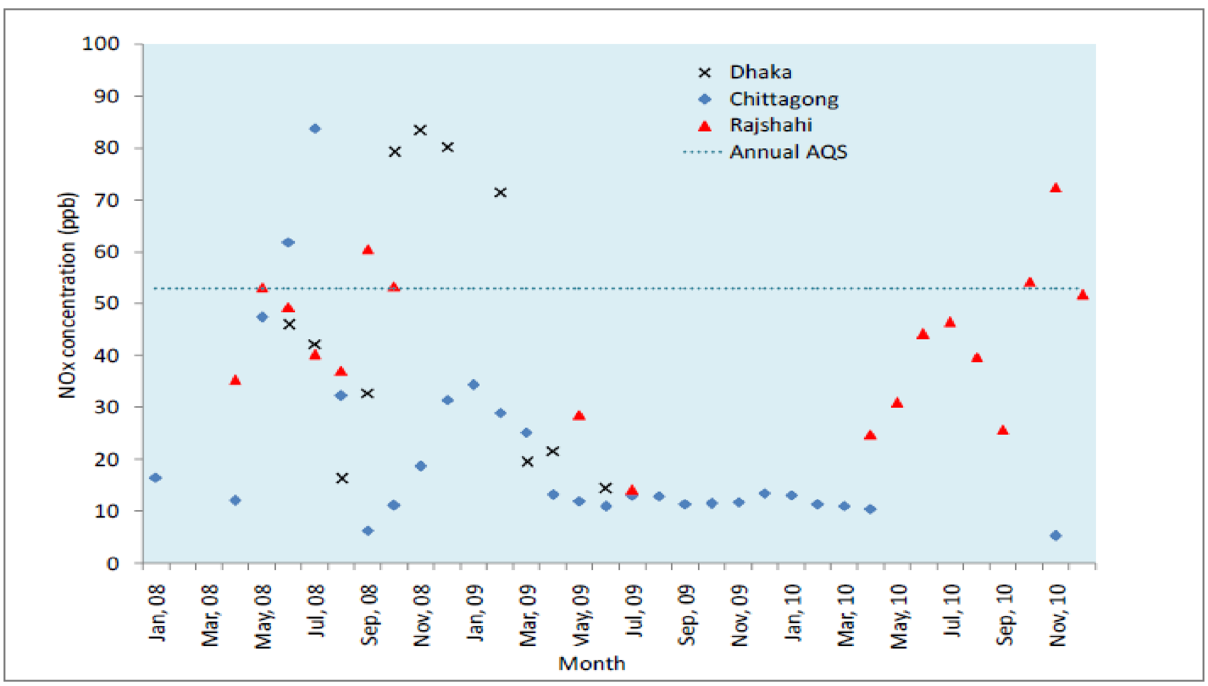
Source: DoE

Figure 4.15: Seasonal distribution of PM10 concentration during 2008-2011



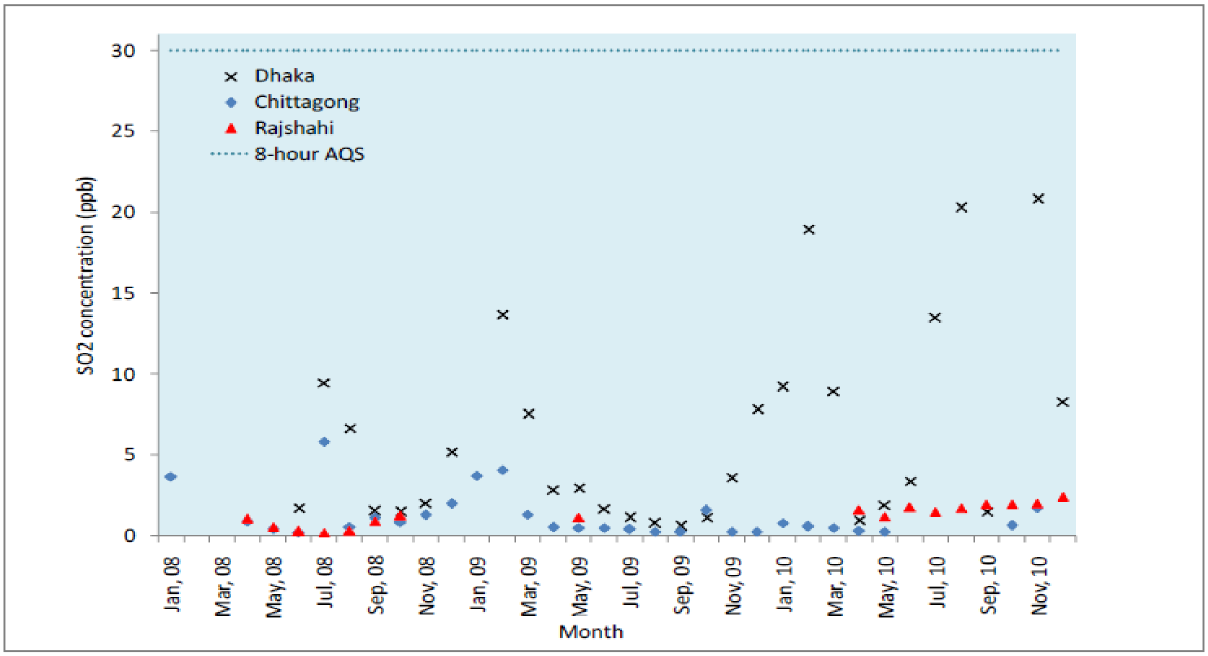
Source: DoE

Figure 4.16: Seasonal distribution of PM2.5 concentration during 2008-2011



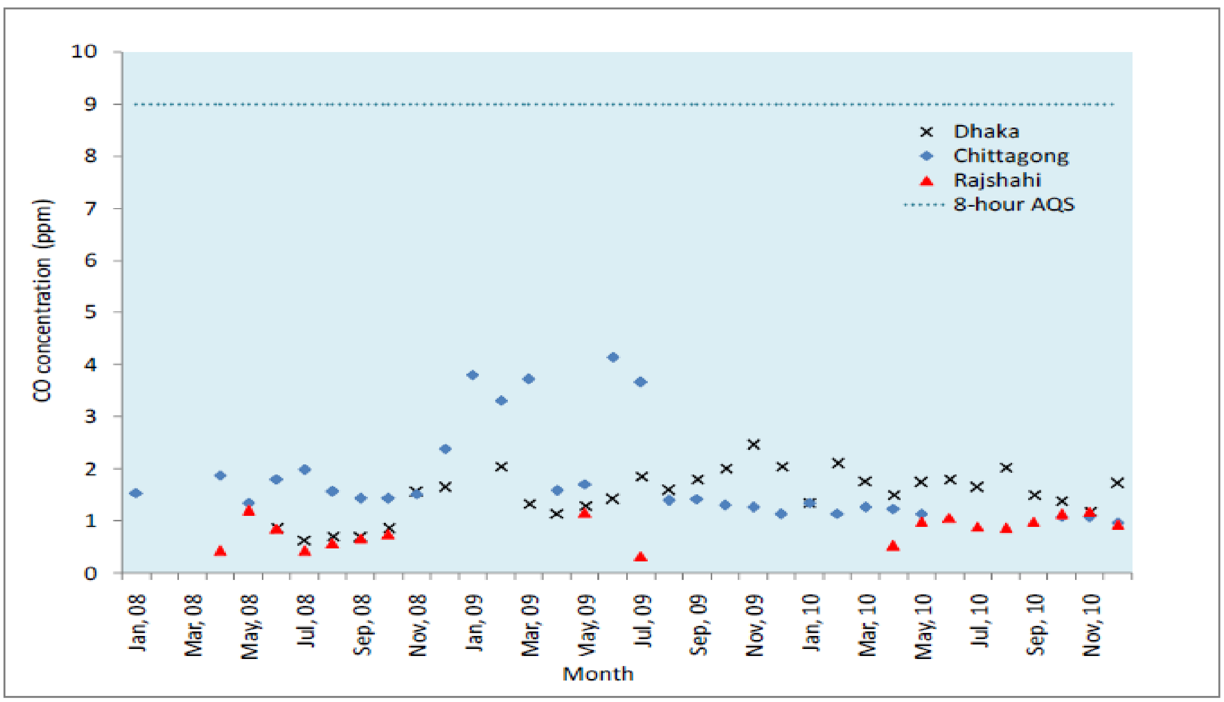
Source: DoE

Figure 4.17: Seasonal distribution of NO2 concentration during 2008-2011



Source: DoE

Figure 4.18: Seasonal distribution of SO2 concentration during 2008-2011



Source: DoE

Figure 4.19: Seasonal distribution of CO concentration during 2008-2011

As can be seen from the above figures that the ambient air quality shows temporal deviation. Gaseous pollutants were within the national and international limits whereas particulate matter though observed crosses the limits with respect to WHO air quality guideline as well as Bangladesh standard. There is a clear temporal trend which shows greater load of air pollution during summer and winter months whereas during monsoon due to wash out effect air pollution level decreases.

4.6 NOISE

The impact of industrial noise on surrounding community depends on

- Characteristics of noise sources (instantaneous or continuous in nature). It is well known that a steady noise is not as annoying as one that is continuously varying in loudness.
- Time of the day at which noise occurs, for example loud noises at night in residential areas are not acceptable because of sleep disturbance.
- The location of noise source with respect to noise sensitive areas determines the loudness and period of noise exposure.

Being a heavy industrial area, noise pollution can be quite prominent near the project site. To test this out, noise monitoring stations were set up to assess the present noise level of the project site. After the construction, sophisticated machineries will be installed in the project area when the industries will be set up after allocation, which will produce little significant noise.The impact of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent, or continuous in nature). It can be observed that steady noise is not as annoying as one which is continuously varying in loudness;
- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance; and
- The location of the noise source, with respect to noise sensitive land use, which determines the loudness and period of exposure.

4.6.1 Selection of the Noise Monitoring Stations

Noise monitoring stations were set up in accessible, convenient and secured position; both near the streets and the river. There were six locations surrounding the project site where noise was monitored to determine hourly equivalent noise levels. The noise sampling was done once during the study period continuously for 24 hours at the six locations, selected on the basis of the site sensitivities within the project area.

4.6.2 Parameters of Noise Monitoring Study

The results of the findings shall be analyzed to work out as follows:

- L_{eq} hourly,
- L_{eq} day and
- L_{eq} night.

4.6.3 Description of the Noise Monitoring Stations

The farthest monitoring at Bidder Bazar is aerially at 5.79 km distance from the project site. The red squared area is the proposed project location and the yellow icons are the monitoring locations. The details of the noise monitoring stations are provided in **Table 4-17** and shown in **Figure 4.20.**

Table 4 17: Noise Monitoring Stations

Name of the Station	GPS Coordinate	Distance from the project site (km)	Direction from the project site	Remarks
Pachani, MongolerGaon, Sonargaon, Narayanganj	23°36'29.66" N 90°34'35.30" E	1.62	West	Near the Road
Mograpara, Sonargaon, Narayanganj	N 23° 38' 8.93" E 90°35'41.36"	3.21	North	Near the Highway
Boiddarbazar, Sonargaon, Narayanganj	N 23°38'57.69" E 90°37'28.22"	5.74	North East	Near the Road
VatiBalaki, Hossaindi, Gazaria. Munshiganj	N 23°34'50.23" E 90°34'0.39"	3.92	South West	Near the River
Jamaldi, Hossaindi, Gazaria, Munshiganj	N 23°35'44.06" E 90°36'54.17"	2.63	South East	Near the Road
Gowalgaon, Gazaria, Munshiganj	N 23º 34 21.64 E 90º 35 22.22	3.83	South	Near the River

Source: AECL Lab, NGO Forum, BUET& BCSIR

4.6.4 Observations on Ambient Noise Level

Day time Leq has been computed from the hourly Leq values between 6.00 a.m. - 9.00 p.m. and night time Leq from the hourly Leq values between 9.00 p.m. - 6.00 a.m. The results are presented in **Table 4-18.**

Table 4 18: Noise Level in Study Area

Location	Noise Level in dB(A)		
	Leq (day)	Leq (night)	Leq (dn)
Pachani	50.9	49.3	56.7
Mograpara	71.2	68.1	74.8
Boiddarbazar	60.7	54.4	62.3
Vati Bolaki	53.8	52.5	58.7
Jamaldi	62.9	57.4	65.0
Gawal Gao	48.1	50.4	56.1
Ambient Noise Standards for Industrial Areas	75.0	70.0	-

Source: AECL Lab

At each location, noise monitoring has been carried out once during the study period over a period of twenty-four hours to obtain Leq values at uniform time intervals of 1 hour. In each hourly time interval Leq values have been computed from SPL readings taken at uniform time intervals of 15 minutes. For each location, day and night time Leq values have then been computed from the hourly Leq values so that comparison could be made with the national ambient noise standards. No heavy traffic was found at the road side. The noise levels during daytime were found in the range of 48.1 to 71.2 dB(A) and during night time Leq value was between 50.4 and 68.1 dB(A). In general noise level was found within the prescribed standards in absence of any major noise source. The nearest monitoring station to the plant location is Pachani which is about 1.62 km from the site. The lowest level of noise level was observed in the Pachani monitoring station. Maximum noise level is observed near highway in the monitoring station Mograpara. The spatial deviation in noise level was due to difference in land use pattern and different noise generating sources. Graphical representation of Leq Day and Leq Night is shown in **Figure 4.21 and Figure 4.22**, respectively.

Noise assesment was also carried at project site during day and night time on 11-12 September 2017 at 3 locations (beside Summit power, middle of the project site and beside Orion Power). The maximum and minimum noise level were recoreded at beside Summit power was 45.3 dB(A)to 56.1 dB(A), at the middle of the project site 46.1 dB(A) to 59.7 dB(A) and beside Orion 51.4 dB(A) to 66.9 dB(A) during the day and night time respectively. The higher level of noise at the night time were observed due to the operation the power plant in the vicinity at maximum efficiency during the pick hours (night time).

Figure 4.20: Noise Monitoring Stations

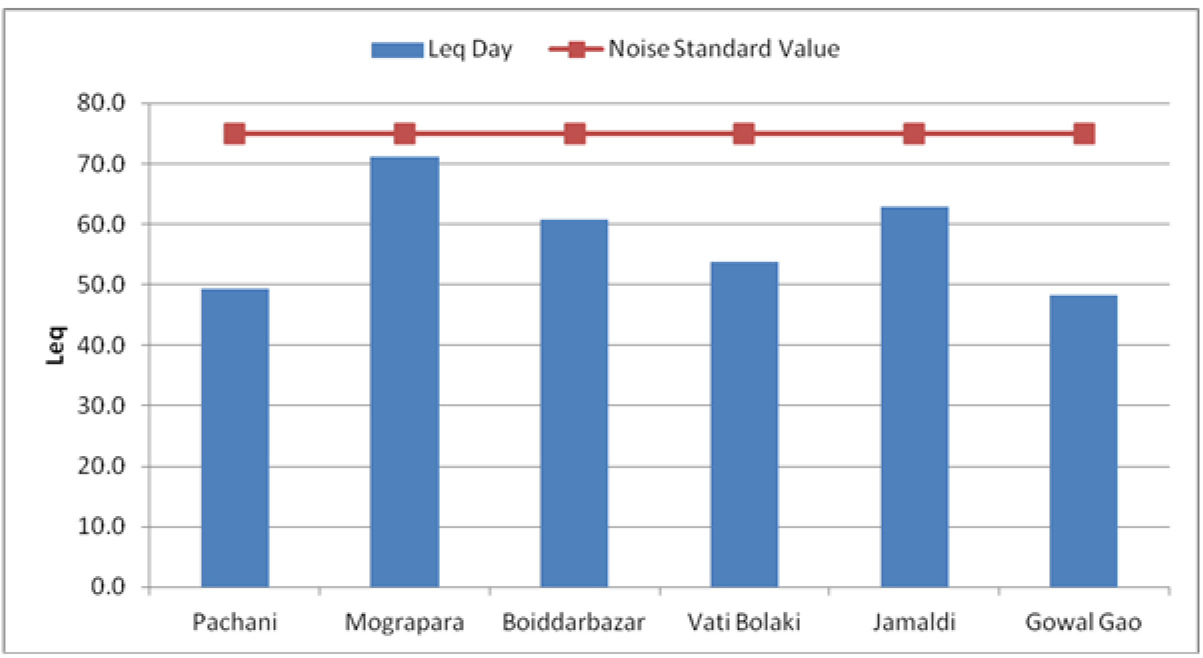


Figure 4.21: Graphical representation of Leq Day

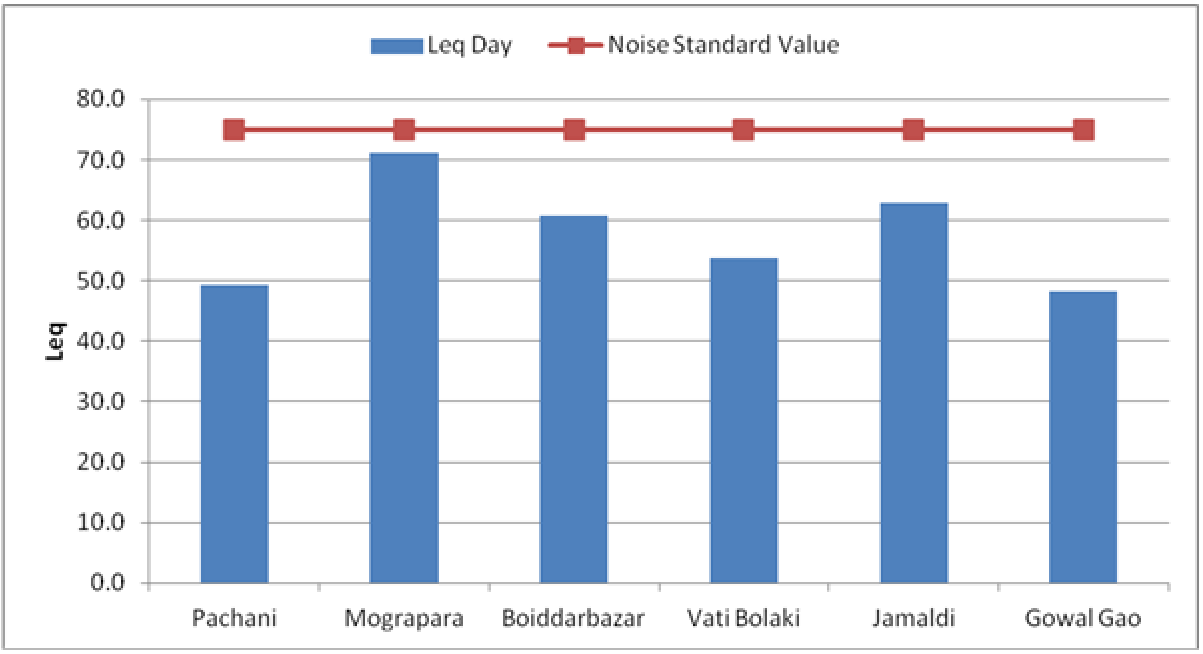


Figure 4.22: Graphical representation of Leq Night

4.7 TRAFFIC STUDY

Information has been collected on traffic volume for this project for roads near the project site by conducting traffic volume monitoring at one location and river traffic in another location. The locations are Mograpara Bus Stop and Char Balaki respectively. The traffic volume counts have been recorded continuously for 24 hours at one time during the study period to assess the existing total daily traffic, peak hour traffic and traffic composition. The full data of the traffic survey is listed in the Table 4-20.

Table 4.19: Passengers Car Unit Factors in Bangladesh

Vehicle Type	PCU Factor
Car	1.0
Bus	3.0
Truck	3.0
Auto Rickshaw	0.5
Bicycle	0.3
Rickshaw	1.0
Motor Cycle	0.3
Tempo	1.0
Bullock Card	4.0

Source: Transport Research Laboratory (UK) Overseas Road Note 13

Table 4 20: Traffic Volume Data (Road Traffic, Location: Mograpara Bus Stop)

Hours	Truck /Lorries	Truck PCU (3)	Bus / Minibus	Bus PCU (3)	Car / Jeep /Micro bus	Car PCU (1)	Motor-cycles /Auto rickshaw	Motorcycle/ Auto PCU (0.5)	Truck PCU
06:00PM	108	324	245	735	70	70	15	7.5	1136.5
07:00PM	105	315	40	120	40	40	15	7.5	482.5
08:00PM	151	453	46	138	48	48	63	31.5	670.5
09:00PM	99	297	28	84	38	38	14	7	426
10:00PM	113	339	40	120	49	49	15	7.5	515.5
11:00PM	190	570	26	78	43	43	11	5.5	696.5
12:00AM	157	471	37	111	40	40	8	4	626
01:00AM	104	312	75	225	50	50	4	2	589
02:00AM	85	255	35	105	50	50	2	1	411
03:00AM	99	297	60	180	40	40	3	1.5	518.5
04:00AM	65	195	66	198	65	65	4	2	460
05:00AM	105	315	70	210	50	50	9	4.5	579.5
06:00AM	80	240	78	234	50	50	12	6	530
07:00AM	76	228	68	204	95	95	19	9.5	536.5
08:00AM	96	288	45	135	110	110	19	9.5	542.5
09:00AM	87	261	53	159	77	77	22	11	508
10:00AM	96	288	32	96	48	48	22	11	443
11:00AM	115	345	72	216	53	53	42	21	635
12:00PM	131	393	128	384	95	95	38	19	891
01:00PM	134	402	97	291	68	68	38	19	780
02:00PM	131	393	80	240	93	93	26	13	739
03:00PM	108	324	97	291	66	66	16	8	689
04:00PM	101	303	62	186	71	71	15	7.5	567.5
05:00PM	123	369	100	300	70	70	15	7.5	746.5
Total	**2659**	**7977**	**1480**	**5040**	**1479**	**1479**	**447**	**223.5**	**14719.5**

Table 4 21: Traffic Volume Data (River Traffic, Location: Char Balaki)

Hour	Direction	Oil Tanker	Goods Ship	Speed boat	Engine Boat	Fishing Boat	Others
01:00PM	Up		1		1	5	
	Down		1		1	3	
02:00PM	Up		4		2	5	
	Down		3		1	8	
03:00PM	Up	1	4				
	Down		2				
04:00PM	Up		2			5	
	Down		5		1	2	
05:00PM	Up		3			4	
	Down		2			3	
06:00PM	Up		2		3	2	
	Down		4			4	
07:00PM	Up		2		1	3	
	Down		1		1	2	
08:00PM	Up		1				
	Down		3				
09:00PM	Up						
	Down						
10:00PM	Up						
	Down						
11:00PM	Up						
	Down						
12:00AM	Up						
	Down						
01:00AM	Up						
	Down						
02:00AM	Up						
	Down						
03:00AM	Up						
	Down						
04:00AM	Up						
	Down					1	
05:00AM	Up	1	1		5	4	
	Down				2	3	
06:00AM	Up				4	3	
	Down				2	3	
07:00AM	Up				3	2	
	Down				1	1	
08:00AM	Up				3	2	

Hour	Direction	Oil Tanker	Goods Ship	Speed boat	Engine Boat	Fishing Boat	Others
	Down				1	1	
09:00AM	Up		3		3	5	
	Down		5		1	4	
10:00AM	Up		1		4	3	
	Down		1		6	4	
11:00AM	Up		3		1	1	
	Down		1			1	
12:00PM	Up		2			3	
	Down		1			1	
Total		**2**	**61**		**45**	**89**	

4.8 SEISMICITY

Bangladesh, a densely populated country in South Asia, is located in the north- eastern part of the Indian sub-continent at the head of the Bay of Bengal. Tectonically, Bangladesh lies in the north-eastern Indian plate near the edge of the Indian craton and at the junction of three tectonic plates – the Indian plate, the Eurasian plate and the Burmese micro plate. These form two boundaries where plates converge– the India-Eurasia plate boundary to the north forming the Himalaya Arc and the India-Burma plate boundary to the east forming the Burma Arc **(Fig. 4.23).**

Active faults of regional scale capable of generating moderate to great earthquakes are present in and around Bangladesh. These include the Dauki fault, about 300 km long trending east-west and north-south situated between Madhupur Tract and Jamuna flood plain, Assam-Sylhet fault located along the southern edge of Shillong Plateau (Meghalaya- Bangladesh border), the 150 km long Madhupur fault trendinlt, about 300 km long trending north east southwest located in the southern Surma basin and the Chittagong-Myanmar plate boundary fault, about 800 km long runs parallel to Chittagong-Myanmar coast **(Fig. 4.24).**

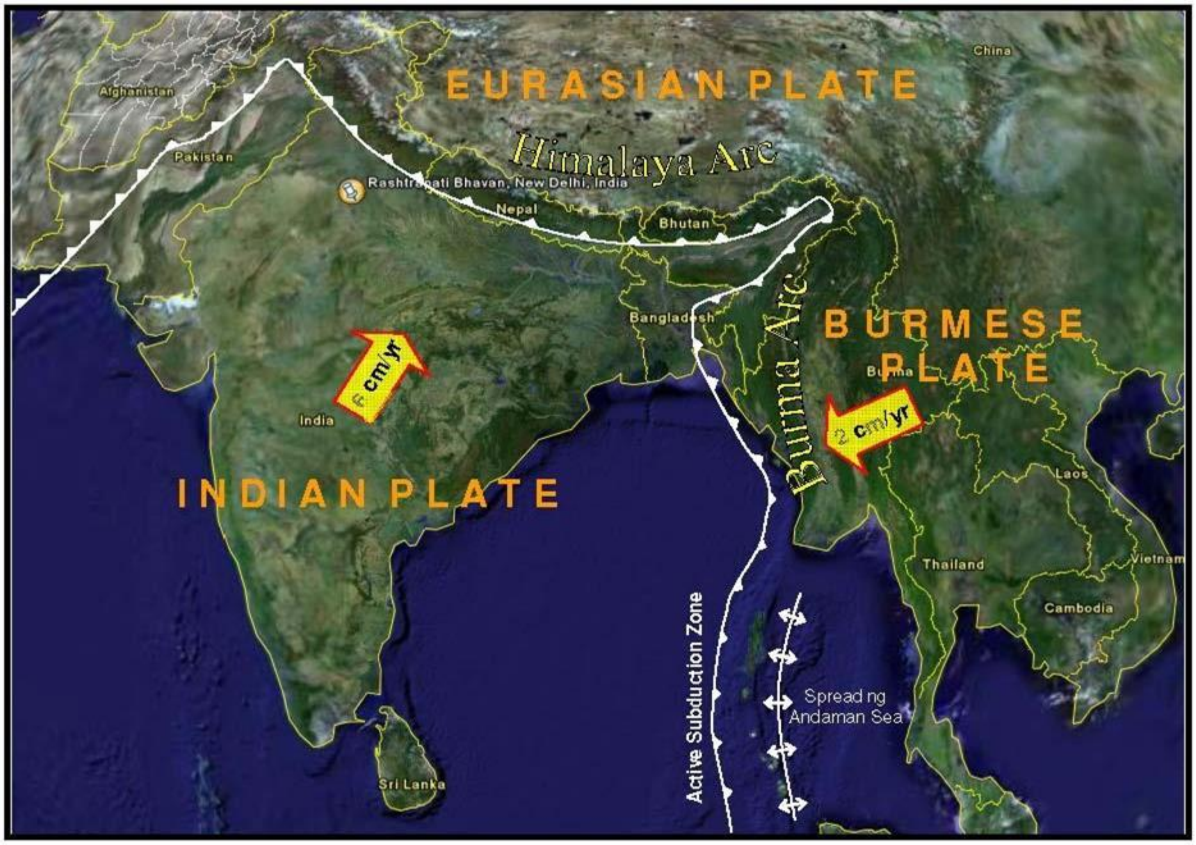


Fig. 4.23: Regional tectonic setup of Bangladesh with respect to plate configuration

The Chittagong- Myanmar plate boundary continues south to Sumatra where it ruptured in the disastrous 26 December 2004 Mw 9.3 earthquake (Steckler et al. 2008). These faults are the surface expression of fault systems that underlie the northern and eastern parts of Bangladesh. Another tectonic element, the 'Himalayan Arc' is characterized by three well defined fault systems (HFT, MBT and MCT) that are 2500 km long stretching from northwest syntaxial bend in Pakistan in the west to northeast syntaxial bend in Assam in the east. It poses a great threat to Bangladesh as significant damaging historical earthquakes have occurred in this seismic belt (Bilham et al., 2001; Mukhopadhyay et al., 2004 and Mullick et al., 2009). The tectonic set-up and the plate motions together place Bangladesh potentially vulnerable to earthquake.

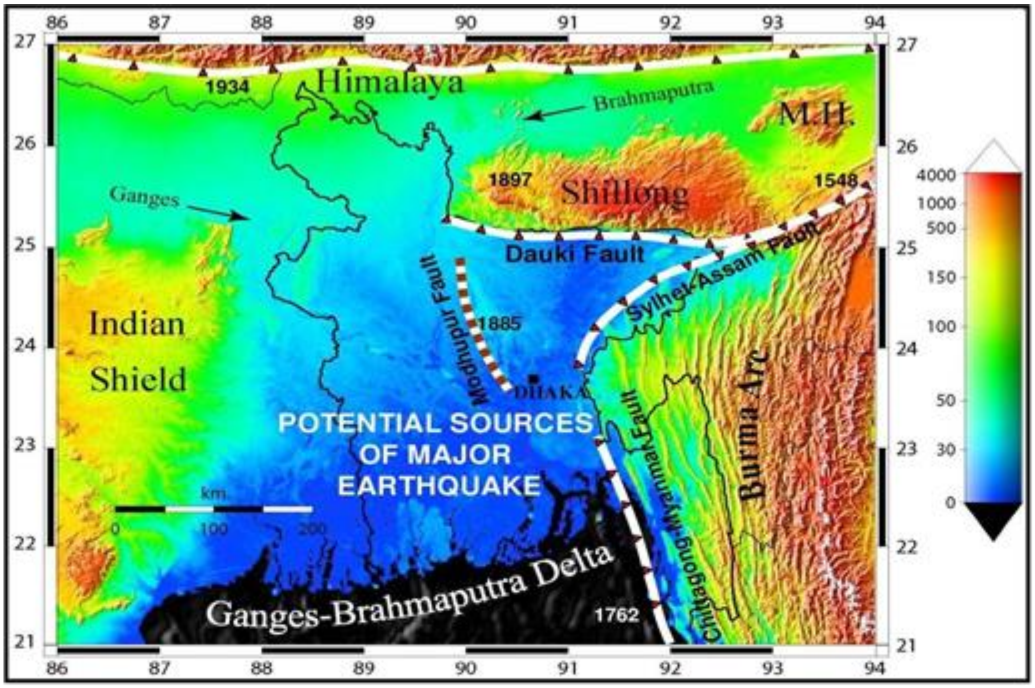


Fig. 4.24: Digital Elevation Model (DEM) of Bangladesh and surroundings showing geological faults – potential sources of major earthquakes in Bangladesh.

On the basis of distribution of earthquake epicenters and morphotectonic behaviour of different tectonic blocks Bangladesh has been divided into three generalized seismic zones **(Fig 4.25).** Zone-II comprising the central part of Bangladesh represents the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. The zone II consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the Bask coefficient for this zone is 0.05. Sonargaon area within the vicinity of Narayanganj falls in seismic zone II of the seismic zoning map of Bangladesh.

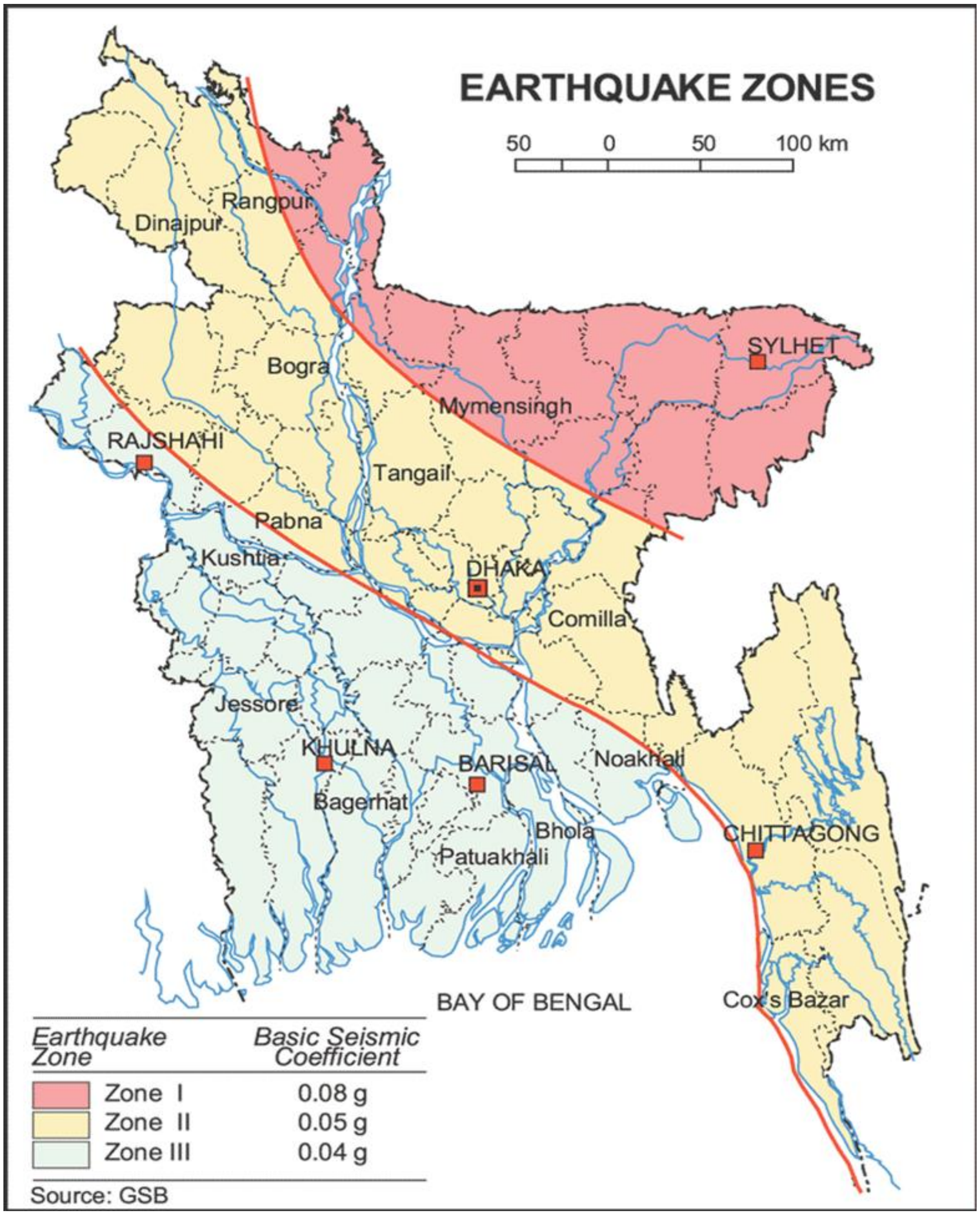


Fig 4.25: Earthquake Zoning Map of Bangladesh

Table 4.22: Seismic Zonation of Bangladesh

Zoning	Area Mercalli Scale	Modified
I	North and eastern regions of Bangladesh (Seismically most active)	IX
II	Lalmai, Barind, Madhupur Tracts, Dhaka, Comilla, Noakhali and western art of Chittagong Folded belt.	VIII
III	Khulna division S-E Bangladesh (Seismically relatively quiet)	VII

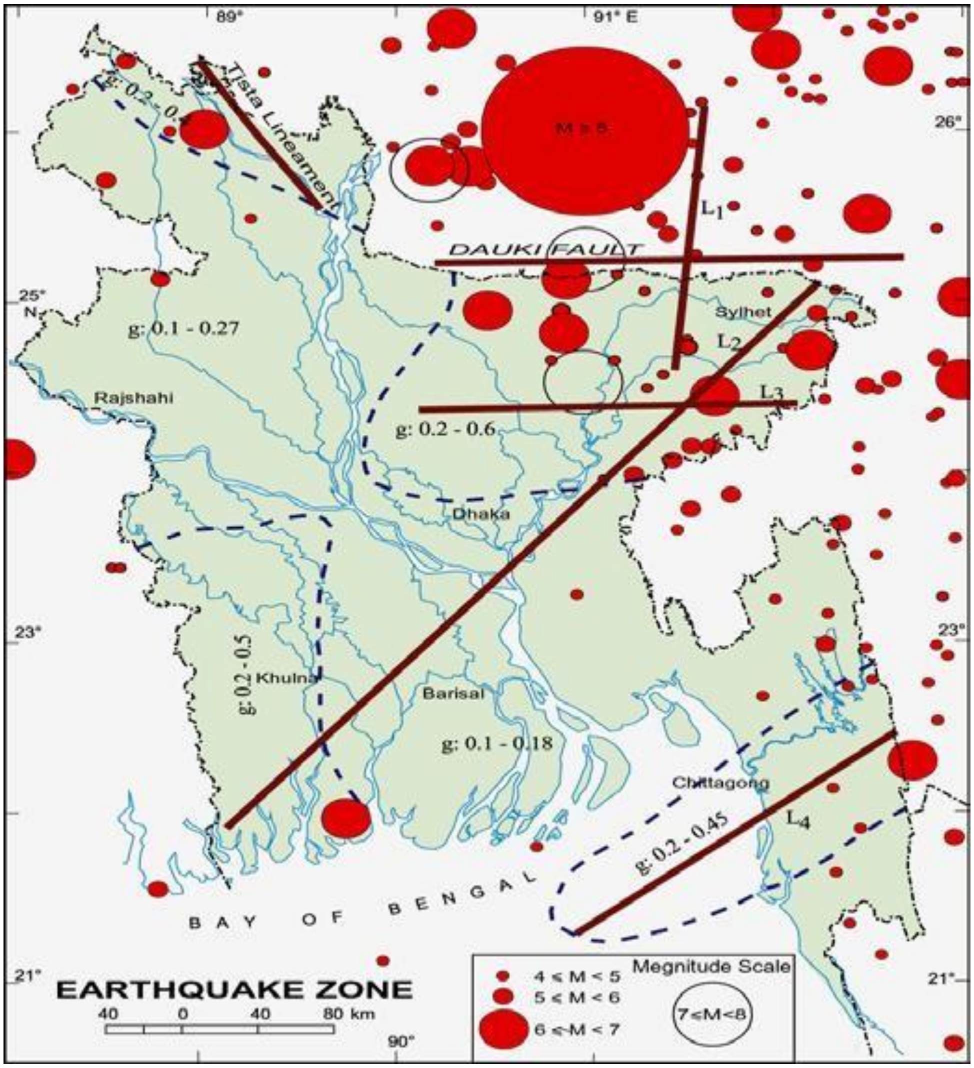


Fig. 4.26: Seismic Activity of Bangladesh

4.9 HYDROLOGY

4.9.1 River Water Flow

The flow of Meghna River at Sonargaon is less affected by tides. The maximum discharge of 16558m3/sec was measured on 9th September 2002; while the minimum discharge of 2050m3/sec was recorded on 10th June, 1998. The water data collected from BWDB for the period from 1998 to 2006 is attached in **Table – 4.23.**

Table 4.23: Flow at the Meghna River (m3/s)

Year	Maximum	Minimum
1998	14669	2050
2000	12109	3197
2001	11630	3135
2002	16558	4448
2003	13229	2938
2004	10571	3742
2005	10786	3658
2006	9463	4230

Source: BWDB

4.9.2 Surface Water Quality

To assess the existing surface water condition, numerous parameters need to be tested. During the period of conducting the study, water has been collected from 3 points; one in the upstream, one in the downstream and another near the project site where water will likely be withdrawn for power plant operation. Then the parameters were tested to assess the quality of the river water. The details of water sampling points are given in Table 4-16and shown in **Figure 4-27.**

Table 4 24: Water Sampling Points

Name of Sampling Point	Coordinate	Temperature	Remarks
Towards the Meghna Bridge	23°36'13.30"N 90°36'25.60"E	27.5º C	Upstream (Location 1)
Near Project Site	23°36'11.24"N 90°35'31.78"E	27.3º C	Probable intake point of Power Plant (Location 2)
VatiBalaki	23°35'12.10"N 90°34'44.80"E	27.3º C	Downstream, **(Location 3)**

The water quality parameters investigated were within the Bangladesh standards. The surface water quality test of the river Meghna is shown in **Table 4-25.**

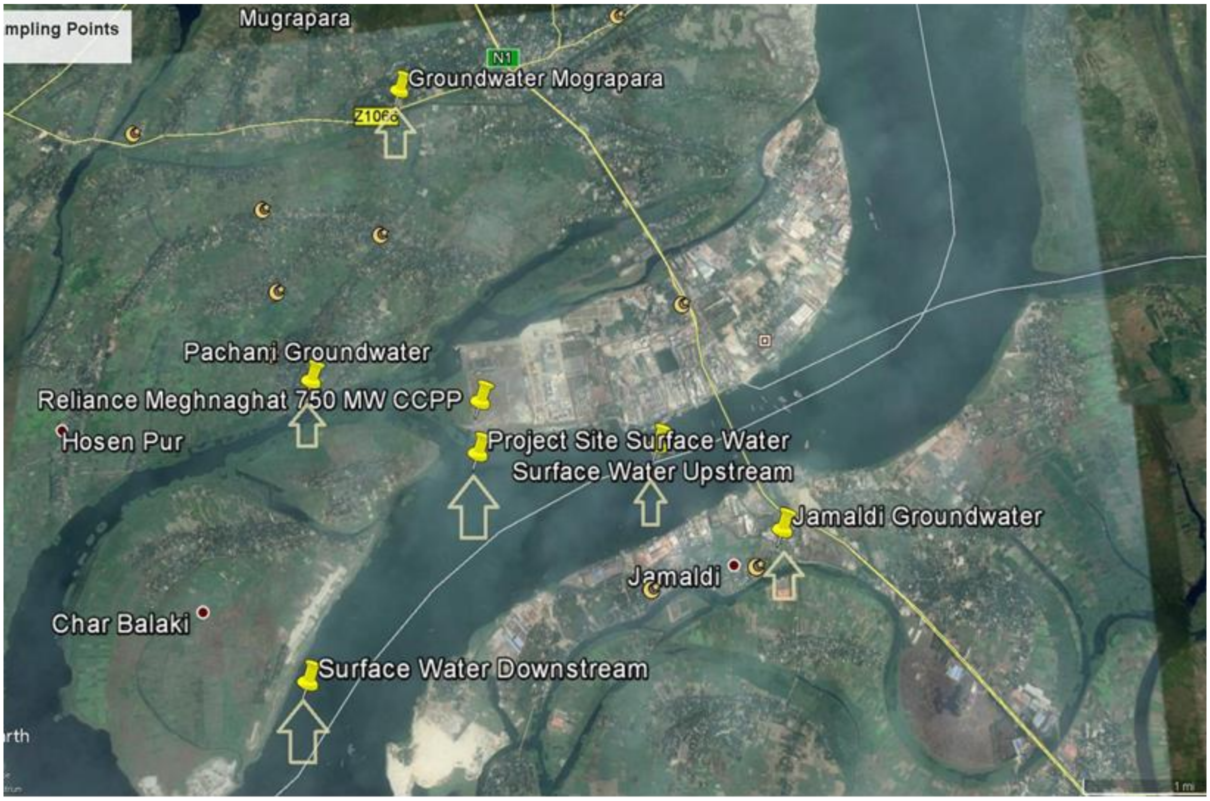


Figure 4.27: Water Sampling Locations

Table 4 25: Meghna River water quality

Sl. No.	Name of Parameter	Concentration Present			DoE (Bangladesh) Standard *	IFC/World Bank Standard	Unit	Method of analysis
		Location 1	**Location 2**	**Location 3**				
1.	pH	7.18	7.18	7.26	6-9	6-9	-	pH Meter
2.	Color	50	72	52	15	15	Pt-Co	USEPA 110.2; SM 2120 C
3.	Temperature	27.3	27.3	27.5	40	NF	^0C	Mercury filled thermometer
4.	DO	8	8	5	4.5-8	NF	mg/L	DO meter
5.	TDS	38	38	37	2100	NF	mg/L	TDS meter
6.	Conductivity	19	19	18.3	NF	NF	µS/cm	Conductivity Meter
7.	Alkalinity	66	66	63	NF	NF	mg/L	Standard Titrimetric method
8.	Iron	0.038	0.038	0.03	2	3.5	mg/L	Colorimetric
9.	Chloride	165	165	140	600	NF	mg/L	Mercuric nitrate titration
10.	Hardness	117	117	125	200-500	NF	mg/L	EDTA titrimetric method
11.								
12.	Arsenic	<0.003	<0.003	<0.003	0.02	NF	mg/L	AAS
13.	TSS	19.5	19.5	11.2	150	50	mg/L	Dried at 103-105
14.	Turbidity	18.7	18.7	9.6	NF	NF	NTU	Nephelometric
15.	Salinity	<100	<100	<100	NF	NF	mg/L	Potentiometry

Sl. No.	Name of Parameter	Concentration Present			DoE (Bangladesh) Standard *	IFC/World Bank Standard	Unit	Method of analysis
16.	Manganese	<0.1	<0.1	<0.1	5	NF	mg/L	AAS
17.	Cadmium	<0.002	<0.002	<0.002	0.50	0.1	mg/L	AAS
18.	Calcium	30.2	30.2	35.5	NF	NF	mg/L	AAS
19.	Chromium	<0.02	<0.02	<0.02	0.5	0.5	mg/L	AAS
20.	Zinc	<0.005	<0.005	<0.005	5	1	mg/L	AAS
21.	Copper	0.08	0.08	0.5	0.5	0.5	mg/L	AAS
22.	Lead	<0.05	<0.05	<0.05	0.1	0.5	mg/L	AAS
23.	Magnesium	46.5	46.5	23.7	NF	NF	mg/L	AAS
24.	Fluoride	0.5	0.5	0.5	2	NF	mg/L	Potentiometry
25.	Nitrate	5.3	5.3	9.7	10	NF	mg/L	Potentiometry
26.	Sulphate	13.5	13.5	8.2	NF	NF	mg/L	Nephelometric
27.	Phosphate	<0.07	<0.07	0.11	NF	NF	mg/L	Photometric
28.	COD	21.8	21.8	33.2	200	250	mg/L	Open Reflux
29.	BOD_5 at 20°C	7.4	7.4	12.6	50	50	mg/L	5-Day BOD test
30.	TC	>160	>160	>160	0	NF	#/100 mL	Membrane Filter Technique
31.	FC	52	52	62	0	NF	#/100 mL	Membrane Filter Technique
32.	Mercury (Hg)	<0.0001	<0.0001	<0.0001				

Source: AECL Lab, NGO Forum, BUET& BCSIR (sample collected on 21.11.2016 and reporting on 22.11.2016)
*Standard for inland surface water.
*NF-Not Found.

The existing water quality of the Meghna River near the project area found to comply with standards. Though three other power plants are located in the same area (Meghnaghat Power Limited, Summit Meghnaghat Power Company Limited and Orion Power Meghnaghat Limited) as well as two cement plants at 3 km upstream of the plant viz. Holcim Cement plant and United Cement plant water quality at all three locations, were found within the limit of national and international standards. The river water is not used for bathing, irrigation and drinking within the project vicinity.

In addition to the point sources, the discharge from non-point sources include those from engine boats, shipping (oil and grease) and run off from agricultural activities containing pesticides and chemical fertilizer residues are also drained into the river.

Table-4.26 Secondary data for Meghna River water

Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	IFC/World Bank Standard
Temperature	25.4^{0}C	40°C	NF
Dissolved Oxygen(DO)	6 mg/L	4.5-8 mg/l	NF
BOD5	6 mg/L	50 mg/l	50 mg/l
COD	14 mg/L	200 mg/l	250 mg/l
Total Dissolved Solids (TDS)	370 mg/L	2100 mg/l	NF
Total Suspended Solids (TSS)	8 mg/L	150 mg/l	NF
pH	7.0	6-9	6-9
Total Alkalinity	70.0 mg/L	NF	NF
Hardness	75.0 mg/L	NF	NF
Iron	0.21 mg/L	2 mg/l	NF
Nitrate	7.52 mg/l	10.0 mg/l	NF
Phosphate	0.16 mg/L	6	NF
Calcium	18.4 mg/l	NF	NF
Oil & Grease	6.42 mg/l	10.0 mg/l	10.0 mg/l
Color	Colorless	Colorle ss	Colorless
Fluoride	Not Detected	NF	NF

Source: AECL Lab (sample collected on 29.01. 2014 from Gowalgao and reporting on 30.01. 2014; Secondary Data)
**Standard for inland surface water.*
**NF-Not Found.*

4.9.3 Groundwater Hydrology Groundwater Level

Groundwater hydrological conditions are established by the availability of developed

Ground water horizon everywhere, adapted to dust foams and sand lenses. The waters are closely connected with the Meghna River and during flooding practically are occurred on surface.

Ground water table in major portion of Bangladesh exists at a shallow to moderate (Generally below 3.0 m) depth with confined, semi-confined and unconfined aquifers which is being recharged by major river systems and by infiltration of rain water. The ground water table fluctuates with seasons approaching near ground surface (within 1.0m) over most of the country during wet seasons (July-September).

Like other parts of the country, ground water is a stable source of water for various activities including irrigation (both shallow and deep tube wells), domestic purposes (hand pumps) and industrial applications (deep wells) in the project area. The fluctuation of ground water in the area in the dry season is lowered to about 6.0m below the ground level. However, groundwater levels return their original position before the end of monsoon. This condition is referred to as an 'aquifer full' response, where ground levels are controlled by rivers or other forms of surface drainage.

Under natural condition the ground water level reflects the wet and dry season as noticed in all the water level stations. The levels are lowest in late April or early May and rise to field capacity during the rainy season. The field capacity is then maintained to the end of the rainy season till the dry season recession conveniences. In general, dry season use of ground water is extensive in most of the project area.

4.9.4 Ground Water Quality

Ground water level exists at a moderate (Generally below 5 - 8.0 m) depth, which is being recharged mainly by infiltration of rainwater. According to Bangladesh Water Development Board, the ground water level of SonargaonUpazila is about 7.0 m. Ground water is the source of water for domestic use in this area. Water from underground source is assumed to be available as most of the period of the year the area remains under water. That means the recharge capacity of the ground water level seems to be adequate.

To assess the quality of that region surrounding the project site, water samples were collected from 3 locations so that the points surround the project site. The details of the sampling locations are given in **Table 4-27**

Table 4 27: Ground Water Sampling Locations

Name of Sampling Point	Coordinate	Direction from Project Site
Pachani (Location 1)	23°36'31.54"N 90°34'40.62"E	E
Mograpara(Location 2)	23°37'58.47"N 90°35'3.67"E	NW
Jamaldi(Location 3)	23°35'50.51"N 90°37'1.90"E	SW

Different parameters of the groundwater near and around the project site were tested. Water sampleswere collected from the tube wells of nearby places.The results of ground water quality test show that all the parameters remain within the allowable limit of drinking water value as per as Environmental Quality Standards for Bangladesh.The parameters which have been analyzed during this study are presented below in **Table 4-28**.

Table 4 28: Ground Water Quality

S. No.	Name of Parameters	Concentration Present			DoE (Bangladesh) Standard	IFC/WB Standard	Unit	Method of analysis
		GW1	GW 2	GW 3				
1.	pH	7.05	7.04	7.16	6-9	6-9	-	pH Meter
2.	Temperatue	25.8	25.8	25.8	40	NF	^{0}C	Mercury filled thermometer
3.	DO	5.01	5.08	5.50	4.5-8	NF	mg/L	DO meter
4.	TDS	353	386	304	2100	NF	mg/L	TDS meter
5.	Conductivity	176.2	193	151.8	NF	NF	µS/cm	Conductivity Meter
6.	Alkalinity	240	186	165	NF	NF	mg/L	Standard Titrimetric method
7.	Iron	0.06	0	0.02	2	3.5	mg/L	Colorimetric
8.	Chloride	120	130	125	600	NF	mg/L	Mercuric nitrate titration
9.	Hardness	240	198	220	200-500	NF	mg/L	EDTA titrimetric method
10.	Arsenic	0.047	0.006	0.017	0.02	NF	mg/L	AAS
11.	TSS	8	6.5	5.5	150	50	mg/L	Dried at 103-105
12.	Turbidity	5.9	4.9	1.8	NF	NF	NTU	Nephelometrc
13.	Salinity	400	400	300	NF	NF	mg/L	Potentiometry
14.	Manganese	0.2	0.1	<0.1	5	NF	mg/L	AAS

S. No.	Name of Parameters	Concentration Present			DoE (Bangladesh) Standard	IFC/WB Standard	Unit	Method of analysis
15.	Cadmium	<0.002	<0.002	<0.002	0.50	0.1	mg/L	AAS
16.	Calcium	85.3	87.5	78	NF	NF	mg/L	AAS
17.	Chromium	<0.02	<0.02	<0.02	0.5	0.5	mg/L	AAS
18.	Zinc	<0.005	<0.005	<0.005	5	1	mg/L	AAS
19.	Copper	0.01	<0.01	<0.01	0.5	0.5	mg/L	AAS
20.	Lead	<0.05	<0.05	<0.05	0.1	0.5	mg/L	AAS
21.	Magnesium	96.5	109.2	88.3	NF	NF	mg/L	AAS
22.	Fluoride	<1	<1	<1	2	NF	mg/L	Potentiometry
23.	Nitrate	14.5	3.5	2.2	10	NF	mg/L	Potentiometry
24.	Sulphate	25.1	9.6	9.4	NF	NF	mg/L	Nephelometrc
25.	Phosphate	0.28	<0.07	<0.07	NF	NF	mg/L	Photometric
26.	COD	5.6	5.8	8.3	200	250	mg/L	Open Reflux
27.	BOD_5 at 20°C	2.3	1.7	3.7	50	50	mg/L	5-Day BOD test
28.	TC	14	4	14	0	NF	#/100 mL	Membrane Filter Technique
29.	FC	0	0	1	0	NF	#/100 mL	Membrane Filter Technique

Source: AECL Lab, NGO Forum & BCSIR

pH value of ground water is ranging from 7.04 to 7.16 in respect to acceptable level of 6 – 9. Most of heavy metals was found below the detectable limit, whereas, slight concentration of Iron and Zinc were observed. However, concentration of Iron and Zinc was found well below the acceptable limits. In general water can be used for drinking, after necessary disinfection.

Table-4.29: Ground Water quality (Secondary Data)

S. N.	PARAMETER	Concentration present	DoE (Bangladesh) Standard for Inland surface water
01	Total coliforms	0 CFU/100mL	0
02	Fecal coliform	0 CFU/100mL	0
03	Total hardness	404.0 mg/L	200-500
04	Salinity	0.4 ppt	-
05	Total Alkalinity	405.0 mg/L	-
06	Calcium	119.2 mg/L	75
07	Turbidity	1.86 NTU	10

S. N.	PARAMETER	Concentration present	DoE (Bangladesh) Standard for Inland surface water
08	Phosphate	0.16 mg/L	6
09	Sulphate	<1.0 mg/L	400
10	Iron	11.64 mg/L	0.3-1.0

Source: icddr, b (sample collected on 29.01. 2014 from Vati Balaki Primary School and reporting on 30.01. 2014; Secondary Data)

4.10 SOIL CHARACTERISTICS

To assess the soil quality of the project area, soil samples were collected from different points in and around the project site. The description of the soil sampling points is given in Table and has been shown in Figure 4-28.

Table 4 30: Soil Sampling Points

Name of Sampling Point	Coordinate	Elevation in meter (From MSL)
Mugrapara	23°37'59.10"N 90°35'5.98"E	8.5
Jamaldi	23°35'49.82"N 90°37'0.69"E	4.25
Project Site	23°36'27.70"N 90°35'40.50"E	1.2
Char Balaki	23°35'17.30"N 90°34'38.60"E	4.5

4.10.1 Findings on Soil Quality

The soil samples were analyzed for all the important parameters like pH, electrical conductance, calcium, magnesium, nitrogen, phosphorus, potassium, etc. The NPK represents the nutrients available in the soil, which directly indicates the soil fertility.The soil quality parameters and their concentration of the samples near and around the project siteare given in **Table 4-31.**

Table 4 31: Soil Quality Parameters and Their Values

SL.	Parameters		Analytical Results				Analytical Methods
			Project Area	Char Balaki	Mograpara	Jamaldi	
Physical Parameters							
1	Particle Size Distribution	Sand (%)	94	88	45	47	Hydrometer Method
		Silt (%)	4	8	38	38	
		Clay (%)	2	4	17	15	

SL.	Parameters	Analytical Results				Analytical Methods
		Project Area	Char Balaki	Mograpara	Jamaldi	
2	Texture	Sand	Loamy Sand	Loam	Loam	Marshal's Textural Triangle Method
3	Permeability (cm/hr)	6.1	5.3	2.5	1.6	Constant Head Method
4	Porosity (%)	53	52	49	48	Core Method
5	pH	7.22	7.33	7.33	6.95	pH Meter 1:2.5
6	Electrical Conductivity (µS/cm)	16.2	12.3	225.2	74.5	EC Meter 1:5
Chemical Parameters						
7	Nitrates (mg/kg)	2.11	3.20	11.20	12.45	KCl extraction and ion chromatography
8	Phosphates (as PO_4^{-3}) (mg/kg)	43.21	48.23	112.06	147.37	Olsen extraction and ion chromatography
9	Iron (Fe) (%)	0.083	0.013	1.56	1.58	Acid digestion and AAS
10	Lead(Pb) (mg/kg)	2.00	*BDL	11.0	10.50	Acid digestion and AAS
11	Manganese (Mn) (mg/kg)	147.5	8.55	375.5	330.4	Acid digestion and AAS
12	Nickel (Ni) (mg/kg)	7.70	1.30	18.30	22.55	Acid digestion and AAS
13	Barium (Ba) (mg/kg)	1226	1145	1736	1875	Acid digestion and AAS
14	Zinc (Zn) (mg/kg)	25.74	5.97	108.72	95.05	Acid digestion and AAS
15	Copper (Cu) (mg/kg)	2.20	0.050	13.55	14.80	Acid digestion and AAS
16	Cadmium (Cd) (mg/kg)	BDL	BDL	BDL	BDL	Acid digestion and AAS
17	Chromium (Cr) (mg/kg)	11.65	2.60	26.15	29.60	Acid digestion and AAS
18	Arsenic (As) (mg/kg)	1.62	0.29	2.56	1.70	Acid digestion and AAS
19	Cation Exchange Capacity (cmol/kg)	0.92	1.88	11.0	10.12	NH_4OAc method

Source: Department of Soil, Water and Environment, University of Dhaka
*BDL: Below Detection Limit

The pH of the soil is an important parameter; plants cannot grow in low and high pH value. It can be seen that the soils in the area are slightly basic in nature with pH values ranging from 7.22-7.33. On Jamaldi, the soil is slightly acidic (pH: 6.95).Electrical conductivity values in the samples varied from 12.5 to 225.2µS/cm. The Cation exchange capacity of soil samples ranges from 0.92 to 11.0meq/100gm; the lesser the value, the sandier the soil gets. Arsenic found in the soil sample ranges from 0.29 to 2.56 mg/kg which is very little. Nitrogen encourages the vegetative development of plants by imparting a healthy green colour to the leaves. It also controls, to some extent, the efficient utilization of phosphorus and potassium. Nitrates in all the four soil samples were found to be from 2.11 (Project Site) to 12.45 (Jamaldi) mg/kg whereas the Manganese ranged from 8.55 (Char Balaki) – 375.5 (Mograpara) mg/kg. Phosphate levels were observed to be 43.21 - 147.37 mg/kg. Thus the soils in the region can be concluded as neutral and suitable for construction.The iron levels in soil samples collected from the study area vary from 0.083 to 1.58%. Concentration of Leadranges from untraceable in Char Balakito 11.0 in Mograpara. The other heavy metals like Cadmium and Chromium were found to be untraceable. The site was developed by BPDB upto root level. The site is vacant and empty.

The soil analysis in table 4.32 has also compared with Duetch intervention values 2013 (Soil Remediation Circular July, 2013) as below

Table 4.32: Soil Analysis

SL.	Parameters	Analytical Results				Duetch Intervention Values 2013 (Soil Remediation Circular July, 2013)
		Project Area	Char Balaki	Mogra para	Jamaldi	
1	Lead(Pb) (mg/kg)	2.00	*BDL	11.0	10.50	530
2	Zinc (Zn) (mg/kg)	25.74	5.97	108.72	95.05	720
3	Copper (Cu) (mg/kg)	2.20	0.050	13.55	14.80	190
4	Cadmium (Cd) (mg/kg)	BDL	BDL	BDL	BDL	13
5	Nickel (Ni) (mg/kg)	7.70	1.30	18.30	22.55	100

Hence, it is inferred that site is not contaminated.

Figure 4.28: Soil Sampling Locations

4.11 BIOLOGICAL RESOURCES

Biological environment is an indicator of changing environmental quality. Thus, an understanding of biological environment of an area is important for environmental impact assessment. Bangladesh has realm number of biological diversity for its geographical location and favorable climatic condition for life. Biodiversity is facing unprecedented levels of threat due to unwise industrialization. For the reasons, it has become imperative to assay diversity prior to any big set up.

Identifying and monitoring biological diversity is a huge and potentially infinite task given its variability in time and space and its spectrum of levels. Biodiversity estimation applying short span studies are becoming ever popular and in this regard preparation of checklists of birds on a wider scale has been given much importance (Roy et al., 2011). The reliance Group of Bangladesh is planning to construct a 750 MW Combined Cycle Power Plant at Meghnaghat, Sonargaon, Narayanganj. The GPS position of the site is 23036'25.56'N, 90035'32.16"E. A rapid floral and faunal diversity assessment was carried out at different locations of the proposed site to get idea about the biodiversity of the area. Though, the short study does not reflect complete biodiversity of that area. Detail investigation is necessary to have a complete list.

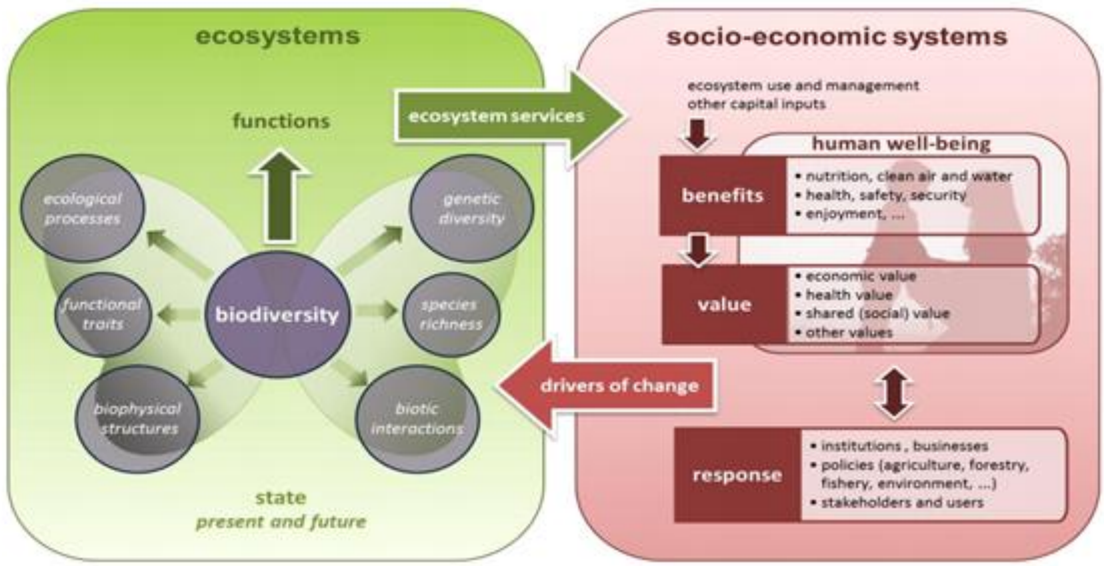


Figure 4.29: Conceptual framework for ecosystem assessment

Indicator species assessment of different biotypes and habitats has been used as tools to assess the biological health of habitats. They are also considered model organisms to assess the effects of global climate change. We made a quick survey on some bioindicator species viz, Odonate, Butterfly, Mollusc, Plankton, Fish and Avifauna. Diversity of these indicator species will give an idea about the health of that specific area.

4.11.1 Industrialization in the Study Area

We cannot avoid demand of industrialization for the better development of the country. But careful decision should be taken prior to any new set up. If any such set up create threat to the biodiversity, country development would not be sustainable. Fisherman of the river near study area informed that they can catch lesser quantity of fish from the river nowadays than they used to years before the industrialization of the area. There are some industries already existed near the study are. Such industries should be very careful for their effluent and byproduct.

Plate 1: Industry near study area

Plate 2: Industry near study area

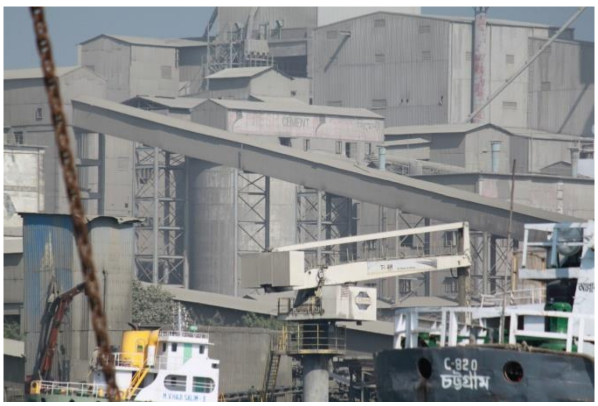


Plate 3: Dust coming out from an industry made shade over the industry building, may also be harmful for all biodiversity

Plate 4: Making carrier ship near the bank of river

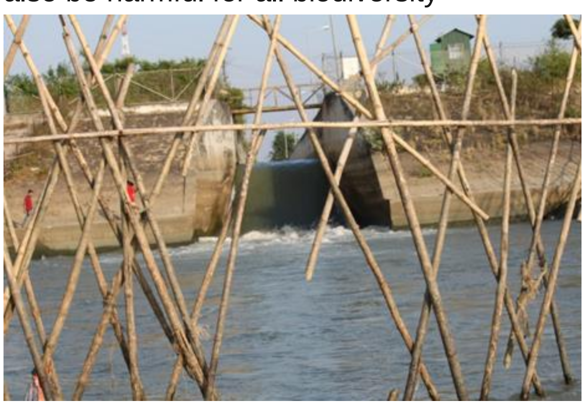


Plate 5: Water coming out from an industry

Plate 6: Carrier vessel in the river

Plate 7: Carrier vessel in the river

Figure: 4.30: Industrialization in the Study Area

4.11.2 Methods of sample collection

A comprehensive survey was conducted at the vicinity of proposed Reliance Meghnaghat 750 MW CCPP on December 2, 2016 to get an idea about the status of the diversity of animals in that area. Water samples of the river were collected from all the TWO locations around the proposed power plant. Different physical parameters of the water samples were checked and recorded. Phytoplankton and Zooplankton nets were used to collect different types of planktons available in each type of water sample. Different types of fishes, macro and micro-invertebrates were collected from each of the location. Several types of fishing nets were utilized for this purpose. To get an idea about the biodiversity of each location, water samples were collected around 40 meter radius of each sampling location. The collected specimens were identified instantly or brought to the laboratory for further confirmation. Proper keys, Journals, books and encyclopedia were consulted for identification of the collected specimens. Fishermen were interviewed to get an idea about the present status and past records of the availability and abundance of fish population of the river. Fish sellers of the local fish market were also interviewed to collect their opinion about the present and past status of the abundance of fishes in the area.

For phytoplankton and Zooplankton survey 10 lit of water (two liters each time) was collected from each sampling location and was sieved by plankton net. 45 ml of sieved water was collected in a 50 ml Falcon tube. Then 5 ml of alcohol was added in each Falcon tube as preservative so that the microorganisms are not damaged before identification, in this way 5 samples were collected from each sampling location 1 ml of water from each 50 ml sample was studied in a “rafter cell counter” under microscope.

4.11.3 Observations

Huge number of floating water hyacinth was trapped by the local people. They use bamboo poles for trapping. They use this place to attract different kinds of fishes as shelter place. Fishermen encircle this area after every 15-20 days with nets and capture fish. During interview with the local people, they informed that during each fishing huge quantity of different kinds of fishes are captured. Water quality includes various physical and biological parameters which has direct influence on the aquatic organisms and vegetation. Abundance of fishes and their growth are dependent on the quality of water and availability of food.

4.11.4 Terrestrial Ecology – Flora

Natural flora and fauna are important features of any environment. They form a distinctive community with mutual dependencies among their component members and show diverse degree of responses and sensitivities to physical influences. Thus, in any environmental analysis where integration of ecological thoughts into planning process is required an analysis of biological environmental status is very important. It is well known that the deterioration of natural environment is a consequence of socio-economic developmental processes unless it is properly planned.

4.11.4.1 Methodology

The present baseline ecological survey was conducted during December 2016. The basic methodological approaches which were followed for the present baseline work are-

- Field survey,
- Site selection for sampling,
- Plant samples collection,
- Identification of plant samples,
- Data analysis and interpretation.

4.11.4.2 Field survey

A comprehensive field survey was conducted almost throughout the designated sites of the proposed power plant areas at Reliance Meghnaghat 750 MW CCPP area during December 2016.

4.11.4.3 Site selection for sampling

All types of ecological habitats like aquatic/wetland, cultivated land, fallow land, homestead area, road side, forest area and salt/shrimp culture area etc. of the designated sites/locations within 2 km radius of the project area were selected for sampling of both qualitative and quantitative data collections.

FIGURE 4.31 : LOCATION FOR SAMPLING OF ECOLOGICAL SURVEY

Point A: Lat 23°36'24.58"N	Long 90°35'29.51"E
Point B: Lat 23°36'24.58"N	Long 90°35'41.04"E
Point C: Lat 23°35'24.23"N	Long 90°35'24.13"E
Point D: Lat 23°36'13.00"N	Long 90°34'20.61"E

Figure 4.31: Location for sampling Ecological Survey

4.11.4.4 Plant samples collection

Plant samples of different species, observed in the visited sites were collected following standard quadrat method (Braun-Blanquet, 1932; Raunkiaer, 1934). The quadrat size- (2m □ 2m) for herbs and grasses, (5m □ 5m) for shrubs and (10m □ 10m) for trees were standardized on the basis of species-area-curve method (Cain, 1938).

4.11.4.5 Identification of plant samples

All the collected plant specimens found in the selected sites of Proposed Power Plant area was identified by taxonomic expertise and through cross-checking with herbarium specimens preserved at BNH/JUH and also matching the taxonomic description, keys or the photographs/illustrations in the relevant literatures, especially the recent Floras and Manuals of

Hooker, 1872-1897; Prain, 1903; Khan, 1972-1987; Khan and Halim, 1987; Siddiqui, 2007a, b; Ahmed, 2008 a,b, c, d; 2009a,b etc.

In each selected sites/location, ten quadrats were randomly applied in diversified habitats. Collected plant samples were processing and preparation of herbarium sheets following standard herbarium techniques (Jain and Rao, 1977).

4.11.4.6 Observations

A total of 192 vascular plant species belonging to 161genera under 78 families have been recorded from the proposed LNG-based power plant area (Table 4-22) where the maximum 153 (80%) plant species belonged to the dicotyledonous group, followed by 32 (17%) and 7 (3%) plant species belonged to the monocotyledonous and pteridophytes (ferns) groups, respectively.

Among the habit categories, the highest number of species 105 (54.69%) were herbs, followed by 42 (21.88%), 16 (8.33%) and 15 (7.81%) species were trees, shrubs and climbers, respectively whereas the lowest number of plant species 11 (5.73%) were recorded as creeper.

Table 4 33: Plant Species of the Proposed LNG-based Power Plant Area

Sl. No	Scientific name	Family name	Local name	Habit	Plant group
1.	*Acacia auriculiformis* A. Cunn. *ex* Benth. & Hook.	Mimosaceae	Akashmoni	Tree	Dicot
2.	*Aegle marmelos* (L.) Corr.	Rutaceae	Bel	Tree	Dicot
3.	*Ageratum conyzoides* L.	Asteraceae	Phulkuri	Herb	Dicot
4.	*Albizia chinensis* (Osb.) Merr.	Mimosaceae	Kkoroi	Tree	Dicot
5.	*Albizia lebbeck* (L.) Benth. & Hook.	Mimosaceae	Kalokoroi	Tree	Dicot
6.	*Albizia procera* (Roxb.) Benth.	Mimosaceae	Silkoroi	Tree	Dicot
7.	*Alternanthera sessilis* (L.) R. Br. ex Roem. & Schult.	Amaranthaceae	Chhoto chanchi	Creeper	Dicot
8.	*Amaranthus gangeticus* L.	Amaranthaceae	Notey shak	Herb	Dicot
9.	*Amaranthus spinosus* L.	Amarantaceae	Katanotey	Tree	Dicot
10.	*Amaranthus tricolor* L.	Amaranthaceae	Lalshak	Herb	Dicot
11.	*Amaranthus viridis* L.	Amaranthaceae	Notey	Herb	Dicot
12.	*Ammannia baccifera*L.	Lythraceae	Acidpata	Herb	Dicot
13.	*Ampelopteris prolifera* (Retz.) Copel	Thelypteridaceae	Dekia	Herb	Fern
14.	*Anisomeles indica* (L.) O. Kuntze	Lamiaceae	Bontulshi	Herb	Dicot
15.	*Annona reticulate* L.	Annonaceae	Ata, Nona Ata	Tree	Dicot
16.	*Annona squamosa* L.	Annonaceae	Shorifa	Shrub	Dicot

Sl. No	Scientific name	Family name	Local name	Habit	Plant group
17.	*Aphanamixis polystachya* (Wall.) R. Parker	Meliaceae	Pitraj	Tree	Dicot
18.	*Artocarpus chama*Buch.-Ham. *Ex* Wall.	Moraceae	Chapalish	Tree	Dicot
19.	*Artocarpus heterophyllus* Lamk.	Moraceae	Kathal	Tree	Dicot
20.	*Arundo donax* L.	Poaceae	Gangabena	Tree	Mocot
21.	*Atylosia scarabaeoides* (L.) Baker	Fabaceae	Kukshim	Climber	Dicot
22.	*Averrhoa carambola* L.	Oxalidaceae	Kamranga	Tree	Dicot
23.	*Axonopus compressus* (Sw.) P. Beauv.	Poaceae	Chapraghas	Herb	Mocot
24.	*Azadirachta indica* A. Juss.	Meliaceae	Neem	Tree	Dicot
25.	*Brassica nigra* (L.) Koch	Brassicaceae	Shorisha	Herb	Dicot
26.	*Cajanus cajan* (L.) Millsp.	Fabbaceae	Arhor	Shrub	Dicot
27.	*Calotropis gigantea* (L.) R. Br.	Asclepiadaceae	Akond	Shrub	Dicot
28.	*Cardiospermum halicacabum*L.	Sapindaceae	Phutkilata	Climber	Dicot
29.	*Carica papaya* L.	Caricaceae	Papaya	Herb	Dicot
30.	*Centella asiatica* (L.) Urban	Apiaceae	Thankuni	Creeper	Dicot
31.	*Chenopodium album* L.	Chenopodiaceae	Botua shak	Herb	Dicot
32.	*Chromolaena odorata* (L.) King & Robinson	Asteraceae	German lata	Herb	Dicot
33.	*Chloris barbata* Sw.	Poaceae	Ghash	Herb	Monocot
34.	*Christella dentate*	Thelypteridaceae	Dekia	Herb	Fern
35.	*Cissampelos pareira* L. var. hirsuta (Buch.-Ham. *ex* DC.) Forman	Menispermaceae	Lotagach	Climber	Dicot
36.	*Citrus grandis* (L.) Osbeck.	Rutaceae	Jambura	Tree	Dicot
37.	*Cleome rutidosperma* DC.	Capparaceae	Hurhurey	Herb	Dicot
38.	*Cleome viscosa* L.	Capparaceae	Holudhurhurey	Herb	Dicot
39.	*Clerodendrum viscosum* Vent.	Verbenaceae	Vat	Shrub	Dicot
40.	*Coccinia cordifolia* Cogn.	Cucurbitaceae	Telakucha	Herb	Dicot
41.	*Cocos nucifera* L.	Arecaceae	Narical	Tree	Mocot
42.	*Commelina benghalensis* L.	Commelinaceae	Kanchira	Herb	Mocot
43.	*Commelina longifolia* Lamk.	Commelinaceae	Kanai, Kanchira	Herb	Mocot
44.	*Corchorus olitorius* L.	Tiliaceae	Bonpat/Titpat	Herb	Dicot

Sl. No	Scientific name	Family name	Local name	Habit	Plant group
45.	*Cotula hemispherica* (Roxb.) Wall, ex C. B.	Asteraceae	Babuni	Herb	Dicot
46.	*Crotalaria pallida* Ait.	Fabaceae	Jhonjhoni	Herb	Dicot
47.	*Croton bonplandianus* Baill.	Euphorbiaceae	Banmarich	Herb	Dicot
48.	*Cucurbita maxima* Duch. ex Lamk.	Cucurbitaceae	Mistikumra	Climber	Dicot
49.	*Cyathula prostrata* (L.) Blume	Amaranthaceae	Chhoto Apang	Herb	Dicot
50.	*Cynodon dactylon* (L.) Pers.	Poaceae	Durba	Herb	Mocot
51.	*Cuscuta reflexa* Roxb.	Cuscutaceae	Sharnalata	Climber	Dicot
52.	*Cyanotis cristata (L.) D. Don*	Commelinaceae	unknown	Herb	Dicot
53.	*Dactyloctenium aegyptium (L.) P. Beauv.*	Poaceae	Ghash	Herb	Monocot
54.	*Dentella repens (L.) J. R. & G. Forst.*	Rubiaceae	Sharpil bhuipata	Herb	Dicot
55.	*Desmodium heterophyllum (Willd.) DC.*	Fabaceae	Bonmotosuti	Herb	Dicot
56.	*Desmodium triflorum (L.) DC.*	Fabaceae	Tripatri shak	Herb	Dicot
57.	*Dillenia indica L.*	Dilleniaceae	Chalta	Tree	Dicot
58.	*Dioscorea esculenta (Lour.) Burkill*	Dioscoreaceae	Chuprialu	Climber	Monocot
59.	*Diospyros peregrina Guerke*	Ebenaceae	Deshigab	Tree	Dicot
60.	*Eclipta alba (L.) Hassk.*	Asteraceae	Kalokeshi	Shrub	Dicot
61.	*Eleusine indica (L.) Gaertn.*	Poaceae	Kechla	Herb	Mocot
62.	*Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.*	Poaceae	Unknown	Herb	Mocot
63.	*Eragrostis unioloides (Retz.) Nees ex Steud.*	Poaceae	Mulakoni	Herb	Mocot
64.	*Eucalyptus camaldulensis Dehnhardt*	Myrtaceae	Eucalyptus	Tree	Dicot
65.	*Euphorbia hirta L.*	Euphorbiaceae	Dudhia	Herb	Dicot
66.	*Evolvulus nummularius (L.) L.*	Convolvulaceae	Khetpapra	Creeper	Dicot
67.	*Ficus benghalensis L.*	Moraceae	Bat	Tree	Dicot
68.	*Ficus hispida L. f.*	Moraceae	Kagdumur	Tree	Dicot
69.	*Ficus religiosa L.*	Moraceae	Ashwath	Tree	Dicot
70.	*Fimbristylis acuminata Vahl*	Cyperaceae	Acumifimbry	Herb	Mocot
71.	*Glinus oppositifolius (L.) A. DC.*	Molluginaceae	Gimashak	Herb	Dicot
72.	*Gmelina arborea Roxb.*	Verbenaceae	Gamar	Tree	Dicot

Sl. No	Scientific name	Family name	Local name	Habit	Plant group
73.	*Gnaphalium luteo-album L.*	Asteraceae	Sadalomi	Herb	Dicot
74.	*Grangea maderaspatana (L.) Poir.*	Asteraceae	Nemuti	Herb	Dicot
75.	*Heliotropium indicum L.*	Asteraceae	Hatisur	Herb	Dicot
76.	*Hedyotis corymbosa (L.) Lamk.*	Rubiaceae	Khetpapra	Herb	Dicot
77.	*Hibiscus rosa-sinensis L.*	Malvaceae	Jaba	Shrub	Dicot
78.	*Hibiscus sabdariffa L.*	Malvaceae	Stholpadda	Shrub	Dicot
79.	*Ipomoea batatas (L.) Poir.*	Convolvulaceae	Misti alu	Creeper	Dicot
80.	*Jasminum sambac (L.) Ait.*	Oleaceae	Jui	Shrub	Dicot
81.	*Kyllinga microcephala Steud.*	Cyperaceae	Muthaghas	Herb	Monocot
82.	*Lablab purpureus (L.) Sweet*	Fabaceae	Shim	Climber	Dicot
83.	*Lagenaria siceraria (Molina) Standl.*	Cucrbitaceae	Lau	Climber	Dicot
84.	*Lannea coromandelica (Houtt.) Merr.*	Anacardiaceae	Jiga	Tree	Dicot
85.	*Launaea aspleniifolia DC.*	Asteraceae	Lonia	Herb	Dicot
86.	*Lawsonia inermis L.*	Lythraceae	Mehedi	Tree	Dicot
87.	*Leucaena leucocephala (Lamk.) de Wit.*	Mimosaceae	Ipil-Ipil	Tree	Dicot
88.	*Leucas aspera (Willd.) Link*	Lamiaceae	Swetdrawn	Herb	Dicot
89.	*Lindernia rotundifolia (L.) Alston*	Scrophulariaceae	Chotohelencha	Herb	Dicot
90.	*Lippia alba (Mill.) Briton et Wilson*	Verbenaceae	Lipia	Herb	Dicot
91.	*Litchi chinensis Sonn.*	Sapindaceae	Litchu	Tree	Dicot
92.	*Luffa cylindrica (L.) M. Roem.*	Cucurbitaceae	Jhinga	Climber	Dicot
93.	*Madhuca longifolia (Koenig) MacBride*	Sapotaceae	Mohua	Tree	Dicot
94.	*Mangifera indica L.*	Anacardiaceae	Am	Tree	Dicot
95.	*Melia azedarach L.*	Meliaceae	Gora Neem	Tree	Dicot
96.	*Melochia corchorifolia L.*	Sterculiaceae	Unknown	Shrub	Dicot
97.	*Merremia hederacea (Burm. f.) Hallier f.*	Convolvulaceea	Unknown	Climber	Dicot
98.	*Mikania cordata (Burm. f.) Robinson*	Asteraceae	Assam lata	Climber	Dicot
99.	*Mimosa pudica L.*	Mimosaceae	Lazzabati	Herb	Dicot
100.	*Mirabilis jalapa L.*	Nyctaginaceae	Shayndhamaloti	Herb	Dicot
101.	*Moringa oleifera Lamk.*	Moringaceae	Shojna	Tree	Dicot

Sl. No	Scientific name	Family name	Local name	Habit	Plant group
102.	*Momordica charantia L.*	Cucurbitaceae	Korolla	Climber	Dicot
103.	*Musa paradisiaca L.*	Mussaceae	Kathalikola	Herb	Mocot
104.	*Neolamarckia cadamba (Roxb.) Bosser*	Rubiaceae	Kadom	Tree	Dicot
105.	*Ocimum sanctum L.*	Lamiaceae	Babuitulshi	Herb	Dicot
106.	*Oldenlandia corymbosa L.*	Rubiaceae	Khetpapra	Herb	Dicot
107.	*Oxalis corniculata L.*	Oxalidaceae	Amrul	Herb	Dicot
108.	*Panicum sp.*	Poaceae	Bashpatighas	Herb	Mocot
109.	*Paspalum flavidum (Retz.) A. Camus*	Poaceae	Moissaghas	Herb	Mocot
110.	*Passiflora foetida L.*	Passifloraceae	Jhumkalata	Climber	Dicot
111.	*Pedilanthus tithymaloides Poit.*	Euphorbiaceae	Bera Chita	Herb	Dicot
112.	*Phyla nodiflora (L.) Greene*	Verbenaceae	Bakan	Herb	Dicot
113.	*Phyllanthus acidus (L.) Skeels*	Euphorbiaceae	Arboroi	Tree	Dicot
114.	*Phyllanthus niruri L.*	Euphorbiaceae	Bhuiamla	Herb	Dicot
115.	*Phyllanthus reticulatus Poir.*	Euphorbiaceae	Sitka	Shrub	Dicot
116.	*Phyllanthus urinaria L.*	Euphorbiaceae	Sitka	Shrub	Dicot
117.	*Physalis minima L.*	Solanaceae	Phutka	Herb	Dicot
118.	*Pogostemon crassicaulis (Benth.) J. R. Press*	Lamiaceae	Aripachuli	Herb	Dicot
119.	*Pouzolzia zeylanica (L.) Benn.*	Urticaceae	Bilati luchipata	Herb	Dicot
120.	*Psidium guajava L.*	Myrtaceae	Peyara	Tree	Dicot
121.	*Punica granatum L.*	Punicaceae	Dalim	Shrub	Dicot
122.	*Richardia scabra L.*	Rubiaceae	Khetpapra	Herb	Dicot
123.	*Ricinus communis L.*	Euphorbiaceae	Rerhi/Vrenda	Shrub	Dicot
124.	*Rorippa indica (L.) Hiern*	Brassicaceae	Bonshorisha	Herb	Dicot
125.	*Sacciolepis interrupta (Willd.) Stapf*	Poaceae	Ghash	Herb	Monocot
126.	*Saccharum spontaneum L.*	Poaceae	Kash	Herb	Mocot
127.	*Samanea saman (Jacq.) Merr.*	Mimosaceae	Raintree	Tree	Dicot
128.	*Scoparia dulcis L.*	Scrophulariaceae	Bandhoney	Herb	Dicot
129.	*Senna alata (L.) Roxb.*	Caesalpiniaceae	Datmardan	Shrub	Dicot
130.	*Senna occidentalis Roxb.*	Caesalpiniaceae	Kolkashunda	Shrub	Dicot
131.	*Senna tora (L.) Roxb.*	Caesalpiniaceae	Kolkashunda	Herb	Dicot

Sl. No	Scientific name	Family name	Local name	Habit	Plant group
132.	*Sida acuta Burm. f.*	Malvaceae	Berela	Herb	Dicot
133.	*Sida rhombifolia L.*	Malvaceae	Pitberela	Herb	Dicot
134.	*Solanum lycopersicum Dunal*	Solanaceae	Tomato	Herb	Dicot
135.	*Solanum melongena L.*	Solanaceae	Begun	Herb	Dicot
136.	*Solanum nigrum L.*	Solanaceae	Kakmachi	Herb	Dicot
137.	*Solanum sisymbrifolium Lamk.*	Solanaceae	Kataegun	Herb	Dicot
138.	*Sphaeranthus indicus L.*	Asteraceae	Mundi	Herb	Dicot
139.	*Spondias pinnata (L. f.) Kurz*	Anacardiaceae	Amra	Tree	Dicot
140.	*Stephania japonica (Thunb.) Miers*	Menispermiaceae	Ghaupata	Climber	Dicot
141.	*Swietenia mahagoni Jacq.*	Meliaceae	Mehagoni	Tree	Dicot
142.	*Synedrella nodiflora (L.) Gaertn.*	Asteraceae	Nakphul	Herb	Dicot
143.	*Syzygium cumini (L.) Skeels*	Myrtaceae	Jam	Tree	Dicot
144.	*Tamarindus indica L.*	Caesalpiniaceae	Tetul	Tree	Dicot
145.	*Terminalia catappa L.*	Combretaceae	Kathbadam	Tree	Dicot
146.	*Thevetia peruviana (Pers.) K. Schum.*	Apocynaceae	Holud korobi	Tree	Dicot
147.	*Tinospora cordifolia (Willd.) Hook. f. & Thoms.*	Menispermaceae	Gulancha	Climber	Dicot
148.	*Trema orientalis (L.) Blume*	Ulmaceae	Jibon	Tree	Dicot
149.	*Tridax procumbens L.*	Asteraceae	Tridhara	Herb	Dicot
150.	*Urena lobata L.*	Malvaceae	Banokra	Shrub	Dicot
151.	*Vernonia cinerea (L.) Less.*	Asteraceae	Kukurshunga	Herb	Dicot
152.	*Xanthium indicum Koen. ex Roxb.*	Asteraceae	Ghagra	Herb	Dicot
153.	*Ziziphus mauritiana Lamk.*	Rhamnaceae	Kul, Boroi	Tree	Dicot

4.11.4.7 Aquatic Flora/ wetland flora

Table 4 34: Aquatic Species in the Proposed Study Area

Sl. No.	Scientific name	Family name	Local name	Habit	Plant group
1.	*Adenosma indianum*(Lour.) Merr.	Scrophulariaceae	Baghjama	Herb	Dicot
2.	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	Henchi	Creeper	Dicot
3.	*Aponogeton appendiculatus*Bruggen	Aponogetonaceae	Jalkachu	Herb	Monocot
4.	*Azolla pinnata*	Azollaceae	Azola	Herb	Fern
5.	*Barringtonia acutangula* (L.) Gaertn.	Lecythidaceae	Hijal	Tree	Dicot
6.	*Colocasia esculenta* (L.) Schott	Araceae	Kachu	Herb	Mocot
7.	*Crateva magna* (Lour.) DC.	Capparaceae	Borun	Tree	Dicot
8.	*Cryptocoryne spiralis* (Retz.) Fischer *ex* Wydler	Araceae	Gangkochu	Herb	Monocot
9.	*Cyperus rotundus* L.	Cyperaceae	Muthaghas	Herb	Monocot
10.	*Cyperus* sp	Cyperaceae	Bhadighas	Herb	Monocot
11.	*Eichhornia crassipes* (Mart.) Solms	Pontedariaceae	Kachuripana	Herb	Mocot
12.	*Enhydra fluctuans* Lour.	Asteraceae	Helencha	Creeper	Dicot
13.	*Ficus heterophylla* L. f.	Moraceae	Latadumur	Climber	Dicot
14.	*Floscopia* sp.	Commelinaceae	Kanshira	Herb	Monocot
15.	*Hygrophila polysperma* (Roxb.) T. Anders.	Acanthaceae	Makhna	Herb	Dicot
16.	*Hygroryza aristata* (Retz.) Nees	Poaceae	Jalghas	Creeper	Monocot
17.	*Ipomoea aquatica* Forssk.	Convolvulaceae	Kolmi shak	Creeper	Dicot
18.	*Ipomoea fistulosa* Mart. *ex* Choisy	Convolvulaceae	Dholkalmi	Herb	Dicot
19.	*Leersia hexandra* Sw.	Poaceae	Aralighas	Herb	Mocot
20.	*Lemna perpusilla* Torrey	Lemnaceae	Khudipana	Herb	Mocot
21.	*Limnophila sessiliflora*(Vahl) Blume	Scrophulariaceae	Limnophila	Herb	Dicot
22.	*Ludwigia adscendens*(L.) Hara	Onagraceae	Keshordom	Creeper	Dicot
23.	*Ludwigia hyssopifolia*(G. Don) Exell apud A. &R. Fernandas	Onagraceae	Bonmorich	Herb	Dicot
24.	*Marsilea minuta* L.	Masileaceae	Susni sak	Creeper	Fern
25.	*Najas minor* L.	Najadaceae	Najas	Herb	Dicot
26.	*Nymphoides indicum* (L.) O. Kuntze	Menynthaceae	Chandmala	Herb	Dicot
27.	*Persicaria assamica*(Meissn.) Sojak	Polygonaceae	Bishkathali	Herb	Dicot
28.	*Persicaria barbata*(L.) Hara	Polygonaceae	Bishkathali	Herb	Dicot

Sl. No.	Scientific name	Family name	Local name	Habit	Plant group
29.	*Persicaria hydropiper*(L.) Spach	Polygonaceae	Bishkathali	Herb	Dicot
30.	*Persicaria orientalis*(L.) Spach	Polygonaceae	Bishkathali	Herb	Dicot
31.	*Pistia stratiotes* L.	Araceae	Topapana	Herb	Mocot
32.	*Polygonum plebeium*R. Br.	Polygonaceae	Bishkathali	Herb	Dicot
33.	*Rotala indica* (Willd.) Koehne	Lythraceae	Deshi ghurni	Herb	Dicot
34.	*Salvinia cucullata*	Salviniaceae	Indurkanipana	Herb	Fern
35.	*Salvinia molesta*	Salviniaceae	Boropatapana	Herb	Fern
36.	*Salvinia natans*	Salviniaceae	Basanpatapana	Herb	Fern
37.	*Schoenoplectus articulatus*(L.) Palla	Cyperaceae	Chechri	Herb	Mocot
38.	*Trewia nudiflora* L.	Euphorbiaceae	Petali	Tree	Dicot
39.	*Vallisneria spiralis* L.	Hydrocharitaceae	Patajahangi	Herb	Mocot

Table 4 35: Redlist categories and existing DAFOR status of the recorded vegetation in the proposed LNG-based power plant area area

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
1.	*Acacia auriculiformis* A. Cunn. *ex* Benth. & Hook.	Mimosaceae	Lc	O
2.	*Adenosma indianum*(Lour.) Merr.	Scrophulariaceae	Lc	R
3.	*Aegle marmelos* (L.) Corr.	Rutaceae	Lc	O
4.	*Ageratum conyzoides* L.	Asteraceae	Lc	F
5.	*Albizia chinensis* (Osb.) Merr.	Mimosaceae	Lc	O
6.	*Albizia lebbeck* (L.) Benth. & Hook.	Mimosaceae	Lc	F
7.	*Albizia procera* (Roxb.) Benth.	Mimosaceae	Lc	A
8.	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	Lc	A
9.	*Alternanthera sessilis* (L.) R. Br. ex Roem. & Schult.	Amaranthaceae	Lc	D
10.	*Amaranthus gangeticus* L.	Amaranthaceae	Lc	F
11.	*Amaranthus spinosus* L.	Amarantaceae	Lc	A
12.	*Amaranthus tricolor* L.	Amaranthaceae	Lc	F
13.	*Amaranthus viridis* L.	Amaranthaceae	Lc	F
14.	*Ammannia baccifera*L.	Lythraceae	Lc	O

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
15.	*Ampelopteris prolifera* (Retz.) Copel	Thelypteridaceae	Lc	F
16.	*Anisomeles indica* (L.) O. Kuntze	Lamiaceae	Lc	R
17.	*Annona reticulate* L.	Annonaceae	Lc	O
18.	*Annona squamosa* L.	Annonaceae	Lc	O
19.	*Aphanamixis polystachya* (Wall.) R. Parker	Meliaceae	Lc	R
20.	*Aponogeton appendiculatus*Bruggen	Aponogetonaceae	CD	F
21.	*Artocarpus chama*Buch.-Ham. *ex* Wall.	Moraceae	Lc	O
22.	*Artocarpus heterophyllus* Lamk.	Moraceae	Lc	O
23.	*Arundo donax* L.	Poaceae	Lc	F
24.	*Atylosia scarabaeoides* (L.) Baker	Fabaceae	Lc	O
25.	*Averrhoa carambola* L.	Oxalidaceae	Lc	O
26.	*Axonopus compressus* (Sw.) P. Beauv.	Poaceae	Lc	A
27.	*Azadirachta indica* A. Juss.	Meliaceae	Lc	F
28.	*Azolla pinnata*	Azollaceae	Lc	R
29.	*Barringtonia acutangula*(L.) Gaertn.	Lecythidaceae	Lc	R
30.	*Brassica nigra* (L.) Koch	Brassicaceae	Lc	A
31.	*Cajanus cajan*(L.) Millsp.	Fabbaceae	Lc	F
32.	*Calotropis gigantea* (L.) R. Br.	Asclepiadaceae	Lc	F
33.	*Cardiospermum halicacabum*L.	Sapindaceae	Lc	O
34.	*Carica papaya* L.	Caricaceae	Lc	F
35.	*Centella asiatica* (L.) Urban	Apiaceae	Lc	A
36.	*Chenopodium album* L.	Chenopodiaceae	Lc	A
37.	*Chloris barbata* Sw.	Poaceae	NE	R
38.	*Christella dentata*	Thelypteridaceae	NT	R
39.	*Chromolaena odorata* (L.) King & Robinson	Asteraceae	VU	A
40.	*Cissampelos pareira* L. var. hirsuta	Menispermaceae	Lc	R
41.	*Citrus grandis* (L.) Osbeck.	Rutaceae	Lc	F
42.	*Cleome rutidosperma* DC.	Capparaceae	Lc	A
43.	*Cleome viscosa* L.	Capparaceae	Lc	F
44.	*Clerodendrum viscosum* Vent.	Verbenaceae	Lc	F

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
45.	*Coccinia cordifolia* Cogn.	Cucurbitaceae	Lc	A
46.	*Cocos nucifera* L.	Arecaceae	Lc	F
47.	*Colocasia esculenta* (L.) Schott	Araceae	Lc	D
48.	*Commelina benghalensis* L.	Commelinaceae	Lc	A
49.	*Commelina longifolia* Lamk.	Commelinaceae	Lc	F
50.	*Corchorus olitorius* L.	Tiliaceae	Lc	O
51.	*Cotula hemispherica* (Roxb.) Wall, ex C. B.	Asteraceae	Lc	F
52.	*Crateva magna*(Lour.) DC.	Capparaceae	Lc	A
53.	*Crotalaria pallida* Ait.	Fabaceae	Lc	F
54.	*Croton bonplandianus* Baill.	Euphorbiaceae	Lc	D
55.	*Cryptocoryne spiralis*(Retz.) Fischer *ex* Wydler	Araceae	Lc	F
56.	*Cucurbita maxima* Duch. ex Lamk.	Cucurbitaceae	Lc	F
57.	*Cuscuta reflexa* Roxb.	Cuscutaceae	Lc	A
58.	*Cyanotis cristata* (L.) D. Don	Commelinaceae	Lc	F
59.	*Cyathula prostrata* (L.) Blume	Amaranthaceae	NE	F
60.	*Cynodon dactylon* (L.) Pers.	Poaceae	Lc	A
61.	*Cyperus rotundus* L.	Cyperaceae	Lc	F
62.	*Cyperus* sp	Cyperaceae	Lc	O
63.	*Dactyloctenium aegyptium*(L.) P. Beauv.	Poaceae	Lc	F
64.	*Dentella repens*(L.) J. R. & G. Forst.	Rubiaceae	Lc	F
65.	*Desmodium heterophyllum* (Willd.) DC.	Fabaceae	Lc	O
66.	*Desmodium triflorum* (L.) DC.	Fabaceae	Lc	A
67.	*Dillenia indica* L.	Dilleniaceae	Lc	O
68.	*Dioscorea esculenta*(Lour.) Burkill	Dioscoreaceae	Lc	O
69.	*Diospyros peregrina* Guerke	Ebenaceae	Lc	R
70.	*Eclipta alba* (L.) Hassk.	Asteraceae	Lc	A
71.	*Eichhornia crassipes* (Mart.) Solms	Pontedariaceae	Lc	D
72.	*Eleusine indica* (L.) Gaertn.	Poaceae	Lc	A
73.	*Enhydra fluctuans* Lour.	Asteraceae	Lc	A
74.	*Eragrostis tenella* (L.) P. Beauv. *ex* Roem. & Schult.	Poaceae	Lc	A

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
75.	*Eragrostis unioloides*(Retz.) Nees *ex* Steud.	Poaceae	Lc	F
76.	*Eucalyptus camaldulensis* Dehnhardt	Myrtaceae	NE	F
77.	*Euphorbia hirta* L.	Euphorbiaceae	Lc	F
78.	*Evolvulus nummularius* (L.) L.	Convolvulaceae	Lc	F
79.	*Ficus benghalensis* L.	Moraceae	Lc	O
80.	*Ficus heterophylla* L. f.	Moraceae	Lc	F
81.	*Ficus hispida* L. f.	Moraceae	Lc	O
82.	*Ficus religiosa* L.	Moraceae	Lc	O
83.	*Fimbristylis acuminata*Vahl	Cyperaceae	Lc	F
84.	*Floscopia* sp.	Commelinaceae	Lc	A
85.	*Glinus oppositifolius* (L.) A. DC.	Molluginaceae	Lc	F
86.	*Gmelina arborea* Roxb.	Verbenaceae	Lc	O
87.	*Gnaphalium luteo-album* L.	Asteraceae	Lc	A
88.	*Grangea maderaspatana* (L.) Poir.	Asteraceae	Lc	A
89.	*Hedyotis corymbosa*(L.) Lamk.	Rubiaceae	Lc	F
90.	*Heliotropium indicum* L.	Asteraceae	Lc	D
91.	*Hibiscus rosa-sinensis* L.	Malvaceae	Lc	O
92.	*Hibiscus sabdariffa*L.	Malvaceae	Lc	R
93.	*Hygrophila polysperma* (Roxb.) T. Anders.	Acanthaceae	Lc	O
94.	*Hygroryza aristata*(Retz.) Nees	Poaceae	Lc	A
95.	*Ipomoea aquatica* Forssk.	Convolvulaceae	Lc	D
96.	*Ipomoea batatas* (L.) Poir.	Convolvulaceae	Lc	F
97.	*Ipomoea fistulosa* Mart. *ex* Choisy	Convolvulaceae	Lc	A
98.	*Jasminum sambac*(L.) Ait.	Oleaceae	Lc	R
99.	*Kyllinga microcephala*Steud.	Cyperaceae	Lc	D
100.	*Lablab purpureus* (L.) Sweet	Fabaceae	Lc	F
101.	*Lagenaria siceraria* (Molina) Standl.	Cucrbitaceae	Lc	F
102.	*Lannea coromandelica* (Houtt.) Merr.	Anacardiaceae	Lc	F
103.	*Launaea aspleniifolia* DC.	Asteraceae	Lc	A
104.	*Lawsonia inermis* L.	Lythraceae	Lc	O

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
105.	*Leersia hexandra* Sw.	Poaceae	Lc	A
106.	*Lemna perpusilla* Torrey	Lemnaceae	Lc	A
107.	*Leucaena leucocephala* (Lamk.) de Wit.	Mimosaceae	Lc	F
108.	*Leucas aspera* (Willd.) Link	Lamiaceae	Lc	A
109.	*Limnophila sessiliflora*(Vahl) Blume	Scrophulariaceae	Lc	A
110.	*Lindernia rotundifolia*(L.) Alston	Scrophulariaceae	Lc	A
111.	*Lippia alba*(Mill.) Briton *et* Wilson	Verbenaceae	Lc	F
112.	*Litchi chinensis*Sonn.	Sapindaceae	Lc	O
113.	*Ludwigia adscendens*(L.) Hara	Onagraceae	Lc	A
114.	*Ludwigia hyssopifolia*	Onagraceae	Lc	D
115.	*Luffa cylindrica* (L.) M. Roem.	Cucurbitaceae	Lc	F
116.	*Madhuca longifolia*(Koenig) MacBride	Sapotaceae	Lc	R
117.	*Mangifera indica* L.	Anacardiaceae	Lc	F
118.	*Marsilea minuta* L.	Masileaceae	Lc	A
119.	*Melia azedarach* L.	Meliaceae	Lc	F
120.	*Melochia corchorifolia*L.	Sterculiaceae	Lc	O
121.	*Merremia hederacea*(Burm. f.) Hallier f.	Convolvulaceea	Lc	F
122.	*Mikania cordata* (Burm. f.) Robinson	Asteraceae	Lc	F
123.	*Mimosa pudica* L.	Mimosaceae	Lc	F
124.	*Mirabilis jalapa* L.	Nyctaginaceae	Lc	R
125.	*Momordica charantia* L.	Cucurbitaceae	Lc	A
126.	*Moringa oleifera*Lamk.	Moringaceae	Lc	O
127.	*Musa paradisiaca* L.	Mussaceae	Lc	F
128.	*Najas minor* L.	Najadaceae	Lc	F
129.	*Neolamarckia cadamba* (Roxb.) Bosser	Rubiaceae	Lc	O
130.	*Nymphoides indicum* (L.) O. Kuntze	Menynthaceae	Lc	F
131.	*Ocimum sanctum* L.	Lamiaceae	Lc	F
132.	*Oldenlandia diffusa* (Willd.) Roxb.	Rubiaceae	DD	F

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
133.	*Oxalis corniculata* L.	Oxalidaceae	Lc	A
134.	*Panicum* sp.	Poaceae	Lc	F
135.	*Paspalum flavidum*(Retz.) A. Camus	Poaceae	Lc	F
136.	*Passiflora foetida* L.	Passifloraceae	Lc	R
137.	*Pedilanthus tithymaloides* Poit.	Euphorbiaceae	Lc	O
138.	*Persicaria assamica*(Meissn.) Sojak	Polygonaceae	Lc	F
139.	*Persicaria barbata*(L.) Hara	Polygonaceae	Lc	F
140.	*Persicaria hydropiper*(L.) Spach	Polygonaceae	Lc	A
141.	*Persicaria orientalis*(L.) Spach	Polygonaceae	Lc	D
142.	*Phyla nodiflora* (L.) Greene	Verbenaceae	Lc	F
143.	*Phyllanthus acidus* (L.) Skeels	Euphorbiaceae	Lc	R
144.	*Phyllanthus niruri* L.	Euphorbiaceae	Lc	A
145.	*Phyllanthus reticulatus* Poir.	Euphorbiaceae	Lc	D
146.	*Phyllanthus urinaria*L.	Euphorbiaceae	Lc	F
147.	*Physalis minima* L.	Solanaceae	Lc	F
148.	*Pistia stratiotes* L.	Araceae	Lc	A
149.	*Pogostemon crassicaulis* (Benth.) J. R. Press	Lamiaceae	Lc	A
150.	*Polygonum plebeium*R. Br.	Polygonaceae	Lc	F
151.	*Pouzolzia zeylanica* (L.) Benn.	Urticaceae	Lc	F
152.	*Psidium guajava* L.	Myrtaceae	Lc	F
153.	*Punica granatum* L.	Punicaceae	Lc	O
154.	*Richardia scabra* L.	Rubiaceae	Lc	A
155.	*Ricinus communis* L.	Euphorbiaceae	Lc	O
156.	*Rorippa indica*(L.) Hiern	Brassicaceae	Lc	A
157.	*Rotala indica* (Willd.) Koehne	Lythraceae	Lc	R
158.	*Saccharum spontaneum* L.	Poaceae	Lc	A
159.	*Sacciolepis interrupta*(Willd.) Stapf	Poaceae	Lc	F
160.	*Salvinia cucullata*	Salviniaceae	Lc	A

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
161.	*Salvinia molesta*	Salviniaceae	Lc	F
162.	*Salvinia natans*	Salviniaceae	Lc	D
163.	*Samanea saman* (Jacq.) Merr.	Mimosaceae	Lc	A
164.	*Schoenoplectus articulatus* (L.) Palla	Cyperaceae	Lc	A
165.	*Scoparia dulcis* L.	Scrophulariaceae	Lc	F
166.	*Senna alata* (L.) Roxb.	Caesalpiniaceae	Lc	A
167.	*Senna occidentalis*Roxb.	Caesalpiniaceae	Lc	F
168.	*Senna tora* (L.) Roxb.	Caesalpiniaceae	Lc	F
169.	*Sida acuta* Burm. f.	Malvaceae	Lc	F
170.	*Sida rhombifolia*L.	Malvaceae	Lc	O
171.	*Solanum lycopersicum* Dunal	Solanaceae	Lc	A
172.	*Solanum melongena* L.	Solanaceae	Lc	A
173.	*Solanum nigrum* L.	Solanaceae	Lc	F
174.	*Solanum sisymbrifolium* Lamk.	Solanaceae	Lc	D
175.	*Sphaeranthus indicus* L.	Asteraceae	Lc	F
176.	*Spondias pinnata* (L. f.) Kurz	Anacardiaceae	Lc	O
177.	*Stephania japonica*(Thunb.) Miers	Menispermiaceae	Lc	O
178.	*Swietenia mahagoni* Jacq.	Meliaceae	Lc	F
179.	*Synedrella nodiflora* (L.) Gaertn.	Asteraceae	Lc	F
180.	*Syzygium cumini* (L.) Skeels	Myrtaceae	Lc	O
181.	*Tamarindus indica* L.	Caesalpiniaceae	Lc	F
182.	*Terminalia catappa* L.	Combretaceae	Lc	O
183.	*Thevetia peruviana* (Pers.) K. Schum.	Apocynaceae	Lc	O
184.	*Tinospora cordifolia* (Willd.) Hook. f. & Thoms.	Menispermaceae	Lc	R
185.	*Trema orientalis* (L.) Blume	Ulmaceae	Lc	O
186.	*Trewia nudiflora* L.	Euphorbiaceae	Lc	A
187.	*Tridax procumbens*L.	Asteraceae	Lc	F
188.	*Urena lobata* L.	Malvaceae	Lc	O

Sl. No.	Scientific name	Family name	Red list status	DAFOR status
189.	*Vallisneria spiralis* L.	Hydrocharitaceae	Lc	A
190.	*Vernonia cinerea* (L.) Less.	Asteraceae	Lc	O
191.	*Xanthium indicum* Koen. ex Roxb.	Asteraceae	Lc	A
192.	*Ziziphus mauritiana* Lamk.	Rhamnaceae	Lc	F

Note: LC= Least Concern, NE= Not Evaluated, NT= Near Threatened, CD= Coservation Dependent, DD= Data Deficient, VU= Vulnerable. D= Dominant, A= Abundant, F= Frequent, O= Occasional, R= Rare.

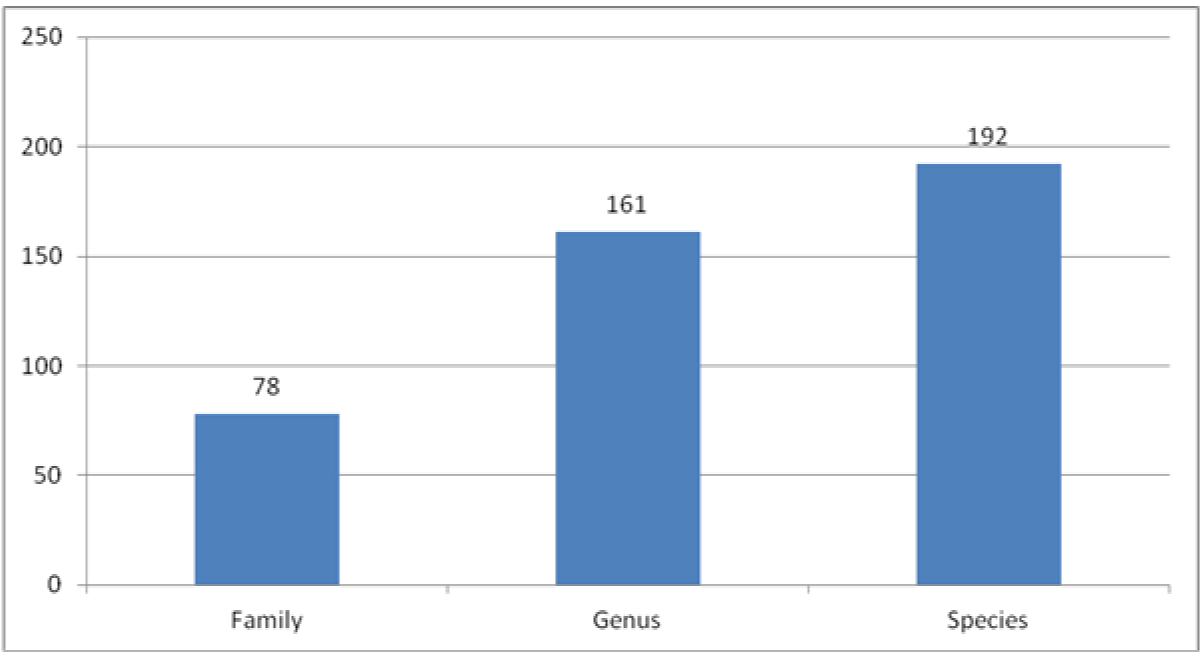


Figure 4.32: Species composition of the the proposed LNG-based power plant area.

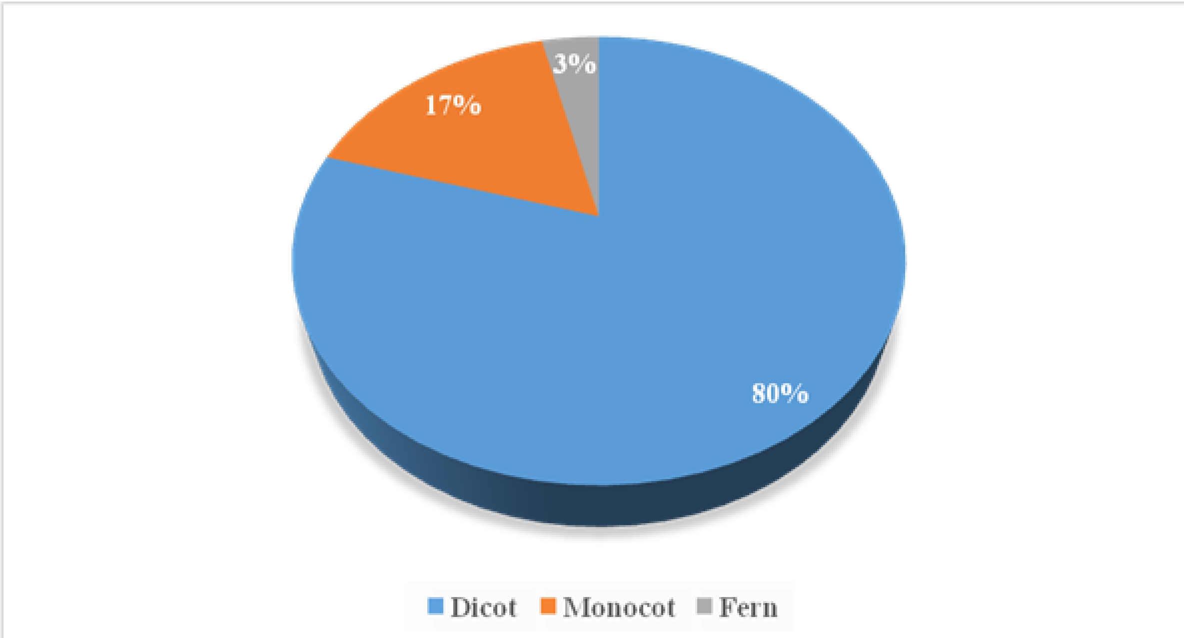


Figure 4.33: Cotyledonary status of the recorded plant species in the proposed LNG-based power plant area.

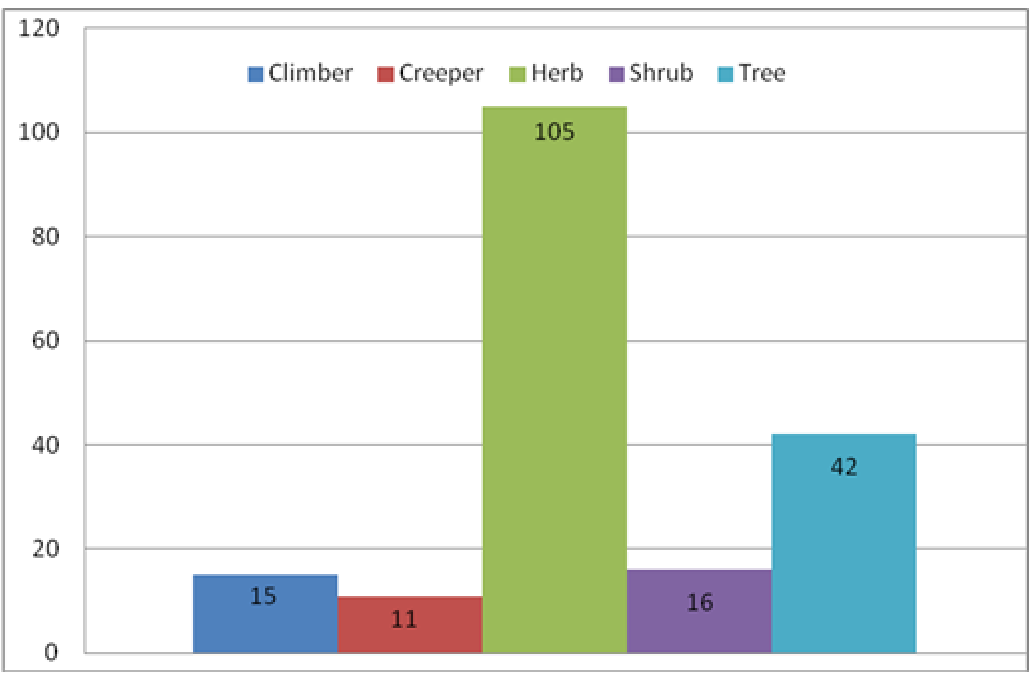


Figure 4.34: Habit categories of the recorded plant species of the present power plant sites.

From the present study, out of 192 recorded plant species, terrestrial habitats represent 153 (79.69%) species whereas the aquatic /or wetland habitats harbored 39 (20.31%) species in the present power plant project sites (Figure 4-35).

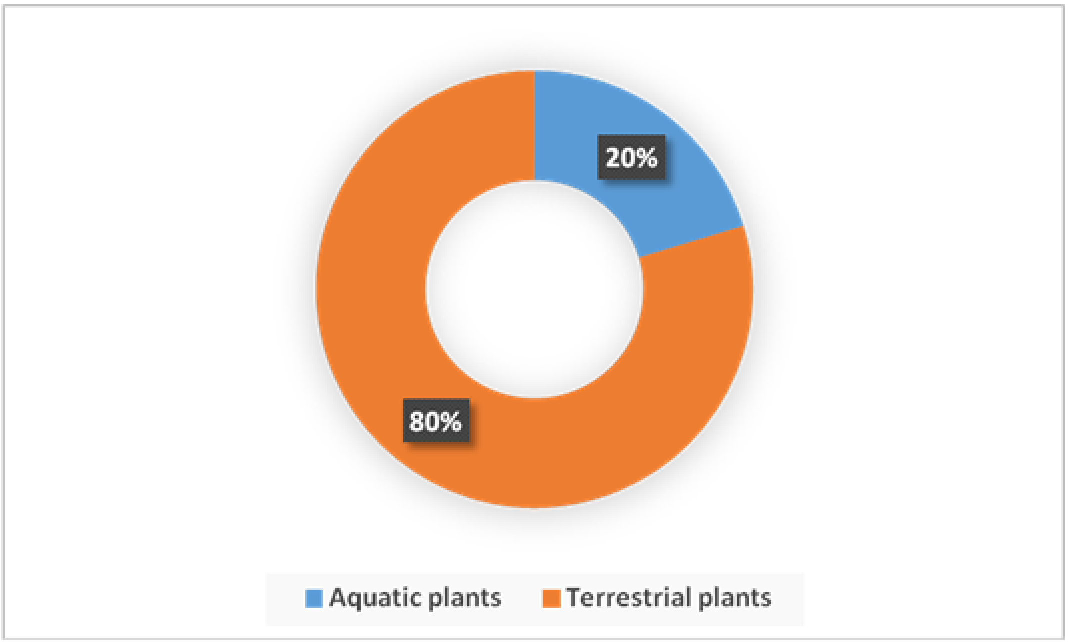


Figure 4.35: Habitat categories of the recorded plant species of the present power plant sites.

The observation infers that in this area Kalmi Leaves, Patajahangi, Lota Tree and Notey are rare, occasional, abundant & dominant flora species respectively.

The detailed findings of the flora have been given in the Annexure 4.1.

4.11.5 Terrestrial Ecology – Fauna

Animals and birds in the study area were documented using following means:

- Secondary sources and published literature
- By interviewing local people
- Actual sighting
- Indirect evidence (pallets, dung, droppings, scat, mould, marking on the trunks etc.)
- Nesting (birds, burrows for small mammals)

The records for the birds, mammals and other faunal groups were made at the same site where vegetation sampling was carried out. Most of the records of the mammalian and reptilian fauna are opportunistic, nonetheless very useful to understand habitat specificity and interrelationship between certain floral and faunal elements and also between certain geological and faunal features.

ODONATA FAUNA

Odonata is an order of carnivorous insects, encompassing the dragonflies (Anisoptera) and the damselflies (Zygoptera). Odonates are aquatic or semi-aquatic as juveniles. Thus, adults are most often seen near bodies of water and are frequently described as aquatic insects. Adult Odonates are terrestrial and are found near water, whereas the immature stages are aquatic and inhabit all typesof freshwater habitats ranging from permanent running waters and lakes to small temporary rain pools (Silsby 2001, Harp 1996, Corbet 1999). Many species are limited to some particular habitats, both during larval and adult lifestages especially the stenotopic species. However, their specificity to aquatic habitats makes them an ideal model for monitoring the health of freshwater ecosystems (Subramanian 2009, Orr 2003, Watanabe et al., 2004). The adults are harmless and their beautiful colorpattern raised strong aesthetic sense to human being. People in some countries also take the adult dragonflies as a minor food item (Chowdhury, 1989; Chovanec 1994; Legner 1995; Clarke 1996; Nikula et al., 2007).

They are carnivorous throughout their life, mostly feeding on smaller insects. Dragonflies and damselflies play key roles in both terrestrial and aquatic habitats. They are predators as both nymphs and adults, feeding on a variety of prey including nuisance species such as mosquitoes and biting flies. Nymphs can be top predators in fishless wetlands and help structure the wetland community. Dragonfly and damselfly nymphs in turn are an essential food resource for fish and amphibians, and adults are eaten by upland predators such as birds, bats, lizards, and spiders.

Odonates can act as bio indicators of water quality in rivers because they rely on high quality water for proper development in early life. Odonate nymphs are important components of most fresh water habitats, intermediate links in aquatic food webs, functioning as both prey and predators. Nymphs are food for birds, fish, and bugs. Since their diet consists entirely of insects, donate density is directly proportional to the population of prey, and their abundance indicates the abundance of prey in the examined ecosystem (Golfieri et al., 2016). Species richness of vascular plants has also been positively correlated with the species richness of dragonflies in a given habitat.

They can be indicators of different biotypes and habitats, and have been used as tools to assess the biological health of aquatic habitats and to detect levels of heavy metals such as mercury. They are also considered model organisms to assess the effects of global climate change. For the reasons, a survey of this group was prime important.

Adult Odonates were observed were recorded and some were collected by using standard hand nets and anesthetized in the field. Back in the laboratory they were identification with the help of taxonomic key provided by Fraser (1933, 1934, 1936, Lahiri (1987), Mitra (1983), Srivastava and Sinha (1993), Needham and Westfall (1954), Walker and Corbet (1975), Westfall (1996) and available photographs. As the survey time was only one day, it was not possible to survey all species. We also consulted previous information to enlist the survey species.Odonates found during the survey are recorded in **Table 4-36.**

Table 4 36: Odonates recorded during the survey

Sl. No.	Common Name	Scientific name
1.	Coral Tailed Cloud Wing	*Tholymistillarga*
2.	Skimmer	*Rhodothemisrufa*
3.	Wandering Glider	*Pantalaflavescens*
4.	Green Marsh Hawk	*Orthetrumsabina*
5.	Fulvous Forest Skimmer	*Neurothemisfulvia*
6.	Ruddy Marsh Skimmer	*Crocothemisservilia*
7.	Ditch Jewel	*Brachythemiscontaminata*
8.	Common Clubtail	Ictinogomphusrapax

Fish

List of fish fauna recorded during the survey is listed in Table 4-37.

Table 4 37: List of fish fauna recorded during the survey as mentioned by the local people and fishermen

Common English name	Local Name	Scientific Name	Abundance
Rohu	Rui	*Labeorohita*	+
Catla	Katla	*Catlacatla*	+
Black Rohu	Kalibaush	*Labeocalbasu*	+
Freshwater Shark	Boal	*Wallagoattu*	+
Long-whiskered Catfish	Ayre	*Sperataaor*	+
Tire-track Spiny Eel	Bain	*Mastacembelusarmatus*	+
Humped Featherback	Chital	*Chitalachitala*	+
Dwarf Chamelonfish	Meni	*Badisbadis*	+
Dwarf Catfish	Batashi	*Batasiotengana*	+
Pama Croaker	Poa	*Otolithoidespama*	+
River Shad	Ilish	*Tenulosailisha*	+
GangeticHairfin	Fasha	*Setipinnaphasa*	+
SilondiaVacha	Shilong	*Siloniasilondia*	+
BatchwaVacha	Bacha	*EutropiichthysVacha*	+
GangeticLotia	Kala Bata	*Crossocheiluslatius*	+
Ghora-chela	Ghora Chela	*Securiculagora*	+

Dragonfy

List of dragonfly species recorded during the survey is listed in Table 4-38.

Table 4 38: List of dragonfly species recorded from the study area

Sl. No.	Common Name	Scientific name	Family
1.	Coral Tailed Cloud Wing	*Tholymis tillarga*	*Libellulidae*
2.	Skimmer	*Rhodothemis rufa*	*Libellulidae*
3.	Wandering Glider	*Pantala flavescens*	*Libellulidae*
4.	Green Marsh Hawk	*Orthetrum sabina*	*Libellulidae*
5.	Fulvous Forest Skimmer	*Neurothemis fulvia*	*Libellulidae*
6.	Ruddy Marsh Skimmer	*Crocothemis servilia*	*Libellulidae*
7.	Ditch Jewel	*Brachythemis contaminata*	*Libellulidae*
8.	Common Clubtail	*Ictinogomphus rapax*	*Gomphidae*

Damselfl

List of Damselfl species recorded during the survey is listed in Table 4-39.

Table 4 39: Damselfly species recorded from the study area

Sl. No.	Common Name	Scientific name	
1.	Saffron-faced Blue Dart	*Pseudagrion rubriceps*	Coenagrionidae
2.	Coromandel Marsh Dart	*Ceriagrion coromandelianum*	Coenagrionidae
3.	Pigmy Darlet	*Agriocnemis pygmaea*	Coenagrionidae
4.	Orange-tailed Marsh Dart	*Ceriagrion cerinorubellum*	Coenagrionidae
5.	Narrow-winged damselfly	*Agriocnemis femina*	Coenagrionidae
6.	Little Blue	*Enallagma parvam*	Coenagrionidae
7.	Common Bush Dart	*Copera ciliata*	*Platycnemididae*

Lepidoptera (Butterfly) Fauna

Lepidoptera (butterfly) is widely accepted as a good indicator of ecosystem health. Butterfly is a primarily day-flying insect belonging to order Lepidoptera. Several characters of the butterflies like their wide distribution, species diversity, and specific to vegetation type, rapid response to perturbation, taxonomic tractability, statistically significant abundance and ease of sampling made them successful and useful organism to check changes in environmental parameters. Butterflies are diverse animals and sensitive to changes in microclimate and habitat (Bobo et al. 2006, Akite 2008 and Bonebrake et al. 2009) which influences their distribution and abundance. Butterflies have been found to be a specific useful indicator group in grasslands and in other open habitats. They also react to pressures such as climate change (Corezzola, 2011). For the reasons mentioned above and well visibility, butterfly fauna was studied in the 2 km radius of the spot area.

Butterfly collection and identification (Methodology):

Field survey and butterflies collections were carried using line transect method described by (Kunte, 1997). All transects were walked between 9.30 am and 4.30 pm, which was a peak time for butterfly activities under sunny weather condition. The study area was covered with cultivated land, wetland and homestead vegetation include trees, herbs, shrubs, grasses and climbers which support butterflies species for their larval food, nectar feeding and resting.

Butterfly species were primarily identified directly in the field or, in difficult cases, following capture using a sweep net and that were immobilized and brought back in the laboratory. Specimens were identified using taxonomic key mentioned in the reference. Previous works of the area was also consulted to prepare the list.

3A total of 24 species of butterflies were recorded during the survey. The existing checklist of butterfly is not complete so further studies are needed to update the checklist. This inventory work will be helpful for decision makers to implant any industry keeping the diversity intact

Table 4 40: List of butterflies of the survey area

Sl. No.	Common Name	Scientific Name	Family
1.	Plain Tiger	*Danaus chrysippus* (Linnaeus, 1758)	Danaidae
2.	Common Crow	*Euploea core* (Cramer, 1780)	Danaidae
3.	Striped Tiger	*Danaus genutia* (Cramer 1779)	Danaidae
4.	Common Rose	*Pachliopta aristolochiae*	Papilionidae
5.	Lime Butterfly	*Papilio demoleus*	Papilionidae
6.	Common Mormon	*Papilio polytes*	Papilionidae
7.	Common Emigrant	*Catopsilia pomona*	Pieridae
8.	Common Grass Yellow	*Eurema hecabe*	Pieridae
9.	Common Jezebel	*Delias eucharis*	Pieridae
10.	Mottled Emigrant	*Catopsilia pyranthe*	Pieridae
11.	Grey Pansy	*Junonia atlites*	Nymphalidae
12.	Lemon Pansy	*Junonia lemonias*	Nymphalidae
13.	Chocolate Pansy	*Junonia iphita*	Nymphalidae
14.	Peacock Pansy	*Junonia almana*	Nymphalidae
15.	Common Duffer	*Discophora sondaica*	Nymphalidae
16.	Striped Pierrot	*Tarucus nara*	Lycaenidae
17.	Pale Grass Blue	*Pseudozizeeria maha*	Lycaenidae
18.	Slate Flash	*Rapala manea*	Lycaenidae
19.	Common Lineblue	*Prosotas nora (*	Lycaenidae
20.	Common Ciliate	*Anthene emolus*	Lycaenidae

Sl. No.	Common Name	Scientific Name	Family
	Blue		
21.	Straight Swift	*Parnara guttatus* (Moore, 1865)	Hesperidae
22.	Conjoined Swift	*Pelopidas conjuncta* (Herrich-Schäffer, 1869)	Hesperidae
23.	Brown Awl	Badamia exclamationis (Fabricius, 1775)	Hesperidae
24.	Common Evening Brown	*Melanitis leda* (Linné, 1758)	*Satyridae*

MOLLUSCA FAUNA

Numerous molluscs live in freshwater and terrestrial habitats, both lotic (flowing water) such as rivers, streams, canals, springs, and underground cave streams (stygobite species) and lentic (still water) such as lakes, ponds. The two major classes of molluscs have representatives in freshwater: the gastropods (snails) and the bivalves (freshwater mussels and clams).Freshwater mollusca populations have been declining for decades and are among the most seriously impacted aquatic animal's worldwide (Bogan 1993, Williams et al.1993). However, in 2004 the IUCN Red List of Threatened Species included nearly 2,000 endangered non marine molluscs.
Collection and Identification

Specimens were collected by hand picking from the dry areas of river bank and from fisherman. Species were identified based upon morphological characteristics of the shell, photographs and other taxonomic keys. The shell characters such as shape, spire length and shape, mouth opening, opercular shape, umbilicus shape and size, color and ornamentation of the shell are used mainly for the identification apart from the internal characters of which the important one is radula.

FINDINGS

Molluscs found during the survey are listed in **Table 4-41.**

Table 4 41: List of Molluscs found in survey areas

Sl No.	Family	Common name	Scientific name
1.	Pilidae	Common Apple snail	Pila globosa
2.	Pilidae	Apple-snail	Pila virens
3.	Viviparidae	River Snail	Bellamya begalensis
4.	Thiaridae	Screw Snail	Melanoides tuberculata
5.	Thiaridae	Brotia Snail	Brotia costula
6.	Lymnaeidae	Lymneid Snail	Lymnaea luteola
7.	Unionidae	Fresh water Mussel	Lamellidens corrianus
8.	Unionidae	Fresh water Mussel	Lamellidens marginalis
9.	Unionidae	Fresh water Mussel	Lamellidens jenkinsianus
10.	Unionidae	Fresh water Mussel	Parreysia corrugata
11.	Sphaeriidae	Striated Fingernail	Sphaerium striatinum

Six Gastropod species and 5 Bivalves were found during survey.

FISH FAUNA

Meghna river estuary is the largest estuarine ecosystem of Bangladesh and support diverse fisheries communities compared to others. Present study was carried out to assess the fish diversity status with relation to major hydrological parameters in both spatio-temporal scales. Fish samples were collected together with water quality parameters from different sampling stations of the Meghna river estuary.

Several types of small fishes were captured and have been presented in Table 4-42. We were not able to capture any single big fish. Names of fishes available at other seasons of the year are presented in Table 4-43. According to fisherman, the rivers becomes devoid of fishes in the dry season. However, in the rainy season, few types of fishes become available. It was learnt from interviews with the fisherman and fish sellers that in the recent past the river had abundant fishes. Several types of big fishes like Rui, Catla, Ayre, Mrigel, and Boal along with different types of small fishes were very common. But at present number of all types of fishes has declined greatly.

Table 4. 42: List of small fishes captured during survey period in the power plant area

Local Name	Scientific Name	Sampling Locations			
		Location 1	Location 2	Location 3	Location 4
Golsha	Mystus cavasius	-	-	-	+
Bele	Glossogobius giuris	-	-	-	-
Tengra	Mystus vittatus	+	-	-	-
Puti	Puntius conchonius	+	+	+	+
Fali	Notopterus	-	+	-	-
Kachki	Coricasu borna	++	++	++	++
Mola	Amblypharyngodon mola	+	-	-	+
Kakila	Xenentodon cancila	-	-	-	-
Chapila	Gudusia chapra	-	+	-	+
Kholisha	Colisha fasciatus	-	-	-	+
Chingri	Macrobrachium eqidense	-	+	-	+
Shol	Channa striatas	-	-	-	-
Taki	Channa punctatus	-	-	-	-
Shing	Heteropneustes fossilis	-	-	-	-
Koi	Anabas testudineus	-	-	-	-
Pabda	Ompok pabda	-	-	-	+

Status: ++Common, +Few, - Absent

Table 4. 43: List of fish fauna recorded during the survey as mentioned by the local people and fishermen

Common English name	Local Name	Scientific Name	Abundance
Rohu	Rui	Labeo rohita	+
Catla	Katla	Catla	+
Black Rohu	Kalibaush	Labeo calbasu	+
Freshwater Shark	Boal	Wallago attu	+
Long-whiskered Catfish	Ayre	Sperata aor	+
Tire-track Spiny Eel	Bain	Mastacembelus armatus	+
Humped Featherback	Chital	Chitala	+
Dwarf Chamelonfish	Meni	Badis	+
Dwarf Catfish	Batashi	Batasio tengana	+
Pama Croaker	Poa	Otolithoides pama	+
River Shad	Ilish	Tenulosa ilisha	+
Gangetic Hairfin	Fasha	Setipinna phasa	+
Silondia Vacha	Shilong	Silonia silondia	+
Batchwa Vacha	Bacha	Eutropiichthys Vacha	+
Gangetic Lotia	Kala Bata	Crossocheilus latius	+
Ghora-chela	Ghora Chela	Securicula gora	+
Giant Snakehead	Gagarr	Channa marulius	+
Walking Catfish	Magur	Clarius batrachus	+
Spotted Snakehead	Taki	Channa punctatus	+
Spotted Snakehead	Shol	Channa punctatus	+
Walking Snakehead	Ranga Cheng	Channa orientalis	+
Victory Loach	Dari	Scistura scaturigina	+
Choukkani	Kanpona	Aplocheilus panchanx)	+
Stinging Catfish	Shing	Heterpeneustes fossilis	+

Status: +Few

Plankton diversity

Phytoplanktons are the producer of the river ecosystem and thus their status are of prime importance. List of Phytoplanktons and Zooplankton found in the water samples of different sampling locations are presented respectively in Table 4-45 and 4-44.

Table 4. 44: List of zooplanktons recorded from the water samples of the study area

Name of the species	Number of the species at different sampling locations			
	Location 1	Location 2	Location 3	Location 4
Escarpia	9	5	11	8
Keratella	2	1	5	8
Brachiomus	4	8	9	13
Lepadella	-	5	9	-
Cyclops	6	9	12	9
Diatomus	7	5	4	13
Bosmina	5	9	3	8
Daphnia	7	3	8	7
Euglena sp	3	9	4	4
Phacus	2	5	2	8
Trichocera	-	1	1	-
Monostyta	1	1	3	1
Nebalia	5	2	8	11
Hexarthra	-	5	11	12
Heterocypris	2	8	12	14

Data from each sampling locations represents total of 5 samples, 1 ml each time. Abundance of zooplankton at different sampling locartions is shown in **Figure 4-36**

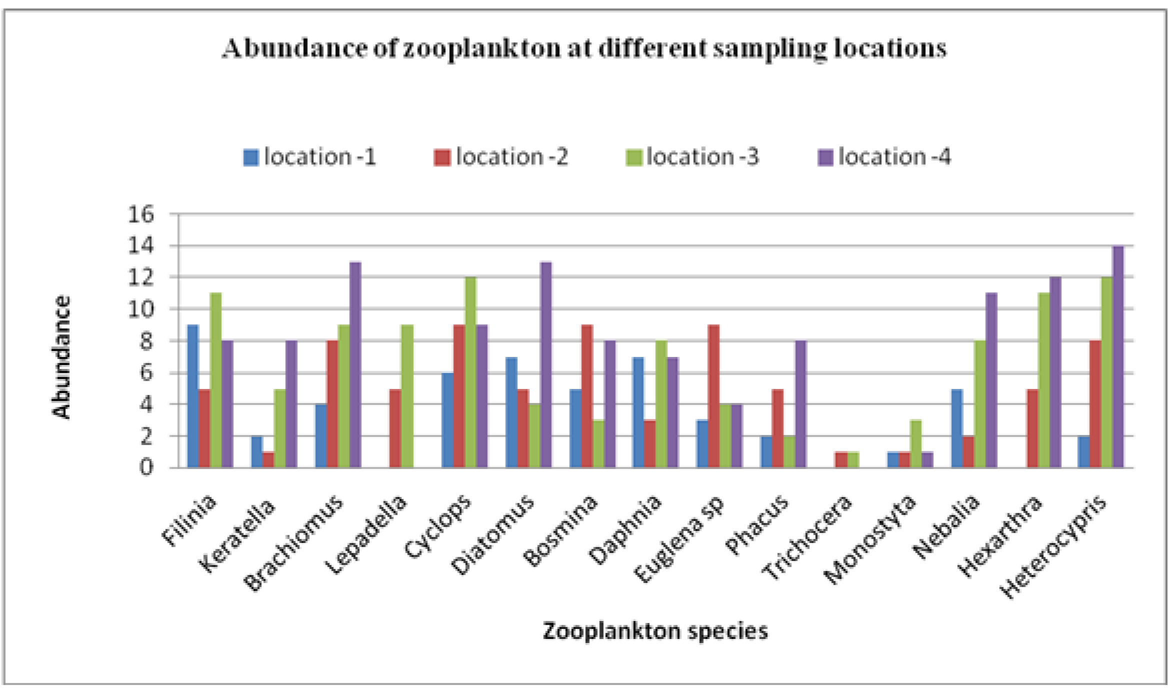


Figure 4.36: Abundance of zooplankton at different sampling locartions

Table 4 45: List of phytoplanktons recorded from the water samples of the river Meghna near the proposed

Name of the species	Number of the species at different sampling locations			
	Location 1	Location 2	Location 3	Location 4
Chlorella	8	3	6	11
Nostoc sp.	3	5	4	8
Chlamydomonas	8	11	-	9
Oedogonium sp.	8	4	7	2
Cosmarium	5	9	11	9
Pithophora sp.	2	11	10	1
Pinnularia	1	3	-	2
Volvox sp.	1	11	2	11
Oscillatoria sp.	4	-	2	-
Chlamydomonas sp.	-	3	2	2
Nitzschia	2	11	2	3
Synedra	3	7	8	1
Navicula sp.	8	-	1	2
Melosira,	2	5	1	-
Cymbella	1	3	2	1
Anabaena	3	2	3	7
Nitzschia sp.	-	1	2	3
Microcystis,	-	2	1	10
Euglena	4	11	8	9

4.12 SOCIOECONOMIC BASELINE DESCRIPTION

The project area is an industrial site beside and adjacent to the Dhaka Chittagong highway and is surrounded by Meghna River in the north, west and south direction. Economically the area is very active. The River Meghna is the main navigation route near the project site which connects Dhaka with north eastern region of the country via Sonargaon river ports .Different types of commodities including quarry, cement and paddy etc. are carried through the river route. So cargo vessel is seen frequently in the river.

Other than the industrial site, remaining areas are low lying agricultural land. Southern part of the project site across the Meghna River is under Gazaria Upazila of Munshiganj district and east part is under Sonargaon Upazila of Narayanganj district. The project is located in Meghnaghat Mouza of Narayanganj Upazila. Bangladesh UK Friendship Bridge across the river Meghna (Meghna Bridge) connects both the banks of Soanrgaon and Gazaria. The Bridge lies on the Dhaka Chittagong Highway. The project site locates in the North West direction of the highway. Beside the project site, there other power plants are located namely Meghnaghat Combined Cycle Power Plant (450 MW), Summit Meghnaghat Power Company Ltd. (335 MW) and Orion Power Meghnaghat Power Plant (100MW). On both banks there are residential areas. During monsoon low lying paddy field is submerged by the flood water. Boro crop is the main crop in the dry season.

4.12.1 Population and Demography

Population and demographic characteristics of the Zila, 4 Upazilas and nearby Zila Munshiganj in the study area have been presented in Table. The table shows that the population density per/sq. km. varies significantly among the different Upazilas and Zila/districts. Population and demographic profiles of the concerned unions have been presented Union and Upazila wise in **Tables 4.46 and Table 4.47.**

Table 4.46: Population and demographic characteristics surrounding the project area (Zila, Upazilas and Paurashavas)

Sl	Population Characteristics	Narayanganj District	Narayanganj Sadar Upazila	*Sonargaon Upazila	Araihazr Upazila	Rupganj Upazila	Munshiganj District
1	Total Area (Sq.km.)	683.14	100.75	171.66	183 .5	247. 97	954
2	Total Household	675652	313312	89565	77462	122140	313258
3	Total Population - Male - Female	2948217 1521438 1426779	1323600 690641 632959	400358 204438 195920	376550 188324 188226	534868 279544 255324	1445660 721552 724108
5	Household Size -Rural -Urban	4.3 4.4 4.2	4.2 4.2 4.3	4.4 4.4 4.4	4.8 4.8 4.7	4.4 4.6 4.0	4.6 4.6 4.5
6	Literacy Rate % (7 years+) - Male - Female	57.1 59.5 54.6	62.7 65.3 60.0	54.6 56.7 52.5	41.0 42.1 39.8	54.8 57.5 51.9	56.1 56.4 55.7
7	Sex Ratio	107	109	104	100	109	100
8	Total Mouza	785	56	351	182	144	642
9	Total Village	1342	132	487	317	285	911
10	Total Union	47	10	11	12	9	67
11	Total Upazila	5	1	1	1	1	6
12	Pourasnava	2	1	-	-	-	2

Table 4.47: Population and demographic characteristics surrounding the project area unions of Sonargaon

Sonargaon Upazila					
SL	**Population Characteristics**	*** Pirojpur**	***Mugra Para**	**Shambhupura**	**Baidyer Bazar**
1	Total Area (Acres)	4239	2089	3859	2251
2	Total Household	9917	7736	5967	4802
3	Total Population- Male - Female	45440 24707 20733	33506 17299 16207	23035 11658 11377	17523 8166 9357
4	Sex Ratio	119	107	96	102
5	Household Size	4.5	4.3	4.5	4.8
6	Literacy Rate % (7 years+)	55.0	60.5	53.5	41.8

Source: Population Census 2011

4.12.2 Population

As per Population Census 2011, population and other relevant information are as follows (Table 4.48).

Table 4.48: Population of the Project Upazila

Upazila	Area (km2)	Total Household (No)	Population (No)	Male (No)	Female (No)	Literacy7+ (%)
Sonargaon	171.66	89565	400358	204438	195920	54.6

The above Table shows that there are (104) males compared to 100 females. Sex Ratio (2001, BBS) in the Dhaka district is 109.5. But the ratio is different in the urban area, namely, 121.9 and the same in the rural area it is 103.6.
Density of population of Narayanganj district is 4308 per square km.

4.12.3 Religion

Religious feature of the manpower are presented in Table 4.49. The community is predominantly Muslim.

Table 4.49: Type of Religion of the sample households Sonargaon Upazila Adjacent to Project Area

Upazila	Total H.H	Muslim	Hindu	Buddists	Christian	Others
Sonargaon	Sonargaon	385539	14484	67	235	33

From the above Upazilla records shows that in Sonargaon 96.3% are Muslim and rest are mainly Hindu communities in the sample area mainly Muslims are residing. Hindu communities are very minor.

4.12.4 Housing Pattern and Ownership

In the project area maximum people live on their own houses but a few in rented houses. As more urbanization more households will reside in the rented house in future. The area is a semi urban area; moreover, it has also a rural character. Most people live in inherited land. Table-4.50 below shows the pattern of the ownership of residence.

Table 4.50 Main house of the dwelling household by type of structure

Upazla	Jhupri (thatched)	Kutcha	Semi Pucca	Pucca
Sonargaon	0.4%	63.7%	22.6%	13.4%

Source: census 2011

4.12.5 Access to Health Facilities

There are government Health complex in the Upazila. Health centers can be found abundantly and the proximity is pretty convenient. There are 1Upazila health complex, 11 health and family planning centers, 3 satellite clinics, and 10 clinics.

Main diseases are waterborne diseases via diarrhea, dysentery, typhoid and sexually transmitted disease (STD). Also Acute Respiratory Infection (ARI) is predominantly seen in the area. The STD is of abundance due to migratory people and workers in the area.

4.12.6 Source of Drinking Water and Sanitation

As reported by DPHE, Sonargaon Upazila has attained 100% sanitation coverage. Total sanitary latrine is 1722. No of total TW is 1539. On average 17.35 households fetch water from a single Tube well. There is no water supply system in the study site. The people are dependent on tube well water for drinking purpose. But the workers, employees and residents of the plant residential areas use treated water from the water treatment plant of RBLPL. No tube well is placed within the 100 meters of the project area.

Sanitation practice is very important for a community. It is a part of social behavior to use soap after toilet use. Earlier it is mentioned that the area has both urban and rural character. Table-4.51 and 4.52 above shows the sanitation coverage in Sonargaon Upazila. Sanitary latrine coverage was 38.19% of the households in Sonargaon Upazila. But present situation has been drastically improved. Sonargaon is at present under 100% sanitation coverage.

Table- 4.51 Access of Drinking Water

Upazila	Household%	Tap%	TW%	Pond%	Others%
Sonargaon	89565	2.03	93.36	0.60	4

Source: BBS, Census 2011

Table- 4.52 Access of sanitary Latrine in percentage

Upazila	Sanitary Latrine	Non Sanitary Latrine	No latrine
Sonargaon	38.19% 42.03% (urban) 38.13% (rural)	57.21% 57.24%(Rural) 55.30% (Urban)	4.60%

4.12.7 Literacy

Education rate is rapidly increasing in the project area. According to the Upazila education office, about 90% enrollments are in the Sonargaon Upazila. Current year, 25,000 students have been new enrollment in the primary schools excluding kindergarten School. The Number of household in the Upazila is 89,565 (Census2011), that means almost from each family one student is enrolled in the primary classes except ultra-poor family of the Upazila.

According to BBS 2001 census in Sonargaon Upazila the literacy rate for both sexes is 54.6%, for male is 56.7% and for female is 52.5%. So it is assumed that near plant site education rate is high to some extent, roughly 65%. Education rate is also increasing among the female.

Table: 4.53 Rate of literacy for male and Female

Upazila	Both	Male	Female
Soanrgaon	54.6%	56.7%	52.5%

Source: BBS, Census 2011

The above Table shows that, literacy rate is 54.6% in the project area for 7+ populations in Sonargaon Upazila.

4.12.8 Electricity Facility

In the project area nearly 99% the households have electricity connection. The area may be considered as largely dependent on electricity due to growing business in the area .Table 4.54 verifies this statement

Table 4.54 Electricity Facility

Area (Upazila Basis)	Electricity Facility Available in Household (No)
Sonargaon	77.63%

Source: BBS, 2011 census

4.12.9 Occupational Pattern

Tables 4.55 below give present and previous situation of the occupational pattern of the people living in the study area. In Table reveals that in Sonargaon, farming is decreasing as occupation. At present farming as occupation is 25.95% at Sonargaon of total households. Pirojpur Union have urban characteristic but some part is predominantly rural. Agriculture activities and business are the main occupation of the area.

Table 4.55 Occupational Patterns of the Households

Soanrgaon	
Occupation	**(%) of Total**
Agriculture	25.95
Industry	4.27
Commerce	23.74
Non -Agricultural	2.60
Transport and communication	4.51
Service	20.31
Construction	1.61
Overseas Work	4.68
Religious service	0.31
Others	3
Total	100

Source: BBS, 2011 census

4.12.9.1 Fishing

There are many Jalmahal (open water fishing zone) below 20 acres in Sonargaon Upazila. The river Meghna is flowing beside the project area. Production of cultured fish is 250kg/Acre (0.25 metric ton) and open water fish production is 500 kg/Acre (0.5 ton.). Major fish varieties are Ruhi, Katla, Taki, Kai, Magur, Singhi and Boal etc. Kai and Singhi are nearly extinct varieties. And rare fishes like River Pangas, Rani, Raia, Mahashail and Lacho fish are totally extinct varieties.

At the present point of time, there is some professional fishing community or fisherman near the project site. During monsoon season, some people catch fishes in the Upper Meghna River Fish is an important resource of the area.

4.12.9.2 Agriculture

The area is low- lying especially Sonargaon portion. Main crops grown in the study area are Aus, Aman and Boro. The paddy is grown in the main three seasons of the year. Besides these, potatoes, sweet potatoes, oil seeds, vegetables, arum, til (sesame), wheat, sugarcane, mustard, bottle gourd etc. are cultivated in the study area. Fruits like, jackfruit, lemon, watermelon are also produced. Further information will be collected on a later date and in details.

4.12.10 Archeological, Cultural Heritage and Religious Site

No known remarkable archeological or historically important structure or sites are reported in the survey area. But at about six to seven kilometer distance from the project site, the historical Panam City is situated. However, there will not be any impact on this historic archeological site due to the project. The probability of finding significant cultural resources in the designated areas is low. Any impacts that may occur as a result of the project would be in future and the overall severity of impact will be low.

There are few other historically significant places situated in the Sonargaon Upazila namely Single domed mosque built by Jalaluddin Fatheh Shah, Tomb of Sultan Ghiyasuddin Azam Shah, single domed mosque built by Alauddin Hussain Shah, Tomb of Shah Langar, Panch Pir Dargah, grand trunk road, khasnagar dighi, Company Kuthi, Yusufganj mosque, Goaldi mosque and Langalband (holy bathing spot). None of these places are close enough to be adversely affected by the project.

There are only few sites of significant archaeological value or sites of tourist interest in and around the survey area. However, people from all over the country usually visit the area but the commercial tourism is not yet developed.

4.12.11 Industry

Now Narayanganj and especially Sonargaon is an industrial zone. There are already three power plants adjacent to the project area namely Meghnaghat Power Limited, Summit Meghnaghat Power Company Limited (SMPCL) and Orion Power Meghnaghat Power Plant (OPML). Within three kilometer radius of this project, there are shipyards, 3 cement plants, a print and packaging industry to name a few. Many chatal (rice husking mills) are found in this bank of the Meghna River. So, many local workers are getting employment in the chatal for husking rice. And most of them are female workers. Across the river from the project site, there are many more industries, e.g. shipbuilding industry, chemical factory, refinery etc. making the area around the project industrially significant at a highest level.

4.12.12 NGO Activities

Different NGOs are working in the area. Name of the major NGOs are ASA, BRAC, Grameen Bank, Proshika, Thengamara Mahila Sabuj Sangha etc.

4.13 ARCHEOLOGICAL, CULTURAL HERITAGE AND RELIGIOUS SITE

No known remarkable archeological or historically important structure or sites are reported in the survey area. But at about six to seven kilometer distance from the project site, the historical Panam City is situated. However, there will not be any impact on this historic archeological site due to the project. The probability of finding significant cultural resources in the designated areas is low. Any impacts that may occur as a result of the project would be in future and the overall severity of impact will be low.

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There are only few sites of significant archaeological value or sites of tourist interest in and around the survey area. However, people from all over the country usually visit the area but the commercial tourism is not yet developed. A map of the religiously, archaeologically and historically important places is shown in **Figure 4-37.**

Figure 4.37: Religiously, Archaeologically and Historically Important Places around the Project Site

Chapter-5

IDENTIFICATION OF POTENTIAL IMPACTS

5.1 GENERAL CONSIDERATIONS

Prediction of Impacts is the most important component in the Environmental Impact Assessment studies. Several scientific techniques and methodologies are available to predict impacts of developmental activities on physical, ecological and socio-economic environments. Such predictions are superimposed over the baseline (pre-project) status of environmental quality to derive the ultimate (Post-project) scenario of environmental conditions.

The prediction of impacts helps in minimizing the adverse impacts on environmental quality during pre and post project execution. In case of water, land and socio-economic environments, the predictions have been made based on available scientific knowledge and judgments. In this chapter, an attempt has been made to predict the incremental rise of various ground level concentrations above the baseline status due to the emissions from this proposed project.

5.2 SCOPING OF IMPACTS

The potential impacts due to implementation of Project are identified by using simple checklists. This method is described below:

5.2.1 Checklist

Checklist is comprehensive lists of environmental effects and impacts indicator designed to stimulate the analysts to think broadly about possible consequences of contemplated actions (Munn, 1979). **Table 5-1** represents the checklists developed for the present plant. In this checklist, actions, which may affect at the various stages of the project activities, are listed and the degrees of Significant Environmental Impacts (SEIs) are shown. The terms none, minor, moderate and major are used in the checklists to evaluate the magnitude of SEIs. In the checklist, both the construction and operational phases of the proposed development are considered separately in order to distinguish the short term and long-term impacts. As can be observed from the checklists, major environmental components, which will be adversely affected by activities of the project, are air quality, water quality and socio-economic environment. All these impacts will arise in operation phase of the project. It should be noted that identification indicated in the Checklist relates to the significant level of impact.

Table 5.1 Impact Identification Checklist for Proposed Power Project

Project Activities	Potential Impacts																											
	Air Quality-PM	Air quality-Gaseous	Noise	Odor	Traffic	Water-resources	Water-Quality	Soil	Drainage Pattern	Land use	Hazardous Waste	Landscape/ Aesthetics	Agriculture	Pasture	Ecology-flora	Ecology-fauna,	Aquatic ecosystem	Socio-economic	Displacement	Livelihood	Health	Infrastructural Development	Social Development	Employment	Local Economy	Cultural	Risk	Occupational health
Pre-construction Stage																												
Land acquisition														✓														
Construction Phase																												
Site Development	✓		✓				✓	✓	✓	✓							✓							✓	✓			✓
Transportation	✓	✓	✓		✓			✓														✓		✓	✓			
Construction Water						✓	✓																					
Labor Camp	✓	✓		✓		✓	✓	✓				✓								✓	✓				✓	✓		✓

Project Activities	Potential Impacts																											
	Air Quality-PM	Air quality-Gaseous	Noise	Odor	Traffic	Water-resources	Water-Quality	Soil	Drainage Pattern	Land use	Hazardous Waste	Landscape/ Aesthetics	Agriculture	Pasture	Ecology-flora	Ecology-fauna,	Aquatic ecosystem	Socio-economic	Displacement	Livelihood	Health	Infrastructural Development	Social Development	Employment	Local Economy	Cultural	Risk	Occupational health
Excavation	✓		✓					✓		✓		✓			✓		✓							✓	✓			✓
Roads	✓	✓	✓		✓			✓	✓	✓	✓											✓	✓	✓	✓			
Jetty Construction			✓		✓																	✓	✓	✓				
Foundations			✓																					✓	✓			
Piling			✓				✓										✓							✓	✓			
Buildings/ Structures	✓		✓			✓	✓	✓	✓	✓		✓					✓							✓	✓			
Transmission Towers																						✓					✓	✓
Excavated Material	✓		✓				✓	✓	✓	✓														✓				
Other			✓	✓				✓																✓				

Project Activities	Potential Impacts																										
	Air Quality-PM	Air quality-Gaseous	Noise	Odor	Traffic	Water-resources	Water-Quality	Soil	Drainage Pattern	Land use	Hazardous Waste	Landscape/ Aesthetic	Agriculture	Pasture	Ecology-flora	Ecology-fauna,	Aquatic ecosystem	Socio-economic	Displacement	Livelihood	Health	Infrastructural Development	Social Development	Employment	Local Economy	Cultural	Risk	Occupational health
wastes																												
Wastewater Disposal							✓								✓		✓											
Pipe Laying							✓		✓																✓			
Equipment Installation	✓	✓	✓																					✓			✓	✓
Operation Phase																												
Lubricating Oil							✓				✓				✓		✓				✓							
Generation of Consumables																					✓						✓	

Project Activities	Potential Impacts																											
	Air Quality-PM	Air quality-Gaseous	Noise	Odor	Traffic	Water-resources	Water-Quality	Soil	Drainage Pattern	Land use	Hazardous Waste	Landscape/ Aesthetics	Agriculture	Pasture	Ecology-flora	Ecology-fauna,	Aquatic ecosystem	Socio-economic	Displacement	Livelihood	Health	Infrastructural Development	Social Development	Employment	Local Economy	Cultural	Risk	Occupational health
Cooling Tower			✓				✓										✓											
Fuel Burning	✓	✓																									✓	✓
Wastewater disposal				✓			✓								✓		✓				✓							
Waste disposal				✓			✓				✓					✓	✓				✓							
Power Transmission												✓										✓					✓	
Green Belt Development										✓		✓																
Rainwater Harvestin						✓	✓		✓																			

Project Activities	Potential Impacts																											
	Air Quality-PM	Air quality-Gaseous	Noise	Odor	Traffic	Water-resources	Water-Quality	Soil	Drainage Pattern	Land use	Hazardous Waste	Landscape/ Aesthetics	Agriculture	Pasture	Ecology-flora	Ecology-fauna,	Aquatic ecosystem	Socio-economic	Displacement	Livelihood	Health	Infrastructural Development	Social Development	Employment	Local Economy	Cultural	Risk	Occupational health
g																												
Induced developments																		✓		✓		✓	✓	✓	✓	✓		
Post Operation/ Decommissioning																												
Dismantling Infrastructure	✓	✓	✓				✓	✓	✓	✓	✓						✓			✓				✓			✓	

Chapter-6

PREDICTION AND EVALUATION OF IMPACTS

6.1 GENERAL CONSIDERATIONS

The methodology adopted for the study of environmental impacts consist in identification, prediction and assessment/ evaluation of likely effects. The prediction of environmental impacts has a basis in pre-project baseline data and anticipated changes. The main objectives of predicting the effects of project activities are delineation of an appropriate mitigation plan that would minimize the anticipated effects on environment. The methodology adopted for prediction in respect of air quality and noise-level changes are based on mathematical modelling. Any empirical model attempts to quantitatively describe the cause-and- effect relationship between pollution source and the environment. In the present report water, land, biological and socio-economic impact studies have used a combination of quantitative / qualitative techniques as well as professional judgement based on the merits of proposed schemes.

6.2 IMPACT APPRAISAL CRITERIA

The criterion which has been employed to appraise impacts on various social and environmental components is presented in Table 6-1.

Table 6 1: Impact Appraisal Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: refers to area of direct influence from the impact of a particular project activity.	Local spread	Impact is restricted within the foot prints of the Project boundary. For transmission line it should be within the right of way.	Except for ecology (which is defined as loss of vegetation only at site) or within the base of tower area
	Medium Spread	Impact is spread from up to 2 km from the boundary of the Project. Within 500m on either side of transmission line	Except for ecology (which is defined as loss of vegetation at site including large trees with limited disturbance to adjoining flora & fauna)
	High Spread	Impact is spread up to 2 km to 5 km from footprint boundary of the Project Beyond 500m on either side of transmission line	Except for ecology (which is defined as loss of vegetation at site and / or damage to adjoining flora and fauna)
Duration: based on duration of impact and the	Short Duration	When impact is likely to be restricted for duration of less than 1 year;	The anticipated recovery of the effected environmental component within 2 years

Criteria	Sub-Classification	Defining Limit	Remarks
time taken by an environmental component to recover back to current state	Medium Duration	When impact extends up to 3 years	With an anticipated recovery of the effected environmental component within 6 years
	Long Duration	When impact extends beyond 3 years	With anticipated recovery of prevailing condition to happen within 6 years or beyond or upon completion of the project life
Intensity: defines the magnitude of Impact	Very Low intensity	When resulting in changes in the environmental baseline conditions is up to 10%	However, it shall be reconsidered where the baseline values are already high.
	Low intensity	When resulting in changes in the baseline conditions up to 20%	For ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	When resulting in changes in the baseline conditions for up to 30%	For ecology, it refers to changes that are expected to be recoverable
	High intensity	When change resulting in the baseline conditions beyond 30%	While for ecology, high intensity refers to changes that result in serious destruction to species destruction to species, productivity or their habitat
Nature: refers to whether the effect is considered beneficial or adverse	Beneficial		Useful to Environment and Community
	Adverse		Harmful to Environment and Community

A significance assessment matrix was developed to assess the impacts based on the appraisal criteria developed above, which is as given in Table 6-2.

Table 6 2: Impact Significance Criteria

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Local	Short	Low	Insignificant	Insignificant
Local	Short	Moderate	Minor	Minor
Local	Medium	Low		
Local	Medium	Moderate		
Medium	Short	Low		
Local	Long	Low		
Local	Short	High	Moderate	Moderate
Local	Medium	High		
Local	Long	Moderate		
Medium	Short	Moderate		
Medium	Medium	Low		
Medium	Medium	Moderate		
Medium	Long	Low		
Medium	Long	Moderate		
High	Short	Low		
High	Short	Moderate		
High	Medium	Low		
High	Medium	Moderate		
High	Long	Low		
Local	Long	High	Major	Major
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Moderate		
High	Low	Low		
High	Low	High		

The Impacts for the proposed project are covered under the following subsections:

- Pre-construction Stage
- Construction Phase
- Operational phase
- Decommissioning Phase

6.3 IMPACT DUE TO PROJECT LOCATION

6.3.1 Land Acquisition

In general, land acquisition may affect the environment and people by the following ways:

i. Loss of Homestead land
ii. Loss of Agricultural Land
iii. Cultural, historical and Aesthetic Loss
iv. Loss of sensible places

Mitigation Measures

The proposed project didn't require any rehabilitation or relocation of homestead since the project will be established on the Meghnaghat power village allocated by BPDB for the development of power project.

About 35 acres of land for the project has been allotted by BPDB. The proposed 750 MW CCPP will be established adjacent west side of Summit Meghnaghat 335 MW CCPP. There is no homestead falls inside the proposed project site. There is no archaeologically important place in the project land and no loss of sensible place. So the above mentioned impacts are absent.

The project area has in built access road. There is no need for construction of separate approach road. Since the construction materials and equipment will be carried through river way, the existing access road will be adequate to meet the requirement of the power project. The access road will be used for the transportation during the construction and operation period. The existing access road should be maintained in proper way.

Power Grid Corporation of Bangladesh already has a 400 kV transmission network available at Meghnaghat which will be utilized for evacuation of power from the Project. The length of transmission line for connecting to the transmission network will be 1.9 km only. National Survey Organization has conducted survey on the location for the proposed three Transmission Towers. The facility for LILO attachment will be built in the existing Govt. land where absolutely no land acquisition is needed and therefore, no resettlement is necessary. But local people use the land for one crop cultivation.

A separate 10.94 acres of land adjacent to the proposed plot boundary of the power plant has been earmarked by BPDB for the proposed temporary storage area and construction of temporary labor camp. No separate land acquisition is required for labor camp.

6.3.1.1 Impact Significance

Impacts on land resource are minor and insignificant for the project site. The impact significance for land use is detailed in Table 6-3.

Table 6 3: Impact Significance on Land Resource

Aspect	Scenario	Spread	Duration	Intensity	Overall
Land Resource	Without Mitigation	Local	Short	Low	Minor
	With Mitigation	Local	Short	Very Low	Insignificant

6.4 IMPACTS DURING CONSTRUCTION PHASE

The construction phase, in general, has adverse influence on all the components of environment. Most of these impacts are short lived and reversible in nature. Construction works generally involve are site clearance, excavation, filling of earth materials, dumping of unusable debris materials, transportation of materials to construction site, and other constructional activities and associated works like mobilization of constructional equipment, setting up of different construction plant, setting up of workforce camp, quarrying, transportation of material, material storage, etc. These activities have certain impacts of various magnitudes on different components of environment. A proper care is essential to minimize the adverse impacts to the possible extent to facilitate the restoration of the environment and can be discussed under following sub-heads.

6.4.1 Site Development activities

6.4.1.1 Impacts

The project will involve development of Gas Based Combined Cycle Power Plant on 35 acres of land. Each development project more or less requires site preparation. The preparation works generally done during constriction stages includes

- Soil Removal
- Vegetation Removal
- Infrastructure disruption
- Connecting toaccess road
- Cut and fill operation
- Drainage works etc.

The impacts generally arise from the above activities are as follows:

- Noise
- Fugitive dust
- Runoff and flooding
- Soil erosion
- Water Pollution through runoff and sedimentation
- Safety Concerns

The proposed site is of the nature that it will cause negligible impacts in the environment. The site will not require land filling. The proposed site has no homestead land so there is no impact from property removal activities. However, site clearing activities, soil excavation and hauling activities will involve movement of heavy machineries which will generate temporary dust and noise. Construction activity during monsoon may lead to run off and flooding of excavated material and construction material which may increase sedimentation load in nearby water bodies and may disrupt aquatic ecosystem temporarily.

6.4.1.2 Mitigation Measures

Cutting and filling operation should be kept at a minimum level. The project authority should ensure the construction of proper drainage facility. Regular water sprinkle should be used to minimize fugitive dust emission. Safe working procedures should be ensured by the contractor. The construction work (Cutting and filling) must be undertaken during dry seasons.

6.4.1.3 Impact Significance

Impacts on land use are minor and limited for the project site. The impact significance for Land resource is detailed in Table 6-4.

Table 6 4: Impact Significance on Land Use

Aspect	Scenario	Spread	Duration	Intensity	Overall
Land Resource	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

6.4.2 Labor Camp

6.4.2.1 Impacts

It is expected that at any given time during the construction phase, the peak manpower strength on construction site comprising of technical staff, clerical/supervisor, skilled and unskilled workers would be about 400 – 500 persons. Since the area has good labour force it is expected that a majority of the work force will be local will come from nearby villages. A few of those come from outside, may either chooses to stay in a camp or in nearby available residential facilities. The health of the project personnel, construction workers and laborers living at the base camp could be impacted if arrangement of sanitation and drinking water is not ensured adequately and properly. During construction stage, lot of local labors will work and hence they would generate considerable amount of human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also. From the construction labour camp 60 kg of solid waste will be generated daily. During the project construction phase, the major source of water pollution will be sewage from labour camps. It has been estimated that peak domestic water requirements would be 30 kld. The domestic water requirement has been calculated at the rate of 45 lpcd for local labours whereas 100 lpcd for the labour camp. It is assumed that about 80% of the water required will be generated as sewage. Thus, total quantum of sewage generated in peak situation is expected to be around 25 kld. Septic tank with soak pit will be provided to manage the waste water generated from the construction labor camp.

6.4.2.2 Mitigation Measures

The labour camp if constructed shall meet the SPS requirement as per the EHS guideline render with the contractor as a part of Contractual agreement annexed with this report as Annexure 6.1 Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured. Contractors and workers should obey appropriate means of waste removal and sanitation measures. Adequate number of toilets and bathrooms at the rate of four number of toilet and four number of urinal separate for male and female per 100 numbers of workers should be made for the construction labor camp. Proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities. Sewage generated from the construction camp will be disposed of through septic tank and soak pit. Solid waste generated from the construction camp will be collected, stored and will should be disposed of in municipal landfill site.

6.4.2.3 Impact Significance

The impact on shall be limited for construction period and confined within the labor camp site. The mitigation measures shall further reduce the impact intensity. The Impact significance as assessed for the proposed project activities is detailed in Table 6-5.

Table 6 5: Impact Significance for Labor camp

Aspect	Scenario	Spread	Duration	Intensity	Overall
Labor Camp	Without Mitigation	Local	Medium	Moderate	Moderate
	With Mitigation	Local	Medium	Low	Minor

6.4.3 Impact on Ambient Air Quality

6.4.3.1 Impacts

Fugitive emissions during site clearing operations and construction activities will increase particulate concentration in ambient air. Besides, vehicular emission and fuel-based emissions will increase in the immediate vicinity of construction site. The site-related activities will be intermittent and therefore will result in generation of pollutants for short duration only. Due to the temporary nature of activities, significant long-term impact on air quality is not envisaged during the construction period of proposed power plant. The major construction activities from which air emission mostly dust emission may occur are;

- Site clearing activities;
- Ground excavation;
- Transportation of construction materials to site;
- Handling and mixing of cement

- Ground Excavation

Site preparation in readiness for construction work may require vegetation clearance, stripping off of overburden material, ground levelling and compaction. These activities will open-up the ground to wind action and thus potentially resulting in dust generation. This is because of the following:

- Vegetation clearance will directly expose the ground to agents of erosion;
- Stripping off of overburden material will loosen soil aggregates thus making them easily susceptible to wind action;
- Removal of tree stumps and roots will weaken soil bounding and thus can easily be blown by wind
- Delivery of Construction Materials to Site

Construction materials such as building blocks, cement, sand, steel bars, ballast will be bulky and thus will require to be delivered on site by a fleet of trucks driving in and out of the construction site. During this exercise dust is likely to be generated from the following:

- Handling of cement which is dusty by nature of the way it is
- Handling of ballast which could contain loose dust particles
- Site clearing of area of holding ballast, building blocks and sand will expose the site to wind action
- Handling and Mixing of Cement

The powdery nature of cement will be a potential source of dust especially during handling and mixing it with other materials such as sand and gravel. Cement dust will likely be of concern during:

- Opening-up of cement bags and emptying the cement in order to mix with other construction material
- During loading and offloading of cement

6.4.3.2 Mitigation Measures

Following mitigation measures are proposed to minimize the air pollution during the construction stage:

- The Project authority should ensure complete the paving of the service road
- Regular sprinkling (twice a day) of water to be done on open surface for dust suppression;
- Transport of materials in tarpaulin- covered trucks
- The sand and other such dispersible material will be stored at site for minimum working period.
- Removal of soil/mud from trucks and other appliances prior to leaving the project area.
- Storage of soil in a safe space
- Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses) ;

- Project management and contractor to enforce strict use of personal protective clothing;
- Complains of dust related ailments among employees and neighbors to be given access to medical attention.
- The construction activity will be carried out during day time only.

The emissions are temporary and not expected to contribute significantly to the ambient air quality and will be within prescribed limits for industrial regions by National Ambient Air Quality Standards.

6.4.3.3 Impact Significance

Considering the size of the project, impact intensity on air quality part shall be moderate; however, proper mitigation measures shall reduce impact to minor level by implementation of mitigation measures discussed above.

Table 6 6: Impact Significance on Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Air Quality	Without Mitigation	Medium	Medium	Moderate	Moderate
	With Mitigation	Local l	Medium	Low	Minor

6.4.4 Impact on Noise Level

6.4.4.1 Impacts

Noise and vibration shall be caused by the operation of earth moving and excavation equipment, concrete mixers & transportation of equipment and materials. Movement of traffic during night hours can also disturb the local community.

For an approximate estimation of dispersion of noise in the ambient air from the source location, a standard mathematical model for sound wave propagation has been used. The sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level with distance from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

For hemispherical sound wave propagation through homogenous loss free medium, one can estimate noise levels at various locations, due to different sources using model based on following equation:

$LP2 = LP1 – 20 \text{ Log } (r2/r1)-AE-AM$

Where, Sound LP2 and LP1 are the Sound Pressure Levels (SPLs) at distances of r2 and r1 from the source.

AE and AM are attenuations due to Environmental conditions (E) and Machine correction (M)

As per OSHA standard about 90 dB (A) of noise is expected to be generated from construction activity. This noise shall attenuate to less than 45dB (A) i.e. night time prescribed noise level at about 100m. The distance of nearest settlement is about 200m. Therefore, no significant impact on nearby settlement is expected due to proposed project activities.

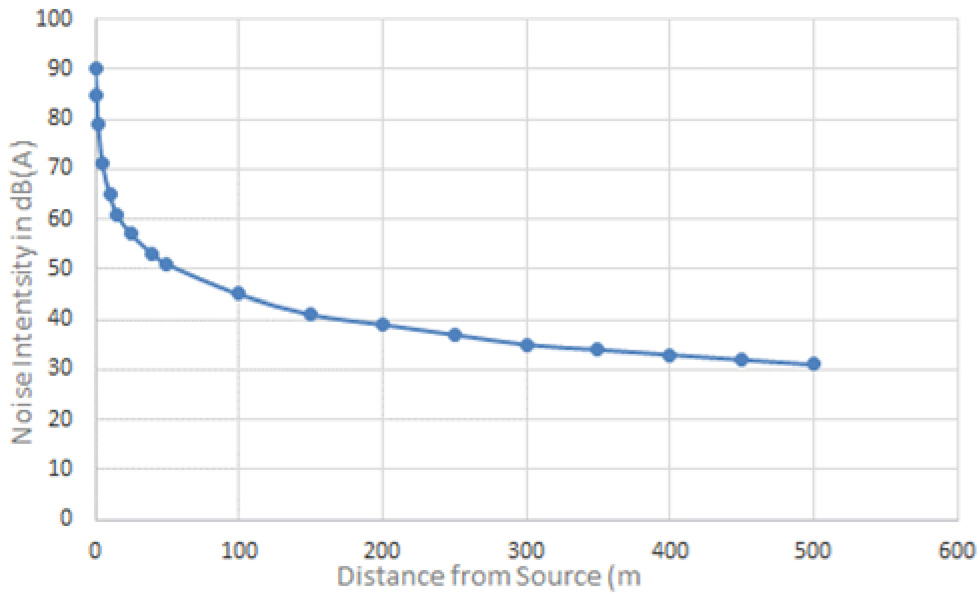

Figure 6.1: Noise Intensity in respect to Distance from Noise Source

6.4.4.2 Mitigation Measures

Considering the capacity and nature of the project, use of construction machineries shall be very limited. Most of noise generating activities like excavation, use of heavy earth moving machineries, etc. shall be limited for the construction phase.

Noise generating activities should be scheduled not to have simultaneous exposure. All construction equipment shall comply with the applicable noise standards. Regular maintenance of equipment's will be ensured to keep noise level under limits. Noise generating activities should be limited for day time only. The personnel as may involve in high noise generating activities should be provided with personal protective devices to minimize their exposure to high noise levels. Construction vehicles and machinery should be well maintained and confirming the noise standards.

6.4.4.3 Impact Significance

Noise impact due to construction activities shall be minor with mitigation measures. Significance of impact on noise level with and without mitigation is presented in Table 6-7.

Table 6 7: Impact Significance on Noise Level

Aspect	Scenario	Spread	Duration	Intensity	Overall

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Nosie Level	Without Mitigation	Local	Medium	High	Moderate
	With Mitigation	Local	Medium	Low	Minor

6.4.5 Impact on Water Quality and Resources

Adequate supplies of drinking water that is compliant with the national drinking water quality standards to all workers should be ensured. In case of groundwater heavy metals (nitrate, arsenic and coliforms) contamination should be checked.

The construction at site can alter the natural drainage pattern of the area at a micro level. There is potential of contamination of low lying areas and surface water quality due to sediment run-off from construction area. Improper disposal of sewage and wastewater from labour camps and construction debris can contaminate the ground water resources in the area.

6.4.5.1 Mitigation Measures

Septic tank with soak pit should be provided in labour area, so that, no contamination due to discharge of sewage may take place. The natural slope of the site should be maintained to the extent possible in order to avoid any change in the drainage pattern. Adequate arrangement for storm water management during construction period should be made to avoid sediment runoff from the site. Storm water flow should be routed to the existing channels after passing through the silt and oil traps to avoid contamination of receiving water body. Temporary silt-trap or digging of pond will be provided toward siltation prevention. Strict supervision should be maintained to avoid blockage of natural creeks during the construction period.

6.4.5.2 Significance of Impact

Overall the impact on water resources shall be moderate without mitigation, whereas, impacts shall further reduce to minor level with implementation of mitigation measures.

Table 6 8: Impact Significance for Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources	Without Mitigation	Medium	Medium	Moderate	Moderate
	With Mitigation	Local	Medium	Low	Minor

6.4.6 Impact due to Waste Handling

6.4.6.1 Impacts

Site clearance, excavation, labour camp and installation work shall produce various kinds of waste. The construction demobilisation shall involve deployment of workers, removal of campsite and other temporary structures. These activities shall result in generation of waste. The major wastes as expected are as follows.

- Construction Debris

- Domestic solid waste from labour camp
- Packaging material of the plant parts
- Waste oil from generator and other construction machinery
- Metal scraps, Paint containers, etc.

The debris generated due to construction activities may spread out in nearby areas. This may lead to soil and water contamination.

Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour shall lead to unhygienic conditions and spread of diseases in the area. It can lead to discontent of local community and result in conflicts with the labour engaged at site.

Improper disposal of packaging materials, boxes, plastics and ropes can lead to littering in the construction site and surrounding areas. Hazardous wastes such as waste oil, lubricants, hydraulic oil etc. can cause contamination of soil and water bodies if adequate precautions for management and handling are not undertaken. Use of chemicals such as paints, curing chemicals can lead to contamination of soil.

6.4.6.2 Mitigation Measures

Considering the plant capacity and labour requirement, quantity of waste generation shall be small and limited. Construction debris should be utilised for levelling of the land and unused debris should be disposed-off to nearest waste disposal site. Efforts should be made to use the locally available labour for unskilled work purpose. Proper sanitation and sewage facility in terms of septic tank with soak pit should be provided. Municipal waste as likely from labour area should be disposed as per Environment Conservation Rules, 1997.

Hazardous waste like paint empty tins, used oils should be stored in separate designated space and should be given to MoEF approved recyclers. Metals scrap should also be given to the approved recyclers.

6.4.6.3 Impact Significance

The overall impact due to solid waste shall be minor and shall reduce to insignificant level after implementation of mitigation measure.

Table 6 9: Impact Significance due to Solid Waste Disposal

Aspect	Scenario	Spread	Duration	Intensity	Overall
Waste Disposal	Without Mitigation	Local	Medium	Moderate	Minor
	With Mitigation	Local	Medium	Low	Minor

6.4.7 Impact on Ecological Impact

6.4.7.1 Impacts

Removal of vegetation may result in loss of habitat for small mammals and birds. However, the ecological survey carried out at site established that the site is primarily open land and does not support any significant ground vegetation. The impact on ecological environment is assessed to be minor for the project. There are water hyacinths around the jetty.

6.4.7.2 Mitigation Measures

The site is primarily agriculture land and devoid of any dense natural vegetation. Therefore, the loss of vegetation at site is considered to be limited. Efforts should be made to retain some of the boundary trees. The noise generating activities should be scheduled during day time only. Movement of construction and transport vehicles should be restricted to construction site only to minimise any harm to small mammals. Water hyacinths normally deposit where there is stagnant water. So there is no possibiliyu of growing water hyacinths near the jetty.

6.4.7.3 Impact Significance

The overall impact on ecological aspect during construction shall be insignificant in nature.

Table 6 10: Impact Significance on Ecological Aspects

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ecology	Without Mitigation	Local	Short	Low	Insignificant

6.4.8 Social acceptability of Construction workers to the host communities

In the construction phase, skilled workers might be engaged in the project to perform technical work and they might come from outside the area. However, since the area has good labor force, most of the laborers will come from the local and nearby villages only.

The potential impacts that might arise in reference to labor related issues have been mentioned below.

- Once the construction activity for the project gets underway, there is a possibility for inflow of migrant workers from other parts of the country in project area. For unskilled work in the construction phase, the local population and its surrounding areas should be given first preference.
- The influx of migrant workers might put pressure on the existing resources like water supply, supply of fuel, provision of basic facilities, waste handling and sewage disposal of the project influenced population which might create frictions between them and the resident population of the area. However, chance of this scenario is rather low considering the project capacity and nature of work.
- With the inflow of migrant workers and their interaction with the local population, health issues among the local community might emerge. Health problems like STD's and HIV Aids might spread in the area because of this floating population. Medical

camps can be conducted amongst the labors and the local population to make them aware about diseases like STD's and HIV Aids.

6.4.8.1 Mitigation measures

Reliance Bangladesh LNG & Power Ltd. has practice of working with the workers of different cultures. It is recommended to aware the foreign workers (if any) about the social & religious acceptability in the area so that they could maintain those when they will have touch with local community. The construction workers will be mainly local people.

6.4.8.2 Impact Significance

The overall impact on cultural aspect during construction shall be insignificant in nature.

Table 6 11: Impact Significance on Ecological Aspects

Aspect	Scenario	Spread	Duration	Intensity	Overall
Social	Without Mitigation	Local	Medium	Low	Minor
	With Mitigation	Local	Medium	Very Low	Insignificant

6.4.9 Impact due to Traffic and Transport

6.4.9.1 Impacts

The construction activities shall require transportation of construction material, mounting structures and other components to the site. The additional traffic movement on the road due to project activities shall increase accident probability. Transportation of construction material in open trucks / tippers can also lead to dust generation along the route. Excess traffic on the road shall create discomfort for locals due to increment in noise level and fugitive dust and gaseous pollution expected to exhaust from the vehicles.

6.4.9.2 Mitigation Measures

Considering the project capacity, increase in traffic nos. will be very marginal. The site is connected with National Road no 1 (Dhaka-Chittagong Highway). The traffic density on the access road is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities.

- The traffic movement in settlement areas should be limited for day time only.
- Only PUC certified vehicle should be deployed for the project to keep the air pollution under check. Tool Box training should be arranged for the driver to create awareness about road safety.
- Management to provide for adequate internal parking, for all vehicles coming to the construction site;
- All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road; and
- Proper signage will be displayed for road and traffic safety.

- The traffic management plan should minimize inconvenience to community by choosing the best alternative routes with less community disturbance, by restricting the unnecessary use of horns while bypas sing any sensitive areas (hospitals, schools, residential areas etc.)
- Most of the materials will be carried by the riverway.Very few of the materials will be carried by roadway which is also a national highway. So the possibility of congestion will be low.

6.4.9.3 Impact Significance

Without mitigation measures, the impact shall be moderate overall. However, mitigation measures shall be implemented to maintain the impact intensity on minor level.

Table 6 12: Impact Significance due to Traffic and Transport

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact due to traffic	Without Mitigation	Medium	Medium	Low	Moderate
	With Mitigation	Medium	Medium	Very Low	Minor

6.4.10 Health and Safety Hazards

6.4.10.1Impacts

Loading and unloading operation of the construction material may cause an injury if not handled properly. During construction works, physical injury can result due to road accidents, construction accidents and other occupational hazards. Over exertion injuries and illness shall potentially be the most common health hazards associated with construction activities. Further there is potential for slips and fall on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction material, liquid spills and uncontrolled use of electrical cords and ropes on ground, which results in injuries and time loss during construction.

Hazards associated with fall of construction material or tools, as well as collapse of constructed slabs, walls and roofs can result in injury to head, eyes and extremities. Transportation and movement of vehicles are associated with road accidents and related hazards, which can lead to injuries and fatalities.

6.4.10.2 Mitigation Measures

An H&S plan will be prepared prior to construction. H&S training will be conducted, including good housekeeping, clean-up of debris and spills, and working in confined spaces and at height. The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessaries. Harnesses and scaffold barriers for work at height will be provided. Segregation of pedestrians and traffic on-site will be segregated.

For community Health and Safety, EHS guidelines should be planned and documented. Public access to the site must be restricted. Disease prevention and traffic safety measures should be adopted.

Excessive waste debris and liquid spills should be cleaned up regularly. Good housekeeping should be ensured at the construction site to avoid slips and falls. PPEs such as safety glasses with side shields, face shields, hard hats and safety shoes should be mandatory at construction site. Ear plugs should be provided for workers in high noise areas.

6.4.10.3 Impact Significance

The project shall have moderate impact on Health and Safety aspect during construction phase. However, this can be reduced to the insignificant level by successful implementation of mitigation measures.

Table 6 13: Impact Significance on Health and Safety Aspect

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Health and Safety Aspect	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

6.4.11 Impact due to Construction of Associated Facilities

6.4.11.1 Impact due to Construction of Temporary Jetty

A temporary jetty will be built adjacent to the project site to transport the construction material and heavy equipment during the construction period of the power project. Previously it was planned to construct the proposed temporary jetty on the western bank of the River Meghna or on the southeast corner of the project site but now it will be built in the North-west corner of the plant and it'll be demolished after the completion of the project. This is a temporary jetty required only for the purpose of transporting construction material and plant equipment during the construction period. Required river draft for temporary jetty operation is 3.0m in the main channel and 2.0m at the Jetty. The excavation activities and pilling work in the riverbed for construction of the jetty will generate fine sediments and will also result in resuspension of sediments in water. The major impacts on water quality are envisaged due to civil work activities like driving piles, movement of construction equipment etc. will have a high probability to disperse the fine-grained sediments in the water, which in turn influence the quality of water in Meghna River. The turbid waters impact on aquatic ecology thus affecting primary productivity. The leakage and spillage of oil and lubricants from machineries and equipment can cause adverse impact on surface water quality.

6.4.11.2 Mitigation Measures

The construction materials to be used will involve raw materials which are non-hazardous in nature such as steel, cement, gravel, rock etc. Cutting and filling should be avoided during jetty construction at the river bank to avoid the river erosion. Construction of permanent structure will be avoided. Resuspension of the sediments will happen for a very short period of time as the constructional period consists of only 3 months. Strict supervision should be maintained so that the impact remains within the project area. The vessels that would be berthed on the jetty should not cause any oil or solid waste pollution while loading and unloading. The project authority has obtained proper permission from the Bangladesh Inland Water Transport Authority prior to construction of the temporary jetty.

Moreover, the current location is far from the main stream river flow area and fishing hamlet. So, the Environmental and Social impact is less. As the location is far from the regular navigation route of Meghna river so it will not create obstruction or trouble to regular navigation due to loading unloading vessels in the jetty. Proper sign, signal and strict supervision should be maintained for navigation of the vessels to avoid accidents. Addition to that, the adjacent channel to the current location of Jetty is not used for regular fishing so it will not have much impact on the fishing around the area.

6.4.11.3 Impact Significance

The project shall have moderate impact on Health and Safety aspect during construction phase. However, this can be reduced to the insignificant level by successful implementation of mitigation measures.

Table 6 14: Impact Significance of Temporary Jetty

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact Significance of Jetty	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5 OPERATION PHASE IMPACT

The operation phase impacts of the project are minor. The impacts are discussed in detailed under headings below.

6.5.1 Impact on Air Quality

Ambient air quality may be affected due to emission of flue gases from the gas turbine stack. Incomplete burning of gases from the operation of gas turbine may also affect the air quality. The situation becomes aggravated when gas contains high percentage of impurities like sulphur, hydrocarbon, nitrogen etc. The high temperature of flue gas also produces impacts on the air quality in terms of thermal pollution. The combustion of fossil fuels for power generation inevitably results in emission of gaseous pollutants to the atmosphere. The major pollutants of potential concern are sulphur dioxide (SO2), oxides of nitrogen (NO2), carbon monoxide (CO) and Carbon dioxide (CO2).

Sulphur dioxide (SO2) emission: The emissions of sulphur dioxide are dependent on the sulphur content of the fuel. Since there is no sulphur content in the natural gas, therefore, there would be no sulphur dioxide emission from the plant.

Nitrogen Oxides (NOx) emissions: Burning of fossil fuels at high temperature (above1600°C) generally produces two forms of nitrogen oxides-nitric oxide (NO) and nitrogen dioxides (NO2); commonly referred to as nitrogen oxides (NOx). Since the gas turbine intakes excess air to the tune of 127% more than required for combustion, and if a fully premixed burner (dry low NOx burner DLN) is used there will be no NOx since the combustion temp is much less (24020F ≈ 1317°C) in the case of such a turbine. The proportion of NOx and NO2 varies depending on the combustion technology, and in the case of gas turbines approximately 90 percent of the nitrogen oxides is present as NO with the remaining being NO2. Once the NO enters the atmosphere, it reacts with oxygen in the air and oxidises to NO2 with passage of time.

Carbon monoxide (CO) emission: Carbon monoxide (CO) is generated when incomplete combustion takes place. As per design, the emission of CO from the gas turbine would be an issue. So the impact due to emission of CO would not be significant for the proposed power plant.
461. Carbon dioxides (CO2) emission: Emission of CO2 is associated with global warming. CO2 gas emission depends on the fuel burned and the carbon content of the fuel. The natural gas contains a significant portion of carbon, which reacts with oxygen to produce CO2 and heat; at full capacity CO2 emission due to the project operation, with its present quantum will not have much impact on global warming

6.5.1.1 Stack Emission

The proposed Reliance Meghnaghat 750 MW CCPP powerplant will be of advanced design with dry low NOx (DLN) burner with premix burning system which restricts the combustion temperature which is much below the NOx forming temperature (16000C). The proposed power plant will produce 25 ppm NOx emission from the gas turbine which will be within the IFC/WB emission limit of 51 mg/Nm3 (25ppm)with15% O2, for gas turbine power plants more than 50 MW located in the degraded or non-degraded air shed. As per Bangladesh ECR 1997, the NOx emission standard of gas turbine power plant of 500 MW or above is 50ppm irrespective of O2 content which is also higher than 25ppm.

6.5.1.2 Ambient Air Quality

The air quality impact of power plant was predicted using Gaussian model. The model used in the present study is a Gaussian Plume Dispersion Model designed for single/multiple point applications. The model simulates the relationship between air pollutant emission and the resulting impact on air quality. Data relating to plant emission, meteorology and other atmospheric conditions determined by formulating impact scenarios were used as inputs while carrying out the simulation studies.

The ambient air quality monitoring data used in the prediction is based on field sampling and analysis. The locations of monitoring stations were earlier fixed based on the occurrence of maximum pollutant concentrations using screening models. Besides, these locations were selected considering the receptor points, prevailing wind directions and settlement. USEPA approved AERMOD view version 9.2.0model was used to estimate emission concentration from the plant. AERMOD view is a Gaussian plume model that incorporates source-related factors, meteorological factors, receptors, terrain and building downwash factors to estimate pollutant concentration from continuous point source emission.

The use of site-specific meteorological data has been collected from the Lakes Environmental, Canada, who has provided 1 Year of MM5-Preprocessed site specific Meteorological data for the period of Jan 01, 2015 to Dec 31, 2015 at Latitude: 23°36'25.56"N, Longitude: 90°35'32.16"E, Time Zone: UTC +6. These data contain hourly value of wind speed & direction, wind velocity, surface roughness, Bowen ratio, albedo, temperature & reference height, precipitation rate, relative humidity, surface pressure and cloud cover over the period mentioned above. The data then have been analysed and processed through MET processing model AERMET View which uses Samson format to process the data and create surface met data file & profile met data file computable to the AERMOD 9.2.0 view dispersion model. These surface met data file & profile met data file were then used in AERMOD view as Met input data for calculation.

The proposed power project will have a 2X255 MW gas turbine fitted with 2 HRSG and a 240 MW steam turbine and the model calculates the values in different configurations by considering individual stack emissions with 70m stack height of NO2 emissions. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO2 concentration contour has been analysed with 500 m interval with a radius of 5000m from the point source. The NO2 concentration contour of 24 hour and annual average of maximum concentration have been analysed.

The parameters and corresponding values are summarized in Table 6-15.

Table 6 15: The exhaust specifications and stack parameters

Sl. No.	Parameters	Values
1.	Stack height (m)	70m
2.	Stack inside diameter (m)	6.30m
3.	Stack gas exit velocity (m/s)	25 m/s
4.	Exhaust temperature (K)	(365+305) = 670
5.	Exhaust flow rate (m3/sec)	615
6.	NO_2 emission rate as NO_2 (g/s)	25 ppm (51 mg/m3) = 31.37 mg/sec
7.	Ambient temperature (K)	305

6.5.1.3 Dispersion Model results

A. Stack emission results (Main Stack)

For 50 m interval up to 1km: The maximum of 1 hour concentration of NOX (above 7 µg/m3) have been predicted beyond 700m radius and the concentration are within 4-7 µg/m3 at a radius of 200-700m at all the sides to the power projects. The maximum incremental annual concentration of NOx has been detected as 0.10-0.20 µg/m3 around the project except it increases to 0.20-0.50 µg/m3 at the 100m to 1000m west of the project.

For 500 m interval up to 5km: The maximum of 1 hour concentration of NOX (6-7 µg/m3) have been predicted beyond 1000m radius around the point source up to 3000m and the concentration are below 6 µg/m3 after 3000m at all the sides to the power projects. The maximum incremental annual concentration of NOx has been detected as 0.10-0.20 µg/m3 around the project except it increases to 0.20-0.40 µg/m3 at the 100m to 5000m west of the project.

B. Stack emission results (By Pass Stack)

For 50 m interval up to 1km: The maximum of 1 hour concentration of NOX (above 5 µg/m3) have been predicted beyond 700m radius and the concentration are within 2-4 µg/m3 at a radius of 200-700m at all the sides to the power projects. The maximum incremental annual concentration of NOx has been detected as 0.249 µg/m3 at around 600- 1000m west to the project whereas the concentrations are within 0.05-0.08 µg/m3 at the 100m to 1000m around the project.

For 500 m interval up to 5km: The maximum of 1 hour concentration of NOX (4 µg/m3) have been predicted at around 5km west and 2km south & north sides to the power projects. The maximum incremental annual concentration of NOx has been detected as 0.20- 0.25 µg/m3 around the project up to 5000m radius of the project.

Review of modelling results:

The modelling result shows the 1 hour concentration of NOx (8-10 µg/m3) has been predicted at a radius of 2000-5000m in different pockets around the project site which is within the IFC standard (200 µg/m3) for 1 hour concentration. The maximum annual concentration of NO2 has been found 0.10-0.09 µg/m3 at 50-3000m north-west to the project which are also less than the Bangladesh, WHO/IFC and USEPA standard. These indicate that the expected power plant does not have major significant adverse impact on the prevailing air quality of that area.

The Table 6-17 shows the maximum NO2 concentrations at six sampling locations around the project during the baseline study period alongwith their distance from the project. The NO2 contribution from the stack emission has also been compared in the table which also proves the minimum contribution of NO2 from this project after operation. This has to be mentioned here that all the power plants and other projects were in operation during the period of baseline study.

Bangladesh National Ambient air quality standard NOx level set for annual average. As the primary data is not available throughout the year to measure at an annual basis, Continuous Air Monitoring Station (CAMS) secondary data is available from Narayanganj CAMS station (Article 4.6) of DOE. The Narayanganj CAMS station (23.63N and 90.51E) is around 10km away from the project site and the concentration of Narayanganj is much higher than the project area considering the volume of industrial activity and emission level. Even considering the highest concentration of NOx at Narayanganj CAMS, still the aggregated NOx concentration is within the limit of IFC/WB and Bangladesh standard.

Table 6 16: Comparison Ambient air quality guideline for NOx

Pollutants	Average period	Ambient concentration	Concentration From RPLBL	Total	Standard in µg/m³		
					BNAAQS***	WHO/IFC 2007*	US EPA
NO_x	1 hr	-	10	-		200**	188
	Annual	35.67****	0.10	35.77	100	40**	100

IFC Environmental Health & Safety Guidelines 2007
** Ambient air quality standard for small combustion facility using gas fuel and spark engine
***Bangladesh National Ambient Air Quality Standard
****Maximum Annual average of NOx as per Narayanganj CAMS

Table 6.17: Stack emission dispersion GLC at Air Monitoring Stations in µg/m3

Name of the station	Distance from the project km	Max Ambient Nox	Main Stack (0-5km)				Bypass stack (0-5km)			
			1hr	annual	%contribution on IFC/WB standard		1 hr	Annual	%contribution on IFC/WB standard	
					1 hr	annual			1 hr	annual
Pachani	1.62	11.2	7	0.3	3.5 %	0.75%	4	0.2	2%	0.5%
Mograpara	3.12	9.4	6	0.3	3%	0.75%	3	0.2	1.5 %	0.5%
Boiddarbazar	5.68	15.7	5	0.3	2.5 %	0.75%	3	0.2	1.5 %	0.5%
Jamaldi	2.51	8.9	7	0.3	3.5 %	0.75%	4	0.2	2%	0.5%
Vhatibalaki	3.92	11.9	6	0.3	3%	0.75%	3	0.2	1.5 %	0.5%
Gowalgaon	3.82	9.0	6	0.3	3%	0.75%	3	0.2	1.6 %	0.5%
Bangladesh Standard				100				100		
IFC/WB Standard			200	40			200	40		

Note: As per IFC/WB Environmental, Health & safety guideline, ambient air quality, General Approach (page 4), an individual contribution to the air shed should not exceed 25% to the guideline value. So, RBLPL contribution in this case would not be more than 3.5%.

475. The emission contour maps of the proposed project at 1 hour and annual average of NOx concentration are shown in Figure 6-2 and Figure 6-3.

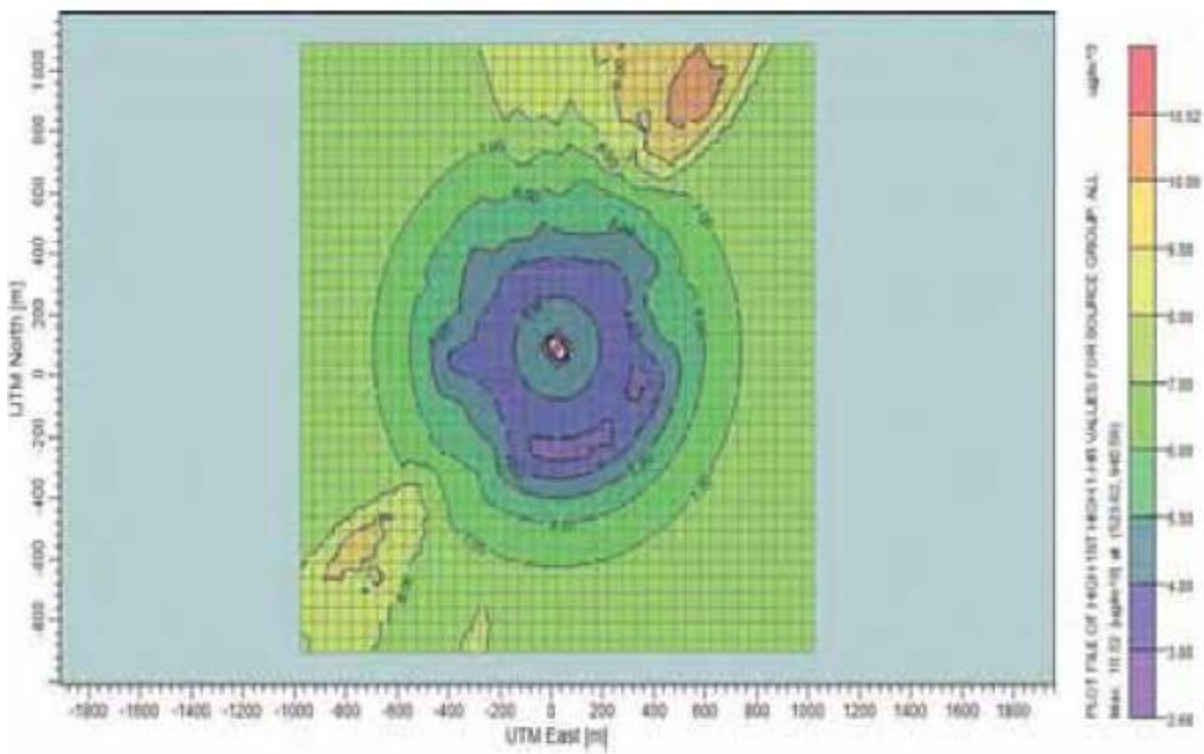

Figure 6.2: Emission contour map showing the NOx concentration (1 hour average up to 100m)

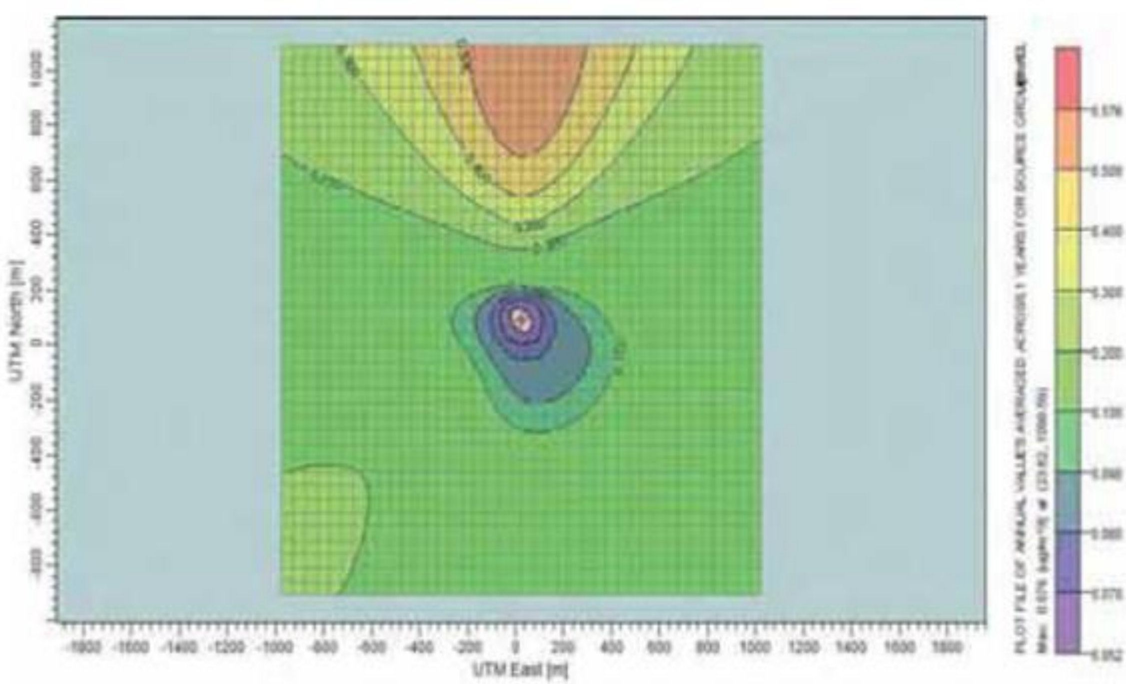

Figure 6.3: Emission contour map showing the NOx concentration (annual average up to 1000m)

Figure 6.3 Emission contour map showing the NOx concentration (annual average up to 100m)
Figure 6.4: Emission Controu map showing the NOx concentration (1 Hour average 5000m radious)

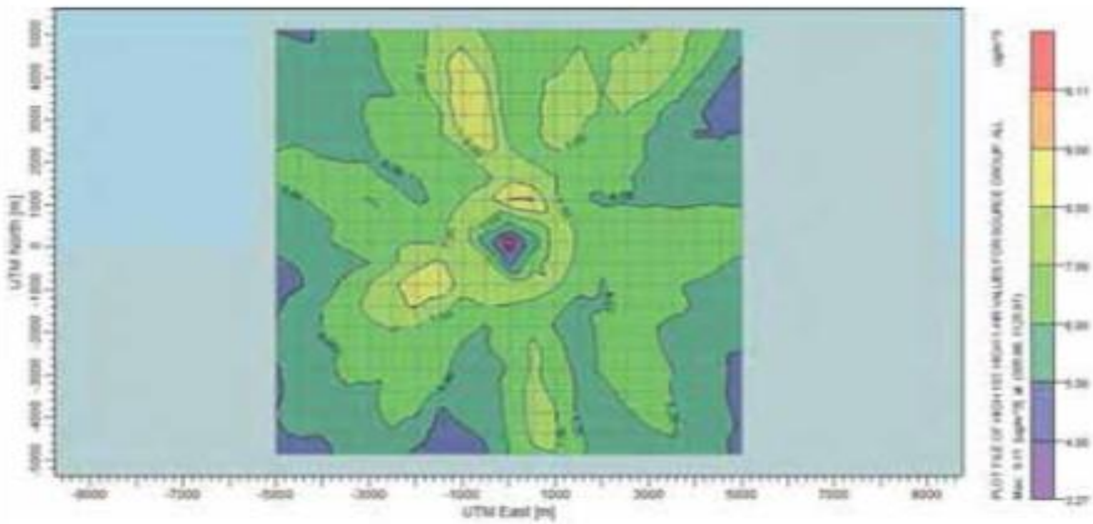

Figure 6.4: Emission contour map showing the NOx concentration (1 hour average 5000m radius)

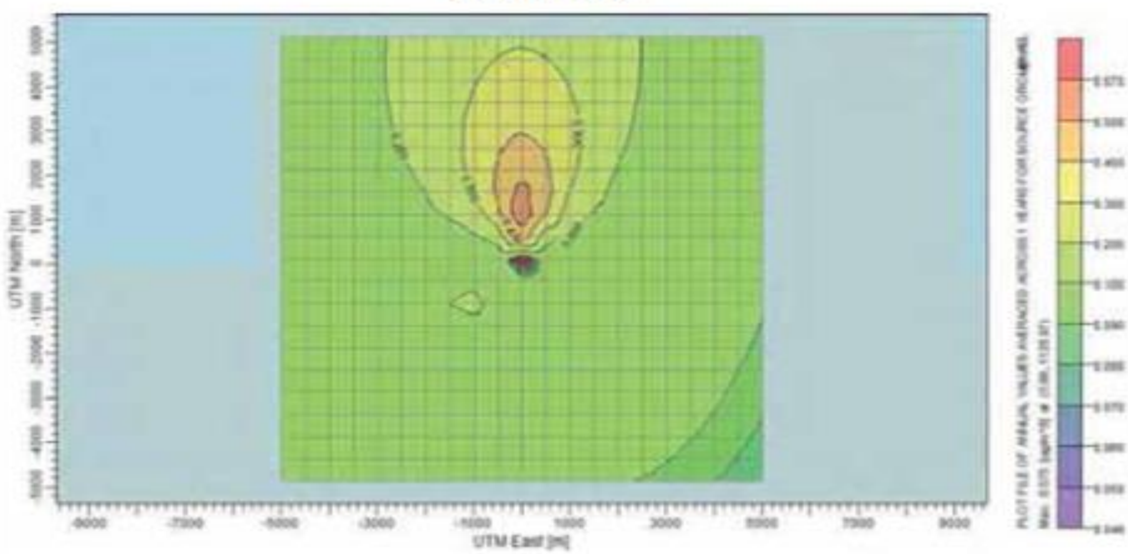

Figure 6.5: Emission contour map showing the NOx concentration (annual average up to 5000m)

Figure 6.5: Emission Controu map showing the NOx concentration (Annual average 5000m radious)

Figure 6.6: Emission Controu map showing the NOx concentration (1 Hour average up to 10000m bypass stack)

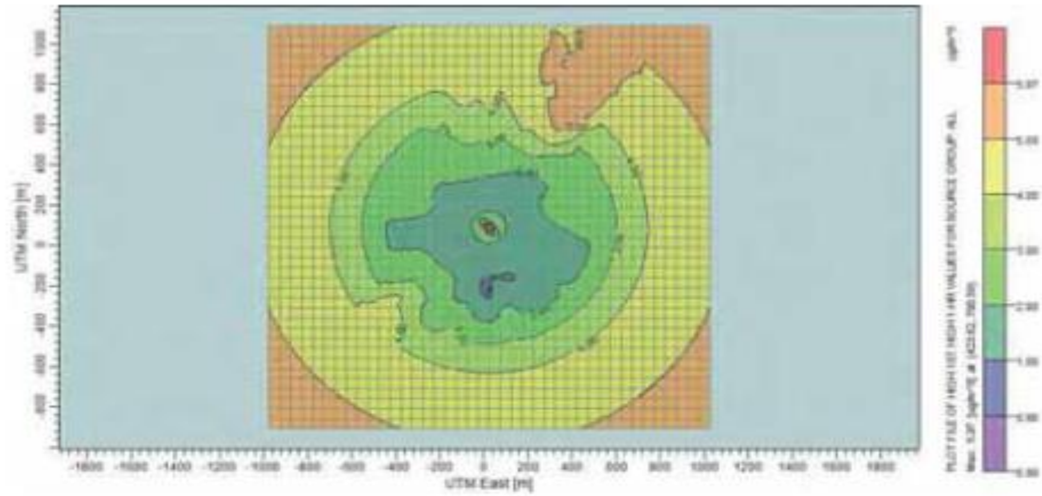

Figure 6.6: Emission contour map showing the NOx concentration (1 hour average up to 1000m bypass stack)

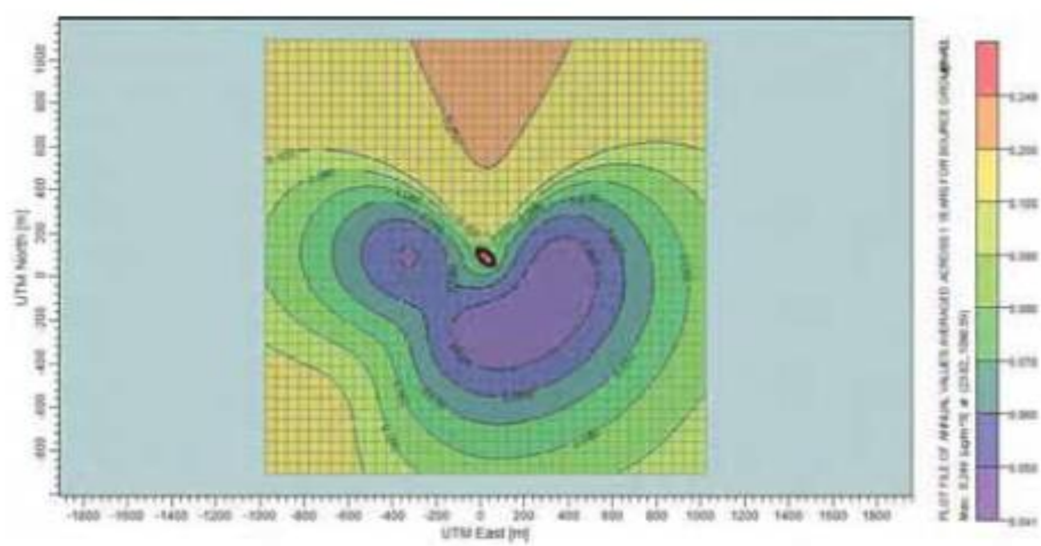

Figure 6.7: Emission contour map showing the NOx concentration (annual average up to 1000m bypass stack)

Figure 6.7: Emission Controu map showing the NOx concentration (Annual average up to 10000m by pass stack)

Figure 6.8: Emission Controu map showing the NOx concentration (1 Hour average up to 5000m bypass stack)

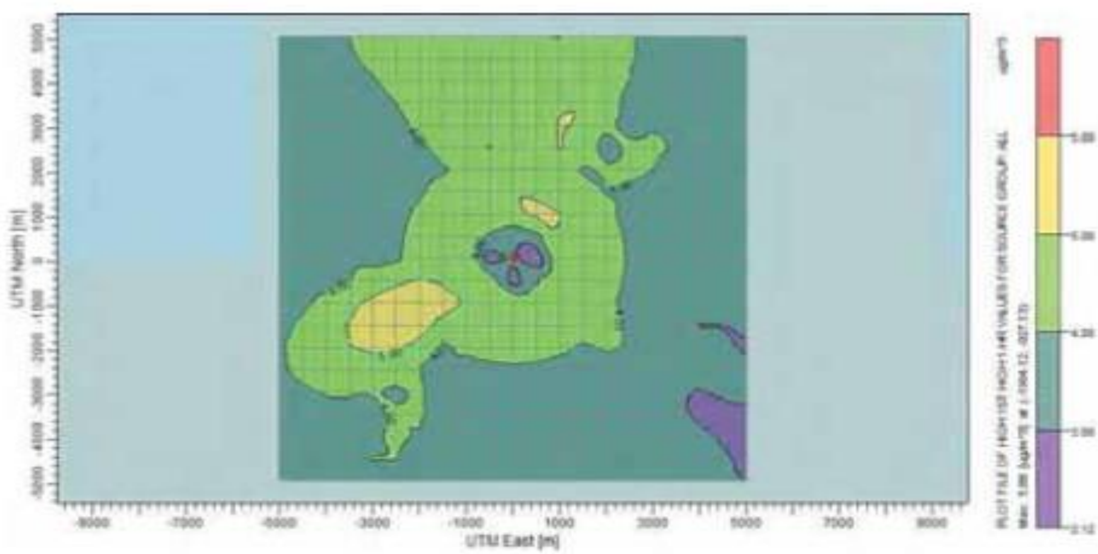

Figure 6.8: Emission contour map showing the NOx concentration (1 hour average 5000m radius bypass stack)

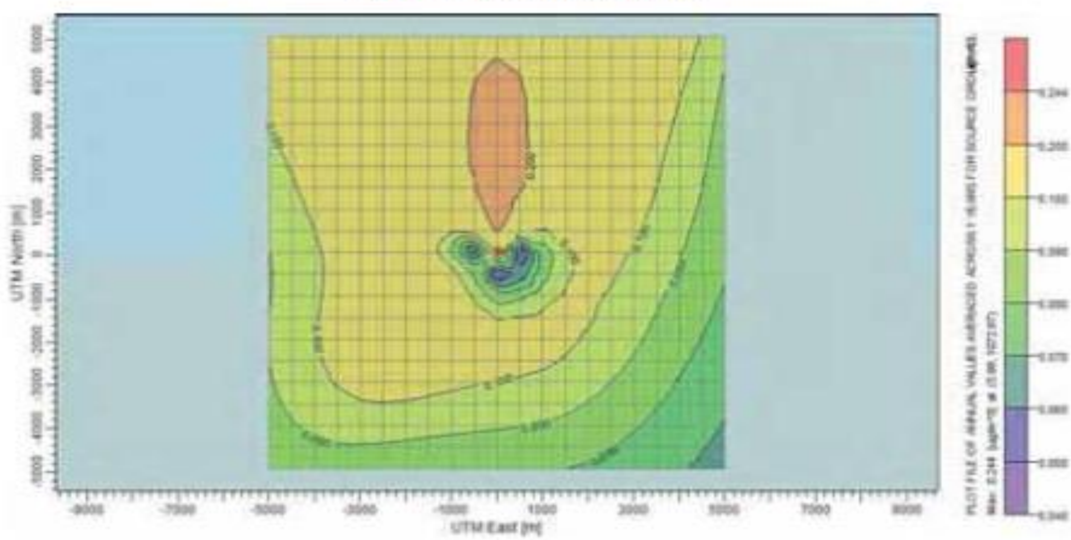

Figure 6.9: Emission contour map showing the NOx concentration (annual average up to 5000m bypass stack)

Figure 6.9: Emission Controu map showing the NOx concentration (annual average up to 5000m bypass stack)

C. Ambient Air Quality by considering the cumulative concentration from other existing power projects near RBPL

An effect on ambient air quality has been assessed based on the cumulative ground concentration of NO2 emissions together with other existing power project of BPDB power village complex. In addition to the 750 MW RBPL CCPP, there are 450 MW CCPP of Meghnaghat Power Limited, 350 MW duel fuel CCPP of Summit Meghnaghat Power Company Limited (SMPCL) and 100 MW HFO based power project of Orion Power Meghnaghat Ltd (OPML) are in operation. USEPA AERMOD view version 9.2.0 model was used to estimate emission concentration from all the plant.

Orion Power neither has any NOx emission data available at site nor has provision in their stack to measure the NOx data. On the other hand, Summit power didn't agree to share their emission data. So, in this calculation, we have used Meghnaghat power data, Ashuganj 400 MW Gas Turbine CCPP data (instead of Summit Meghnaghat as it is almost near to their capacity) and 750 MW CCPP of RPBL data together as point source to determine the cumulative ground concentration of NOx in the area. Though 100 MW Orion HFO power plants emission data is not used but is already taken care with the monitoring of existing baseline data monitoring. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO2 concentration contour has been analysed with 500 m interval with a radius of 5000m from the point source. The NO2 concentration contour of 1 hour and annual average of maximum concentration have been analysed. The parameters and corresponding values are summarized in Table 6-18 and Table 6-19.

Table 6.18: The exhaust specifications of "Meghnaghat Power Company Ltd."

Sl. No.	Parameters	Values
1.	Stack height (m)	60
2.	Stack inside diameter (m)	5.7
3.	Stack gas exit velocity (M/S)	20.3
4.	Exhaust flow rate (cu.m/sec)	517.9
5.	Exhaust temperature (K)	393
6.	NO_2 emission rate as NO_2 (g/s)	20.00
7.	Ambient temperature (K)	293
8.	Receptor height above ground	0.000

Table 6 19: The exhaust specifications of Summit Meghnaghat Power Ltd.

Sl. No.	Parameters	Values
1.	Stack height (m)	65m
2.	Stack inside diameter (m)	6.25m
3.	Stack gas exit velocity (m/s)	9 m/s
4.	Exhaust temperature (K)	(90+293) = 383
5.	NO_2 emission rate as NO_2 (g/s)	15.38
6.	Ambient temperature (K)	293
7.	Receptor height above ground	0.000

6.5.2 Dispersion Model results (Cumulative)

The NO2 concentration contour of 1 hour and annual average of maximum concentration have been analysed. The maximum of 1 hour concentration of NO2 has been predicted within 20-30 µg/m3 at a radius of 0-5000m north-west and south-east to the project, whereas the concentrations are within 10-20 µg/m3 at the other sides within the study area. The maximum annual concentration of NO2 has been detected as 0.50-0.80 µg/m3in a pocket at a radius up to of 500-200m north-west to the project whereas the concentration are within 0.10-0.08 µg/m3 at the either sides further down to the project site up to 5000m.

Review of modelling results:

The modelling result shows the 1 hour ground level concentration of the NO2 (max 20-30 µg/m3) is within the IFC standard (200 µg/m3) for 1 hour concentration. The maximum annual concentration of NO2 has been found 0.50-0.8µg/m3 is also less than the Bangladesh, WHO/IFC and USEPA standard. These indicate that the expected power plant does not have major significant adverse impact on the prevailing air quality of that area.

Bangladesh National Ambient air quality standard NOx level set for annual average. As the primary data is not available throughout the year to measure at an annual basis, Continuous Air Monitoring Station (CAMS) secondary data is available from Narayanganj CAMS station (Article 4.6) of DOE. The Narayanganj CAMS station (23.63N and 90.51E) is around 10km away from the project site and the concentrations at Narayanganj is much higher than the project area considering the volume of industrial activity and emission level. Even considering the highest concentration of NOx at Narayanganj CAMS, the aggregated NOx concentration (36.47 µg/m3) in the project area is still within the limit of IFC/WB and Bangladesh standard. But the maximum & minimum 24hr NOx concentration has been found in our baseline study at Vatibalaki as 11.9 µg/m3 on November and 5.1 µg/m3 on October respectively.

Table 6.20: Comparison Ambient air quality guideline for NO_2

Pollutants	Average period	Ambient concentration	Concentration From RPLBL	Total	Standard in µg/m³		
					BNAAQS***	WHO/IFC 2007*	US EPA
NO_2	1 hr		30			200**	188
	Annual	35.67****	0.80	36.47	100	40**	100

* IFC Environmental Health & Safety Guidelines 2007
** Ambient air quality standard for small combustion facility using gas fuel and spark engine
***Bangladesh National Ambient Air Quality Standard
**** Maximum Annual average of NOx as per Narayanganj CAMS

The emission contour maps of the proposed project at 1 hour and annual average of NO2 concentration are provided in Figure 6-4 and Figure 6-5. Both BNAAQS and IFC do not have any standard for 24 hours so 24- hour modeling is not considered.

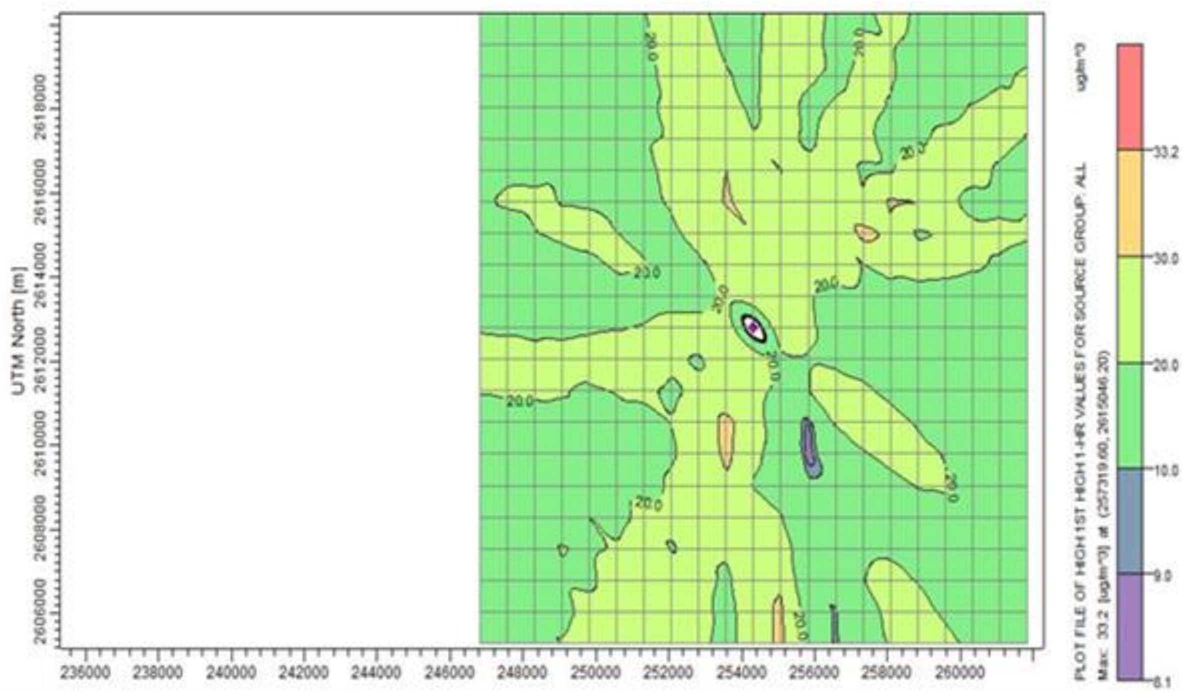

Figure 6.10: Emission contour map showing the NOx concentration (1 hour average) combined source

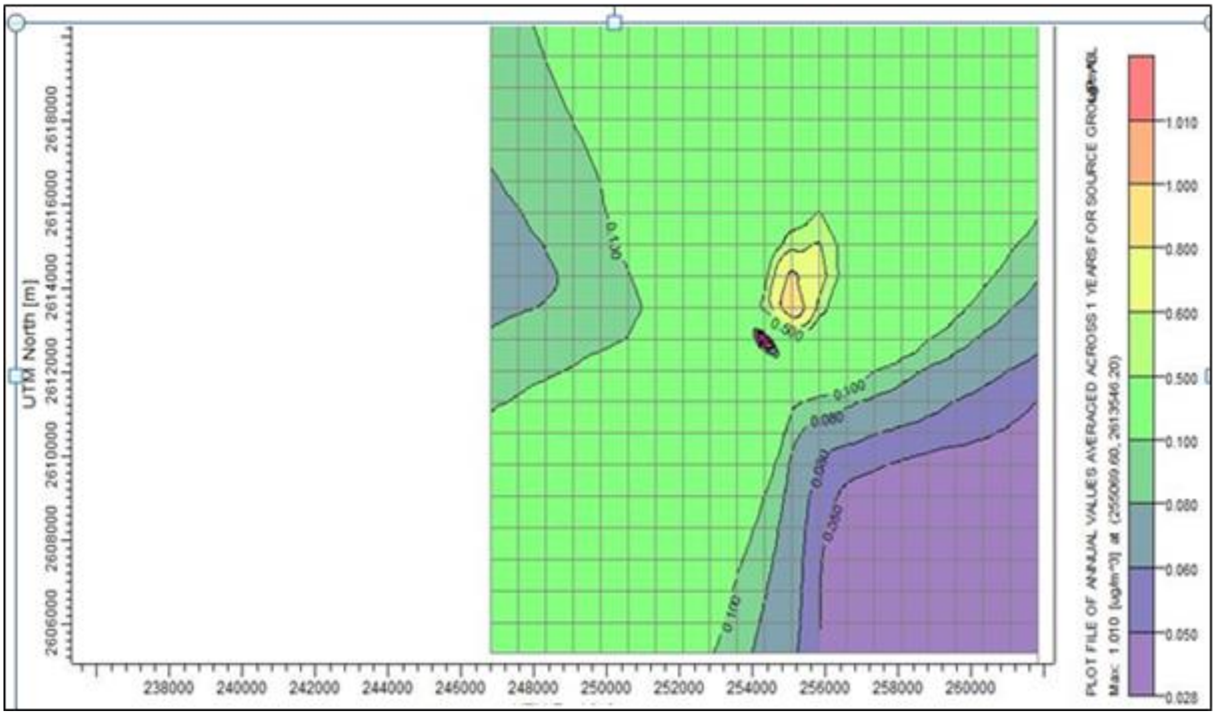

Figure 6.11: Emission contour map showing the NOx concentration (annual average) combined source

6.5.2.1 Mitigation Measures

It has been discussed earlier that the proposed power plant would be constructed with a modern design and sophisticated machinery setting. The power plant would be operated by natural gas, so CO, Particulate Matter and SO2 would not be a concern in terms of emission. The NOx emission from the power plant would be kept at a minimum level with optimum designed cycle efficiency in order to maximize the MW output.

6.5.2.2 Impact Significance

Impacts on air quality are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

The onsite data for baseline represents the worst case scenario. As RBLPL will be collecting further two seasons' data hence, will draw a comparison in the data set of baseline and will represent in to update ESIA.

Table 6 21: Impact Significance on Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Air Quality	Without Mitigation	Local	Long	Very Low	Minor

6.5.3 Impact on Climate Change

Greenhouse gases are those that absorb and emit infrared radiation in the wavelength range emitted by Earth which eventually contributed to global warming and finally climate change. In order, the most abundant greenhouse gases in Earth's atmosphere are:

- Water vapor (H2O)
- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)
- Ozone (O3)
- Chlorofluorocarbons (CFCs)

Emission of CO2 is associated with this project which relates to global warming. CO2 emission depends on the fuel burned and the carbon content of the fuel. The natural gas contains a significant portion of carbon, which reacts with oxygen to produce CO2 and heat; at full capacity CO2 emission due to the project operation, with its present quantum will not have much impact on global warming.

The Table 6-22 shows the comparison of IFC CO2 Emission rate for Combine Cycle Gas Turbine Plants and the specification of 750 MWCCPP:

Table 6 22: Comparison of IFC CO2 Emission rate and the specification

Parameter	Performance of CO_2 emission as per Engine Catalogue	IFC/WB Typical Values for CO_2 Emissions in a CCGT Plant (Natural Gas)		
		Efficiency, (% Net, HHV)		Efficiency (% Net, LHV)
		(w/o CCS*)	(with CCS*)	
Efficiency, (% Net)	58.4	50.8	43.7	**54-58**
CO_2 Emission, (t CO_2 / GWh)	342.1	355	39	**348-374**

CCS-Carbon capture and storage

The CO2 emission factor for RBLPL750 MWCCPP 342.1 tCO2/GWh. Assuming 85% plant load factor, the total annual CO2 emissions of RBLPL750 MWCCPP is estimated:
0.75 GW x 8760 hours/year x 0.85 = 5584.5GWh/year
5584.5GWh/year x 342.1 tCO2/GWh=1,910,457.45 tCO2/year
Note: All the calculations are done considering efficiency for combined cycle power plant

6.5.4 Mitigation Measures

It has been discussed earlier that the proposed power plant would be constructed with a modern design and sophisticated machinery setting. The power plant would be operated by natural gas and a combined cycle operation, so CO2emission in this project would be minimal and as per the IFC guideline which would be at minimum level with optimum designed cycle efficiency in order to maximize the MW output.During the development or operation phase, if the generation of CO2 emissions is high then according to SPS 2009, CO2 emission of 1,00,000 tCO2/year or more will require monitoring and the provision of offsets through the project.The monitoring should be done as per the calculated value for the emissions.The projet authority should consider establishing Turbine with H-class efficiency gor lesser emission.

Table 6 23: Impact Significance on Climate Change

Impacts on climate change are assessed as minor in nature.

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Climate Change	Without Mitigation	Local	Short	Very Low	Beneficial (Moderate)

Impact on Climate Change without Mitigation Local Short Very Low Beneficial (Moderate)

6.5.5 Impact due to Liquid Discharge

6.5.5.1 Domestic Wastewater

The wastewater collection system will collect sanitary wastewater from sinks, toilets, and other sanitary facilities, and will be managed by the septic tank. The waste water generated from the above sources will be disposed to underground septic tank and soak well system. Proposed septic tank and soak well details are shown in Figure 6-6.It is estimated that15 kld wastewater will flow from the building sewer line to the septic tank where both heavy and light solids are separated from the wastewater. Solids that are heavier than water settle out forming a sludge layer on the bottom of the septic tank. Solids lighter than water float to the top of the wastewater forming a scum layer. A liquid layer of water with suspended solids, nutrients, microorganisms and other pollutants separates the sludge and scum. Anaerobic bacteria — those that can live without oxygen — begin to break down waste in the septic tank. As wastewater flows into the septic tank, an equal volume of the liquid layer, called effluent, flows out of the septic tank into the effluent treatment system. In a properly designed, functioning and maintained septic tank, scum and sludge will not flow out with the effluent.

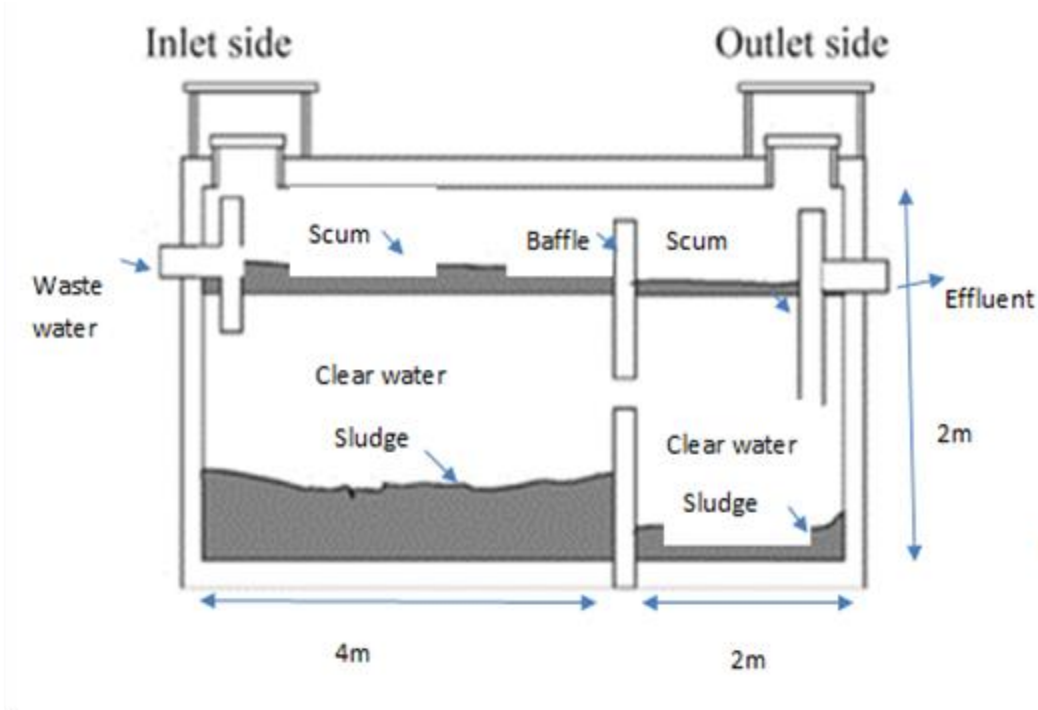

Figure 6.12: Septic tank details

While septic tank effluent may appear clear, microorganisms such as bacteria and viruses, nutrients such as nitrate and phosphorous, dissolved materials and very small particles of suspended solids are present. To protect the environment and human health, effluent must receive additional treatment as soak well system.

Solid waste is removed from septic tank every five years interval. This anaerobically digested septic tanks solid waste/sludge is used as a soil conditioner or fertilizer provided it first tested to confirm suitability pr national requirements.

If the septic tank will not be constructed 100 m away than any river or tube well then the package sewage treatment plan will be the best option to protect ground water contamination.
However, the inclusion of package sweage treatment plant shall be explored during detailed enigineering to be used during plant operation phase.

6.5.5.2 Wastewater from Plant Drains

General facility drainage will consist of area cooling water blow down, occasional equipment& floor wash, service water, rejection from DM water etc. will be collected and treated in a wastewater treatment facility which has a capacity of 20cu.m/hour. Water from these areas will be collected in a system of floor drains, hub drains, sumps, and piping, and routed to the facility wastewater collection system.

Treated effluents are equalized in Guard pond before reuse and recycling within the plant. Excess treated and equalized effluent will be disposed off through plant's effluent outfall. This discharge will thus meet the permissible standards

Treated Effluent quality shall be as per the following:

pH	: 6.0 – 9.0
Suspended solids	: 50 mg/l
Oil and grease	: <10 mg/

The Effluent Treatment Plant conceived will handle effluent from the following facilities-

- Neutralized waste from DM plant
- Cooling tower blow down
- Boiler blow down
- Waste water from the plant wash

Neutralized waste from DM Plant, Cooling tower blow down and Boiler blow down do not need any treatment except only dilution and retention of effluent in CMB is envisaged before discharging outside the plant boundary.

For waste water from the plant wash, Treatment plant is envisaged with suitable capacity before discharging through CMB. The capacity envisaged is 20 cum/hr. The following treatment will be done in the ETP:

- Collection tank
- Coagulation & Flocculation
- Solid separation by clarifier
- clean water to CMB
- Sludge thickening
- Sludge dewatering by centrifuge

Sludge generated from Pre Treatment plant shall be treated suitably and solid waste generated shall be disposed outside plant.

Drains that could contain oil or grease will first be routed through an oil/water separator and then directed to the effluent treatment plant. The amount of wastewater generated from this system is anticipated to be minimal.

6.5.5.3 Wastewater from Close circuit cooling system

The proposed Combined Cycle power project will use river water in the steam condensing unit at rate of 1076 m3/hour flow for which 990 cu.m/hour will be used as make up water in the close loop steam condensation cooling system. Recirculating cooling system with Induced draft cooling towers using fresh water being most environments friendly should be adopted. The CCCW (Closed Cycle Cooling Water) system meets the cooling water requirements of all the auxiliary equipment of the GTG, STG and HRSG units such as turbine lube oil coolers, generator coolers, BFP auxiliaries, condensate pump bearings, sample coolers and air compressors auxiliaries. The water shall be reused for COC 5. About 206 cum/hr. of water is expected to discharged from the plant to the river after necessary treatment which will have a discharge temperature of about + 3 degree C of the ambient temperature. Hence, the impact of discharge from the proposed project shall be minimal having almost no impact on river water quality.

The minimum flow in Meghna River was 2050 cum/sec, considering this mean flow, the abstraction of this project is 0.00014% of the river mean flow and the discharge is 0.00002% of the river flow. The neighborhood power plants are using open circuit cooling and their average discharge flow is around 65000 cum/hour where RPLBL will discharge only 204 cu.m/hour. RBLPL will use the same mixing zone of the other two power projects in which the RBLPL's contribution will only be 0.31% than others, so, there will not be any impact on temperature from RBLPL discharge. Proper care will be taken in the design of water circulation system for the Combined Cycle power plant that no contamination or waste is carried to the river. Thus, the river water will remain free from any sort of negative impact originated from the power plant.Impacts on Water quality are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

Table 6.24: Impact Significance on Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Water Quality	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5.6 Impact due to Solid & Municipal Waste

6.5.6.1 Impact Origin

The operation of the plant itself would not generate any solid waste. Solid waste generated by the people working at the proposed site is paper, cartoons, bags, boxes, office wastes, pallets, empty drums etc. along with negligible quantity of domestic waste. There will have waste Air filters and waste rugs be generated occasionally which need to be properly disposed. During operation phase of the project around 150-200 workers will be employed. It is estimated that around 40 kg/day municipal solid waste will be generated.

6.5.6.2 Mitigation Measures

All solid waste will be collected properly. Segregation of solid waste primarily will be at source. The World Bank EHS guidelines on Hazardous Materials Management, Waste Management and Thermal Power will be followed for all solid and hazardous waste management. Recyclable Waste will be sold to the authorizedrecycler. Other solid wastes will be disposed to designated landfill facility of Sonargaon Upazilla. Records of all waste transfer will be kept. The air filters and waste rugs should be collected in a safe place and should be disposed to the land fill.

6.5.6.3 Impact Significance

Impacts on solid and municipal waste are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

Table 6.25: Impact Significance on Solid and Municipal Waste

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Solid and Municipal Waste	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5.7 Impact of Hazardous Waste

Hazardous waste that may also be generated during the operation phase of the proposed project includes small amounts of waste/spent oil, batteries, lighting lamps, E waste, etc.

6.5.7.1 Lubricating Oil

Insignificant amount of used lubricating oil would be generated from the plant. The generated waste oil will be stored in a sealed tank.
6.5.7.2 E Waste

A variety of E-wastes will be generated during the operation of power plant. The quantity/volume and characteristics of e-waste depend on many factors such as nature and scale of operation and maintenance activities. Proper handling and Management of E-Waste is required to avoid any damage to human health, local environment including land, water and air.

Kinds of E-wastes generated from different sources/ activities at division/ unit offices/ operational areas are:

- Used and obsolete IT and telecom equipment: electronic and electrical hardware/ components, PC peripherals, etc.
- Faulty/scrap meters and metering equipment, electronic timers;
- PCBs,
- Faulty/used electronic and electrical equipment,

Capacitors i.e. electrolytic capacitors and capacitors containing Polychlorinated Biphenyls;

6.5.7.2 Battery Waste

In the life of the plant, there's a chance that battery waste will be generated and if not handled properly, battery can release hazardous substance harmful for human health at the end of its life.

- Batteries are one of the most common forms of industrial hazardous waste, containing metals toxic to human health and the environment.
- As batteries start to break down in landfill, the heavy metals they contain can leach into surface and groundwater, polluting soil and water, and harming humans and wildlife.

6.5.7.3 Mitigation Measures

IFC EHS guidelines on Hazardous Materials Management and Waste Management will be followed. The EHS department of the RBPL will be responsible for proper handling of hazardous waste in compliance with all applicable law. The RBPL will provide personnel training to the related plant workers to handle the hazardous waste, accumulation limits and times, and reporting and recordkeeping. The wastes that require disposal would be characterized based on generator knowledge or analytical testing to determine the appropriate management and handling procedures. Once properly characterized, the wastes would be temporarily stored at the site in appropriate containers and impermeable storage areas according to all applicable hazardous waste storage law. Impermeable surface should also be used for refueling whilst there will be training of workers for spill response and provision of keeping stock of spill equipment such as bunds, soaking material etc. at project site. Oily waste and chemicals should be stored in a tank have sufficient secondary containment (110% more than its capacity).

All the hazardous waste should be properly levelled, where the following information should be added:

1. Name & type of waste
2. Quantity of waste
3. Date of waste generation (period of waste generation)
4. Waste generation site
5. Disposal site
6. Responsible authority who handles this waste.

The waste will be removed from the site with a regular interval for safe disposal at designated permitted facility.

The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility of 110% bigger than the allowable maximum storage capacity. The waste lubricated oil thus collected will be supplied /sold to the venders or the Lube Oil Re-cycling plants approved by DoE at throwaway price. As there is no chance of mixing and disposal of oil onto land or water, so there is no mitigating measure to be suggested.

6.5.7.4 Impact Significance

Impacts on Hazardous waste are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

Table 6.26: Impact Significance on Hazardous Waste

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on hazardous Waste	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5.8 Noise and Vibration Impacts

6.5.8.1 Impact Origin

During operation, the maximum expected noise level from turbine generator and other sources will be < 85 dB(A) on any specific source point within plant premises. The sound pressure levels generated by various noise sources decrease with increasing distance mainly due to wave divergence. Since the various plant equipment are located at large distances, higher cumulative levels are not achieved. However, prediction was performed for the maximum expected noise levels at various locations. The community-level noise calculation was also performed to arrive at the anticipated levels the community is likely to get exposed to for a longer period of time.

6.5.8.2 Mitigation Measures

Necessary noise abatement measures will be taken as required avoiding adverse noise & vibration impact on the neighborhood. To reduce the effect, most costlier and effective Critical Type Silencer will be used in the stack. In particular, significant noisy components such as the gas turbine sets are enclosed in buildings acoustically designed, providing Styrofoam filler of 50 mm width in between 300 mm thick brick walls around the power house building. Moreover, thick doors are provided and holes which may create sound pollution are sealed with sound proof materials. Vibration pad will also be used at the bed of all power generation units to prevent the vibration.

Table 6.27: The following are the noise protection capacity of the material which would be used for sound insulation for the power house building:

Material	Thickness, mm	Surface density, kg/sq.m	Transmission loss,dBA
Styrofoam (Acrylic -Poly-Methyl-Meta-Acrylate (PMMA)	15	18	32
Brick with or without plaster	150	288	40

As per above calculation the Styrofoam filter and brick wall are capable to absorb more than 112 dB(A) noise from the engine room, but the approximated engine room noise is around 85dBA near the turbines, which is lower enough to minimize the engine room noise by the acoustic measurement. Moreover, Vibration pad will also be used at the bed of all power generation units to prevent the vibration. Proper PPE should be provided to the worlkers who will exposed to high noise in the control room and turbine room. High noise areas should be signed properly.

For the measurement of the dispersion of the stack noise to surrounding environment, a noise modelling simulation has been done by using CUSTIC-3.2 noise modelling software. The model has calculated the noise from the exhaust stack of 85dBA and the result of the modelling has been given below:

Table 6.28: The distance of the following noise level has been calculated from the center of the stack row

Radius, m	50	100	200	300	400	500
Output Sound power level in dBA	32.16	26.80	21.44	16.08	10.72	5.36

Figure 6.13: Plot of output noise power level in dB(A)vs Radius in meter

The modelling result shows that the power plant will produce max noise 32.16dBA within the boundaries whereas the noise level is 5.36dBAwithin 500m radius of the project.

Table 6.29: IFC and Bangladesh standard for the ambient noise:

Standard	Zone	Day time dBA	Night time, dBA
IFC EHS Guideline 2007	Residential, Institutional, educational	55	45
	Industrial, commercial	70	70
Bangladesh ECR, 1997	Mixed area	60	50
	Commercial	70	60
	Industrial	75	70

It is observed from the noise emission modelling that the max noise level within the 50m radius is 32.16 dBA. If we consider 1 am (night time) noise level (max 39.2dBA) as the background noise (Article 4.7), the combined effect can be found from the link(-http://www.sengpielaudio.com/calculator-spl.htm) and applying the formula of (∑L = 10. Log10 (10L1/10 + 10L2/10) dBA. The calculated table is presented below:

Table 6.30: calculated table

Radius, m	50	100	200	300	400	500
Output Sound power level in dBA	32.16	26.80	21.44	16.08	10.72	5.36
Ambient sound level in dBA	39.2	39.2	39.2	39.2	39.2	39.2
Summation of two sound level	39.98	39.44	39.27	39.22	39.2	39.2

Bangladesh Governmentdoesn't have declaration of zones for comparing the noise with standards. From the nature of the development, it is evident that the area falls under industrial zone since there are many medium and big industries are already exists in the area; moreover, there is no homestead settlement near the project site. The result clearly stipulates that the sound intensity level is within the Bangladesh and WB guideline (70 dBA at industrial zone or even 60 dBA for mixed zone) at all sides from the center of the stack and gradually reduces at further distances. Apparently there will not be effect of noise contribution from the power project beyond 300m radius from the stack. Ear plugs will be provided for working in high noise zone.

6.5.8.3 Impact Significance

Impacts on noise and vibration are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

Table 6 31: Impact Significance on Noise quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Noise Quality	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5.9 Occupational Health

6.5.9.1 Impact Origin

The proposed project will employ around 160 people during its operational period. The workers who work inside the plant will face occupational health hazards due to different operational processes. Safe and good occupational health status of the employees and workers is important for only the persons working in the plant, but also for the better plant operation and maintenance.

6.5.9.2 Mitigation Measures

Protective clothing, earplug, helmets, shoes and accessories should be provided to the workers. Adverse impact on worker's safety would be minimized by implementing an occupational health program. Regular medical check-up would be done to ensure the soundness of health of employees and workers. Pollution control measures would duly adopt if necessary, including noise and air pollution.

6.5.9.3 Impact Significance

Impacts on occupational health are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

Table 6 32: Impact Significance on Occupational Health

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Occupational Health	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5.10 Impact on Ecology

6.5.10.1 Impact Origin

The proposed project will be a 750 MW combined cycle power project and may have long term impact on the ecological resources in the area if not properly addressed. Proper mitigation measures should be implemented if the negative impact identified on this issue

6.5.10.2 Mitigation Measures

The following are the ecological resources and discussed individually to address the impact and its mitigation measures

Flora: The power plant would not emit any toxic gas or dust during operation so the impact on floral species in the area is insignificant.

Fauna: The power plant would have close circuit cooling system and will not emit thermal discharge to water body, the nominal discharge from the project would be controlled by in house WWTP and discharge quality will be within national limit, so, the impact on aquatic fauna in the area is insignificant.

Fishery: Since the project would not have any thermal discharge, so, the impact on fishery in the area would not be an issue.

Forest: There is no forest in the vicinity of the project. Nevertheless, there would not be any impact on forest by this project activity since there is no toxic emission.

Wildlife: Since there is no forest in the vicinity of the project, there is no wild life passage in the area. So, there would not be any impact on wildlife by this project activity.

6.5.10.3 Impact Significance

Impacts on ecology are assessed as moderate in nature and shall further be reduced to minor after implementation of Management Plan.

Table 6 33: Impact Significance on Ecology

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Ecology	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

6.5.11 Impact on Fishing Activities

6.5.11.1 Impacts

Net raw water requirement for the proposed project is about 1076 m3/hr at full load. Initial year's water requirement will be more and in view of emergency 10% margin has also been considered for raw water pumping system. Cooling water make-up requirement for the proposed project will be about 990 m3/hr considering 5 COC.

Power plant intake structures harm waterways. Since intake structures sit well below the surface of the water, fish and other aquatic life are hit the hardest. A single power plant can destroy billions of fish eggs and larvae and millions of adult fish in a single year. In addition to fish, intake structures also harm aquatic animals.

6.5.11.2 Mitigation Measures

The volume of water requirement for makeup would have been increased by .... times, hence the quantum of water to be extracted will be too small in comparision to the available volume considering the flow in the meghna river. The water will be extracted though intake well only wher in fine mesh will be installed at intake pipe to prevent entry of fish in intake structure. On the other hand, there is minimal thermal discharge meeting the + 3 Deg C of ambient temperature from the proposed power project and will also have much diluation as the power plants in the vicinity which have adopted Once trhough colling discharges much more water than this proposed power project. Hence the anticipated impact is minimal due to power plant discharge and abstraction.

6.5.11.3Impact Significance

The overall impact on fishing activity shall be moderate in nature.

Table 6 34: Impact Significance on Ecological Aspects

Aspect	Scenario	Spread	Duration	Intensity	Overall
Fishing Activity	Without Mitigation	High	Long	Moderate	Major
	With Mitigation	Medium	Long	Low	Moderate

6.5.12 Socio-economic Impacts

Impact on Land: The land identified for the proposed project is revenue land which is identified for commercial purpose by the government of Bangladesh. Approximately 35 acres of government land has been procured on lease for proposed Thermal Power Project at Meghnaghat, Sonargaon, Narayanganj, Bangladesh. The proposed site has no homesteads land. It does not involve any physical / economical displacement.

Rehabilitation and Resettlement: Based on site investigation, land is identified for commercial purpose by the government of Bangladesh so that it was recorded that the government of Bangladesh has agreed to lease the land to the developer at Meghnaghat site for setting up of the Project. Hence, this project does not involve any resettlement in terms of physical and economical aspects. Therefore, it does not attract Resettlement Plan as per applicable national/state legislation.

Impact on Indigenous People: Based on the site investigation, information provided by Reliance, The land was low lying char land owned by Government (Government Khas land); PDB acquired the land in 1995 and developed the area as Power village. So that there is no any SC or ST land involved in the proposed project. It does not involve any restriction of access of village community to any public resources. There is no any anticipated impact on indigenous people.

Community Development Activity: As per Reliance's CSR Policy, Reliance will propose community development programme on the basis of need based assessment and consultation with local villagers and relevant stakeholders.

Employment: The local business communities engaged in trade and commerce will be benefited. On the other hand, people living in abject poverty are expected to marginally gain in terms of greater number of employment days. As the labour demand grows, a general wage increase is expected. The socioeconomic enhancement on account of these positive changes is anticipated both in core as well as buffer area. Daily wage labours, mostly in and around project site have been observed during site visit and tried to consult them. Consultation with the labours highlights that as the proposed Thermal Power Project supported their employment during construction period and helped them tackle the seasonal unemployment in the area. The project activities are expected to enhance economic activities in the area which will benefit the overall economic development of the area by way of meeting energy demands. Income generating opportunities will also grow in the area on account of creation of new job opportunities. The job opportunities in non-agricultural sector are likely to increase. The installation of proposed plant is expected to further increase the prospects by bringing in some direct and indirect employment opportunities.

6.6 IMPACT DURING DECOMISSIONING

6.6.1 Impacts

The plant has been designed for an operation period of 25 years. Decommissioning of the project involves dismantling of the power plant structure and all associated electrical infrastructure and site buildings. The impacts associated with decommissioning activities are:

- Improper disposal of demolition waste and obsolete machineries shall lead to contamination of soil and discontent of community
- Demolition activities shall lead to generation of dust which can be carried downwind to habitations
- Land may lose fertility potential during the year as no agriculture activity shall take place during the year of Operation

6.6.2 Mitigation Measures

Dismantling activities should be taken care by experienced professionals under the guidance of plant EMS Head. All the dismantled infrastructures and debris should be segregated and stored separately with cover facility to negotiate with contamination effects of such wastes.

The metal structure should be sold out to the approved recyclers, whereas, debris should be disposed-off as per their characteristics. The construction debris can be utilized for land filling in nearby low areas and debris having contamination potential should be transported to nearby TSDF site.

6.6.3 Impact Significance

Decommissioning phase impact shall be limited to the site and minor in nature. However, impact shall further be mitigated to the insignificant level.

Table 6 35: Impact Significance for Decommissioning

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact of Decommissioning	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

Table 6 36: - Summary of Environmental and Social Impact of the Construction Phase

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
Environmental Issues **Construction Noise**— Disturbance to surrounding communities of power plant due to operation of construction machinery at the plant site	Disturbance to communities in surrounding areas of the proposed plant site due to construction machinery operation	The BNEQS for noise require that the sound level in industrial area should not exceed 75 dBA at day time and 70 dBA at night time, IFC guidelines for noise also require that the noise level in commercial/industrial areas should not exceed 70 dB(A) during the day and 70 dB(A) during the night	• Reduction of equipment noise at source • Conduct pre operation noise survey • Prepare noise control plan • Pre-construction noise survey of the construction equipment • Select low noise equipment for the power plant • Minimization of vehicular noise • Training of all staff members for the use of PPE (Personal Protection Equipment, including hearing protective devices) • A temporary noise barrier around the site if necessary
Emissions— Particulate matter, NO_x and SO_2 emitted during construction activities can result in deterioration of ambient air quality in the vicinity of the source, and be a nuisance to the community.	Dust—nuisance to surrounding communities of the proposed plant due to emission of dust during construction on the plant site Vehicle and equipment exhaust—Combustion exhaust from vehicles and construction can affect the ambient air quality of the Study Area	An increase in visible dust beyond the boundaries of the proposed power plant due to the activities undertaken at the plant site, or onthe access road. Adverse impact on community assets, or There are persistent complaints from the community or the vehicles are not incompliance with the BNEQS for vehicles	• Sprinkling of water on unsealed surfaces for dust suppression • Wheel wash • No open burning permitted • Use of wind shield around aggregate and soil stockpiles • Covering of material piles • Restrictions on speed on unpaved roads • Transportation of material in covered trucks and speed limits strictly observed • Safe distance between the batching plant and the community • Stockpiles will be placed at l 100 m from the community • All vehicles and equipment will be properly tuned and maintained • Medical attention will be free of charge
Vegetation Loss— Loss of vegetation as a result of	Unnecessary or excessive removal of	Preparation of a Reinstatement Plan; Minimization of the felling of trees and clearing	• Try to avoid unnecessary cutting of trees. • Plan a proper plantation and green belt plan for creating good landscape.

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
land clearance for the power plant	trees and shrubs	of vegetation; and avoidance of the use of fuel Wood	
Soil and Water Contamination— Different types of effluents, solid waste and hazardous material may contaminate the water and soil resources of the Study Area	Untreated wastewater and other effluents from the construction activities may contaminate the water resources of the study area. Hazardous materials and non-hazardous waste if disposed of into the surroundings, may contaminate the soil and water resources of the study area	If the run off contains visible quantities of oil and grease and contains silt above BNEQS levels or if it flows towards the community. If any BNEQS and IFC non-compliant effluent is released to the Environment. If any person is exposed to hazardous waste generated from project related activities. Disposal of waste outside designated areas	• Use of spill prevention trays and impermeable sheets to avoid soil contamination • Storage of fuels, chemicals and lubricants in bounded areas with impervious flooring and secondary containment of 110% capacity. • Emergency Response plan will be developed for hazardous substances • Equipment and material containing asbestos, poly-chlorinated biphenyls(PCBs), and ozone depleting substances • (ODSs) will not be used • Material Safety Data Sheet (MSDS) will be maintained
Socioeconomic Issues **Community Safety—** Safety hazards associated with the construction activity, particularly the increase in traffic on the plant site access road	The proposed construction activity can potentially be safety hazard for the community. In particular, the increase in construction related traffic on the proposed project access road.	A significant community hazard will also be considered, if a condition is created during the construction activity that would be considered a safety hazard in a standard occupational and safety health assessment	• A public safety plan will be developed • A speed limit of 20 km/h will be maintained on the proposed access road • Night time driving of Project vehicles will be limited where possible • Community complaint register and other means will be adopted for the community to complain about non-adherence of Project traffic to speed limits, safe driving and other safety-related concerns • Work areas outside the proposed plant site, especially where machinery is involved will be roped off and will be constantly monitored to ensure that local people, especially children stay away
Employment Conflicts—	The potential employment related issue includes	A significant impact will be interpreted if the proportion of available unskilled jobs offered to	• Maximum number of unskilled and semiskilled jobs will be provided to the local communities

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
Conflicts may arise if the nearby communities feel that they are not given substantial share in project related job opportunities	dissatisfaction among localcommunities over the number of jobs offered to them, disagreement on definition of 'local' and also on distribution of jobs within the local community	the locals in the immediate area is less than around 50%	• A local labor selection criterion will be developed in consultation with the community
Hazardous and Non-Hazardous Waste **Management—**Improper waste management may lead to health and aesthetic issues	Exposure to potentially hazardous waste; Generation of excessive waste; Recyclable waste and reusable waste is discarded; Littering; Improper disposal.	A significant impact will be considered, if the waste are not handled and disposed properly. The BNEQS is violated for the collection, storage and disposal of hazardous and non-hazardous waste at site.	Development of a waste management plan; Separation at source of the recyclable material; Regular audits; Maintenance of a Waste Tracking Register; Separation of hazardous waste from non-hazardous waste; On-site storage facility for hazardous waste; Recyclable waste to be disposed via approved waste contractors; Dumping of non-hazardous, non-recyclable waste either to landfill or municipal disposal; Emergency response plan; Trainings; Labelling and avoidance use of asbestos, polychlorinated biphenyls (PCBs), and ozone depleting substances (ODSs)
Project and Community Interface—Inter-cultural differences between the project staff from other areas and the local community	community complaints	A community hazard may be created, if the migrated workers will have social, racial and religious conflict with the local community.	Training of the non-local project staff on local culture and norms; Avoidance of unnecessary interaction of local population with the non-local project staff; Prior notice to residents of the area before project activities

Table 6.37- Summary of Environmental and Social Impact of the Operation Phase

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
Environmental Issues Plant Noise	Unacceptable increase in noise levels in the communities	The BNEQS for noise require that the sound level in industrial area should not exceed 75 dBA at day time and 70 dBA at night time, IFC guidelines for noise also require that the sound level in commercial/industrial areas should not exceed 70 dB(A) during the day and 70 dB(A) during the night	• Low noise equipment will be preferred • Fans for cooling tower will be of low noise type • Silencers will be used on vents and ventilators • Proper stack height to be maintained • Proper acoustic design for the power house building. • Noise levels will be monitored regularly within the communities in order to take timely corrective measures, if needed
Plant Effluents	The power plant is expected to generate liquid effluents in the form of oily water, plant cooling water, washing water, blow down water, treatment system effluent and sanitary wastewater	No discharge of untreated effluent to the environment or the canals	• The power plant water treatment systems will be designed to ensure that the wastewater meets BNEQS before it is drained into the river.
Emission	Emission from the plant can potentially affect air quality	BNAAQS and the IFC Thermal Power Plants Emission Limits	• Low NO_x burner should be selected for turbine selection • Proper stack height to be maintained.
Water Resources	An adverse impact on the water resources will be interpreted if it is established that the water consumed by the Project has directly affected the ability of the community to meet their water needs	The extraction of water for the power plant construction activities can affect the groundwater availability for the Study Area communities	• Availability of ground water to be studied • Use surface water where possible • Initiation of a water conservation program
Hazardous and Non-Hazardous Waste	Various types of wastes such as packing waste, metal scrap, and excess materials, air filters, oily rags, will be generated during the operation phase. The waste can be a health hazard and pollute waterways, if disposed improperly	Material Safety Data Sheets (MSDS)	• Storage and handling of hazardous materials in accordance with international standards and appropriate to their hazard characteristics. • All hazardous waste will be separated from other wastes • Storage of fuels, chemicals and lubricants in bounded areas with impervious flooring and secondary containment of 110% capacity • Availability of supporting information such as the MSDS • A Hazardous Materials Register to be in place

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
Waste Management	Waste generated during power plant operation can potentially damage the environment	Any person is exposed to potentially hazardous waste generated by the Project. Project generates waste that can be avoided through practicable means(waste minimization) Reusable waste generated by the Project is discarded. Recyclable waste instead of separation at the source is dumped at the trash bins. Non-recyclable and non-reusable waste ends up at any place other than the designated landfill site.	• IFC EHS Guidelines on Hazardous Materials Management, Waste Management and Thermal Power will be followed • Separation of recyclable materials • Regular audits of waste management system • Maintenance of a Waste Tracking Register and all records will be kept • Separation of hazardous waste from non-hazardouswaste. • On-site segregation and initial storage of hazardous waste • Off-site disposal of hazardous waste in approved hazardous waste disposal facility. • Recyclable waste to be disposed via licensed waste contractors • Audits of the waste disposal contractors and waste disposal facilities • Develop an emergency response plan for the hazardous substances • Training of personnel in identification, segregation, and management of waste • Appropriate labelling of all containers of hazardous waste
Occupational Health &Safety of workers	Non-ionizing radiation, Heat, Noise, Confined spaces, Electrical hazards, Fire and explosion hazards, Chemical hazards, Dust, sanitation, safe drinking water etc.	Proper monitoring for work place environment, health & safety condition of the workers, PPE check, Fire drill and training of workers	• IFC EHS guidelines on Occupational H&S, Community H&S and Thermal Power will be followed. • Regular health check-up of workers • Proper PPE should be provided to protect from the heat, electric shock and noise protection, • Regular awareness and training should be provided for fire safety & chemical hazard, • Safe drinking water should be provided

Chapter-7

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 Background

In the context of a project, Environmental Management Plan is concerned with the implementation of the measures necessary to minimize or offset adverse impacts and to enhance beneficial impacts. All mitigation and monitoring measures will follow the World Bank EHS Guidelines and Bangladesh national. Unless the mitigation and benefit enhancement measures that identified in the ESIA are fully implemented, the prime function of ESMP cannot be achieved. All the measures are said to be successful when they comply with the Environmental Quality Standard (EQS) of Bangladesh. Thus the objectives of ESMP for the present project would be

- Mitigation measures to reduce or eliminate negative impacts
- Enhancement measures to maximize positive impacts
- Monitoring requirement and
- Monitoring indicators

Feasible and economically expedient measures are planned to be implemented at EMP which can reduce to a reasonable level and/or exclude possible essential negative consequences of environmental impact.

At ESMP, in particular:

- Expected adverse environmental impacts at construction stage and operation are identified and generalized;
- Impact reduction measures are described;
- Interrelation with existing impact reduction plans are established;
- Parameters subject to measurement, monitoring methods to be applied, places of supervision, frequency of measurements are specified.

The environmental and social management plan includes the following elements facilitating its timely and effective realization:

- Management system - reflects implementation mechanism of ESMP;
- Roles and responsibilities - identify persons responsible for realization of measures on impact reduction and monitoring;
- Impact importance assessment - is intended for timely reveal of aspects invoking particular measures on impact reduction;
- Environmental and social management plan includes the list of actions on impact decrease, monitoring, and also amount of expenses for their realization.

In case any non-compliance, change in scope, or unanticipated impact arises during project implementation, corrective action will be taken accordingly as per ADB SPS 2009 and national requirements.

Each of these elements is described below in details.

7.2 System of environmental and social management

For effective implementation of recommendations on impact reduction it is necessary to organize a system of environmental and social management.

The model of the management system consists of four basic components:

- planning includes development of particular actions and procedures on their realization;
- introduction and functioning - are direct realization of actions;
- checks and correcting actions include monitoring of environmental objects and control over execution of actions;
- analysis includes reporting and efficiency assessment of the introduced actions.

The system of environmental and social management assumes conformity to the Standard of environmental management system ISO 14001 according to which constant improvement of the developed model (periodic updating with entering necessary revisions) is necessary. It is important to note, that special attention during management is paid to interaction with stakeholders, including submission of reporting and processing notes and offers received.

7.3 Roles and responsibility

For realization of ESMP, it is necessary to identify persons responsible for performance of impact decrease/prevention actions, and also those responsible for control over the given actions and to define their role at all stages of the project implementation. The Project proponent Reliance Bangladesh LNG and Power Ltd will be overall responsible for EMP implementation of the project. During construction stage, Project Implementation unit (PMU) will be responsible for EMP implementation whereas during operation stage Operation & Maintenance unit will be responsible for EMP implementation.

RPLBL authority has been developed a EHS norms for all the contractors will be working at the project site. Under the provision of the guideline, all contractors should submit their own Environmental & Social Management Plan/System in accordance to ESIA and ADB's SPS Guideline, 30 days before commencing the work. Accordingly they will follow this guideline while performing the job. Refer Annexure 6.1

7.3.1 EMP Implementation during Construction Phase

During construction stage, Project Implementation unit (PMU) will be overall responsible for EMP implementation. Construction contractor will be responsible for construction as well as maintenance of sanitary and health condition at construction site including labour camp. The construction contractor will be responsible for preparation and maintenance of records and all required reporting data as stipulated in the ESMP. The PMU will play oversight supervisory role for implementation of ESMP at site. The roles and responsibilities of EMP implementation during construction stage are heighted in **Table 7-1.**

Table 7 1: Roles and Responsibilities of EMP Implementation during Construction Stage

Role	Responsibilities
EHS Manager	• Preparation and implementation of the Environmental Supervision Plan during construction • Ensure that all construction personnel and subcontractors are informed of the intent of the ESMP and are made aware of the required measures for environmental and social compliance and performance • Supervision of contractor performance on implementation of the Construction and Work Camp Management Plan • Reporting any incidents or non-compliance with the ESMP to the PMU • Ensuring adequate training and education of all staff involved in environmental supervision • Making recommendations to the RBLPL (PMU) regarding ESMP performance as part of an overall commitment to continuous improvement
Asst. EHS Manager	• Prepare and maintain records and all required reporting data as stipulated by the ESMP • Ensure that all construction personnel and subcontractors are informed of the intent of the ESMP and are made aware of the required measures for environmental and social compliance and performance • Preparation and implementation of the Environmental Monitoring Plan during construction • EHS Audit, Training of project Personnel
Community Manager	• GRC / Public & Stake Holder Consultation

7.3.2 EMP Implementation during Operation Phase

During operation stage, operation and maintenance unit will be overall responsible for EMP implementation. The EHS team of operation and maintenance unit will be responsible for preparation and maintenance of records and all required reporting data as stipulated in the ESMP. The roles and responsibilities of EMP implementation during construction stage are heighted in **Table 7-2**

Table 7 2: Roles and Responsibilities of EMP Implementation During Operation Stage

Role	Responsibilities
Project Director	• Effective and environment friendly operation of the project, • Set guiding tools and suggestions which need to be followed at various stages of plant installation, operation and maintenance.
Supervising Engineer	• Coordinating with EHS team for effective implementation of Environmental safeguards in O & M schedule of the plant.
EHS Manager	• Prepare and maintain records and all required reporting data as stipulated by the ESMP • Ensure that all project personnel are informed of the intent of the ESMP and are made aware of the required measures for environmental and social compliance and performance • Implementation of the Environmental Monitoring Plan • EHS Audit, Training of project Personnel
External Independent Environmental Monitoring Consultant	• Report to RBLPL on project compliance with environmental and social commitments in the ESMP, ESIA and other applicable standards
Community Manager	• GRC / Public & Stake Holder Consultation

7.3.3 Construction stage

General construction management and control over conducting technological process during construction works will be assigned to the contractor and RBLPL project management. The contractor, in turn, concludes contracts with subcontract organizations performing works at the construction site. The RBLPL authority bears responsibility under Project Implementation unit (PMU) for selection and assessment of subcontract organizations. Control functions over contract organizations activity in the field of labour safety, industrial safety and preservation of the environment are also assigned to the Consortium. The following are the management team of RBLPL who will be responsible for the monitoring program of the proposed project during the construction period; Team for Environment monitoring and ensuring compliance during construction period is highlighted in **Figure 7-1.**

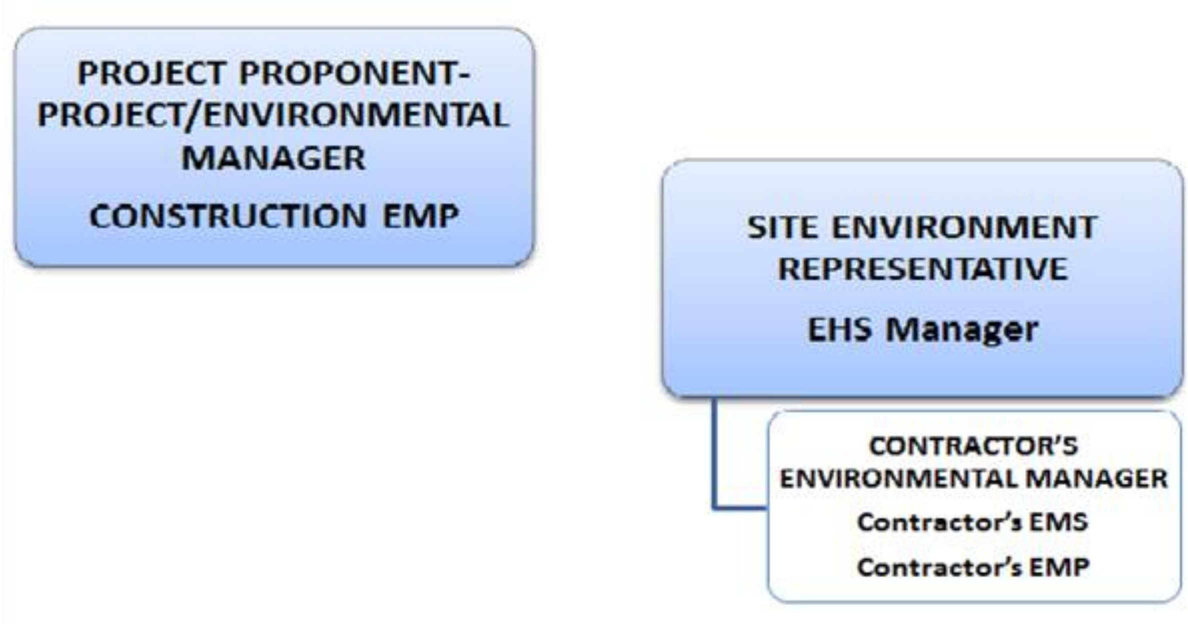

Figure 7.1: Organizational Structure during Construction Phase

7.3.4 Operation phase

RBLPL Management will be responsible to operate the power project under Operation & Maintenance unit (O&M) during the operation phase and will be responsible to maintain the environmental and social standard of the project (Figure 7.2). Team for Environment monitoring will ensure compliance during operation

Figure 7.2: Organizational Structure during Operation Phase

7.4 MITIGATION/BENEFIT ENHANCEMENT MEASURES

For effective and environment friendly operation of a project, a set for guiding tools and suggestions are necessary which need to be followed at various stages of plant installation, operation and maintenance. This plan generally has various components of management depending on the type of project or plant activity and types of discharge and their pollution potential. This Environmental and Social Management Plan (ESMP) once prepared forms the basis of environmental management actions from the part of the project authority may need modification or up-gradation because of changes in the plant operation or accurate pollution load/environmental problems detected afterwards.

All beneficial and adverse impacts which may likely to occur at different phases of the project have been identified in section 6.0. Predictions, evaluation, aspect of mitigation and benefit enhancement measures have also been discussed concurrently with impacts prediction and evaluation. In view of the earlier discussion summary of recommended mitigation and benefit enhancement measures are presented in **Table 7.3.**

Table 7.3: Identification of Impacts, Mitigation measures, Monitoring and Management during Construction period

<table>
<tr><th rowspan="2">Issue/Impact</th><th rowspan="2">Mitigation Measures</th><th rowspan="2">Implementation Schedule</th><th rowspan="2">Monitoring</th><th colspan="2">Responsibility</th><th rowspan="2">Monitoring Indicators</th><th rowspan="2">Type and Frequency of Reporting/ monitoring</th><th rowspan="2">Management and Training</th></tr>
<tr><th>Implementation</th><th>Supervision</th></tr>
<tr><td>Pre-Construction and Construction</td><td>Undertake additional baseline studies for one year during construction to include:
• Ambient air quality monitoring at sensitive receptors within the zone of maximum deposition.
• Seasonal 24hr noise monitoring at nearest sensitive receptors (in absence of construction work)
• Seasonal monitoring of river water temperature 500m upstream and downstream of the discharge point (away from the influence of the outfall channel).
Detailed design for 750MW CCPP to incorporate mitigation measures set out in the ESIA and the EHS General and Thermal Power Plant Guidance.
Detailed design to demonstrate:
1) Emission standard of 25ppm NOx will be met</td><td>Before and during construction</td><td>A continuous daily visual inspection by trained staff of the contractor is needed.
Weekly monitoring and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during decommissioning.</td><td>Implementation of Good Site management practices shall be the responsibility of all contractors on site under supervision of the RBLPL nominated
Project Manager.</td><td>RBLPL Project
Manager in collaboration with the Consultant's Site Manager& third party consultant</td><td>Standards for Air (PM10, PM2.5, NO2, SO2 & CO.) as per DoE (ECR, 1997) and WHO air quality guideline</td><td>Monthly reporting of summary results and submitted to the RBLPL and any other concerned authorities. (e.g. DOE, ADB, etc.).</td><td>RBLPL responsible basic training of persons employed to operate and maintain the monitoring system.

RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.</td></tr>
</table>

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	through adoption of dry low NOx burner (catalytic removal will be retrofitted if necessary following review of annual ambient air quality data) with dust filters on air intake to ensure no particulate or SO_2 emission, 2) Noise level of 70dB can be achieved at the site boundary and that there will be no increase in background noise levels greater than 3dB at the nearest sensitive receptors, 3) There will be no increase in the temperature of the river above the existing discharge temperature near the outfall. 4) Structural engineering meets the applicable seismic design standards for location of the power plant, and 5) H&S measures for the EHS of Thermal Power plant guidelines are incorporated, undertake quantitative risk							

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	assessment of gas-related elements to demonstrate there will be no increase in risk level at the nearest sensitive receptors from gas leak, fire or explosion. Finalize IEE for associated facilities including grievance redress mechanism and to address hazardous materials and waste management. Prepare Construction Environment Management Plan incorporating site waste management plan and emergency response procedures, Construction Health and Safety Plan incorporating emergency response procedures, and Construction Traffic Management Plan.							
Air Quality: Dust emissionscaused by constructionactivities, construction vehicle movements, and transport of	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction. Though air quality in the study area comply with national ambient air quality standards	Before construction and during construction	A continuous daily visual inspection by trained staff of the contractor is needed. Weekly monitoring and supervision by RBLPL is	Implementation of Good Site management practices shall be the responsibility of	RBLPL Project Manager in collaboration with the Consultant's	Standards for Air (PM10, PM2.5, NO2, SO2 & CO.) as per DoE	Monthly reporting of summary results and submitted to the RBLPL	RBLPL responsible for the management of the air quality monitoring system. Submission of monthly summary

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
construction materials.	but the dust levels in some of the monitoring stations crosses WHO IT-I value. Therefore, precautionary actions should be ensured that no extra dust load is added in the area due to the project. Mitigation practices including: • appropriate sitting and maintenance of stockpiles of materials so as to minimize dust blow (seek to achieve a distance of at least 500m from nearest sensitive receptors); • minimizing drop heights for material transfer activities such as unloading of materials; • construction phase to begin with construction of access roads; • roads will be kept damp via a water browser; • provide wheel wash for all vehicles leaving the project site; • do not permit any open		required to ensure the implementation of good site management practices by all contractors during construction. Measurements and analysis of different pollutants to be made on a continuous basis (at least monthly) by a third party consultant and the report to be submitted to the RBLPL authority. Monitoring to be carried out on site and surrounding.	all contractors on site under supervision of the RBLPL nominated Project Manager.	Site Manager& third party consultant	(ECR, 1997) and WHO-Air Quality guideline	and any other concerned authorities. (e.g. DOE, ADB, etc.).	reports to DOE and any concerned authorities. Basic training of persons employed to operate and maintain the monitoring system. RBLPL to ensure all Contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	burning on the project site; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting construction materials and soil; • enforcement of vehicle speed limits on nonmetal roads to <20 km/h.							
Aquatic Environment: Construction of the intake structure and water discharge structure.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction.	During construction of intake and discharge structures	Continuous daily visual Inspection by trained staff of the contractor. Weekly monitoring and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the RBLPL the Project Manager.	RBLPL Project Director in Collaboration with the Consultant's Site Manager& third party consultant.	.Standards for Water (Temp., pH, COD. BOD, TSS, TDS, DO, oil & grease etc.) as per DoE (ECR, 1997)	Monthly reporting of summary results and submitted to the RBLPL and any other concerned authorities. (e.g. DOE, ADB, etc.).	RBLPL to ensure that all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice These mitigation Measures must be a condition of any construction contracts.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction. River water quality must be within prescribed limits of the national ambient water quality standards. Mitigation activities will include the following: • No discharge of effluents into the river- all effluents shall be collected and removed off site for treatment by approved firms or disposed after proper treatment at site (records of effluent transfers to be maintained); • No discharge of surface water runoff direct into the river - development of a temporary site drainage plan which reduces flow velocity and sediment load by passing discharge through a sediment pond; • Surface water run off should be disposed after	During construction	Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly monitoring and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction. River water sample should be collected monthly by a third party consultant from three locations, 500m upstream and downstream of works and at the works site-outfall, if preliminary monitoring campaign shows strong variations in water quality additional locations may be required	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the RBLPL Project management.	RBLPL Project Director in collaboration with the Consultant's Site Manager& third party consultant.	Standards for Water (Temp., pH, COD. BOD, TSS, TDS, DO, oil & grease etc.) as per DoE (ECR, 1997)	Quarterly reporting of summary results and submitted to the RBLPL and other concerned authority, e.g. DOE, ADB, etc., if required.	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	passing through sedimentation tank and oil water interceptors. • Protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; • Maintenance of well kept • Construction site. • All fuel, oil and chemicals should be stored in bonded area 110% volume. • impermeable surface should be used for refueling • Regular training of all workers in spill response • Provision of spill equipment at easily accessible locations around the site Treatment of all wastewater must be consistent with the standards and measures in the EHS guidelines on wastewater and ambient water quality							

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
Noise: Increased noise in the project area as a result of the use of noisy machinery and increased vehicle movements.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. And no unprotected ear should be exposed to a peak sound pressure level of more than 140 dB(C). The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85dB(A). Emissions at the site boundary and nearest sensitive receptors must be within prescribed limits of the EHS Noise Guidelines. Implementation of good site	During construction	Continuous dasily visual inspection will be conducted by trained staff of the contractor. Weekly monitoring and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction. Monitoring of 24-hr noise levels to be made on a continuous basis (at least monthly) by a third party consultant at the site boundary and nearest sensitive receptors and the report to be submitted to the RBLPL authority.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the RBLPL project management.	RBLPL Project Director in Collaboration with the Consultant's Site Manager& third party consultant.	Noise complaints register to identify concerns. Check the noise level using noise Measuring devices.	RBLPL will produce a monthly log of valid complaints and actions taken. Monthly reporting of summary results and submitted to the RBLPL and any other concerned authorities, e.g. DOE, ADB etc., if required.	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	practices including: • Provision of noise barrier around the project site to reduce off-site noise levels; • enforcement of vehicle speed limits; • Strict controls of vehicle routing; • Diesel engine construction equipment to be fitted with silencers; • Limited noisy construction activities at night; • Prohibition of light vehicle movements at night; • • Use of protective hearing equipment for workers.							
Flora and Fauna Site Clearance-Vegetation removal and Habitat disturbance.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction. • Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. • Specific mitigation measures include restricting personnel and vehicles to	During construction.	Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly inspection and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the RBLPL project	RBLPL Project Director in collaboration with the Consultant.	Good conservation of floral wealth.	Quarterly reporting No. of floral species conserved or planted, if any.	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and Site management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	within construction site boundaries, lay down areas and access roads.		construction.	management.				practices.
Soils and Hydrology Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction. The potential impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented: • Development of effective site drainage systems designed to include allowance for climate change; • •Restriction of access only to construction site areas; • Disposal of waste materials unsuitable for reuse on-site, (e.g. for landfilling) at appropriately licensed sites; • Provision of oil and suspended solid interceptors; • Management of excavations during	During Construction.	Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good Management practices during construction. Weekly inspection and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction. Quarterly monitoring of drinking water in tube wells within 1km of a septic tank location by third party consultant to confirm that national drinking water standards are met.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the RBLPL project management.	RBLPL Project Director in collaboration with the Consultant.	• Site drainage. • Access only to construction site areas. • Waste materials. • Oily waters. • Drainage pathways. • Potential spillage in Operational areas. Visual Inspection	Quarterly reporting of summary results submitted to the RBLPL and any other concerned authorities (e.g. DOE, ADB etc., if required.	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	construction to avoid the generation of drainage pathways to underlying aquifers; • Revision of impermeable bases in operational areas to prevent absorption of spillages.							
Socio-Economic Environment: Positive impacts Identified.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction and Community Health and Safety. Public access to the site must be restricted. All activities related to the construction of the new plant will take place within the area belonging to RBLPL, i.e. there will be no off-site activities or associated land acquisition during construction. Transmission lines & gas line will connect the new power plant to the existing substations and RMS. Ensure H&S measures per the EHS electric power and distribution guidelines and EHS onshore oil	During construction.	Record local employment provided by the project. Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction. Weekly inspection and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction. Daily monitoring of drinking water provided to construction staff to confirm national drinking	RBLPL Project management	RBLPL Project Director in collaboration with the Consultant.	Workers satisfaction as measured by staff interviews and complaints reported. Visual Inspection	Quarterly reporting	Responsibility of RBLPL.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	and gas development guidelines are incorporated The entire labor force will be daily commuters, thus no worker housing or associated facilities will be erected on site during construction. If any off-site accommodation for the labor force needs to be developed the ESIA and EMP should be updated accordingly. No forced or child labor (under age 18) to be employed. All employees to be legal. Regular talks on communicable diseases including HIV to be held for all workers. The contractors will be responsible for relevant temporary water / toilet Facilities during construction and the need to provide appropriate services will be specified in their contracts. Provide adequate supplies of drinking water that is compliant with the national drinking water		water standards are met.					

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	quality standards to all workers. Provide adequate sanitation facilities as outlined in the ESIA. Toilets and bathrooms must be properly equipped including hand washing facilities with hot water and with separate facilities for men and women. Regular talks on sanitation to be held for all workers to encourage cleanliness.							
Traffic and Transport: Disruption, noise and increased air pollution due to increased traffic, light loads and abnormal loads.	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction and Community Health and Safety. Standard good practice measures will be implemented as follows: • Adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • Construction shifts will be staggered; • Scheduling of traffic to avoid peak hours on local	During construction.	Daily monitoring of traffic entering the site during morning &evening peaks to ensure the implementation of good site management practices by trained staff of the contractor. Weekly inspection and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the RBLPL project management.	RBLPL Project Director in collaboration with the Consultant.	Increased congestion Travel time (compared to reasonable daily commute) Visual Observation	Quarterly reporting of summary results submitted to the RBLPL and any other concerned Authorities (e.g. DOE, ADB etc.), if required.	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and Site management practices.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	roads; • Routing of transport to avoid residential areas; • Provision of adequate signage and flagmen along transport route and at site entrance; • Transportation of construction workers by contract bus. Ensure all roads and bridges used by construction traffic are maintained in at least their current state during construction with any damage immediately repaired. Condition survey of roads and bridges to be undertaken by third party consultant prior to start of works to provide a baseline for monitoring compliance.		construction. Quarterly monitoring of road and bridge condition by third party consultant to ensure maintenance being kept up.					
Archaeology: Potential chancefinds of archaeologicalremains duringconstruction.	The project site does not lie on, or in the immediate vicinity of any known archaeological areas of interest. If remains are found RBLPL is committed to: • Cease activities and consult	During construction.	Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices	RBLPL project management will allocate responsibilities in accordance with the	RBLPL Project Director in Collaboration with the Consultant.	Visual observation	Quarterly reporting of summary results And submitted to the RBLPL	RBLPL to ensure that all workers on site are aware of the importance of archaeological remains and must

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	archaeological department; • Protection in situ if possible; • Excavation of areas where protection not feasible following discussion and agreement of archaeological department;		during construction. Weekly supervision of construction activities by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction.	construction site plan.			and any other concerned authorities (e.g. DOE, ADB etc.), if required	report any potential finds immediately.
Natural Disasters Flash flooding.	Good engineering design will incorporate the following mitigation measures: • Drainage system designed to direct flood water from main plant areas into the river and direct potentially contaminated waters through the oil interceptor.	During construction.	Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly monitoring and supervision by RBLPL is required to ensure the implementation of good site management practices by all contractors during construction.	RBLPL project management	RBLPL Project Director in collaboration with the Consultant.	Visual observation	Quarterly reporting of summary results submitted to the RBLPL and any other concerned authorities (e.g. DOE, ADB etc.), if required	RBLPL to ensure that all workers on site receive training in emergency preparedness and response procedures.
Solid Waste Management	Follow mitigation measures set out in this ESIA and the EHS Guidelines on Construction and Waste Management. Good practice measures such as the following:	During construction.	Contractor to keep daily records of all waste transfers. Weekly monitoring by RBLPL is required to ensure the implementation of good	Implementation of Good Site Management practices shall be the responsibility of	RBLPL Project Director in collaboration with the Consultant	Management contract in place, visual observation and record check	Quarterly reporting of summary results submitted to the RBLPL	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	1) All waste taken off-site will be undertaken by a licensed contractor and RBLPL will audit disposal procedure; 2) Collection and segregation of wastes and safe storage; 3) Recording of consignments for disposal; 4) Prior agreement of standards for storage, management and disposal with relevant authorities. It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly disposal Contract.		site management practices by all contractors during construction	all contractors on site under supervision of the RBLPL project management			and any other concerned authorities (e.g. DOE, ADB etc.), if required	given basic induction training on good construction and site Management practices.
Occupational Health & Safety	Good local and international construction practice (as per the ESIA and EHS Construction and Occupational H&S Guidelines) in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Regular H&S training will be	During construction.	Daily inspection is required to ensure the implementation of EHS Policies, plans and practices during construction. Weekly monitoring and supervision by RBLPL is required to ensure the implementation of good	Implementation of good site management practices and the EHS policies shall be the responsibility of all contractors on site under the supervision of the RBLPL	RBLPL Project Director in collaboration with the Consultant.	Management procedures in place. Workers health and safety as measured by number of incidents.	Daily inspection Quarterly reporting of summary results submitted to the RBLPL and any other concerned authorities	RBLPL to ensure all contractors and sub-contractors for workers on site include reference to the requirement of the ESMP and are aware of the EHS policies of the project. All employees will be

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	conducted for all construction staff, including training on good housekeeping, cleanup of debris and spills, and working in confined spaces and at height. Measures include: • Implementation of EHS procedures as a condition of contract all contractors and subcontractors; • Clear definition of the EHS roles and responsibilities for all construction companies and staff; management, supervision, monitoring and record-keeping as set out in plant's operational manual; • Pre-construction and operation assessment of the EHS risks and hazards; • Completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • Provision of appropriate training on EHS issues for		site management practices by all contractors during construction. Record all fatalities, accidents and near misses that occur during construction work and implement corrective action to ensure such incidents are not repeated in future.	project management.			(e.g. DOE, ADB etc.), if required	given basic induction training on EHS policies and practices. Contractors are responsible for ensuring that a Fire Safety Plan, is prepared and implemented prior to commissioning of any part of the plant under supervision overbill project management.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	all workers; • Provision of health and safety information; • Regular inspection, review and recording of EHS performance; • Appointment of site nurse and provision of free on-site medical care for all construction staff; • Pest and vector control; • Maintenance of a high standard of housekeeping at all times. • Provision of first aid equipment at easily accessible locations around the site							
Supply Chain Management	Good and international supply chain guideline should be followed to ensure: • Flow of the service of construction workers is experienced and professional to ensure the completion of the project in	Before and during construction	A continuous daily visual inspection by trained staff of the contractor is needed. Weekly monitoring and supervised by RBLPL is required to ensure the implementation of good	The contractor assigned for the project	The authority of RBLPL	Adequate propagation of the construction work and completion of each step in time	Weekly monitoring by the contractor and monthly monitoring by the RBLPL authority.	RBLPL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	time. • No child labor included • Equipment supplier and sub-contractors should follow proper guideline during supplying and selecting the equipment and material at site.		site management practices by all contractors during decommissioning.					construction and site management practice.
Institutional setting and implementation arrangements	The EMP (mitigation plan) will be included in the construction contract and the contractor will be responsible for implementation of the measures associated with design and construction	Before and during construction	A continues monitoring is needed in order to ensure the maintenance of the institutional setting	EPC Contractor	RBLPL	Obtaining statutory clearances required during pre-construction stage of the Project.	Once a week by the contractor and once a month by RBLPL	Basic instructions must be given to all the contractors and subcontractors.

Table 7 4: Identification of Impacts, Mitigation measures, Monitoring and Management during Operational period

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
Air Quality Emissions from stack are not expected to exceed standards.	Implement mitigation as set out in the ESIA and EHS Guidelines on Air Emissions and Air Quality and Thermal Power. Emissions standards to be achieved during operation are 51 mg/m3 or 25ppm NOx.	Life time of plant operation.	Automatic monitoring of stack emissions for NOx, to be installed in the stacks. Annual stack emissions testing of NOx by third party consultant. Monitor and record annual gas consumption to calculate annual emissions of CO2.	The analyzer stations will be owned and operated by RBLPL	RBLPL Top Management & EHS department.	Standards for noise Gaseous emission from Industries or projects waste (ECR, 1997)	Continuous Hourly data acquisition. Quarterly reporting to RBLPL. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	Records must be kept and summary data (including any deviations from DOE and World bank standards) will be submitted to the DOE and ADB as regular basis.
Ambient air quality affected by emissions from the power plant.	RBLPL will implement the mitigation measures suggested in the ESIA report. If ground level concentrations are found to be above the National Ambient Air Quality Standards, options for further mitigation will need to be implemented.	Life time of plant operation.	Conduct continuous ambient air quality monitoring for NOx, SO2, CO, PM10 & PM2.5 at four different locations in the impact area located within the zone of maximum deposition.	Third party monitoring	RBLPL Top Management & EHS department Third party inspection.	Standards for Air (PM_{10}, $PM_{2.5}$, NO_2, SO_2& CO.) as per DoE (ECR, 1997) and WHO- Air Quality guideline.	Quarterly reporting to RBLPL. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	Quarterly reporting by RBLPL to Government and ADB etc. (or more frequently if required) highlighting key features and comparing results with air quality standards and prediction in ESIA report
Aquatic Environment Discharge of process water.	Implement mitigation as set out in the ESIA and EHS Guidelines on Wastewater and Ambient Water Quality and Thermal	Lifetime of the Plant	Third party consultant to prepare and undertake a monthly water Quality monitoring program of all discharges, 500m	RBLPL Project management. Third party monitoring supervised by the	RBLPL management & EHS department.	Standards (pH, TSS, oil and grease, total residual chlorine,	Quarterly reports Prepared by RBLPL or third party. Reports are tube available to any of	Records will be kept and compared on regular basis against Bangladesh and

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	Power. Effluent discharge of process water to meet standards set out in Table 5 of the EHS Guidelines on Thermal Power. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Sanitary discharges to meet national wastewater treatment standards. Good site management practices including the following will be implemented: 1) Proper treatment of contaminated water or cooling water before discharge to natural water body. 2) No disposal of solid wastes into the discharge structure; 3) Regular		upstream & downstream of the project site and at the outfall location to the river including: temperature, pH, COD, BOD, TSS, oil & grease and residual chlorine.	RBLPL Management		temperature, BOD & COD) for Sector wise industrial effluent as per ECR, 1997.	the concerning Authorities (DOE, ADB, etc.).	World Bank standards and impacts predicted in ESMP. RBLPL to ensure that all Employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	maintenance of site drainage system to ensure efficient operation; 4) All discharges will comply with local and World Bank guidelines. 5) All fuel, oil and chemicals should be stored in bounded area 110% volume 6) Regular training of all workers in spill response 7) Provision of spill equipment at easily accessible locations around the site							
Noise Quality	Implement mitigation as set out in the ESIA and EHS Guidelines on Noise and Thermal Power. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. And no	Life time of the plant operation.	When the plant is fully operational, quarterly noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at sensitive noise receptors around the plant. Monitoring to be	RBLPL Project management. Third party monitoring supervised by the RBLPL Management	RBLPL management & EHS department.	Power plant to comply with ESMP suggestions.	Monthly noise reports Prepared by RBLPL or by third party. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	Should any complaints be received regarding noise, these will be logged and the RBLPL EHS team will investigate the problem. RBLPL to ensure that all employees

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	unprotected ear should be exposed to a peak sound pressure level of more than 140 dB(C). The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85dB (A). Emissions at the site boundary and nearest sensitive receptors must be within prescribed limits of the EHS Noise Guidelines. Specific design mitigation measures to minimize noise impacts include: • Gas turbines, steam turbine generators; air		carried out on site and at the nearest receptor.					are given basic induction training on the requirements of the ESMP, good site management practices and EHS procedures.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	compressors, pumps and emergency diesel engines are enclosed in the Buildings with proper acoustic design; • Provision of a noise barrier around the project site to minimize off-site noise levels.							
Flora and Fauna: Disturbance to habitats as a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: • restrict personnel and vehicle movements to access roads and within boundaries of site only; • Control of noise during operation.	Lifetime of the plant.	No monitoring is envisaged.	RBLPL Project management	RBLPL management & EHS department.	Good plantation	Yearly report prepared by RBLPL or by third party.	RBLPL to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and EHS procedures.
Visual Impact Visual image of Power plant from surrounding areas.	The visual effect of the power plant will be improved through: • creation of landscaped boundary along the fence of the power plant. • Planting sufficient amount of trees around	Lifetime of the plant.	No monitoring is envisaged.	RBLPL Project management	RBLPL management & EHS department	Improved visual image		Management to consider the landscaped areas to maximize visual image and habitat creation. RBLPL to manage and maintain

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	the project site							proper landscaped areas.
Soil and Hydrology: Spillage of oils, chemicals or fuels onsite.	Follow mitigation measures in ESIA and EHS Guidelines on Hazardous Materials Management and Waste Management. Good site management measures as described in the ESMP, under aquatic environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation. Septic systems should only be used for treatment of sanitary sewage, and are unsuitable for process wastewater treatment.	Lifetime of the Plant	The RBLPL authority will continuously monitor application of ESMP and good site management 6 monthly monitoring of drinking water in tube wells within 1km of a septic tank location by third party consultant to confirm that national drinking water standards are met. See also water quality monitoring program above.	RBLPL Project management	RBLPL management &EHS department	Quality of bunds and drainage systems. Efficiency of operation.	Yearly report prepared by RBLPL EHS department Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	RBLPL to ensure all employees will receive related training. Standard Operating Procedure (SOP) of hazardous waste management is enclosed as **Annexure 7.1.**
Solid Waste	Follow mitigation measures in ESIA and EHS Waste Management Guidelines. Good practice measures	Lifetime of the plant	Daily records of waste transfers to be kept. Continuous monitoring is required to ensure the implementation of good	RBLPL Project management	RBLPL management & EHS department	Efficient waste collection and disposal system should be done by either RBLPL	Quarterly reports from the EHS to RBLPL management. Reports are to be	RBLPL to ensure all employees are given basic induction training on good operation

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	undertaken during the construction phase will be continued into the operation phase. It is of highest importance that final disposal of wastes shall be strictly adhered to environment No solid waste should be used as fertilizer unless it is first tested to confirm suitability per national requirements.f Friendly disposal contract. Records of all waste transfers to be maintained.		Management practices during operation.			or Contractor in place.	available to any of the concerning Authorities (DOE, ADB, etc.).	and site management practices.
Occupational Health and Safety, Risks and Hazards	Follow mitigation measures in ESIA and EHS Occupational Health and Safety and Thermal Power Guidelines. Drinking Water provided to employees to meet drinking water standards. Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an	Lifetime of the Plant	Regular on-site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management. Record all fatalities, accidents, near misses and occupational diseases that occur during operation and implement corrective action to ensure such	RBLPL Project management	RBLPL management & EHS department.	Management procedures in place. Workers health and safety status, incidents, injuries, slip, trip, falls and near misses are properly documented.	Quarterly reports from the EHS to RBLPL management. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	RBLPL to ensure that all employees are given basic induction training on EHS policies and procedures, Emergency Preparedness and Response Plan.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	EMF safety program. Use of warning signs near noisy environments and high temperature surfaces and provide personal protective equipment (PPE) as appropriate, including ear muffs and insulated gloves and shoes. The stand mitigation that has been suggested in the ESMP report will be implemented and followed on site.		incidents are not repeated in future. Quarterly health check of employees with respect to EMF exposure and other occupational hazards. Daily monitoring of drinking water provided to employees to confirm national drinking water standards are met.					
Supply Chain Management	Good and international supply chain guideline should be followed to ensure: • Uninterrupted generation of electricity • Continuous supply of raw materials at site. • Proper labor law followed and no child labor included • Equipment & raw material supplier and	Life time of the project	Monthly monitoring and supervision by RBLPL is required to ensure that all supplies and services procured by RBLPL complies the international supply chain guideline.	RPLBL project management	The authority of RBLPL	Record check and visual inspection	Quarterly monitoring by the RPLBL authority.	RBLPL to ensure all contractors and subcontractors working at site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
	other sub-contractors should follow proper guideline during supplying and selecting the equipment, material and services at site.							
Repair and maintenance schedules for the turbines and cooling system	The gas turbine, steam turbine and cooling system require repair and maintenance schedules for the turbines and cooling system to maximize life cycle and operation efficiency.	Lifetime of the Plant	• As per the manufacturer's schedule the gas turbine set needs timely minor, hot gas path and major inspection at specific time interval. • The repair and maintenance of steam turbine and cooling water system will be done according to the manufacturer's recommendation and as required.	RBLPL Project management	RBLPL management & EHS department.	Schedule check	Schedule for GT & cooling tower maintenance will be carried out as per manufacturer recommendation.	RBLPL to conduct the inspection with specialists as per schedule.

7.4.1 Environmental Management Plan for Relocated Temporary Jetty

For the Power plant we have considered a 5km bounding impact area and the location has been shifted only 600m. So, the impact area and Monitoring will be same as the Power plant. Monitoring suggested for the power plant will be enough for inspecting the impacts due to the temporary Jetty. An ESMP for the proposed Temporary Jetty is given below:

Table 7.5: The ESMP for the proposed Temporary Jetty may be structured as follows

Issues/aspects	Location	Mitigation measures	Key verifiable indicator	Person responsible	Remarks
Construction Phase					
1.Impact on Air Quality	Around the project site	• Regular Watering should be done. • All soil, sand, and aggregate piles should be covered (whether on the site or on trucks). • The sand and other such dispersible material must be removed after completion of work • Proper stack height wshould be maintained for Generator	PM_{10} and $PM_{2.5}$	Contractor	Same Monitoring as the Power Plant.
2.Noise/vibration Hazard	Around the project site and nearest receptor	• Construction works should be limited to daytime hours. • All employees likely to be exposed to ear noise must use ear protectors. • Proper Acoustically designed machinery should be used	Noise at different locations	Contractor	Same Monitoring as the Power Plant.
3.Solid Waste management		• Awareness must be raised among workers on solid waste management. • Follow the approved Site Waste Management Plan. • No waste should be dumped in water body.		Contractor	
4. Accidents or Occupational Health Hazard		• The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessaries. • Set up warning signs, signals and provide helmets for workers in		Contractor	

Issues/aspects	Location	Mitigation measures	Key verifiable indicator	Person responsible	Remarks
		accordance with relevant accident prevention and work safety procedure			
5. Community Health, Safety and Security	Near the project site	• Speed limit and proper sign board should be provided along the approach road.		Contractor	
6.Sanitation hazard and impact on drinking water		• Supply good quality drinking water to the workers. • Provide well-planed sanitary facilities. • Promote sanitation education campaign among workers.		Contractor	
7. Labor and Working Condition	Project area	• Discrimination between male and female labors should be avoided. • Leave for illness, maternity, vacation or holiday should also be maintained		Contractor	
8.Traffic congestion, impact on safety		• Avoid carrying of materials in peak hour of road traffic. • Provide adequate parking for vehicles. • Raise awareness among all users to follow traffic rules.		Contractor	
9.Impact on Groundwater	Near Project Site	• Sanitary waste should be adequately disposed of to avoid ground water contamination	Groundwater level, pH, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	Contractor	Same Monitoring as the Power Plant.
10.Impact on Surface water quality	At Meghna River	• No construction or domestic waste should be dumped in the Meghna River	Water temp., DO, BOD5, COD, Oil and Grease and heavy metals (Cr, Cd, Pb)	Contractor	Same Monitoring as the Power Plant.
11. Impact on Drainage	Around the	• Spoil soil should be stored at a safe		Contractor	

Issues/aspects	**Location**	**Mitigation measures**	**Key verifiable indicator**	**Person responsible**	**Remarks**
	project site	distance from the drainage system			
12. Impact on Sediment	Around the project site	• Strict supervision during the construction work so that disturbance of sediment is minimal		Contractor	
Operation Phase					
1.Impact on health and safety		• Set up warning signs, signals and provide helmets and masks for workers in accordance with relevant accident prevention and work safety procedure. • Supply good quality drinking water to the workers. • Provide well-planned sanitary facilities. • Provide regular health inspection among workers. • Promote health education campaign among workers.		EPC Contractor of power plant	
2. Noise/vibration Hazard	Around the project site and nearest receptor	• Noise level monitoring should be performed periodically. • All employees likely to be exposed to ear noise must use ear protectors.	Noise at different locations	EPC Contractor of power plant	Same Monitoring as the Power Plant.
3.Impact on Air Quality	Around the project site	• Proper Stack height should be maintained for Generator • The vehicles will be kept in good order and regular fitness checkup should be conducted to minimize automobile exhaust emissions.	PM_{10} and $PM_{2.5}$	EPC Contractor of power plant	Same Monitoring as the Power Plant.
4.Impact on solid waste		• Follow the approved Site Waste		EPC	

Issues/aspects	Location	Mitigation measures	Key verifiable indicator	Person responsible	Remarks
		Management Plan.		Contractor of power plant	
5. Increase in Vehicular and River traffic in the Area		• Management to provide for adequate internal parking • Vessels movement must be properly supervised • To prevent ineerruption in vessel movement to other jetty operation, proper navigation sign and signals should be followed and strict supervision of vessel movement should be implemented. • In case of accidents, the contractor should try to rescue as soon as possible and should inform the responsible authority i.e. BIWTA.		EPC Contractor of power plant	
6. Overland Drainage and Impact on surface water		• Strict supervision should be maintained to avoid blockage of natural creeks		EPC Contractor of power plant	
7. Accidental spillage of Hazardous Material	Near the project area	• Skilled labors should be appointed for the unloading work • Regular checking and monitoring of the vessel movement • In case of any spill, it should be immediately acted up on. To combat spillage equipments i.e. booms, skimmers, dispersants, PPE etc. should be available		EPC Contractor of power plant	

Issues/aspects	Location	Mitigation measures	Key verifiable indicator	Person responsible	Remarks
8.Impact on sanitation and drinking water		• Supply good quality drinking water to the workers. • Check the quality of drinking water. • Workers will use the toilets inside the power plant		EPC Contractor of power plant	
9. Labor and Working Condition		• Discrimination between male and female labor should be avoided • Leave for illness, maternity, vacation or holiday should also be maintained • Child and forced labor should be avoided		EPC Contractor of power plant	
10.Fire hazard, explosion or any medical emergency		• First aid facilities should be available. • Firefighting equipment must be present. • Fire safety management training and mock drill should be practiced periodically.		EPC Contractor of power plant	
11.Occupational Health & Safety		• Personal Protective Equipment (PPE), visible vest, gloves, helmets, shoes, mask and accessories should be provided to the workers. • Implementation of an occupational health program. • Regular medical checkup would be done to ensure the soundness of health of employees and workers.		EPC Contractor of power plant	
12. Community Health, Safety and Security		• Vessel movement should be controlled properly • Speed limit and proper sign board		EPC Contractor of power plant	

Issues/aspects	**Location**	**Mitigation measures**	**Key verifiable indicator**	**Person responsible**	**Remarks**
		should be provided along the approach road			
13.Groundwater	Near Project Site	• Domestic and Sanitary waste should be adequately disposed off to avoid ground water contamination. • Accidentalo spillage should be monitored	Groundwater level, pH, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	EPC Contractor of power plant	Same Monitoring as the Power Plant.
14. Impact on Sediment	Around the project site	• Strict supervision during the operation work so that tdisturbance of sediment is minimal		EPC Contractor of power plant	

7.5 MONITORING PLANS AND SCHEDULES

7.5.1 During Construction Phase

The environmental monitoring program should be carried out as an integral part of the project planning and execution. It must not be seen merely as an activity limited to monitoring and regulating activities against a pre-determined checklist of required actions. Rather it must interact dynamically as project implementation proceeds, dealing flexibly with environmental impacts, both expected and unexpected. For this purpose, it is recommended that the Project Director (PD) for this specific project should take the overall responsibility of environmental management and monitoring. The PD will form a team with required manpower and expertise to ensure proper environmental monitoring, as specified in Table 7.7 below, and to take appropriate measures to mitigate any adverse impact and to enhance beneficial impacts, resulting from the project activities. The PD through it's team will make sure that the Contractor undertake and implement appropriate measures as stipulated in the contract document, or as directed by the PD to ensure proper environmental management of the project activities. It should be emphasized that local communities should be involved in the management of activities that have potential impacts on them (e.g., traffic congestion in the surrounding areas). They should be properly consulted before taking any management decision that may affect them. Environmental management is likely to be most successful if such decisions are taken in consultation with the local community.

Table 7.6 summarizes the potentially significant environmental impacts during construction phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts.

Table 7.6 Potentially significant environmental impact during construction phase and mitigation measures

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Influx of Workers	Generation of sewage and solid waste	• Construction of sanitary latrine and septic tank system (one latrine for 20 persons) • Erecting "no litter" sign, provision of waste bins/cans, where appropriate • Waste minimization, recycle and reuse • Proper disposal of solid waste (in designated waste bins)	Contractor (Monitoring By RBLPL)
	Possible spread of disease from workers	• Clean bill of health, a condition for employment • Regular medical check-up of workers	
Transportation of equipment, materials and personnel; storage of	• Increased traffic/navigation • Generation of noise, especially affecting the nearby residential areas	• Scheduling of deliveries during after regular working hours • Protecting local community from traffic hazard during construction phase, with installation of proper traffic sign and warnings	Contractor (Monitoring by RBLPL)

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
materials		• Speed reduction to 10 km per hour within the RBLPL complex	
	• Deterioration of air quality from increased vehicular movement, affecting people in the surrounding areas	• Keeping vehicles under good condition, with regular checking of vehicle condition to ensure compliance with national standards.	
	• Wind-blown dust from material (e.g., fine • aggregate) storage areas	• Watering unpaved/dusty roads (at least twice a day; cost estimate provided). • Sprinkling and covering stockpiles. • Covering top of trucks carrying materials tithe site and carrying construction debris away from the site.	
Construction activities, including operation of construction equipment	• Generation of noise from construction activities(general plant and access road construction),especially affecting the local resident	• Use of noise suppressors and mufflers in heavy equipment. • Avoiding, as much as possible, construction equipment producing excessive noise during at night. • Avoiding prolonged exposure to noise (produced by equipment) by workers creating a buffer zone between the neighbouring community and construction site.	Contractor (Monitoring by RBLPL);
	• Deterioration of air quality from wind-blown dust and possible use of equipment, such as stone (aggregate crushers)	• Not using equipment such as stone crushers at site, which produce significant amount of particulate matter. • Keeping construction equipment and generators in good operating condition • Using equipment, especially generators with high levels of emission control. • Immediate use of construction spoils as filling materials. • Immediate disposal/sale of excavated materials. • Continuous watering of bare areas.	
	• Generation of construction Waste	• Hauling of construction debris away from the site and their appropriate disposal in a designated disposal site	
	• Accidents	• Regular inspection and maintenance of equipment • Environmental health and safety briefing • Provision of protective gear	
	• Spills and leaks leading topsoil and water • contamination with hydrocarbon and PAHs	• Good house keeping • Proper handling of lubricating oil and fuel • Collection, proper treatment, and disposal of spills.	
	• Employment of work/labour force	• Local people should be employed in the project activities as much as possible.	

7.5.2 Operation Phase

Most of the environmental parameters will experience beneficial effects during the operation phase of the power plant project. Efforts should be made to enhance these beneficial impacts, which may include incentives for proper growth of more projects in the area. The plant management authority of RBLPL should be responsible for overall environmental monitoring during the operation phase of the project.

Table 7.7 summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts.

Activity/ Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Power Generation	• Emission from the power plant	• Using stack as specified in the design; • Using low nitrogen oxide burners, as specified in the design; • Installation of stack emission monitoring equipment for major pollutants. An in-house Continuous Air Monitoring Station (CAMS) may be considered; • In stack design due consideration should be given to proper insulation; • Planting of trees around the project site.	RBLPL
	• Generation of noise	• Provision of silencers for generators and turbines; • Planting of trees around the project site; • Regular plant maintenance; • Regular noise monitoring, especially at the project boundary and residential quarters located nearby; • Use of ear-muffs and ear-plugs by plant personnel working in the generator and turbine facilities of the plant.	
Surface Water discharge	• Increase of river water pollution	• Regular monitoring of surface water discharge and river water quality includin at the upstream and downstream of the discharge point	RBLPL

Activity/ Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Waste Generation	• Inappropriate disposal of sewage causing environmental pollution • Generation of solid waste including sludge from demineralizer. • Possible water pollution	• Good housekeeping • Proper construction and maintenance of wastewater disposal system for the plant premises. • Ensuring proper storage, treatment, and disposal of all solid waste • Monitoring of effluent quality from treatment plant • Monitoring of river water quality and discharge water quality	RBLPL
Occupational Health & Safety of workers	Non-ionizing radiation, Heat, Noise, Confined spaces, Electrical hazards, Fire and explosion hazards, Chemical hazards, Dust, sanitation, safe drinking water etc.	• Regular health check-up of workers • Proper PPE should be provided to protect from the heat, electric shock and noise protection, • Regular awareness and training should be provided for fire safety & chemical hazard, • Safe drinking water should be provided	RBLPL
Turbines and cooling system inspection	Machine performance may deteriorate with time.	• As per the manufacturer's schedule the gas turbine set needs timely minor, hot gas path and major inspection at specific time interval. • The repair and maintenance of steam turbine and cooling water system will be done according to the manufacturer's recommendation and as required.	RBLPL

7.6 Monitoring Parameters

7.6.1 Construction Period

There are two types of monitoring during construction, 1) Visual Monitoring and 2) Analytical Monitoring. The following are the visual monitoring, its parameters and monitoring frequency for the RBLPL 750 MW CCPP east:

1. **Visual monitoring and observation**

Table 7 8: Monitoring plan during construction phase of the project (Visual)

Issue	Key aspects	Monitoring Frequency	Responsibility
Traffic volume	Incoming & outgoing traffic, traffic movement records	Monthly	EPC Contractor/ Consultant
Site Security	Proper fencing, isolation of site from general access, marked passage for workers and visitors	Monthly	EPC Contractor/ Consultant
Personal Protective Equipment	Ensure every single person involved in the construction activity wear proper PPE	Monthly	EPC Contractor/ Consultant
Incident/ accident record & reporting	Documented record of all incident, accident, near misses etc. and its remedial process.	Monthly	EPC Contractor/ Consultant
Solid waste	Quantity of solid waste, segregation and disposal process	Monthly	EPC Contractor/ Consultant
Oily waste generation & disposal system	Quantity of oily waste, storage and disposal process	Monthly	EPC Contractor/ Consultant
Worker's health	Monitoring process of worker's health	Monthly	EPC Contractor/ Consultant
Complain from neighbours	Any significant complain from neighbours and it's remedial procedure	Monthly	EPC Contractor/ Consultant
Safety orientation & training of workers	Frequency of training & orientation of workers for safety	Monthly	EPC Contractor/ Consultant
Sanitation & drinking water facility to workers	Availability of safe drinking water and sanitation to the workers	Monthly	EPC Contractor/ Consultant
Site Drainage	Maintaining proper drainage	Monthly	EPC Contractor/ Consultant
Fishing & navigation	Biodiversity controlling	Monthly	EPC Contractor/ Consultant

2. Analytical Monitoring during construction

Table-7.9: Monitoring plan during construction phase of the project (Analytical)

Issue	Parameters	Monitoring Frequency	Responsibility
Ambient air Quality	PM_{10} and $PM_{2.5}$	Monthly	EPC Contractor/ Consultant
River water	Water temp., DO, BOD_5, COD, Oil and Grease and heavy metals (Cr, Cd, Pb)	Monthly	EPC Contractor/ Consultant
Groundwater	Groundwater level, p^H, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	Once in 6 months	EPC Contractor/ Consultant
Soil quality	Cr, Cd, Pb and Oil and Grease	Once in 12 months	EPC Contractor/

Issue	Parameters	Monitoring Frequency	Responsibility
			Consultant
Noise level	Noise at different locations	Monthly	EPC Contractor/ Consultant
Drinking water	p^H, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	Monthly	EPC Contractor/ Consultant

7.6.2 Operational Period

The following are the monitoring parameters and monitoring frequency for the RBLPL 750 MW CCPP east during operation:

Table 7.10 Monitoring plan during operational phase of the project

Issue	Parameters	Monitoring Frequency	Responsibility
Stack emissions	NOx, and temperature	Continuous and Annual	RBLPL
Ambient air quality	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2	Quarterly at four locations, seasonal or half yearly monitoring at other sensitive receptors	RBLPL
River water	Water temperature and DO, PH, COD. BOD, TOC, DO, TSS, oil & grease etc.	Monthly	RBLPL
Effluent quality	pH, DO, Sulphate, TSS, TDS, BOD, COD, Total N, Total P, Discharge Water Temperature	Monthly On Line	RBLPL
Groundwater	pH, Colour, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe , Mn and Coliforms; Groundwater level	Once in 6 months	RBLPL
Noise level	Noise at different locations	Once in 3months	RBLPL
Fisheries, Phyto &, Zooplankton, Vegetation etc.	Number and Condition	Once in 6 months	RBLPL
OHS	Health status and safety	Once in 3 months	RBLPL
Fishing & navigation	Biodiversity controlling	Monthly	EPC Contractor/ Consultant

NOTE

1.Though the stack emission in the above Table is suggested for operational phase it is suggested to undertake stack emission testing during the commissioning period to confirm that PM and SO2 emissions contribute negligibily.

2. Monitoring stations for the air quality will be selected at the locations correspond to appropriate receptors in vicinity of the modelled maximum GLC.

Table 7 11: Standards to be maintained during monitoring according to DOE and IFC/WB:

Parameter	DOE	IFC/WB	Unit
Air Quality			
CO	NF	10,000	µg/m³
NO_x	200	100	µg/m³
PM_{10}	150	150	µg/m³
$PM_{2.5}$	75	65	µg/m³
SO_2	125	365	µg/m³
SPM	NF	200	µg/m³
Ground Water			
pH	6.5-8.5	6.5-8.5	-
DO	6	NF	mg/L
TDS	≤1000 mg/L	NF	mg/L
Conductivity	NF	250	µS/cm
Alkalinity	NF	NF	mg/L
Iron	0.3-1.0	NF	mg/L
Chloride	150-600	250	mg/L
Hardness	200-500	NF	mg/L
Temperature	(20-30)°C	NF	^{0}C
Arsenic	0.05	0.01	mg/L
TSS	10	NF	mg/L
Turbidity	10	NF	NTU
COD	5.6	NF	mg/L
BOD_5 at 20°C	2.3	0.2	mg/L
TC	14	0	#/100 mL
FC	0	0	#/100 mL
Oil & Grease	54.5	0.01	mg/L
Color	5	15	Pt-Co
Surface Water			
pH	6-9	6-9	-
DO	4.5-8	NF	mg/L
TDS	2100	NF	mg/L
Conductivity	NF	NF	µS/cm
Alkalinity	NF	NF	mg/L
Iron	2	3.5	mg/L
Chloride	600	NF	mg/L
Hardness	200-500	NF	mg/L
Temperature	40	NF	^{0}C
Arsenic	0.02	NF	mg/L
TSS	150	50	mg/L
COD	200	250	Pt-Co
BOD_5 at 20°C	50	50	mg/L
TC.	0	0	mg/L

Parameter	DOE	IFC/WB	Unit
FC.	0	0	#/100 mL
Color	10	10	#/100 mL

7.6.3 Monitoring cost

The proposed monitoring parameters and the frequency to be monitored in accordance with the monitoring plan have been presented in Table 7.7& Table 7.8 during the construction and the operation of the proposed project respectively. The estimated cost of EMP, environmental monitoring and training program during the construction phase and operation phase has been given in **Table 7-12, Table 7-12& Table 7-13.**

Table 7.12 Cost estimate for environmental monitoring and environmental management during construction

Item	Parameter	unit cost (Taka)	Unit per year	Total cost per year (Taka)
Visual	Visual monitoring	50000.00	12	600,000.00
Ambient air Quality	CO, NOx, PM10 and PM2.5	25000.00	12	300,000.00
River water	Water temp., DO, BOD5, COD, Oil and Grease and heavy metals (Cr, Cd, Pb)	30000.00	12	360,000.00
Groundwater	Groundwater level, pH, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	30000.00	12	360,000.00
Soil quality	Cr, Cd, Pb and Oil and Grease	50000.00	2	100,000.00
Noise level	Noise at different locations	10000.00	26	260,000.00
Process waste	Solid waste	5000.00	52	260,000.00
Health	Health status of the workers	20000.00	6	120,000.00
	Total Cost			23,60,000.00

Table 7.13 Cost estimate for environmental monitoring during operational phase

Item	Parameter	unit cost (Taka)	Unit per year	Total cost per year (Taka)
Stack emissions	CO, NOx, SPM, O2 and temperature	30000.00	04	120,000.00
Ambient air quality	CO, NOx, PM10, PM2.5,	30000.00	04	120,000.00
River water	Water temperature and DO	5000.00	12	60,000.00
Effluent quality	pH, DO, Sulfate, TSS, TDS, BOD, COD, Total N, Total P	30000.00	04	120,000.00
Groundwater	pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe , Mn and Coliforms; Groundwater level	30000.00	02	60,000.00
Noise level	Noise at different locations	10000.00	12	120,000.00

Item	Parameter	unit cost (Taka)	Unit per year	Total cost per year (Taka)
Vegetation	Number and Condition	25000.00	01	25000.00
Occupational health and safety	Health status and safety	25000.00	02	50,000.00
	Total cost			6,75,000.00

Table 7.14 Cost estimate for training during operational phase

Item	Number	unit cost (Taka)	Total cost per year (Taka)
Safety and occupational health	02	200,000.00	400,000.00
Environmental management system	02	300,000.00	600,000.00
Total cost during operational phase			1,000,000.00
		Total	**2,000,000.00***
This excludes the cost of CAPEX to be incurred for installation of pollution control devices.			

7.7 Monitoring of Relocated Temporary Jetty

For the construction of power plant, we have considered 5 km radius bounding impact area for the monitoring, which also covers the impacts of Temporary Jetty. So, for the relocation of the temporary Jetty, separate monitoring will not be required. The monitoring of Power plant will also reflect the impacts due to the temporary Jetty.

7.8 CORPORATE SOCIAL RESPONSIBILITY (CSR)

Reliance Bangladesh LNG & Power believes in principle that “Growth Does Not Exist in Isolation”. For Reliance, being socially responsible is not an occasional act, but it is an on-going year-round commitment, which is integrated into the very core of their business objectives and strategy. Reliance Bangladesh LNG & Power Ltd. believes that an environment of common trust and confidence building is essential during project implementation.

The main principles of RBLPL’s Corporate Social Responsibilities are:

- Adopt an approach that aims at achieving a greater balance between social and economic development;
- Adopt new measures to accelerate and ensure the satisfaction of the basic needs of all people;
- Work towards elimination of all barriers to the social inclusion of disadvantaged groups- such as the poor or the disabled; and

- Give unfailing attention to children for in their hands lies the future of the society. It is for their sake that health, education and environment are given priority in their programme and investments.

The list of CSR activities will be carried out by Reliance, regularly in surrounding villages of the Reliance Meghnaghat 750 MW CCPP are as follows:

- Organized Health Camps for the villagers in tie-up with nearby hospital and / or local NGOs;
- Distributed free medicines to health sufferers;
- Organized specialized medical camps such as eye treatment, malnutrition, dental treatment, gynaecological treatment, screening cum fitment camps for People With Disabilities (PWDs);
- Distributed free spectacles, performance of cataract operation;
- Organized as Polio & Vaccination drive;
- Awareness towards child literacy and adult literacy programs;
- Distributed study material (school bag, note books, drawing books, colour box, slates, pencils, pencil box etc.);
- Organized felicitation ceremony for the students who scored higher marks in HSC/SSC examination or received any merit on educational front;
- Equipped schools with reference books, blackboards or other teaching aids, sports kits (as per requirement);
- Cooperated and coordinated in the village festivals; and
- Provided basis civic amenities like street lights, drinking water facilities etc. in the nearby villages

During and after the execution of proposed expansion project, the said CSR activities will not only continue but also be enhanced considerably.

7.9 GREEN BELT DEVELOPMENT

Even after taking stringent measures for pollution control, in different stages, a significant amount of pollutants are produced such as dust, noise and NOx during the operational phase. A sustainable and green solution for this problem could be minimized by developing a "Green Belt". In the surrounding areas, trees of specific species can reduce the pollution as well as can provide enhanced oxygen for the surrounding area.

The air pollution that can be emitted by the industries in the area settles on the ground and vegetation of surrounding area. The plants interact with both gaseous and particulate pollutants and to great extent absorb them and thus, remove them from the atmosphere. This pollution removal property of the plants has been known for long time. Many scientists have suggested the green belt for reducing the pollution originated from the industrial operations. (Flemming 1967; Hanson and Thorne 1970)

Table 7 15: Suitable plant Species for "Green Belt Development"

Name of the Plant	Name in Bangla	Type	Function
Australian wattle	আকাশমণি	Tree	Reduces Particulate Matter
Bael tree	বেলগাছ	"	"
The Siris Tree	শিরিষগাছ	"	"
White Siris	করই	"	"
Sugar Apple	আতাগাছ	"	"
Kadam	কদম	"	"
Nim	নিম	"	"
Bamboo	বাঁশ	"	"
Australian Whistling Pine	ঝাউ	"	"
Rangan	রঙ্গন	Shrub	Noise Attenuation
Kamini	কামিনী	"	"
Karabi	করবি	"	"
Guava tree	পেয়ারা	"	"
Tagar	টগর	"	"
Mastered Green	সরিষা	Forb/Herb	NO_x Absorption

7.9.1 Resources and Implementation

The environmental parameters to be monitored during the construction and operational phases along with the monitoring schedule have been presented in the previous sections. The responsibilities for the implementation of the proposed monitoring plan may be entrusted with the external contractor in association with the RBLPL personnel and under the direct supervision of the RBLPL management.

It is very important to make sure that the potentially significant impact during both the construction and operation phases are properly addresses through adaptation of the proposed mitigation and enhancement measures. It is equally important to undertake environmental monitoring during both the construction and operation phases according to the proposed monitoring plan.

These should therefore be made integral part of the proposed power plant project. The following are the management team of RBLPL who will be responsible for the monitoring program of the proposed project during the construction and operation period; Team for Environment monitoring and ensuring compliance during construction

7.9.2 In house capabilities of RBLPL for Environmental Monitoring

It is important for RBLPL to create in house capabilities for Environmental Monitoring for the proper implementation of the EMP during the operational period of the project. For this RBLPL will have to establish their own laboratory with the facility to monitor the parameters that have been suggested in the Environmental Monitoring Plan of the EMP. The probable equipment list and budget for the equipment have been outlined below in Table 7.16:

Table 7 16: Cost estimate for setting Environmental Laboratory

Item	Quantity	unit cost (Taka)	Total cost (Taka)
High Volume Samplers	02	500,000.00	1,000,000.00
Fine Particulate Samplers	02	600,000.00	1,200,000.00
Online Emission Monitoring Equipment	01	2000,000.00	2000000.00
Noise Level meter	02	20,000.00	40,000.00
pH meter	02	15000.00	30,000.00
DO meter	01	50000.00	50,000.00
TDS meter	01	30,000.00	30,000.00
Turbidity Meter	01	25000.00	25,000.00
Incubator	01	250,000.00	250,000.00
Refrigerator	01	50,000.00	50,000.00
Analytical Balance (5 digit)	01	400,000.00	400,000.00
COD reactor	01	100,000.00	100,000.00
Spectrophotometer	01	500,000.00	500,000.00
Decicator	01	25000.00	25,000.00
Distilled water machine	01	20000.00	20,000.00
Magnetic Stirrer	01	50000.00	50,000.00
Burette, conical flask, BOD bottle etc.	1 lot	50,000.00	50,000.00
Other glassware	1 lot	50000.00	50,000.00
Different chemicals	1 lot	150,000.00	150,000.00
Filter papers, thimbles etc.	1 lot	150,000.00	150,000.00
Miscellaneous items		100,000.00	100,000.00
		Total	**6,270,000.00**

The above laboratory could be set up under the EHS manager and the following

Chemist	-	01 person
Lab technician	-	01 person
Sample collector	-	02 person
Lab Assistant	-	01 person

7.9.3 Decommissioning and Dismantling

At the stage of the project planning & implementation process, the necessity for planning and timing of the decommissioning of the construction equipment & structures after the completion of construction and end of life power project of the RPLBL 750 MW CCPP is important. RPLBL authority has planned to prepare a full scale decommissioning plan for the project after construction and after the life expectancy of the project to clean up the site.

7.9.3.1 AFTER COMPLETION OF THE CONSTRUCTION OF POWER PLANT

The EPC contractor is responsible for the decommissioning of the Equipment and temporary structure at the project site. After the completion of the construction, there will have plenty of construction equipment, scrap metal, construction materials, different types of waste chemicals as well as the jetty. The EPC contractor should follow the Decommissioning plan that will be prepared by RPLBL before leaving the site.

It will be ensured by the contractor that no hazardous substance will be discharged to the atmosphere.

7.9.3.2 AT THE END OF PLANT'S LIFE

After the power plant will reach its end of life, RPLBL authority should dismantle the entire power plant project and restore the project site back to the normal unless otherwise mentioned by the BPDB. The RPLBL will follow the detail decommissioning plan will prepared prior to this.

7.9.3.3 GENERAL PRINCIPLES OF DECOMMISSIONING

The general principles of the decommissioning of a project are detailed below. These principles must be required to be revisited and supplemented in the event of decommissioning of the power plant.

On decommissioning of the power project, EPC Contractor and RPLBL will:

- Ensure that all sites not only vegetated are vegetated as soon as possible after operation ceases with species appropriate to the area.
- All the temporary & permanent structures, foundations, concrete, and tarred areas are demolished, removed and waste material disposed of at an appropriately licensed waste disposal site.
- All equipment, vehicle and machineries should be dismantled, recycled or disposed of at an appropriately licensed disposal site.
- The aggregates, steel and other construction materials should be sold secondarily to the licensed vendor.
- All disturbed areas are compacted, sloped and contoured to ensure drainage and runoff and to minimize the risk of erosion.
- All hazardous materials should be kept separate, documented and disposed to the safe recycling or disposal site.

A detail decommissioning and restoration of site plan should have to be developed prior to the decommissioning of the Power project by EPC contractor and RPLBL.

7.10 ESMP MONITORING AND REVIEW

The environmental unit of the RBLPL shall periodically review, monitor and audit the effectiveness of the ESMP, including all sub-plans. The audit program should adequately cover the scope, audit frequency and methods that are typically required for large infrastructure projects. The frequency of audits should reflect the intensity of activities (typically more common during construction), severity of environmental and social impacts and non-compliances raised in prior audits.

7.10.1 Review of the ESMP

The environmental unit of the RBLPL shall review the ESMP & ESIA to assess its effectiveness and relevance as follows

- A full review shall be undertaken annually;
- Following a reportable incident, or a significant non-compliance; and
- Following an addition, up-date or change order to the ESMP, or a sub-plan.

The review of the ESMP should consider the following:

- Adequacy of data collection, analysis and review;
- Reporting;
- Non-compliances; and
- Corrective actions implemented.

The ESMP shall also be reviewed periodically to evaluate environmental controls and procedures to make sure they are still applicable to the activities being carried out. Reviews will be undertaken by the RBLPL Environmental Unit as follows:

- The full ESMP shall be reviewed at least annually;
- Relevant parts of the ESMP shall be reviewed following a reportable incident;
- Relevant parts of the ESMP shall be reviewed following the receipt of an updated sub plan;
- Relevant parts of the ESMP shall be reviewed on request of stakeholders, Contractor, Supervising Engineer, World Bank/DOE or the host communities.
- The review shall include analysis of the data collection and analysis of data, monitoring reports, incident reports, complaints/grievances and feedback from stakeholders, community reports, and consultation meeting minutes and training records to evaluate the effectiveness of ESMP procedures. Site visits, interviews and other auditing methods may also be used.

Chapter-8

EMERGENCY RESPONSE AND DISASTER MANAGEMENT PLAN

8.1 INTRODUCTION

An emergency is any situation or occurrence of a serious nature, developing suddenly and unexpectedly, and demanding immediate action. An emergency can cause serious injury / loss of life / lives and may cause extensive damage to property and environment causing serious disruption both inside and outside the plant.

Emergencies have been broadly classified into two categories:

- On–site Emergency.
- Off–site Emergency.

8.2 ON SITE EMERGENCY

An on-site emergency is a kind of situation, which can cause casualties / equipment / property damage, work environment damage within the site premises. It may need to take help of outside agencies to bring the situation under control.

8.3 OFF SITE EMERGENCY

An emergency that takes place in an installation and the effects of emergency extends beyond the premises or the emergency created due to an accident, catastrophic incidents, natural calamities, etc. It no longer remains the concern of the installation management alone but also becomes a concern for the general public living outside and to deal with such eventualities will be the responsibilities of district administration.

A response plan is required to control and mitigate the effects of catastrophic incidents in above ground installation (AGI) or underground installations (UGI) or road transportation. This plan shall be prepared by the district administration based on the data provided by the installation(s), to make the most effective use of combined resources, i.e. internal as well as external to minimize loss of life, property, environment and to restore facilities at the earliest

The off-site emergency plan outlines actions that employers and employees must take in the event of an emergency situation to ensure employee safety and to minimize property damage.

Such procedures include:

a) Ways to alert employees;
b) Reporting emergencies;
c) Evacuation;
d) Designated assembly locations;
e) Contact people and their telephone numbers;
f) First aid and medical assistance;
g) Clean-up and business resumption;
h) Employee training;
i) Ways of testing the plan (mock drills); and
j) Communication with media, community and employees and their families.

Available off site resources for handling emergency situations:

1. Fire Station: Bandar Fire Station is the nearest fire station which is 14.2 km from the project site. During the Off-Site Disaster, the main role of fire services will be as follows:

    - Fire fighting
    - Spraying water to knock down toxic gases/vapors
    - Washing away spilled chemicals
    - Rescue of people trapped in fire services must be aware of the properties and behavior of various industrial chemicals.

    While fighting an emergency they themselves should not be get affected by the toxic gases or any other harmful chemicals. Proper protective equipment should be used for this purpose.

2. Hospital: Nearest General Hospital is 4.2 km from the project site. Quick medical treatment of people injured in a major industrial/transportation accident is essential. Medical services should be geared up to meet special requirements of an industrial accident.

8.4 EMERGENCY SITUATIONS AT 750 MW CCPP PROJECT SITE

Based on relevant experience and best professional judgment, it is believed that the following types of hazards (Source, Situation, Act, or combination thereof) have the potential to occur at the plant:

1. Excavation cave-ins
2. Explosion
3. Facility Blackout - loss of electric power
4. Fire, caused from:

    a) Bitumen
    b) Electrical short circuits

c) Flammable materials storage areas – materials that can cause fire incident include - Adhesives (at stores), Diesel, Hydraulic oil, Lubrication oil /Grease, Paints and Paint thinners
d) FRP Storage area (Used for cooling tower works)
e) Oil rags/waste at work locations
f) Shuttering material storage yard
g) Wooden cases storage area
h) Wooden scrap yard

Note: Possible quantity of storage has been considered while determining severity

5. Medical conditions/emergencies - Serious injuries or ill health; causes include but not limited to:

a) Asphyxiation from lack of oxygen during working in confined space
b) Electric shock / Electrocution (non-fatal)
c) Fall from height
d) Person suspended in safety harness

5. Pandemics/epidemics/outbreaks of communicable disease
6. Traffic accidents
7. Natural calamities
    a) Earthquakes
    b) Flooding (heavy rains)

8. Presene of other industries

8.5 RISK ASSESSMENT OF POSSIBLE EMERGENCIES AND CONTROLS MATRIX

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
1	Earthquake	Remote	Earthquake	Whole of project site	1) High severity 2) Effects are proportional to earthquake magnitude	1) Site located in Seismic Zone II; no history of such incident 2) Design of plant has considered relevant safety factors of seismic zone potential effects	Review and implementation of remedial measures after assessing the magnitude of effects – by top management
2	Excavation cave-in	Likely	Excavation cave-ins caused by unsafe work practices	Across site – varied locations	1) High severity 2) Effects localized	1) Safe work practices to be established and implemented 2) Work in excavated areas are supervised with prior-to work assessments of conditions for work 3) Work is always carried out under supervision from above the excavation level	Medical emergency procedures are followed

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
3	Explosion	Likely	Acetylene gas cylinder – accidental explosion due to pressure build-up; catch fire with nearby flame sparks (if working with)	Gas cutting works area (Max permitted storage is 20 Cylinders)	1) High severity – bodily burns 2) Effects localized	1) Safe work practices established and implemented 2) Fire extinguishers kept nearby workplace	1) Fire extinguishing by trained persons 2) Medical emergency procedures are followed for the affected personnel
4	Explosion	Likely	LPG Cylinders	1 or 2 Cylinders at Underground pipe coating area; used for heating coating material	1) High severity – bodily burns 2) Effects localized	1) Safe work practices to be established and implemented 2) Fire extinguishers kept nearby workplace	1) Fire extinguishing by trained persons 2) Medical emergency procedures are followed for the affected personnel
5	Facility Blackout	Likely	Loss of electric power	Whole project site	1) Low severity 2) Effects localized to the area 3) People may panic and may be affected of it	1) Readily available flashlights; 2) Adequate emergency lighting; 3) Alternative lighting arrangement will be in stand-by at critical work areas while working at night 4) Candles are not lit and kept near any	1) Depending upon the cause immediate measures will be taken 2) All electrical equipment, especially those will be switched off till the power is reinstated 3) Panic personnel will be counseled 4) Attention is given to

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
						flammable items 5) No burning candles are unattended	the fact that the re-establishment of electrical power can be with a power surge. Heavy equipment' high electrical load factor could adversely impact
6	Fire	Likely	Shuttering material (wood) – accidental catching up fire due to sparks/ flying fire objects from nearby work area	Shuttering material storage	1. Low severity 2. Effects localized to the area	1. The whole site is declared as no smoking zone 2. Fire extinguishers are kept near all storage area to extinguish the fire at its initial stage 3. Water hoses are provisioned which is near-by	1) Firefighting, and 2) evacuation of personnel at that location to the safe place at once
7	Fire	Likely	Bitumen – accidental catching up fire due to sparks/ flying fire objects from nearby work area while material handling	Bitumen stored in project site			

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
8	Fire	Likely	Oil rags/waste – accidental catching up fire due to sparks/ flying fire objects from nearby work area	Equipment / Piping erection area			
9	Fire	Likely	Leaks in 200 L Diesel drums	Stores			
10	Fire	Likely	Wooden scrap	Wooden scrap yard			
11	Fire	Likely	Wooden Materials	Wooden cases at material storage yard			
12	Fire	Likely	Due to electrical short circuit	Offices / PC Work Stations	1) Low severity 2) Localized to the area	1) Prevent the loose connections 2) Prevent over loading 3) Prevent multiple connections from one source 4) Prevent the overheating of the equipment's 5) Keep the electrical equipment's in healthy condition	1) Switch off the power supply 2) Use suitable fire extinguisher to extinguish the fire

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
13	Fire	Likely	Accidental catching up fire due to sparks/ flying fire objects from nearby, electrical short circuits in store room, unattended lit candles, etc.,	Stores maintaining: • Adhesives • Diesel • Hydraulic oil • Lube. oil • Grease • Paints and Paint thinners	1) Low severity 2) Effects localized to the area	1) The whole site is declared as no smoking zone 2) Fire extinguishers are kept near all storage area to extinguish the fire at its initial stage 3) Water hoses are provisioned which is near-by	1) Firefighting 2) Evacuation of personnel at that location to the safe place at once
14	Fire	Likely	FRP – accidental catching up fire due to sparks/ flying fire objects from nearby work area	FRP Storage area (for cooling tower construction works)	1) Medium to high severity since FRP fire spreads faster 2) Can affect the surrounding area	1) Prevent multiple electrical connections from one source 2) Do not keep flammable items or materials nearby Fire extinguishers, water hose near-by	1) Switch off the power supply 2) Firefighting by trained personnel and Fire Tender help sought if required
15	Flooding of water in to the site	Likely (during rainy season)	Inundation (deluge / flood) of water due to heavy rains	All work areas	1) Low severity 2) Effects mainly in the excavated area / trenches 3) None - since	1) Pre alert given based on forecast and on situational day-to-day basis 2) Working in excavated areas, trenches,	1) Evacuate all personnel from areas of danger - on sensing the danger 2) Rescue team to

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
					situation can be predicted / detected instantly	Open confined vessels or areas are provided additional vigilance 3) The drains always kept clean especially in the rainy season 4) Keep the mobile pump ready to pump out the water	verify and act to rescue if someone got caught inside 3) Provide medical aid as needed
16	Medical Emergency - Electrical Shock / Electrocution	Likely	Due to contact with live wires or due to electrical faults	All work areas wherever there are electrical points	1) Low to medium severity 2) Localized to the area	1) Provide double earthling to Equipment; periodical checks for effectiveness 2) Provide E L C B's 3) Provide rubber matting's in front of control panels & isolators. 4) Signage - Never touch the live circuit 5) Safe work practices - Isolating the circuit before carrying out the maintenance 6) Use of PPE's	1) Switch off the power supply 2) Administer artificial resuscitation if required 3) Provide medical aid as needed
17	Medical	Likely	Asphyxiation	During	1) Medium to high	1) Personnel work	Follow appropriate

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
	Emergency		from lack of oxygen	working in confined space at Cooling water pipelines, bypass stack, and HRSG (aftercompletion of installation)	severity 2) Localized to the area	competence ensured 2) Preventive maintenance of equipment and machinery 3) Workplace monitoring prior to task execution 4) SCBA provided where necessary	medical procedures
18	Medical Emergency	Likely	Fall from height	1) Structural erection, 2) Bypass stack erection, 3) Scaffolds, 4) HRSG erection, 5) High roof at Electrical control buildings	1) Medium to high severity 2) Localized to the area	1) No un- protected openings on any roof ensured 2) Safety harness, safety life line provisioned while working at height 3) Only competent & medically fir persons are allowed to work at height	1) Follow rescue procedure in case person is in suspended harness 2) If panic, provide medical counseling
19	Medical Emergency	Likely	Fall from height	While climbing higher heights on ladder (does not have railing) with fall protection	1) Medium to high severity 2) Localized to the area	Fall arrestor used for high rise climbing using ladders	1) Follow rescue procedure in case person is suspended harness 2) If panic, provide medical counseling

S. No	Emergency	Likelihood of occurrence	Potential cause / Incident	Area	Severity of consequence	Preventive measures	Mitigation
20	Pandemics/ epidemics/ outbreaks of communicable disease	Likely	Unpredictable Outbreaks for unknown reasons	All personnel at site	Medium to high	HR will initiate actions immediately upon getting news from media. Health precautions from Government and Health organizations will be followed	Affected personnel will be provided with medical assistance Affected personnel will not be allowed to workplace till normal health is restored
21	Traffic accidents (within project site)	Likely	Violation of safety rules, unforeseeable road /terrain conditions	Throughout work site	Medium to high	1) Speed limit is restricted 2) Security watch and guide traffic at designated places 3) Road and terrain conditions inspected and attended to correct faults 4) All vehicles mandatorily use reverse horn while moving in reverse / rear direction 5) Only authorized, competent persons are allowed to drive vehicles within site premises	1) Personnel injury is dealt as per medical procedure

Fire resist and extinguish act 2003 has to be followed for fire prevention & safety features as per Bangladesh law. For protection of power plant equipment and operating personal against fire, any one or a combination of the following systems will be provided for all yards, areas, buildings and equipment

- Hydrant system – Entire Plant
- Medium Velocity Water Spray System – Cable Gallery
- High Velocity Water Spray System - Transformers and LO Tanks
- Portable Fire Extinguishers – Entire Plant
- CO_2/ Clean Agent Systems – Switchgear Rooms, Control Rooms
- Sprinkler System for Office Buildings
- Foam cabinets and portable foam system
- Fire resistant doors and fire seal walls will be provided as per code requirements.

8.6 PLANT FACILITIES FOR EMERGENCY

- Emergency Control Centre
- Emergency Siren system
- Hand held Wireless Communicator (Walkie-Talkie used) - with security & operations personnel – Total quantity : 15
- 2 Fire Tenders (One at existing plant which is at less than one KM and another at site)
- Fire hydrant and fire extinguishers at critical / identified locations (In addition, being a multi-employer work site, respective contract organizations also maintain required emergency response facilities)
- Call points – intercom phone in all departments
- Trained Fire Fighting team
- Trained First-Aiders
- First Aid facility at Occupational Health Centre at 750 MW CCPP
- Ambulance Van 1

Table 8 1: Supportive resources exclusively maintained for emergency response activities

S. No.	Particulars	Qty	S. No.	Particulars	Qty
1	Leather glove 16”	4	12	Artificial resuscitators	4
2	PVC Glove 16”	4	13	Helmets	4
3	Rubber Glove 16”	4	14	Rain coats	4
4	Shock proof glove 16”	4	15	Gum Boots	4
5	FIRE Suite 36” 42”	4	16	Stretchers	2
6	Leather apron	4	17	Blankets	2
7	Plain glass goggles	4	18	Torch light with cells	4
8	Goggle for gas welding & cutting	4	19	Safety Belt	4
9	Welding Shield	4	20	Gas mask	4
10	Spark resistant tools	1 Kit	21	Barricade tapes	1 Rollof 5 Kg.
11	SCBA Sets	3			

8.7 EMERGENCY CONTROL ORGANIZATION [ECO]

8.7.1 Emergency Control Centre (ECC)

There will be an emergency control center inside the premises of the project to take action as soon as possible.

8.7.2 Emergency Siren

A wailing siren with different frequencies (short intervals) indicating that there is an emergency situation at site.

An emergency siren will be installed for the Project. If the emergency arises at proposed plant and if it is determined that situation will affect the power plant, then siren will be blown at existing plant control room as well as project site control room.
8.7.3 Emergency mitigation teams

Two teams function separately in emergency mitigation activity.

Team 1: Incident Control Team (emergency mitigating team functioning at the site of incident)

The team is headed by the incident controller (who is HOD of the concerned area, where emergency situation occurred) and he is assisted by:

- Emergency mitigating (Firefighting) team
- Emergency technical support team
- First aid team

- Rescue team

Team 2: Emergency Control Team (assists emergency mitigation activities from emergency control center)

The team is headed by CPD. In his absence Vice President (C&I) takes charge as Chief emergency Controller. (In his absence next higher official \ delegated person takes the charge as chief emergency controller). Chief emergency controller is assisted by Emergency advisory team.

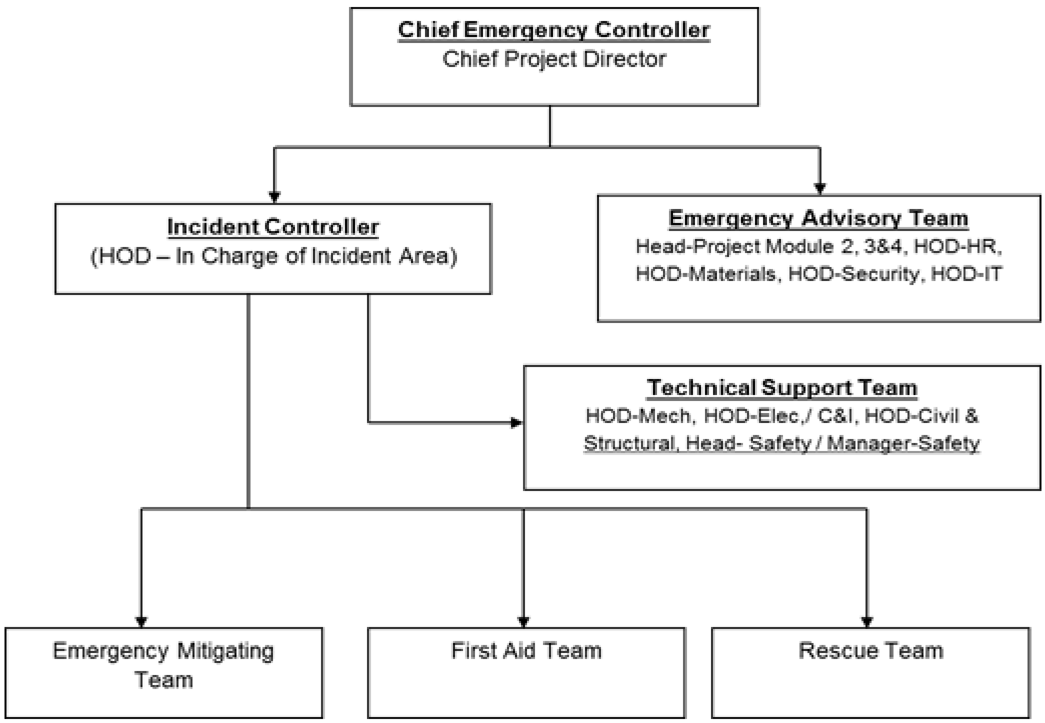

Figure 8.1: Emergency Control Organization Chart

8.7.3 Roles and Responsibilities

The roles and responsibilities described hereunder are in full. However, all elements may not be applicable to all emergencies. The responsibilities that need to be executed are specific to a type of emergency. The response procedure for each category of emergency is described in section 8.

8.7.3.1 Role of Unit Head (Chief Emergency Controller (CEC) – Project

- Assumes charge as Chief Emergency Controller
- Establish contact with incident controller through cell phones or public address system and other available systems, assesses the severity of the emergency.
- Alert other CEC and rush to the spot if required.

- In case of requirement declares emergency by arranging for blowing of emergency siren.
- Directs the team members who are assisting him regarding
- Medical arrangements at outside hospitals if required
- Transportation for evacuation of personnel
- Contacting and interacting with statutory authorities / media / relatives of the injured persons in case of any casualty through Head - HR.
- Arranging additional outside help from the nearby fire stations and industries for mitigating the emergency through Head- HR/Security
- Necessary food supplies etc. for the emergency mitigating team.
- Authorizes the sounding the All Clear siren after the emergency is over.
- Arranges for investigation of the incident.

8.7.3.2 Incident Controller (HOD / In charge of the area or delegated person)

The Incident Controller will take control of handling the emergency. The responsibilities of the Incident Controller include:

- To stop all the activities at the affected area, isolates power supply if needed
- To assess the scale of the incident and take decisions as may be required.
- After assessment of risk, if necessary, inform CPD / VP- Project to declare emergency.
- To establishes contact with chief emergency controller and inform about the situation from time to time
- To initiate the emergency procedures with the help of available facilities to secure the safety of employees, minimize the damage to plant and property and minimize the loss of material; to guide fire squad, salvage squad, first-aid squad and auxiliary team
- To direct rescue and fire-fighting operations.
- To search for casualties
- To arrange for evacuation of non-essential workers to assembly areas.
- To setup a communication point with the emergency control team within the Plant
- To assume the responsibilities of the Chief Emergency Controller till the person arrives.
- To provide support to the emergency services as requested.
- To issue verbal communication to engineers for necessary isolations and precautions, this will be treated as permit to attend emergency situations.
- To ensure that all clear siren is given in consultation with Fire squad / Combat team when emergency has been brought under control.
- To arrange for clearing of spills and waste at the site and restoring normalcy for regular operations / activities
- To collect evidences that will be necessary for subsequent inquiry to the root cause of the emergency and for concluding corrective measures to avoid recurrence

8.7.3.3 Role of Emergency Technical Support Team

- Arrange for the resources / material for controlling the emergency and to get back to normal operations
- Arranging for cranes, required tools, equipment, electrical assistance for controlling the emergency and to get back to normalcy
- Evaluate the technical aspects in the control / mitigation of the emergency & operational continuity
- Carrying out the technical study and recommend as per the requirement
- Communicate with emergency advisory team and furnish required clarification
- Identifying and establishing contact with outside technical expertise as per requirement and getting advices or necessary help from them

8.7.3.4 Role of Emergency Advisory Team

- In absence of CPD (CEC – Project) , VP- Project assumes responsibility as Chief Emergency controller and carries out the activities as mentioned under the role of Chief Emergency controller.
- Others report to the Chief emergency controller guides him in controlling the situation and acts as per his instructions.
- Log the sequence of events so that report of the emergency action can be prepared for review and for identifying flaws, so as to correct the same.
- If required establishes contact with statutory authorities and media personnel as per the advice of Chief Emergency controller and gets outside help or to appraise about the situation and get help in case event turns off site emergency.
- Establishes contact with outside hospitals / nursing homes for prior information and readiness in case of sending injured to the hospitals, getting additional ambulances etc.,
- Prepare record of affected personnel with local and permanent address, establishes contact with the relatives of the injured or victimized personnel and assures them about the situation and renders necessary help as per Chief Emergency controllers' advice.
- Keep additional vehicle with drivers as stand-by and authorized to utilize any vehicle during emergency.
- Provide vehicles as directed by the emergency control Center.
- Co-ordinate with state transport authorities and other transport agencies for maximum mobilization of vehicles.
- Arranging for food, water and other requirements
- Establishing contact with nearby / industries and appraise them about the situational requirements and agree upon mutual help during emergencies. Alert them in case they are getting affected of an emergency at site to get additional help from them.

8.7.3.5 Role of Emergency Mitigating (Fire Fighting) Team

- Immediately after hearing the emergency siren the team will get ready to face the incident
- After receiving the information from CEC or Incident Controller they should report to the incident controller (HOD / in charge of concerned dept.).
- Takes directions from incident controller they should start fighting of emergency situation for general fire.
- During firefighting shall follow :
  1. Personnel Safety by wearing the required PPE.
  2. Plant, Property and Environment Safety.
  3. Minimum loss due to the incidence.

8.7.3.6 Role of First Aid / Rescue Teams

- Immediately after hearing the siren they should report to the incident controller (HOD / in charge of concerned dept.).
- To have directions from incident controller to start rescuing the entrapped personnel and give the necessary first aid before sending them to actual medical aid.

8.7.3.7 Role of Security

- Stop entry of all external vehicles and personnel from outside the premises.
- Shall stand in readiness for further instructions from Chief Emergency Controller and shall act as per the instructions given by him.
- Direct all the vehicles (such as ambulances, fire tenders etc.) coming for help from outside organizations to the incident spot.
- During nights if any incident which is alarming or which can cause emergency, security guard should immediately inform the same to the senior official available in the shift by mobile phone and act as directed by him.

8.7.3.8 Mutual Aid / Role of Nearby Companies

<u>Role played by members of neighboring industries</u>

- On receiving information and call for assistance they shall extend all possible help.
- The place of incident shall be informed and guided by the main gate security guard once they approach for providing assistance.
- Fire Crew in-charge on arrival will report to the incident controller of Reliance and as per his directions, he shall go to the site of emergency and report to the incident controller and starts their activity as directed by him.

8.7.3.9 Head – HR

- He is the only authorized person to issue public statements; coordinate & liaise with the GOVT. Officials
- He shall coordinate & liaise with medical team for arranging medical help
- He shall coordinate with the Chief Emergency Controller & arrange for required help from external agencies

8.8 TRAINING & MOCK DRILLS

8.8.1 Training

Emergency plan and response procedures have been prepared taking in to consideration prevailing industrial / sector safety best practices. Accordingly the roles & responsibility to the concerned personnel are assigned and they are trained to carry out tasks effectively. The following aspects have been emphasized during training:

- Saving the life has been given top priority
- Reducing the loss & damage to the property

The emergency response team members undergo periodical refresher program to ensure their continued ability to render services more effectively.

Mock drills are conducted to ensure ever-preparedness of the teams to respond to any identified emergencies.

8.8.2 Mock Drills

Emergency response procedures are established for the identified emergencies. Mock drills for identified potential emergencies shall be conducted as per the mock drill schedule.

Mock drill includes any of the following scenarios:

- Fire emergencies
- Other OH&S emergencies

Of the above emergencies, one live mock drills and a table-top mock drill areconducted alternatively. The scenario for the mock drill may be chosen from any of the above mentioned emergencies and all aspects of the emergency.

8.8.3 Review of Mock Drill

For every mock drill, the safety committee reviews the efficiency and response time of the exercise as per the following criteria:

- Did the operations go on as per the plan?
- Did all persons assigned with specific responsibilities perform as planned?
- Did they experience any difficulty in performing their duties?
- How was the cooperation between the teams?
- Were there reasons for any confusion or conflicting instructions?
- Were all the persons contacted in time?
- Could they isolate plant equipment as per standard operating procedure

Rating of response to emergency is done based on the following parameters:

a) Communication;
b) Equipment;
c) Manpower and skill;
d) Coordination within the team and with other teams.

The safety committee designates two observers for each of the Mock Drill and their Evaluation Report is discussed and corrective actions are implemented.

8.9 EMERGENCY RESPONSE PROCEDURE - FIRE INCIDENT

8.9.1 Emergency response procedural steps

- All personnel at site – shall move out of their workplace and assemble at the nearest safe assembly point
- Emergency mitigating (Firefighting) team – Mitigate the Fire as per procedure (Trained)
- Emergency technical support team – Mobile resources as need for the situation
- First aid team – Provide first-aid to the affected persons before sending them to actual medical aid
- Rescue team – Assist and ensure all personnel in the emergency affected site are evacuated; carry out intensive search in the area to make double0sure that no person is left un attended
- Security – Stop vehicle / personnel entry in to the site; control traffic within site
- Head – HR - Coordinate with rescue team and arrange for additional help such as logistics and other medical arrangements for the affected personnel
- Incident controller – Blow siren for all clear indication after the emergency is over.
- Concerned HODs and Contractors – Shall ensure that they take stock of their personnel to determine whether anybody is missing. Coordinate with security, HR as needed

8.9.2 Clean-up and/or restoration

The Emergency mitigating (Firefighting) team and the Emergency technical support team shall ensure clean-up of affected area to enable restoration of normalcy for work– Mobile resources as need for the situation

8.9.3 Reporting

The concerned contractor organization's safety representative / safety officer (if the emergency location is SMPL office, then it will the responsibility of Manager-Safety) shall report the emergency incident. This reporting is done on completion of the emergency response.

8.10 OTHER EMERGENCIES

Action to be taken is given against each of the identified potential emergency. On observing any of the following situations, the first observer shall report it to Safety Officer. Based on the need, Safety Officer shall plan and depute competent personnel / team to mitigate the situation.

8.11 EXCAVATION CAVE-IN

- Raise alarm as per requirement or disperse unwanted personnel move away from sight of incident to
- Inform the emergency to the concerned persons as per plan
- Rush ambulance, first aid, rescue teams to the scene of incident
- Arrange to provide artificial respiration such as oxygen masks etc., if needed
- Check for any toxic gas presence before sending the rescue if possible
- Give prior information to the nearby / tie up hospitals for emergency attention to the injured
- Arrange proper equipment for removal of soil and careful rescue of trapped persons
- Deal with the injured persons carefully in case of fractures such that the fractured portion is stabilizing and not disturbed.
- Take roll call of persons working at the area to identify any missing persons and for continuing the search.
- Follow Medical emergency procedures

8.11.1 Explosions

Fire emergency procedures are described in section 8-7.

8.11.2 Facility Blackout - loss of electric power

Safety measures include

a. Readily available flashlights;
b. Adequate emergency lighting; and

c. Security measures to prevent theft and vandalism

Safety tips in case of loss of electric power:

- NEVER use a generator indoors (example, small gen set in a room or like structure at site) where there are possibilities that exhaust fumes which contain carbon monoxide can be deadly if inhaled.
- USE portable generators outdoors only, in a dry, ventilated area
- PLUG individual appliances into the generator using heavy-duty outdoor-rated cords with a wire gauge adequate for the appliance load.
- DO NOT USE wet electrical appliances.
- DO NOT TURN ON damaged electrical appliances.
- DO NOT PUT candles on or near anything that will burn.
- NEVER leave burning candles unattended.

8.11.3 Fire, caused from other sources (with a less magnitude of severity)

Following materials used at construction site has the potential to cause fire:

- Bitumen,
- Electrical short circuits
- Flammable materials storage areas – materials that can cause fire incident include - Adhesives (at stores), Diesel, Hydraulic oil, Lubrication oil /Grease, Paints and Paint thinners
- FRP Storage area (Used for cooling tower works)
- Oil rags/waste at work locations
- Shuttering material storage yard
- Wooden cases storage area
- Wooden scrap yard

8.11.3.1 Fire mitigation:

Use a fire extinguisher only if ALL of the following apply:

- the fire is small, contained and not spreading beyond its starting point;
- the exit is clear so you can exit safely;
- you can avoid smoke inhalation;
- a proper extinguisher is readily available; and
- You know how to use the extinguisher.

If any of these conditions do not apply, do not use the fire extinguisher. Call on “Emergency Number” for help and leave the area immediately.

8.11.4 Typical extinguishers and their uses

Water extinguishers are suitable for class A (paper, wood, etc.) fires.

Dry chemical extinguishers are useful for class ABC fires and are your best all-around choice. Their advantage over CO2 extinguishers is that they leave a blanket of non-flammable material on the extinguished material which reduces the likelihood of re-ignition. Dry chemical extinguishers cause a messy residue that will need to be cleaned.

CO2 (carbon dioxide) extinguishers are for class B and C fires. Their advantage over dry chemical is that they leave behind no harmful residue.

8.12 MEDICAL CONDITIONS/ EMERGENCIES SERIOUS INJURIES

Medical Conditions/ Emergencies Serious Injuries or Ill Health; Causes Include but not Limited to:

- Asphyxiation from lack of oxygen during working in confined space
- Electric shock / Electrocution (non-fatal)
- Fall from height
- Person suspended in safety harness

In case of any medical emergency call occupation health centre; either doctor or the paramedical staff will guide for further action. Use emergency numbers to immediately communicate the emergency and to initiate action

The rescue of a worker who has fallen and is being suspended in his/her safety harness needs to be undertaken as quickly as possible for several reasons:

- The worker may have suffered injuries during the fall and may need medical attention.
- Workers suspended in their safety harness for long periods may suffer from blood pooling in the lower body and this can result in “suspension trauma.”
- The suspended worker may panic if they are not rescued quickly.
- The event that led to the fall may create additional risks that need to be addressed.

8.12.1 General Rescue Procedures:

A. If Elevating Work Platform is available on site:

- Bring it to the site and use it to reach the suspended worker.
- Ensure that rescue workers are protected against falling.
- Ensure that the EWP (Elevated work platform) has the load capacity for both the rescuer(s) and the victim.

- If the victim is not conscious, 2 rescuers will be probably be needed to safely handle the weight of the victim.
- Position the EWP platform below the worker and disconnect his lanyard when it is safe to do so.
- Treat the victim for Suspension Trauma and any other injuries.
- Arrange for transport to nearest hospital.

B. If no Elevating Work Platform is available:

- Where possible, use ladder(s) to reach the victim.
- Rig separate lifelines for rescuers to use while carrying out the rescue from the ladder(s).
- If worker is not conscious or cannot reliably help with his/her own rescue, at least 2 rescuers may be needed.
- If worker is suspended from a lifeline, where possible, move the suspended victim to an area that can be safely reached by the ladder(s).
- If victim is suspended directly from his/her lanyard or from a lifeline, securely attach a separate lowering line to the victim's harness.
- Other rescuers should lower the victim while he/she is being guided by the rescuer on the ladder.
- Once the victim has been brought to a safe location, administer First Aid and treat the person for Suspension Trauma and any other injuries.
- Arrange for transport to nearest hospital.

C. If the injured person is suspended near the work area and can be safely reached from the floor below or the area they fell from:

- Ensure that rescuers are protected against falling.
- If possible, securely attach a second line to the workers' harnesses to assist in pulling them to a safe area. (Note: at least 2 strong workers will be needed to pull someone up.)
- Ensure that any slack in the retrieving lines is taken up to avoid slippage.
- Once the victim has been brought to a safe location, administer First Aid and treat the person for Suspension Trauma and any other injuries and arrange for transport to the nearest hospital.

D. If a person has fallen and is suspended in an inaccessible area (e.g. a tower, against a building or structure that has no openings):

- Specialized rescue techniques are needed for this type of situation. It may involve a rescuer rappelling or being lowered down to the victim, it may involve using the lifeline to retrieve the fallen worker, or the use of high-reach emergency equipment.
- Due to the inherent risk to the rescuers and/or the victim, this type of rescue should not be undertaken by people without specialized training and experience

8.13 PANDEMICS/EPIDEMICS/ OUTBREAKS OF COMMUNICABLE DISEASE

Generally media (Newspapers / TV) provides alerts of such situation. If any person working on SMPL site is suffering from or has symptoms of or someone else at site suspects co-worker of having pandemic / epidemic / outbreaks of communicable disease, immediately inform HR. HR and Admin will take immediate action to protect the workforce at site

8.13.1 Traffic accidents

1) Disperse unwanted personnel move away from sight of incident to the nearest assembly points

2) Inform the emergency to the concerned persons as per plan
3) Rush ambulance, first aid, to the scene of incident
4) Give prior information to the nearby / tie up hospitals for emergency attention to the injured

5) Deal with the injured persons carefully in case of fractures such that the fractured portion is stabilizing and not disturbed

8.13.2 Natural calamities

8.13.2.1 Earthquake

In case of earth quake, no siren will be given all the personnel inside the plant are instructed to shut down their operations and come out in to open yard and assemble at the assembly points. If required, transportation will be arranged for sending the people to safer places. Rescue operation will be carried out by security personnel for any possible casualties and the same are given first aid treatment and will be sent to the nearest hospitals in case of requirement.

8.13.2.2 Flooding (Heavy rains)

When there is a flood caused by heavy rain, those who are in the basements and ground floor should reach the upper floors through the exit stairways and assemble just outside main gate. Water flood will endanger building basement and low level floors. Remain in the upper floors till the water recedes or as instructed.

8.14 ACTIONS TO BE TAKEN

De-energize equipment immediately if the flood is isolated to your facility due to sprinkler system activation, broken pipes. Cover equipment with waterproof sheeting.

a) Monitor conditions and escape routes.
b) Shut off electrical power and utilities if flooding is imminent.
c) Immediately evacuate to higher ground—flood waters often raise rapidly.
d) Call fire services if needed.

8.14.1 Recovery action

a) Ensure that facilities and equipment are cleaned, dehumidified, sanitized and deodorized before allowing the re-entry of employees.
b) Do not turn on utilities until the structure, appliances and utilities are dry and the building is checked for safety.
c) Be sure water supplies are safe to drink. Dispose of any food or consumables that may have been in contact with flood waters.
d) Begin mitigation planning to avoid repetition of same problems in future.

8.14.1.1 Cyclones / heavy winds

a) Know about the severity / direction of the cyclone from news bulletins / meteorological dept.
b) Review the activities / operations planned and stop operations which may create an emergency situation due to cyclone / high winds
c) Ensure emergency equipment such as batteries / torches etc., are in availability
d) Ensure food supplies to the work force
e) Ensure readiness of emergency vehicles / medicines, medical center with staff etc.

8.15 DISASTER MANAGEMENT PLANNING FRAMEWORK DURING NATURAL CALAMITIES

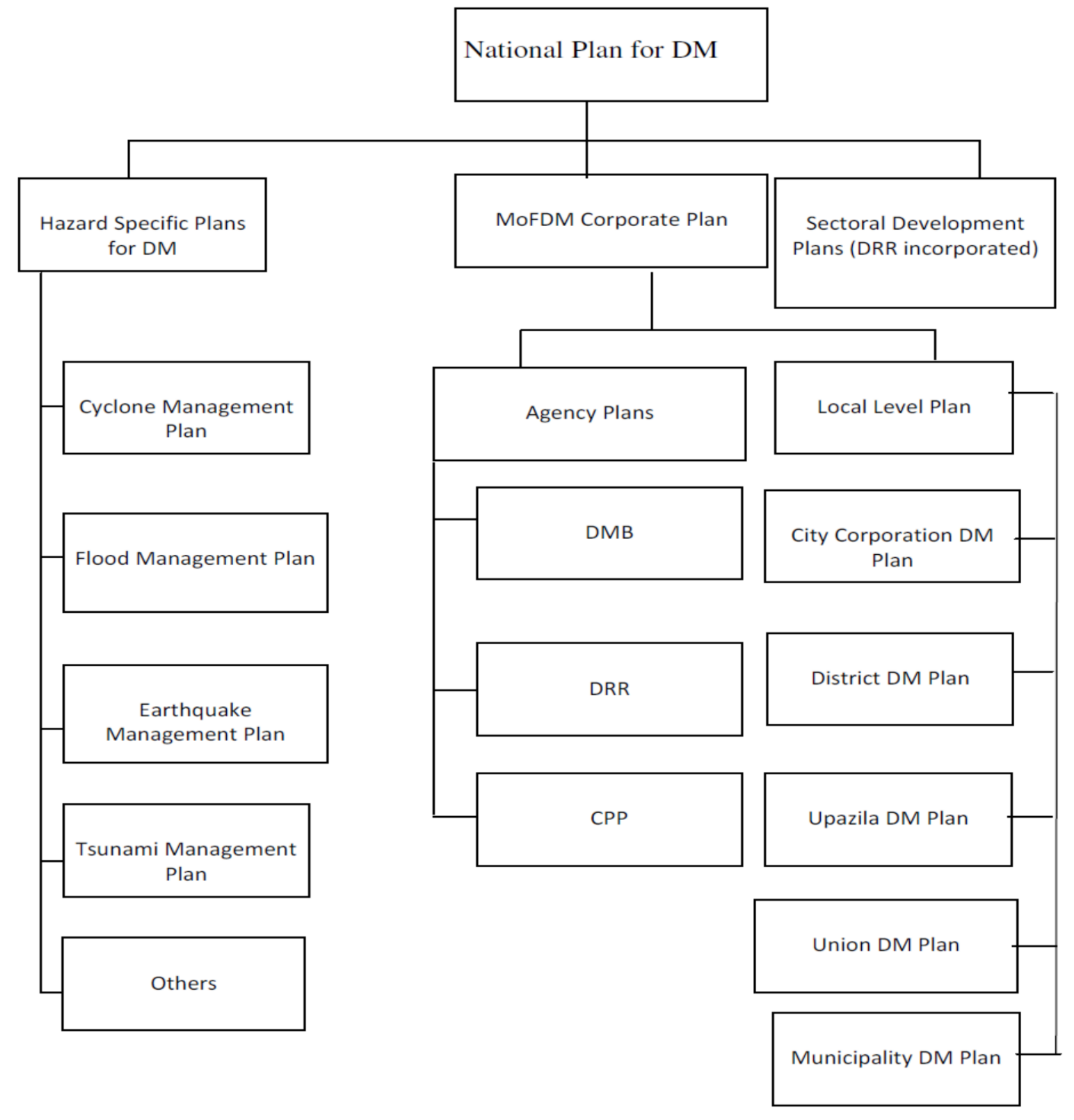

Figure 8.2: Disaster Management Planning Framework

Chapter-9

ANALYSIS OF ALTERNATIVES

9.1 SITE DESCRIPTION

Apart from fulfilling the existing environmental guidelines as per ADB and IFC, one of the utmost priorities is to identify the potential alternatives for the site(s) as well as technological aspects.

Selection of potential sites for power plant operations depends on availability of land, transmission facilities, accessibility in transportation, and proximity to fuel, water sources, and infrastructural and power evacuation facilities.

The present land for the proposed 750 MW gas base CCPP has been allotted by BPDB. The present land is owned by BPDB and has been earmarked for development of power plant only. The site has distinct advantages in respect of the following:

- Availability of land
- Rail/road accessibility
- Availability of fuel and proximity to source
- Availability of water and proximity to source
- Proximity to the grid for evacuation of power
- Environmental consideration
- Rehabilitation & Resettlement issues

The most important criteria for selection of site for TPS is availability of land with least R&R issues, fuel availability and its transportation, water availability within a reasonable distance and the acceptability from the environmental considerations. After investigating the overall site features discussed above conforming to the requirements and considering the demand of power generation as per Power system Master Plan 2010 in the Bangladesh, the land agreement has been accorded between Reliance Bangladesh LNG and Power Limited and BPDB for the development of power project.

9.2 SITE SUITABILITY

No major impact on environmental conditions around the Site location. Reliance Bangladesh LNG and Power Limited finally decided to establish the Power plant at Meghnaghat where already 3 other power projects are in operation, Project Location is suitable for the proposed LNG based CCPP at Meghnaghat. Site suitability has been described in following section:

9.2.1 Land

Land is acquired by the BPDB in 1995 for the Power projects. Bangladesh is a densely populated country due to which land cost is generally very high and acquisition is a serious concern if the land is inhabitable. No other land area in this district is suitable for the setup of power plant since it is away from the urban setting.

9.2.2 Accessibility

The site location is 2 km away from the Dhaka-Chittagong Highway and 8.9 km away from the Narayanganj Railway Station. But since accessibility of the road network from the regional road network to the project site requires much of strengthening of roads and bridges, transportation of the heavy equipment through construction jetty is an alternate cost effective option.

9.2.3 Fuel

The fuel proposed for this project is primarily Natural gas and RLNG. The gas requirement for 750 MW CCPP is about 130 mmsc fd at 100% loads& 110 mmscfd at 85% load respectively. The fuel (LNG) will be brought to the site through existing gas pipeline network. It is found that natural gas to the existing power project site consists of 20 pipelines with gas supply from Titas gas. However, the gas requirement of 130 mmscfd at 100% load will be tied up with FSRU terminal & other swapping mechanism with the gas grid. Proposal has been made for 500 mmscfd FSRU based LNG terminal for supplying re-gasified LNG to the power plants, to be setup together with the Plant at Kutubdia Island in Cox's Bazar region of Bangladesh.

9.2.4 Water

The main source of water in Bangladesh is from river, ground or sea. For the project operations, water will be needed for

- Cooling water system for steam condenser. This system in a power station is the largest consumer of water.
- Cooling water for STG & HRSG auxiliaries, compressors, A.C. System etc.
- Cooling of Gas Turbine auxiliary equipment.
- Make-up water for power cycle (HRSG make-up).
- Other auxiliaries like service and make up water.

The fresh water requirement envisaged for the project is around 1076 cum/hr with closed cooling water system. It is identified that the demand of water will be fulfilled through Meghna stream adjacent to the site location.

9.2.5 Power Evacuation

The power generated from the proposed plant will be evacuated at 400 KV voltages having adequate nos. of transmission lines and connected to Grid. Govt. of Bangladesh shall facilitate firm power evacuation for the Project. For the plant capacity of 750 MW, 400kV two double circuit lines will be used for the evacuation of power. It is proposed to connect plant substation to the 400kV lines connecting Amin bazar using a LILO as a temporary measure. Further, it will be connected to PGCB400 kV AI Sat Meghnaghat in future once it is ready.

9.2.6 Resettlement and Rehabilitation

The project site is located on a government land which has pre-existing power plants. The land doesn't belong to any individual or personal owner; hence requires no R&R consultation or component.

9.3 ALTERNATIVE TECHNOLOGY OPTIONS

9.3.1 Alternative Technology Option with respect to configuration

Alternative technology options for combined cycle power plant configuration are:

- Option 1: Single block of 750 MW in single shaft configuration
- Option 2: Two blocks of 375 MW in single shaft configuration

9.3.1.1 Option1: Single block of 750 MW in single shaft Configuration

For the project, Reliance Power Limited has proposed LNG based combined cycle power generation technique with latest available modern technology to maximize the efficiency of power generation process. The proposed 750 MW gas-fired combined cycle plant will consist of two gas turbines, two heat recovery steam generators and one steam turbine. Advanced Hot Gas Path is envisaged and is an integrated system solution that delivers improved reliability, higher efficiency, increased power output, while maintaining NOx and CO emission levels. Heat Recovery Steam Generator (HRSG) which converts the exhaust heat generated from the gas turbine into steam and delivers it to the Steam turbine further which delivers additional electricity. If HRSG not used, the exhaust heat would otherwise escape through the stack into the air.

9.3.1.2 Option 2: Two blocks of 375 MW in single shaft configuration

The site gross output varies from about 339 MW to about 364 MW and the efficiency varies from about 55.92% to 56.79%. This configuration would be suitable for base load application. The start-up time is shorter and the operation would be simpler compared to the multi-shaft configuration. Here the Gas turbine and steam turbine design has to be coordinated as the GT, HRSG and ST would be offered as a single block. The area required for two blocks of 375 MW (in total 750 MW) power, each block comprising of 1 GT, 1HRSG and 1 ST and a common generator along with their auxiliaries in single shaft configuration would be about 50% extra. The number of generators for a typical block of 350 MW power island in single shaft configuration would be one (common for both GT and ST) and for the ultimate capacity of 750 MW comprising totally 2 blocks of 350 MW, there would be 2 generators.

9.3.2 Single v/s Combined Cycle

A gas turbine could function in simple cycle, in combined cycle or in both cycles. In simple cycle, high-temperature exhaust gases are released directly into the atmosphere through bypass stack, while in combined cycle exhaust gases enter the recovery boiler for production of steam. The steam then enters the steam turbine for production of electric energy.

9.4 CONCLUSION

BPDB has acquired the land back in 1995 and since then it has been uses only for the purpose of building power plant projects. There are three other projects adjacent to the site and there is no better ground in sight for the power plant project at this moment. The project aesthetic looks are modern and environment compatible, the site is environmentally acceptable. Currently, there are some existing power plants at the area and the site area has been developed for power hub of BPDB. Therefore, the project site is suitable for the proposed Reliance Meghnaghat 750 MW Combined Cycle Power Plant.For the project, Reliance Power Limited has proposed LNG based combined cycle power generation technique with latest available modern technology to maximize the efficiency of power generation process. So there is no logical need to look into alternative sites or alternative technology.

Table 9.1: Site selection Matrix

Table 9.1: Site selection matrix

Sl No	Site Selection options	Selection Criteria			Remarks
		Negative	Nutral	Positive	
1	Site Suitability			√	Allocated for power plant
2	Land			√	Developed land
3	Accessibility			√	Built access road
4	Fuel			√	Clean fuel, Natural Gas
5	Water			√	Near to river
6	Power Evacuation			√	Built in for other projects
7	Ressettlement & Rehablitation			√	Not an issue
8	Technological options			√	The best available technology from techno commercial point of view is considered.
a.	Combined cycle operation			√	More efficient
b.	Close loop cooling			√	No thermal pollution
c.	Turbine selection of low NOx and H class high efficient turbine			√	Highly efficient compared to conventional one.

STAKEHOLDER CONSULTATION

10.1 STAKEHOLDERS CONSULTATION

Stakeholder consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability. Public consultation and participation has been viewed as a continuous two ways process involving, promoting of public understanding of the processes and mechanisms through which developmental problems and needs are investigated and solved. The public consultation, as an integral part of environmental and social assessment process throughout the project preparation stage not only to minimizes the risks and unwanted hurdle against the project implementation but also bridges the gap between the community and the project formulators which leads to successful and timely completion of the project and making the project people friendly.

Therefore, keeping in mind the above objective public consultation with the people of different section of the society, like local administrative officials, some related social agencies, business groups, community representatives, respectable and influential persons of the project, area were made. Moreover, potential vulnerable people were also consulted with the aim to make people aware and minimize adverse impacts of the project. The option of alternative design was also discussed to achieve accelerate the implementation of proposed solar project with people's involvement.

Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision-making. Stakeholder consultation was therefore conducted in the project area not only to satisfy the legal requirements of the ESIA process in Bangladesh but also to improve and enhance the social and environmental design of the project.

As per the Safeguard Policy Statement (SPS) of ADB, Public Consultation and participation plan needs to be included in the EIA/ESIA Report for all stages of the project (project design, construction and operations phase) for categories "A" and "B". Also, a documentation of meaningful consultation with affected local communities especially project affected persons needs to be carried out.

10.2 IDENTIFICATION OF THE STAKEHOLDERS

People who live near and around the project who will be directly and indirectly affected by the project are considered as the stakeholders. For this particular project, stakeholders are the fishermen, the people who live near the project, the cow owners and the workers of the nearby factory. For the sake of their interest, it is an absolute necessity to consult all primary and secondary stakeholders.

Table 10 1: Identified Key stakeholders

Key stakeholders Identified	
FGDs conducted	Local communities, Men, Women and local elders
Meeting	Local Government representatives Chairman and Secretary of Pirojpur Union Parishad)
Meeting	NGOs
FGDs	Community involved in Fishing activity and their family
FGDs	Cow Owners
Meeting	District Fisheries Department
Meeting	Department of Environment, (DoE)

10.3 OBJECTIVES OF STAKEHOLDERS CONSULTATION

The process of public participation and consultation was endorsed in the United Nations Conference on the Environment and Development (UNCED) in 1992 through one of the key documents of the conference Agenda 21. Agenda 21 is a comprehensive strategy for global action on sustainable development and deals with issues regarding human interaction with the environment. It emphasizes the role of public participation in environmental decision-making for the achievement of sustainable development.

For projects that have environmental and social impacts, consultation is not a single conversation but a series of opportunities to create understanding about the project among those it will likely affect or interest, and to learn how these external parties view the project and its attendant risks, impacts, opportunities, and mitigation measures. Listening to stakeholder concerns and feedback can be a valuable source of information that can improve project design and outcomes and help a company to identify and control external risks. It can also form the basis for future collaboration and partnerships. For stakeholders, a company's consultation process is an opportunity to get information, as well as to educate company staff about the local context in which a project will take place, to raise issues and concerns, ask questions, and potentially help shape the project by making suggestions for the company to consider and respond to through the public consultation process, the Reliance Bangladesh LNG and Power Ltd. hope to:

- Promote better understanding of the project, its objective, and its likely impact;
- Identify and address concerns of all interested and affected parties of project area;
- Provide a means to identify and resolve issues before plans are finalized and development commences, thus avoiding public anger and resentment and potentially costly delays;

- Encourage transparency and inculcate trust among various stakeholders to promote cooperation and partnership with the communities and local leadership;
- Assessment of possible requirement of improvements;
- Solicit the views of affected communities/individuals on environmental and social problems;
- Improve environmental and social soundness;
- To settle problems with mutual consent;
- Create accountability and sense of local ownership during project implementation.

10.4 CONSULTATION PROCESS

The process of stakeholder consultation includes:

- Identification of the relevant stakeholders including all those individuals, groups and organizations potentially affected by or interested in the project;
- Imparting information about the project and its potential impacts on their lives in local and simple language;
- Recording of their concerns and aspirations through survey and discussions;
- Responding to their queries in a neutral manner.

In the primary survey a list of open-ended questionnaire is used in both the focus group discussions and the individual interviews. A two-person survey team carried out the discussions and the interviews. Project proponent, Local communities, Men, Women and Old persons, Members of Narayanganj, Local Fishermen and their Family member, Cow owners, Consultation with NGOs, villages, government officials of revenue and rural development department, local labours, contractors were our stakeholders to whom we consulted.

Primary stakeholders were consulted during informal and formal meetings held in the project area. The consultation process was carried out in both languages Bangla and English. During these meetings a simple, non-technical, description of the project was given, with an overview of the project's likely human and environmental impact. This was followed by an open discussion allowing participants to voice their concerns and opinions. In addition to providing communities with information on the proposed project, their feedback was documented during the primary stakeholder consultation. The issues and suggestions raised were recorded in field notes for analysis, and interpretation.

By reaching out to a wider segment of the population and using various communication tools—such as participatory needs assessment, community consultation meetings, focus group discussions, in-depth interviews, and participatory rural appraisal—ESIA involved the community in active decision-making. This process will continue even after this ESIA has been submitted, as well as during future ESIAs in which similar tools will be used to create consensus among stakeholders on specific environmental and social issues in the context of a proposed project.

It was important not to raise community expectations unnecessarily or unrealistically during the stakeholder consultation meetings in order to avoid undue conflict with local leaders or local administrators. The issues recorded in the consultation process were examined, validated, and addressed in the ESIA report.

10.5 PROJECT DISCLOSURE: AWARENESS ABOUT THE PROJECT

A focused group discussion / public consultations were conducted in District Meghnaghat, Narayanganj and Village Char Balaki. All the attendees expressed their full support for Combined Cycle Power Plant. Local community found comfortable with proposed development. Locals were already aware of the upcoming project. In consultation, approximately 10-12 people at each location were participated. Consultant team has also consulted/discussed informally with youths, women and daily wage workers in and around the project site. At the very beginning of the public consultation/discussions the participants were introduced about the details of CCPP. It was explained to them that the project was explained and those present were informed that the project will be constructed in Narayanganj. No acquisition of land is needed for the proposed project. No permanent acquisition of land and consequent resettlement will be required for the project. Some noise, air pollution may occur, but it will be minimized using proper methods. The consultant has carefully studied all types of impacts in the locality likely to be affected by the proposed plant and informed the gatherings of the impacts. Information dissemination and consultation will continue throughout the project implementation period.

10.6 STAKEHOLDER CONSULTATION TECHNIQUE

In recognition of the diversity of views within any community, it is very important to obtain a clear understanding of the different stakeholders and to analyze their capacity and willingness to be involved in some or all of the project and its planning process. It is important to be aware of how different power relations can distort participation. It is also important to examine how community skills, resources, and 'local knowledge' can be applied to improve project design and implementation. All of this can be achieved by careful use of the various tools of Stakeholder Consultation. Therefore, the following participatory technique was employed during stakeholder consultation:

- Informal meetings with communities in surrounding areas. Men, women and local elders attended these meeting.

10.7 STAKEHOLDERS CONSULTED

In the consultation process for ESIA, there were two types of stakeholder consultation; Formal and Informal. Formal stakeholder comprises of those government officials and institutions whose consent and consultation views would be prime i.e. Government agencies, NGOs, and District fisheries department. Given below is a description

10.7.1 Informal Stakeholder Consultation

Following key stakeholders were consulted during the informal consultation process:

10.7.1.1 Local communities, Men, Women and local elders

People of different age group attended the meetings. They were briefed about the project activities and its impact on the environment. The participants talked about their concerns and expectations.

10.7.1.2 Local Fishermen & their family members

The local fishermen are one of the most significant stakeholders of this project. They were consulted on multiple occasions including in two focused group discussions (FGD). They were well informed after the consultation process and they discussed about their concerns and their expectations.

10.7.1.3 Cow owners

There are no formal cattle farm near the project area but some people lived near the project area use to graze some of their domestic cows on the project land due it is unprotected and have no fence. The num2ber of cows is merely 25-30 and there are plenty of green fields around the project vicinity where they could find alternative grass land for the grazing of their cows. They are aware of the project and they informed that they will drive their cows elsewhere once the proposed land is occupied.

10.7.2 Formal Stakeholder

10.7.2.1 Local Government representatives

The local government representatives were made aware of the project and they extended their help during collecting statistics of the local establishments

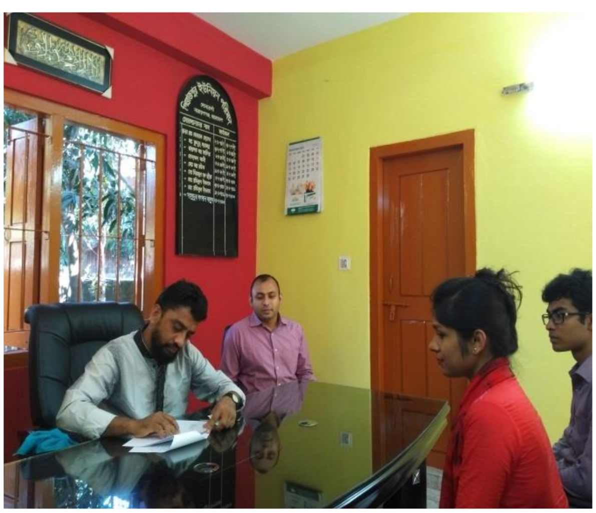

Figure 10.1: Consultation with Local Government Representative (Chairman and Secretary of Pirojpur Union Parishad)

Figure 10.2: Consultation with Local Community

10.7.2.2 NGOs

The local NGOs working in the community were consulted during the consultation process and they provided help during collecting data of the socio economic condition and the present employment statistics

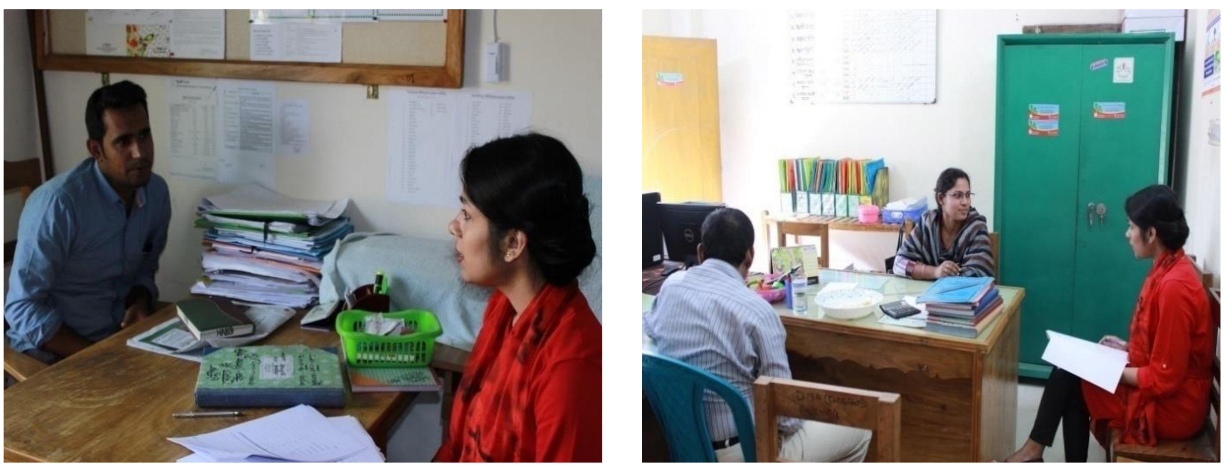

Figure 10.3: Consultation with NGOs

10.7.2.3 FGD with Fishermen

The village, Char Balaki, has roughly 200 families living there nearly for many years. Most of the households depend on the fishing for their livelihood. On the aspect of livelihood currently their greatest needs are

- Lack of safe landing station for travellers, commodities and goods;
- No proper communication means to reach from mainland to the char;

- Lack of variety of fish nets;
- Seasonal variation of number of fishes found

Nearly 70% people in the village are poor, 20% are low middle class and 20% middle class who earn nearly BDT 5000.00-10000.00 and 10000- 20000 per month respectively as reported by the participants. They identified the major reasons of concern are as:

- Lack of capital;
- Traditional Fishing methodology;
- Provide them opportunity for safe fishing with the intervention from District and Local Administration;
- RBLPL should pursure for them for a permanent landing station in both side of the river for safe fishing,
- Establish primary schools.
- Provide them capital with easy and low interest rate,
- Establish one cyclone shelter that can be used as primary schools during normal time,
- Arrange income generation activities for women along with training.
- Provide employment opportunity for the poor both men and women,
- Provide electricity for the betterment of the people from all age

The participants including men and women were noticed from the local people about installation of Reliance Meghnaghat 750 MW CCPP and they do not find any negative impact on their livelihood/fishing. Instead they welcome the power generation activities for the betterment of the country but they regret being deprived of electricity till days. In the past, they didn't find the activities of the power plants detrimental to the fishing activity. They seek help from the "Reliance" to provide employment to skilled and unskilled workers. They also hope that Reliance will contribute to the betterment of the locality by providing hospitals, training centres and roads for gentrification of the community.

Figure 10.4: Consultation with Fishermen (FGD)

10.7.2.4 Inventory of Fishing Activity of the Surrounding Area

Fishermen in the village do fishing within 5-6 kilo meters around the char including 40-50 meters from the outfall. Some fishermen do fishing in other areas sometimes. Each fishermen consisting of two members can catch 5-10 kg fish per day in rainy season and 1.5 - 2 kg per day in winter season. Per kg of fish is sold ranging from BDT 500.00 to 700.00 tk.

The fishermen generally catch small fish like prawn and catalee. They also catch Aiyeer, Ruhi, Ishish, Boyal, Kachki, Chapila, Cheowa etc. abundantly from this area. Some fishermen make their living entirely on catching prawns of different size. The whole surrounding area near the project site and Char Balaki is enriched with various fishes.

Figure 10.5: Types of Fishes Caught in the Area

In the entire island of Char Balaki, there are more than 100 fishermen families whose incomes are primarily dependent on fishing activity. According to the fishermen, they make somewhere between 10,000 to 20,000 tk per month depending on the season and availability of fish.

The main concern of the fishermen is that after the heavy industrialization of the area (especially chemical factories and ship breaking yards), the amount of fishes that can be caught daily has lowered than it used to be 10-15 years ago. But they stated that the power plant projects have not affected their fishing activities because the existing power plants have imposed strict regulations in terms of the discharge. The people fishing around the power plant discharge points are mainly intermittent or recreational fishermen and they have not complained about the river water near the existing power plants.

The seasonal availability of fishes is shown in Figure 10-6 (according to fishermen).

After consultation they have stated a few demands:

- As the cows are their second source of income, the project authority must consider them while recruiting for the construction and operation phase.
- The road across Mongoler Gaon is in terrible shape and them what the authority to help them fix their road.

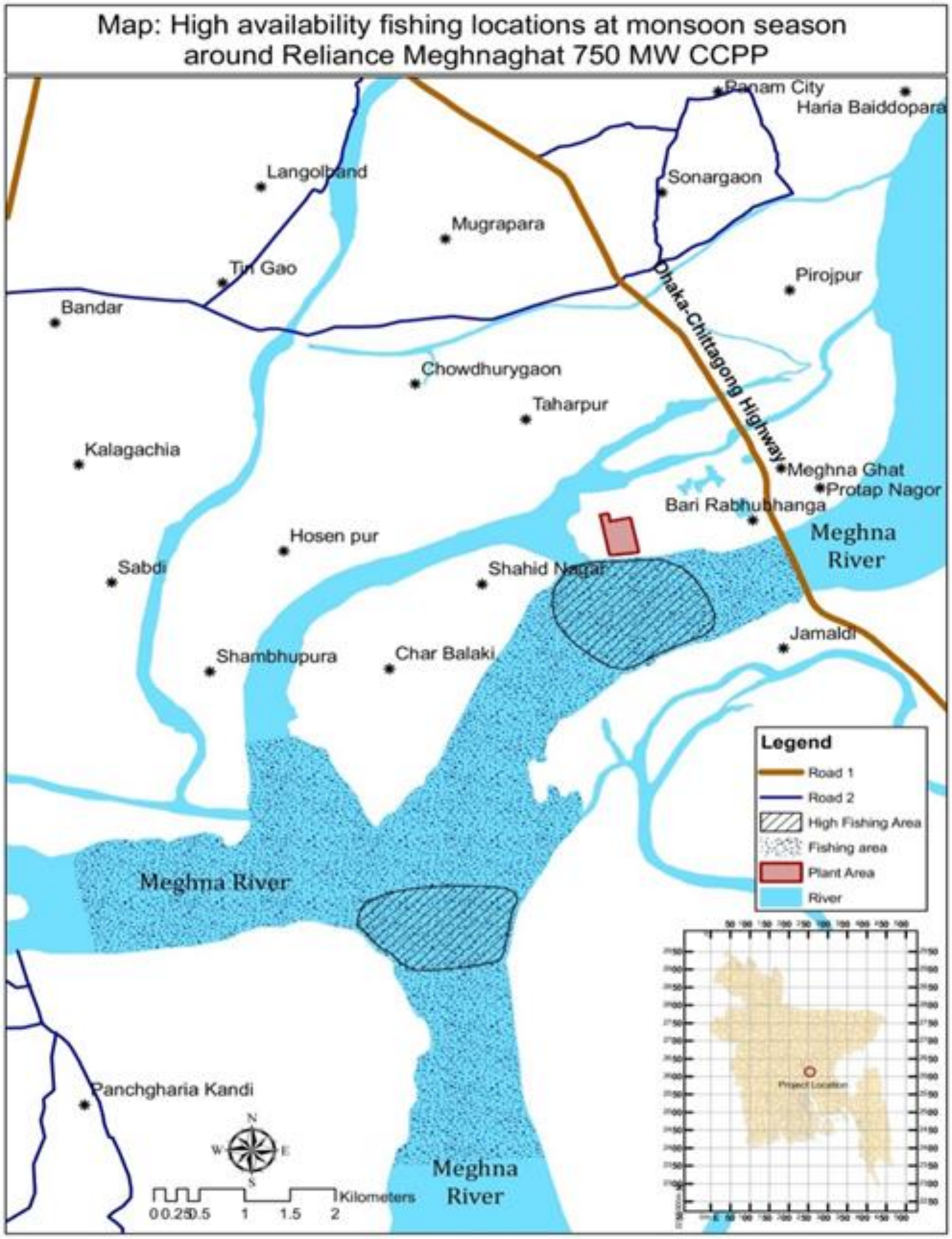

Figure 10.6: Areas of Fish availability in the Monsoon (According to the Local Fishermen

10.7.2.5 FGD of Cow Owners

As the project site is empty at present and without any fencing, people living around the area use the area as a cattle grazing ground. There are 25 to 30 cows that graze in the existing project site every day. People living in the area named Mongoler Gaon are the ones who own most of these cows. It is their secondary source of income and many of them are workers of existing power plants. They have been consulted about the future of their now used grazing ground. They have been informed about how much place will be occupied by the proposed project.

10.7.3 Alternate Grazing Ground

According to the cow owners, the Project site is not the only place they use for grazing their cows. They graze their cows wherever they can manage an empty piece of land covered with grass. The project will not occupy the entire land; therefore the remaining land can be used as a grazing ground. As per their indication, the future grazing ground has been shown in Figure 10.3.

Figure 10.7: Consultation with Local Cow Owners (Mongoler Gaon)

Figure 10.8: Consultation with Local Cow Owners (Mongoler Gaon)

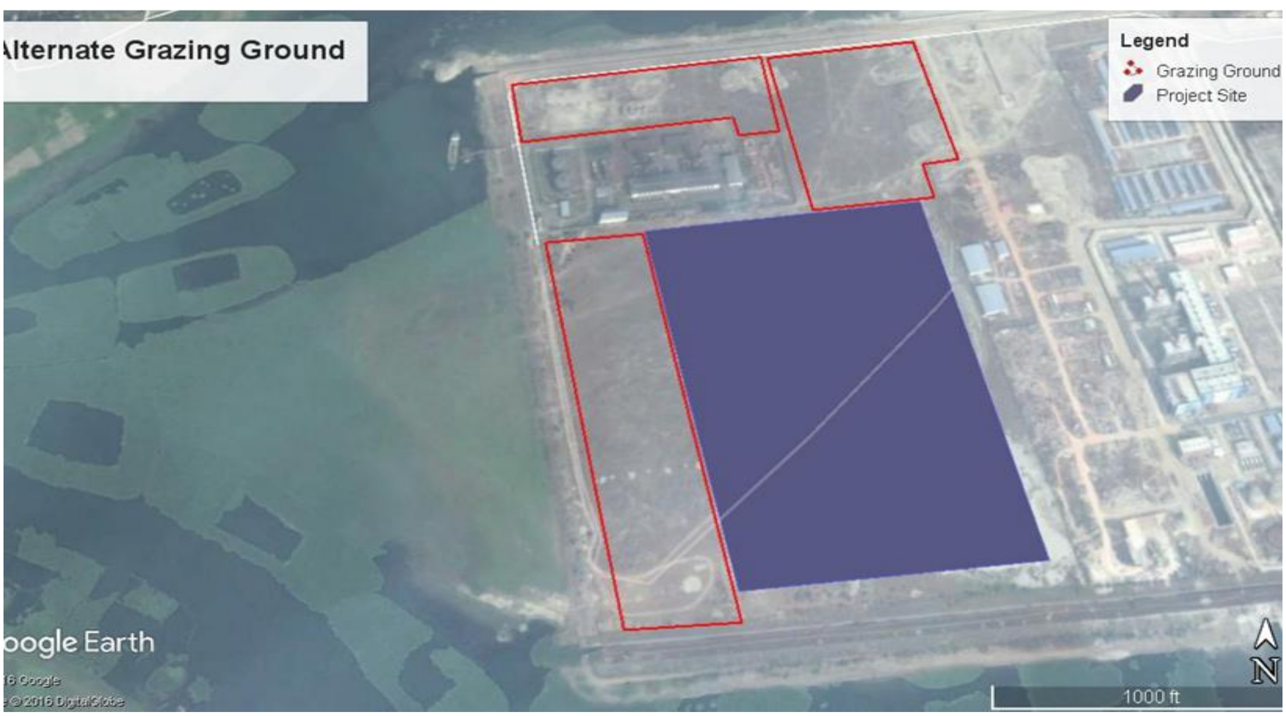

Figure 10.9: Alternative Grazing Ground after the Completion of the Project

10.8 STAKEHOLDER CONCERNS AND RECOMMENDATIONS

10.8.1 Community Concerns

The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities is evident. The proponent recognizes that benefits from the project should be distributed judiciously and equitably especially among primary stakeholders in the project area, and will continue to ensure that this principle is followed in its projects and community development program. The consultation process should include the local people with different life styles.

10.8.2 Resettlement/ Relocation

The proposed project is situated in the Meghnaghat mauza of Sonargaon, Narayanganj. The site is surrounded by Meghna River in the north, west and south direction. There are three major power plants situated in the east of the project site. The land was low lying char land owned by Government (Government Khas land); PDB acquired the land in 1995 and developed the area as Power village. Therefore, resettlement or relocation is not an issue for this proposed project.

10.8.3 Local Employment

Communities in the project area emphasized that local people should be given priority when employing people for various project-related works and activities according to their skills.

10.8.4 Compensation

As the proposed power plant site will be established in an empty land leased by BPWD to Reliance, compensation is not required in the proposed project activities.

10.8.4.1 Interaction with Local Community

Non-Local work force coming in the project area that will not be aware of the local customs and norms, may result in conflicts with the local community, keeping in mind the sensitive law and order situation and culture of the area.

10.8.4.2 Impact on Environment & Livelihood

The public consultation should include the impact on people of their living environment and livelihood. In the public consultation meetings, people should be asked regarding this issue.

10.8.4.3 Impact on Fishing

Since the proposed project would have close circuit cooling and no thermal discharge, the temperature rise in the Meghna River not be an issue for such project; therefore, the project will not hamper aquatic life.

10.8.4.4 Impact on Grazing

The project site is currently empty, unprotected and not confined. Currently scattered cow owners use this land to graze their cows taking the advantage of unprotected nature. After consulting the cow owners, it appeared that they are concerned about their activities and they are motivated themselves to find alternative space for the cow grazing near the river bank once the project will be implemented. They still appreciated this endeavor which will lead to the development of the surrounding area and create employment opportunities.

10.9 COMMUNITY RECOMMENDATIONS

- They local community recommends and demands development of infrastructures surrounding the project area to provide better communication.
- They demand employment of the local young manpower during construction and operation phase.
- They want to be provided with technical and vocational training centers to help them build up their skills.
- They want training centers for the local women so that they can join the workforce as well.
- There is no hospital nearby the project site. A medical facility will be a great facility for the community.
- Primary and high schools need to be built up to ensure educational

10.10 LOCAL GOVERNMENT &OTHER REPRESENTATIVES

During the consultation, the proponent and Local Government representatives were present and consulted. The local NGO people were welcomed and consulted. By considering all local people, government officials and NGO people, the meetings were be run through direct queries and feedbacks.

10.11 FORMAL STAKEHOLDER CONSULTATION

A formal stakeholder consultation was carried out on August 28th, 2017 with a vision to engage with the community a lot better than the informal ones.

10.11.1 Public Notice

An advertisement was published on 21st August, 2017 in Daily Iyad (দৈনিকইয়াদ), a local newspaper of Narayanganj, to send the announcement to the general dwellers of Sonargaon.

Photographs of the Public consultation

Figure 10.10 Photographs of the Public consultation

10.12 FUTURE STAKEHOLDER ENGAGEMENT PLAN

Almost all categories of the stakeholders have been considered during the stakeholder consultations and focus group discussions. Moreover, newspaper advertisement was also published prior to conduct formal public consultation so as to convey the information to all type of people within the area.

Stakeholder consultations are ongoing process, for the betterment of the community, the Reliance Bangladesh LNG & Power Limited authority is advised to hold future stakeholder consultation during construction and operation phase in order to make sure that the dwellers are not being harmed by any means.

The consultation process must be carried out at regular interval with people near and around the project site. It can be carried out half yearly or annually and in those meetings, the Reliance authority must listen to their voices and try to solve their problems if any that will be caused for the project.

Declaration

It is hereby declared that Adroit Environment Consultants Ltd. has collected the baseline data and prepared this report named "Environmental & Social Impact Assessment and Management Plan for 750 MW Gas based Power Station at Meghnaghat, NaraynGanj, Bangladesh. M/s Voyant Solutions Pvt Ltd. was entrusted to re-write the report in alignment with Safeguard Policy of Asian Development Bank, SPS 2009. We hereby validate and declare the ownership over the data and content of the report for all purposes.

Chapter-11

GRIEVANCE REDRESS MECHANISM

11.1 GRIEVANCE REDRESS MECHANISM

Public participation, consultation and information disclosure should be undertaken as part of the local ESIA process. Continued public participation and consultation have been emphasized as a key component of successful project implementation. As a result of this public participation during the initial stages of the project, major issues of grievance are not expected. During the construction and operational phase of the project, the complaints that may be anticipated are mostly related to dust, noise & vibration of the construction activities and turbines. However, unforeseen issues may also occur. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances will be established. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

The Grievance Mechanism will be implemented during both the construction and operational period of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties. The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations should be available. Confidentiality and privacy for complainants should be honored where this is seen as necessary or important.

A grievance redress mechanism and procedures is setup to provide opportunity for project affected persons to settle their complaints and grievances amicably. The established grievances redress procedures and mechanism ensures that project affected persons are provided with the appropriate compensations and that all administrative measures are in line with the law. It also allows project affected persons not to lose time and resources from going through lengthy administrative and legal procedures. Grievances are first preferred to be settled amicably.

RBLPL shall set-up a grievance redressal committee that will address any complaints during both the construction and operational period of the project. RBLPL through its Grievance Redressal Mechanism intents to form a committee, where the Project Manager will be the prime contact and officer who will drive the action. In the panel female members will be deputed who will be from project itself, as to bring inclusion of all gender related issues and grievances identified. Team leaders from workers community and site/village panchayat level will also be made prime stakeholders. All the grievances from the individual/ community level will be directly addressed to PMU/Project Manager in written and verbal form, further an apt action will be taken to address the query. If the grievance is related to women or has some gender sensitive component it will directly be transferred to senior female authority deputed in GRM of RBLPL. Given below is a tentative diagram to clarify the mechanism:

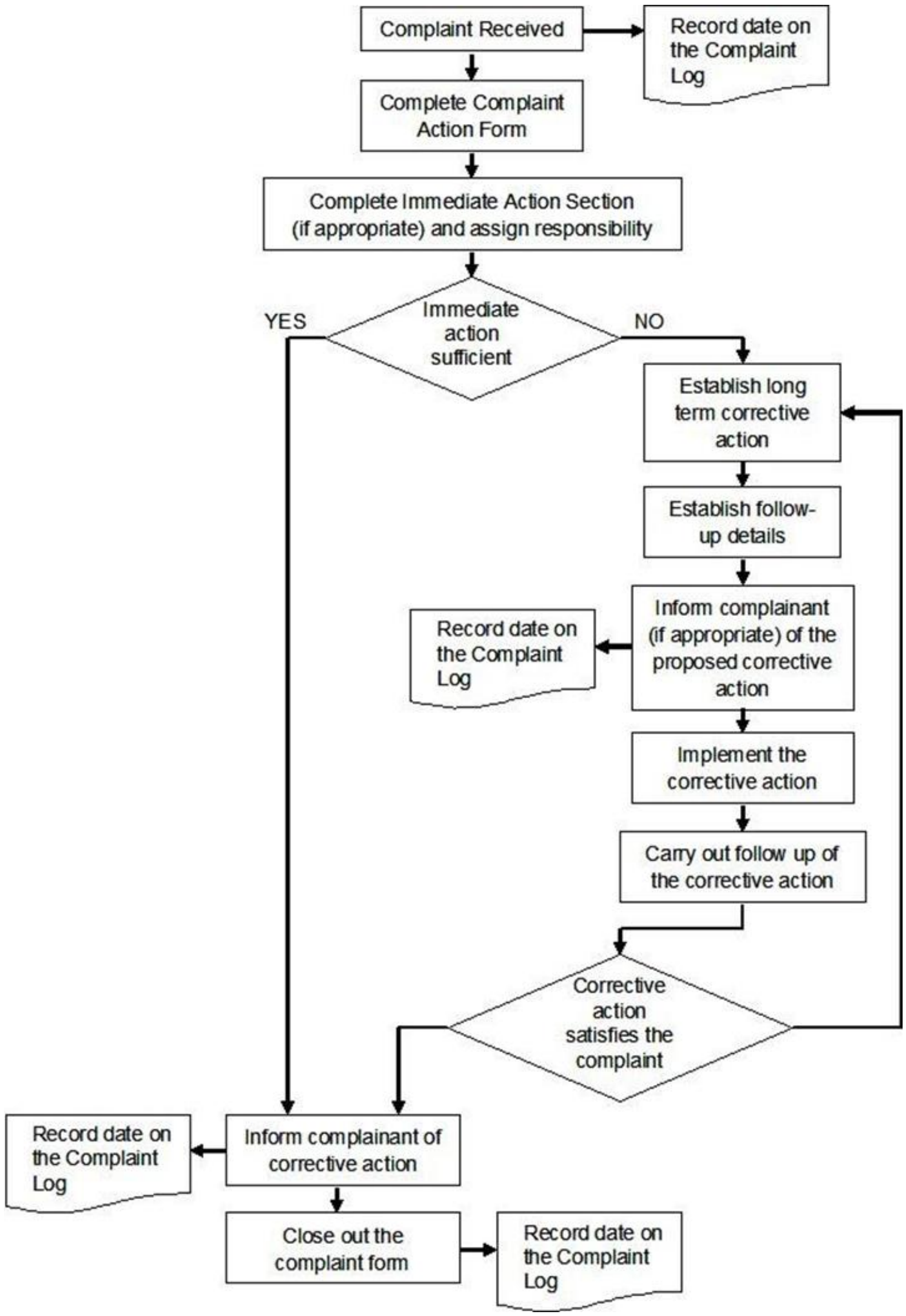

Figure 11.1 - Flowchart of Complaints/Grievance Procedure:

The representation in the committee makes project affected persons to have trust and build confidence in the system. The grievance redress committee reports its plan and activities to the Implementation committee.

GRC will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome. The GRC will maintain records of the grievances received, in written and oral form, including the details of the complaint, the subject of the grievance, the appropriate department, and the status of the grievance. A sample recording format is provided in the following **Table 11-1.**

Table 11 1: Sample Recording Format for Grievance Redressal:

SI No.	Date	Village	Name of Complainant	Details of Grievance	Concerned Department	Status	Remarks

The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand. Uniform process for registering complaints will provide project affected persons with free access to the procedures. The response time between activating the procedure and reaching a resolution should be as short as possible. An effective monitoring system will inform project management about the frequency and nature of grievances. GRC will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints. Database is to be monitored and reviewed by third party consultant to ensure the required transparency. In addition to the above, if there are any grievances related to environmental management issues in the project area, the GRC will record these grievances and suggestions and pass it on to the relevant consultant for necessary action and follow-up.

GRC will be responsible to response for the grievances within a time limit. The initial movement to identify the causes should be taken within 48 hours. The GRC will not take more than two weeks to take the final initiative.

In case a dispute is not resolved by arbitrational tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law. However, the preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties.

11.2 GRIEVANCE REDRESSAL MECHANISM FOR EMPLOYEES AND CONTRACTUAL WORKERS

A schematic representation of the grievance redress procedure for employee and contractor will be followed by RBLPL is shown in **Figure 11-2.**

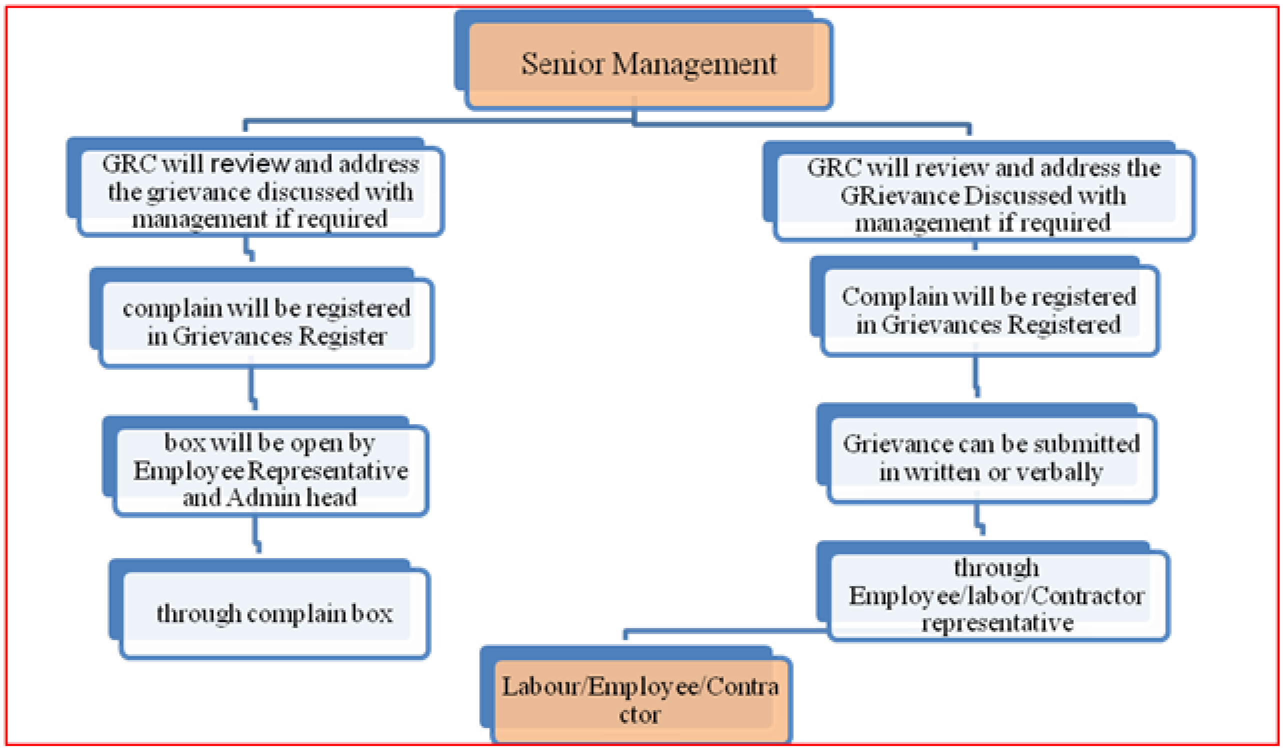

Figure 11.2: Grievance Redressal Mechanism for Employees and Contractual Workers

As stated in the above figure, the employees and contractual workers can register their grievances in verbal or written form by communicating their grievances to the compliance personnel or group audit personnel or by dropping the grievance in the compliant box, which will be located at every strategic location of the facility. The GRC will maintain a log of all complaints received in the form of a Grievance Register. Grievance log will help to track cases, respond to grievances in a timely manner, check the status of complaints and track progress, measure effectiveness, and report on results.

The GRC will then review and investigate the grievance, along with the representatives from the concerned departments; will identify measures to resolve the grievance as appropriate. This could involve provision of information to clarify the situation, undertaking measures to remedy actual problems or compensate for any damage that has been caused, and introduction of mitigation measures to prevent recurrence of the problem in the future. Where a grievance is found to be not a real problem a clear explanation will be provided to the complainant.

On the basis of the investigation, a formal response detailing how the grievance has been resolved will be provided to the complainant within 15 days where possible, and at the most within 4 weeks. Where resolution is delayed the complainant will be provided with regular updates on progress. On the basis of the response, the grievance form will be updated and the grievance will be closed.

11.3 SUGGESTIONS AND COMPLAINT HANDLING MECHANISM:

RBLPL recognizes the importance of complaint handling mechanism and hence intends to establish a SCHM (Suggestions and Complaint Handling Mechanism) for the project. The communication channels to report project related complaints/concerns will be disclosed at all levels of institutions. Under the provisions of the Right to Information Act, 2009, an Act of the Republican of Bangladesh which provides for setting out the practical regime of right to information for citizens, any citizen may request information from a "Responsible Officer" who shall provide the information within 20 working days from the date of receipt of application. In case more than one information providing unit or authority is involved with the information requested, then information shall be given in 30 working days from the date of application. The Act also requires every public authority to computerize their records for wide dissemination and to pro-actively publish certain categories of information so that the citizens need minimum recourse to request for information formally. However, it is quite likely that many people may not use the provisions of this Act, and will only restore to the Act in limited cases covering serious concerns. Being a project involving several divisions, districts and large scale of civil works along with Environment issues, the project is likely to receive many suggestions, complaints, inquiries, etc. through the project implementation period.

11.4 FUNCTIONAL PREMISES OF GRC FOR GRIEVANCE REDRESSAL:

The GRC meetings will be held in RBLPL project office at site and the same will be widely publicized in project area for the knowledge of general public. The key responsibilities of GRC are as follows:

- Review, consider and resolve grievances related to social and environmental aspects received by the RBLPL site office.
- Entertain grievances of indirectly affected persons and/or persons affected during project implementation.
- Resolve grievances within a period of two weeks at the GRC level and communication of the resolution to the aggrieved party.
- The GRC shall not engage in any review of the legal standing of any “complaint” nor shall deal with any matters pending in the court of Law.
- Arrive at decisions through consensus, failing which resolution is based on majority vote. Any decision made by the GRC must be within the purview of Environmental Management Plan, Corporate EHS and Social Policies or any such documents of relevance of that matter.
- If needed, may undertake field visits to verify and review the issues, dispute or other relevant matters.

11.5 MONITORING AND EVALUATION:

Similar to other project components, GRM will be monitored to ensure that the stakeholders are having no or limited issues with the project and in case there are concerns, they are being adequately addressed as per the mandate. In order to keep track on the effectiveness of GRM, it is the responsibility of the GRC to compile and maintain database on grievances for periodic review. The process of monitoring will include an internal monitoring and an external monitoring process.

The internal monitoring will be undertaken by the GRC, on a regular basis (at least at an interval of 6 months). This process will allow for a review of the GRM to be undertaken, in terms of the efficacy of the mechanism and the average time taken for the redressal of the grievance received. These monitoring reports will be shared with the PMU of RBLPL.

In addition to the internal monitoring process, the project will consider engaging an external agency for undertaking monitoring of the GRM on an annual basis. This monitoring process will allow for an assessment to be undertaken of the number and nature of grievances received, the manner in which the grievances were settled and the number of pending grievances. The external monitoring report will also be disclosed to the local community and other identified stakeholders.

11.6 DISCLOSURE OF THE GRIEVANCE REDRESSAL MECHANISM:

The process of existing disclosure mechanism of GRM followed by RBLPL facility, will keep the following aspects in mind:

- The grievance redress process shall be disclosed and the procedures mentioned therein shall be properly disseminated to the identified stakeholders.
- RBLPL shall integrate the grievance redress mechanism as a part of the induction training programme especially those conducted for self-employees and the contractors.
- The disclosure of the information shall clearly mention the name and designation of the grievance redress officials, office location and their respective contact details.

11.7 BUDGETING

The RBLPL administration shall ensure adequate budgeting and resource allocation for implementing the grievance redressal mechanism.

Chapter-12

CONCLUSION

12.1 CONCLUSION

Reliance Meghnaghat 750 MW Combined Cycle Power Plant,an upcoming project of Reliance Bangladesh LNG & Power Ltd., intends to build and operate a 750 MW gas turbine combined cycle power plant at Sonargaon, Narayanganj inside Meghnaghat power village. An ESIA has been prepared for the project according to the requirement of DoE for necessary environmental clearances as it is made mandatory in ECA'95 for any new industrial set up. The ESIA has been prepared through identifying the potential impacts, assessing them and recommendation possible mitigating and enhancing measures for negative and positive impacts, respectively.

The assessment process included scoping, site visits, site surveys for impact assessment based on project level information provided by the project developer, primary baseline studies and monitoring and extensive stakeholder consultations along with reviewing of Site and Configuration Selection Report, Reconnaissance Survey Report and studying satellite imageries. Through this process, an assessment has been undertaken of the potential environmental and social risks and impacts that may be attributed by the development of the project in its pre-construction, construction and operation phases. Assessments of the impacts have been presented with impact rating of each potential impact. Alternatives to the Project and key design aspects were also taken into consideration.

The existing land that has been identified for the proposed power plant project is a government Khas Land. The land is currently empty and has been leased out by the Bangladesh Power Development Board (BPDB), Government of Bangladesh. There is no locality within the two kilometers radius of this project site. This part of Meghnaghat is mainly used for industrial land use. There are few industries in this area including 3 other power plants adjacent to the proposed Reliance Meghnaghat 750 MW CCPP.

Land will also be required for the 1.9 meter transmission line. There will be three Transmission Towers. The facility for LILO attachment will be built in the existing Govt. land where absolutely no land acquisition is needed and therefore, no resettlement is necessary. But local people use the land for one crop cultivation. If those lands are used, they need to be paid for the crop 2-3 times from market price.

During the construction phase of the Project, the key Environmental issues are noise and dust generation. There is also a risk of contamination of soil, groundwater and Meghna river water from accidental spills and leaks of hazardous materials (e.g. oil) during handling, transportation, and storage at the site. In addition, erosion of soil and infill material brought to the site during the rainy season may lead to increased turbidity in the Meghna river water. Construction of jetty will require excavation of riverbed material near shore and will involve piling work. The excavation activities and pilling work in the riverbed will generate fine sediments and will also result in re-suspension of sediments in water. This expected to increase the turbidity of water and this have an adverse impact on surface water quality. The turbid water may have impact on aquatic ecology; thus affecting primary productivity. Labour camp will be constructed for accommodation of the labours. There will be sewage and solid waste generation from the labour camp.

Increase noise and dust levels including contamination of ground water constitute public health concerns. Deterioration of environment quality would be considered as a moderate adverse impact. Various mitigation measures will be developed by the Project Developer for implementation through the EPC Contractor. Regular monitoring and supervision will be implemented for effective implementation of environment management plan to protect the environment. An Environmental Monitoring Plan will be designed as a regular supervision of environmental quality.

During the operation phase of the Project, the three key impacts will be from the increase in ambient noise, Water consumption and air quality levels due to operation of plant equipment and auxiliary machinery. It has been demonstrated through air quality dispersion modeling that the incremental ground level concentrations due to the operation of the plant will be well within the applicable GOB and WHO ambient air quality standards. Continuous emission monitoring from the stacks and periodic ambient air quality monitoring throughout operations will verify adherence with the applicable standards and enable identification of further measures to reduce impacts. Incremental noise levels are planned to be within the applicable GOB standards for industries. Critical Type Silencer will be used in the stack. In particular, significant noisy components such as the gas turbine sets are enclosed in buildings will be acoustically designed, providing Styrofoam filler of 50 mm width in between 300 mm thick brick walls around the power house building. Moreover, ambient noise monitoring at the nearby sensitive location will be conducted to check and assess the requirements for further mitigation to reduce impact. Water requirement for the project will be 1076 m3/hr. Surface run off from oil storage waste handling unit (waste oil, used oil, etc.) may lead to the pollution of receiving water bodies. The surface run off may contain oil and lubricant, in case there is spillage from above mentioned areas. However, taking into account the provision of onsite drainage system with sedimentation tank, oil filters, etc., pollution load will not be significant. The sewage generated from the residential facilities or office area of will be treated through septic tank and soak pit; therefore, any direct discharge is not envisaged. Effluent from plant operation will be treated in Effluent Treatment Plant. However a surface water quality monitoring program, along with quarterly monitoring of aquatic ecology and fisheries will be undertaken. The effective implementation of the EMP and adherence with the GOB and IFC guidelines will assist in minimizing the environmental impacts to acceptable levels.

From the flora study, out of 192 recorded plant species, terrestrial habitats represent 153 (79.69%) species whereas the aquatic /or wetland habitats harbored 39 (20.31%) species in the present power plant project sites. According the DAFOR status, the existing flora of the visited site represents 17, 39, 74, 50 and 12 species as rare, occasional, frequent, abundant and dominant respectively. According to the Red List categories, out of 192 recorded plants, 1 species were Near Threatened (NT), 1 species were Conservation Dependent (CD), whereas 1 species was recognized as Vulnerable (VU) categories. There are no protected areas like National Park, Wildlife Sanctuary of Ecologically Critical Areas etc. within the study area of 5 km radius. Meghna river estuary is the largest estuarine ecosystem of Bangladesh and support diverse fisheries communities. Several types of big fishes like Rui, Catla, Ayre, Mrigel, Boal along with different types of small fishes are very common. But at present number of all types of fishes has declined greatly.

The Project Proponent should ensure that construction activities be limited in the project site only. The project proponent should also consult with Forest Department and NGOs involved in conservation of species for in situ conservation measures of species of significance, if any.

The Project will have both positive impacts on social environment. The positive impacts will include temporary employment opportunity for the local laborers during the construction period, business opportunities for the local vendors.

Post environmental assessment, surveillance and monitoring are essential to track and sustain the effectiveness of the mitigation measures suggested. A detailed monitoring plan has been prepared as part of the EMP.

The environmental analysis has revealed that the project can be set-up according to the proposed design and configuration in the proposed site and location. The environmental impacts are of limited nature, whereas the benefits of the project are many.

12.1 RECOMMENDATION FOR THE PROJECT

No development can be expected without any adverse impact on the environment. The beneficial impacts on the nation as well as human beings would only be meaningful and sustainable development would only be possible if adverse impacts are minimized through strict maintenance and control measures as mentioned for this project. All this would need vigilant care and cost money, and the project authority should take these into consideration.

The primary reason why the environmental impact from the plant is minimal is that the project proponent is abide by Bangladesh/ADB/ IFC Standards and build a plant, which will meet the emission standards of Bangladesh, ADB and the World Bank. The excellent characteristics of the fuel used, equipment and machinery, which conform to international standard and good operation practices all combine to make the proposed power plant project acceptable one

However, the following are the recommendations should be followed by the RBLPL during the construction and operation of the project:

The Environmental monitoring Plan should be followed properly and review of the EMP should be done as per plan.

Seasonal continuous baseline study for water, aquatic ecology and fishing should be conducted for filling any gaps before works start.

Continuation of the baseline air monitoring study: Since the baseline air monitoring study has been conducted from Sep-December, a follow up baseline air quality monitoring should be conducted at July-Aug and Jan-Feb so that the proper monsoon and dry season data would be reflected. It is suggested to monitor air quality for 9 locationsto get the seasonal monitoring.

Continuation of the Stakeholder Consultation: To evaluate the true consequences of the project, the Stakeholder consultations should be continued during the Construction and operation of the project in a regular interval. The stakeholder consultation should address the following issues while doing future consultations:

- Social Conflict
- Acceptance of the Foreign and migratory workers
- Change in livelihood.

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