Draft Environmental and Social Impact Assessment

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BAN: Bibiyana II Gas Power Project

Prepared by Bangladesh Centre for Advanced Studies and ENVIRON UK Limited for Summit Bibiyana II Power Company Limited

Environmental and Social Impact Assessment Report

Summit Bibiyana II Power Company Limited Project

Parkul, Nabigonj, Habigonj, Bangladesh

Prepared for:

Summit Bibiyana II Power Company Limited

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Version Control

The ESIA report has been subject to the following revisions:

First Draft

Title: Social and Environmental Impact Assessment (SEIA) Report
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Description: SEIA report, including Chapter VII, Section C, Resettlement Action Plan.

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Title: Environmental Impact Assessment (EIA) Report
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List of Acronyms

3R	:	Reduction, Reuse and Recycling
ADB	:	Asian Development Bank
ALARP	:	As-Low-As-Reasonably-Practicable
APSCL	:	Ashuganj Power Station Company Ltd.
AQM	:	Air Quality Monitoring
BBS	:	Bangladesh Bureau of Statistics.
BCAS	:	Bangladesh Centre for Advanced Studies
BERC	:	Bangladesh Energy Regulatory Commission
BIPP	:	Bibiyana Independent Power Project.
BOI	:	Board of Investment
BOT	:	Build, Operate and Transfer
BPDB	:	Bangladesh Power Development Board
CBN	:	Cost of Basic Need
CCGT	:	Combined Cycle Gas Turbine
CCPP	:	Combined Cycle Power Plant
CDM	:	Clean Development Mechanism
CDO	:	Community development Officer
CLO	:	Community Liaison Officer
CPR	:	Common Property Resources
DCI	:	Direct Calorie in-take
DESA	:	Dhaka Electric Supply Authority
DESCO	:	Dhaka Electric Supply Company
DLAO	:	District Land Acquisition Officer
DM	:	De-mineralised
DMP	:	Disaster Management Plan
DoE	:	Department of Environment
DTW	:	Deep Tube Well
EE	:	Energy Efficiency
EGCB	:	Electric Generation Company of Bangladesh
ESMMP	:	Environmental and Social Management and Monitoring Plan
GDP	:	Gross Domestic Product
GHG	:	Greenhouse Gas
GNI	:	Gross National Income
GoB	:	Government of Bangladesh
HAZOP	:	Hazard and Operability Study
HRSG	:	Heat Recovery Steam Generator
HTW	:	Hand Tube Well
IEE	:	Initial Environmental Examination
IFC	:	International Finance Corporation
IFS	:	Income and Expenditure Survey
IPP	:	Independent Power Producer
JGFC	:	Jalabad Gas Field Company Ltd. (also known as ‘the Gas Supplier’)
JCCR	:	Joint Commission for Community Relations
km	:	Kilometre
LPL	:	Lower Poverty Line
MOF	:	Ministry of Finance

MPEMR	:	Ministry of Power Energy & Mineral Resources.
MW	:	Mega Watt
N2	:	National Highway-2
NEMAP	:	National Environment Management Action Plan
NEP	:	National Energy Policy
NGO	:	Non-Government Organization.
NOX	:	Oxides of Nitrogen
NO_2	:	Nitrogen Dioxide
OHSP	:	Occupational Health and Safety Programme
PAH	:	Project Affected Household
PAP	:	Project Affected Person
PDB	:	Power Development Board
$PM_{2.5}$	:	Particulate Matter < 2.5µm
PM_{10}	:	Particulate Matter < 10µm
PPA	:	Power Purchase Agreement
QRA	:	Quantified Risk Analysis
RAP	:	Resettlement Action Plan
RE	:	Renewable Energy
REB	:	Rural Electrification Board.
ROW	:	Right of Way
RP	:	Resettlement Plan
SBPCL II	:	Summit Bibiyana Power Company Limited II
SBC	:	Sadharan Bima Corporation
SBU	:	Strategic Business Units
SED	:	Small Enterprise Development
ESIA	:	Environmental and Social Impact Assessment
SHM	:	Safety Health Manager
SPM	:	Suspended Particulate Matter
UNFCCC	:	UN Framework Convention on Climate Change
UPL	:	Upper Poverty Line
WZPDCL	:	West Zone Power Distribution Company Limited.

Environmental & Social Impact Assessment (ESIA)
Executive Summary

Introduction

Bangladesh Centre for Advanced Studies (BCAS) was commissioned by Summit Bibiyana Power Company Limited II (herein referred to as 'SBPCL II') to undertake an Environmental and Social Impact Assessment ('ESIA') to assess the potential environmental and social impacts associated with the proposed development of a 341 MW Combined Cycle Gas Turbine ('CCGT') power plant on land in Bibiyana, Bangladesh (herein referred to as 'the Proposed Development' when referring to the SBPCL II Power plant, construction lay down area and associated facilities 'the SBPCL II Power Plant' or 'Project Site' when discussing the SBPCL II Power Plant and construction lay down area specifically).

A first draft of the ESIA report (titled 'Social and Environmental Impact Assessment (SEIA) Report') was issued in June 2011. The report was subsequently updated and amended, with a separate 'standalone' Resettlement Action Plan (RAP) report, and a second draft of the report (titled 'Environmental Impact Assessment (EIA) Report') was issued in September 2011. A third draft was submitted to SBPCL II in February 2012.

The configuration of the project has since changed the third draft of this report, in particular SBPCL II have decided to implement only the SBPCL II Power Plant and will no longer take responsibility or invest in the associated facilities, namely the gas pipeline, the access road and the power evacuation facilities. Furthermore, at the time of previous drafts of this report the project sponsor was proposing to develop two power plants (formerly known as SBPCL I and SBPCL II). However, the project configuration has been amended and SBPCL II is now proposing to develop only the SBPCL II Power Plant. Therefore the ESIA report has been amended to primarily consider the SBPCL II Power Plant. It is understood that in the future two further additional power plants may potentially be constructed by separate third parties (not any entity associated with SBPCL II or the Summit Group) in close proximity of the SBPCL II Power Plant (respectively known as 'Bibiyana I Power Plant' and 'Bibiyana III Power Plant'). Both the potential Bibiyana I Power Plant and Bibiyana III Power Plant have been considered in this ESIA report under potential cumulative impacts from the Proposed Development. Furthermore it is noted that this ESIA considers the Proposed Development as a whole and therefore has also taken into account the potential environmental and social impacts of the associated facilities. This ESIA is accompanied by the following standalone report:

- Resettlement Action Plan (RAP).

Project Background, Rationale and Objectives

Bangladesh is now facing an acute electricity shortage. This has been due to lack of proper planning and acute demand growth. The Gross Domestic Product (GDP) growth has stagnated over the years due to absence of electricity both in terms of quality and quantity.

The policy of the Government of Bangladesh ('GoB') has been trying to ensure extension and stabilization of the power sector, through both public and private sector undertakings, toward not only meeting the existing power deficiency throughout the country but also ensuring unhindered power provision in view of the projected future demand.

A Request for Proposal (RFP) was issued by Power Cell (the Power Division of the GoB Ministry of Power, Energy and Mineral Resources) on 3rd May 2010 (and subsequently amended on 2nd September 2010) for a sponsor to develop a 330-450 MW CCGT power station at Bibiyana on a 'build, own and operate' basis. The RFP was signed by SBPCL II on 6th September 2010 and in May 2011 SBPCL II signed: Implementation Agreements (IAs) with the GoB and the Power Grid Company of Bangladesh (PGCB); Power Purchase Agreements (PPAs) with the Bangladesh Power Development Board (BPDB); Land Lease Agreements (LLAs) with the BPDB; and Gas Supply Agreements (GSAs) with the Jalalabad Gas Transmission and Distribution System Limited ('the Gas Supplier'). In addition, an Engineering, Procurement and Construction (EPC) contract was signed with a joint venture comprising the First Northeast Electrical Power Engineering Co. and Northeast China International Electric Power Corporation (herein referred to as 'the EPC Contractor') in June 2011.

The primary objectives of the Proposed Development are twofold. Firstly, in accordance with Bangladesh environmental policy, *The Environmental Conservations Rules 1997*, the Proposed Development is classified as a 'Schedule 1, Red Category' project and a Site Clearance Certificate has been obtained from the Department of Environment (DoE). An Environmental Clearance Certificate (ECC) must be obtained before going into commercial production; SBPCL II will apply for the ECC following the submission of the ESIA report to the DoE. The second primary objective is to obtain development funding from financial institutions, including the International Finance Corporation (IFC); the Asian Development Bank (ADB);the Islamic Development Bank (IDB) and other possible financial institutions. The Proposed Development is considered to be a 'Category A' project, in accordance with Equator Principles financial institutions categorisation of development projects, and therefore an ESIA of the Proposed Development is required in order to obtain development funding.

The broad objectives of the ESIA have been to assess the environmental and socio-economic impacts of the Proposed Development, suggest mitigation measures to minimise potential adverse impacts and enhancement measures of beneficial impacts and formulate environmental and social management and monitoring plans.

The Scope of Work and Methodology

Scope of Work

The scope of work for the ESIA included: (i) conducting a baseline environmental and social study for the area of influence (AoI); (ii) performing an initial environmental examination (IEE); and (iii) assessing potential environmental and socio-economic impacts during the pre-construction, construction, operational and decommissioning phases of the Proposed Development, and developing appropriate mitigation and enhancement measures. The assessment includes an Environmental and Social Management and Monitoring Plan (ESMMP), which comprises a set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate, offset or reduce environmental and social impacts to acceptable levels. The ESMMP also sets out the actions and finance which would be required to implement these measures.

Methodology

Based on the above Scope of Work, this ESIA has used the baseline survey carried out previously by BCAS as Environment and Social Consultant for the IFC in 2008-2009 and the Initial Environmental Examination (IEE) conducted by BCAS during February-March, 2011. The IEE exercise resulted in a standalone report which was submitted to the DoE in order to obtain a Site Clearance Certificate (the first stage in obtaining regulatory approval for the Proposed Development).

This ESIA was carried out as a follow up study of the IEE and has used much of the primary data generated during the IEE study period. This information was supplemented by field surveys undertaken by BCAS between March-November 2011. This approach was set out in the Terms of Reference (ToR) for this current ESIA (provided in Annex 1) which was drawn up in 2013. The ToR stipulates that the existing baseline data 2008-2011 would be used for the purpose of this ESIA, subject to a detailed review of their validity. The ToR and this approach was approved by IFC and the ADB.

During the ESIA validation process, the following steps were undertaken:

- Validation of survey/monitoring data obtained during the IEE and generating additional primary and secondary data via surveys of the environmental and social baseline with an aim to update the baseline identified in the 2012 version of the ESIA;
- Understanding of the technical aspects of the Proposed Development;
- Identification of potential environmental and social impacts;
- Assessing, evaluating and, where possible, quantifying potential impacts;
- Developing mitigation measures to eliminate, offset, or reduce adverse environmental and social impacts to acceptable levels; and
- Devise an ESMMP including monitoring programs to assess the effectiveness of the proposed mitigation measures.

The ESIA has been prepared following relevant guidance and policies of the ADB, IDB and IFC. Further details regarding specific guidance and policies is provided in Section 2 of this ESIA.

The Proposed Development

Site Location

The Project Site is located adjacent to the southern bank of the Kushiyara River, at 91°39′37″ E longitude and 24°38′18″ N latitude. The Project Site is located approximately3 km to the west of the Sherpur Bridge, approximately 45 km south-west of Sylhet (the district headquarters) and approximately 180 km north-east of Dhaka. Administratively, the Project Site is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of

Habiganj district (refer to maps 3.1 to 3.4). The SBPCL II Power Plant will be served by natural gas from the Bibiyana gas field, which is located approximately6.5 km to the west of the Project Site at Karimganj.

The Proposed Development consists of the following primary components and associated facilities:

- Primary Components of SBPCL II Power Plant:
  - Development of the main power generating plant for the SBPCL II Power Plant; and
  - Development of a Construction laydown area;

- Associated Facilities (not being constructed by SBPCL II):
  - Development of a switch yard for the installation of the electricity sub-station;
  - Development of a 2 km long access road to connect the Proposed Development as well a potential future power plants (Bibiyana I Power Plant and Bibiyana III Power Plant) to the Dhaka-Sylhet (N2) highway;
  - Development of a 8.8 km gas pipeline from Proposed Development, as well a potential future power plants (Bibiyana I Power Plant and Bibiyana III Power Plant), to the Bibiyana Gas Field at the Karimpur distribution point;
  - Development of 70 m transmission lines from the switchyard to the nearest tower of the national grid.

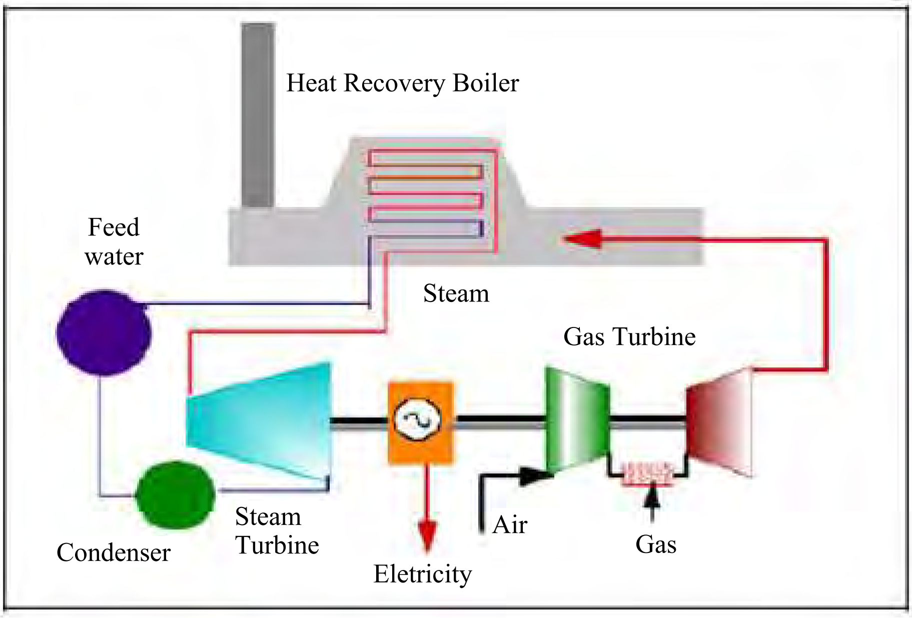
The Project Site occupies an area of approximately **25** acres, which includes a an approximate 14 acre construction ‘lay-down’ area in the northern section of the Project Site. The proposed switch yard, which is to be developed and built by PGCB under the GoB’s own financing and not by SBPCL II, occupies an area of approximately 26 acres (approximately 105,000 m^2).The access road and gas pipeline alignment, which are also to be developed by a third party, occupy an area of approximately 4.20 acres (approximately 17,000 m^2) and 16.58acres (approximately 67096.879m^2) respectively.

Technological Description

The SBPCL II Power Plant will employ multi-shaft combined cycle technology based on one gas turbine generator unit and one steam turbine generator unit, each having a separate power connection to the grid.

The gas turbines will have a capacity of about 222 MW while the capacity of the steam turbines will be 119 MW, giving a net electrical capacity of 341 MW. The ‘PG 935 IFA’ Gas turbine with hydrogen cooled generators will be installed, with Dry Low NO_X (DLN) combustors with 18 stage axial compressors, 3 stage axial turbines and a common rotor.

Figure 1.1 A simplified schematic of a typical combined cycle gas turbine (CCGT) unit



The SBPCL II Power Plant will run on natural gas from the Bibiyana gas field situated approximately 6.5 km to the west the Project Site at Karimganj. Several configuration options are available to achieve an output of 341 MW. The option preferred by SBPCL II is:

Stack Height: .... 60 meters
Effective Stack Height: .... 60 meters
Stack diameter .... 3 meters
Exit gas velocity: .... not less than 15 m/sec.
Fuel consumption per unit power production .... 4021 BTU/kWh
Mass of pollutant emission per unit power production: .... 0.697 g/kWh
Mass of pollutant emission per unit time: .... 87 g/sec NOx
Emission control system used if any: .... Low NOx burners (<25 ppm)

Water Supply System

The SBPCL II Power Plant will operate a closed-loop cooling water system. A volume of 17,500m^3 will be pumped from the adjacent Kushiyara River once during start-up for use in the cooling system unit. The water from the Kushiyara River will be pumped to the Project Site through a pumping station located approximately 15 m from the river bank; no barrage will be built. During operation there will be a need, due to evaporation losses, for replenishment of cooling water ('make-up' water) which will be abstracted from the Kushiyara River at a rate not exceeding 1,200 m^3/hr. In addition, during operation demineralised water will be required for use in the Heat Recovery Steam Generator (HRSG), as well as service water, fire fighting water and potable drinking water. The total water requirement for various uses during the operational phase will be 10,000 m^3 per day.

Wastewater Treatment

The SBPCL II Power Plant will operate a single effluent treatment plant where effluent from the following sources will be treated:

- Effluent contaminated with chemicals from chemical storage area and laboratory;
- Regeneration waste from the demineralisation Plant;
- Cleaning wastewater containing grease and oil from the power house, transformer area, and workshop and maintenance house;
- Sanitary wastewater from the office building; and
- HRSG Blow down.

Cleaning waste from the HRSG will be collected in the special wastewater pond for preliminary treatment and will then be directed to the chemical wastewater pond.

Wastewater containing oil and grease will be collected in an oily wastewater pond and then passed through a Corrugated Plate Interceptor (CPI) to skim the oil from the wastewater. The oil free wastewater will be transferred to the chemical wastewater pond and the skimmed oil will be stored for disposal. The CPI oil separator functions on the principle of differences of specific gravity of oil and water.

The wastewater from the chemical wastewater pond will be pumped to a pH adjustment tank for neutralization either by acid or by alkali depending on pH. A coagulant will be added to a coagulation tank to aid settlement of the suspended particles in the wastewater. The wastewater will then be directed to a sedimentation basin where the sludge will gradually settle to the bottom of the tank to be collected by a rotating scrapper. The sludge collected from the bottom of the sedimentation basin will be mixed with a polymer for further thickening and the concentrated sludge will be dewatered with a belt filter press. It will be collected in a hopper for disposal after drying. The wastewater from belt filter press is sent back to the chemical wastewater pond. The treated effluent will then be held in an effluent tank and then discharged in to the adjacent Kushiyara River.

The Gas Pipeline

As per the gas supply agreements, natural gas for the SBPCL II Power Plant will be supplied by the Gas Supplier from the Bibiyana gas field, which is operated by Jalabad Gas Field Company Ltd. (JGFC). The gas will be transmitted through a 20 inch high-pressure pipeline, which stretches from the Bibiyana gas-field at Karimganj up to the connecting point of the SBPCL II power plant. The pipeline will be approximately 8.8 km in length and the route, which will predominantly pass through agricultural land, was determined by JGFC with an aim to minimise disruption to homesteads and water bodies. The pipeline will be constructed on a strip of land of 8 m width (i.e. 4 m either side of the pipeline) and an additional 15 m width (i.e. 7.5 m either side of the pipeline) will be provided for construction and laydown. . At the time of writing the gas pipeline is under construction.

The Access Road

Vehicular access to the Proposed Development and potential future power plants (Bibiyana I Power Plant and Bibiyana III Power Plant) will be provided by the development of a 2 km long access road to connect the Proposed Development to the Dhaka-Sylhet (N2) highway. The route of the access road will be from the south-eastern boundary of the potential Bibiyana I Power Plant and head southwards, passing entirely through a seasonal beel (a type of wetland with static water). In the wet season there is fishing activity and in the dry season the water completely recedes and there is agricultural activities in the beel. Throughout the access road there are several culverts designed to drain water and prevent flooding. The approach road connects with the N2 highway, approximately 1.7 km to the south of the southern boundary of the proposed, potential Bibiyana I Power Plant.

The Transmission Line

The electricity produced from the SBPCL II Power Plant will be transmitted by the Power Grid Company of Bangladesh (PGCB) through a high tension transmission line (T-line), which will ultimately connect with the national grid. The transmission line will approximately be 70 m in length from the switchyard to the nearest tower of the national grid.PGCB is responsible for construction of the T-line.

Sand Mining

As previously stated, the Project Site is located adjacent to the southern bank of the Kushiyara River. The majority of the Project Site, which occupies an area of approximately 25 acres, is situated at an elevation of 7.8 m above sea level (asl). The elevation of the highest recorded flood is 10.15 m asl and, consequently, the Project Site has been designed to be 11.2 m asl (i.e. 1 m above the highest recorded flood). In order to raise Project Site levels by 3.4 m, approximately 300,000 m^3 of sand has been imported to the Project Site.

In Bangladesh, the District Commissioner (DC) gives permission for sand mining from rivers, based on the Bangladesh Water Development Board (BWDB) Hydrographic Chart, which details where potential sand mining areas are located. A Bathometric Survey was commissioned by SBPCL II and carried out in 2011 to determine the distribution and quality of sand deposits at nine areas in the vicinity of the Project Site, which are allocated by the DC for sand mining.

During the validation survey in September/October 2013, it was found that land filling work had already been completed at the Project Site in 2012. Sand mining was undertaken at six sites, identified later in this report, with a total excavation of approximately 300,000 m^3.For the excavation, sand was mined by suction sand barge as suggested in earlier versions of the ESIA report. The sand was then transported to the river bank at the Project Site by sand carrier, before being pumped to the dedicated location. Excavation was not permitted in certain locations due to the presence of fish sanctuaries (identified in the third draft of the ESIA report); the sand mining contractors were prohibited to carry out sand mining from these excluded locations.

Consideration of Alternatives

Technology Options

Renewable energy currently attracts significant political and media attention. However, with the exception of large scale hydro-electric schemes, the power generation of which has already reached its limiting value in respect of meeting the ever-expanding power deficit in the country, it remains a niche area that does not have the capacity to provide the power delivery at the scale and reliability needed in Bangladesh in view of the existing power deficit scenario. Statistics published shows that the annual consumption of electricity is increasing at a rate of 10% per annum (BPDB Annual Report 2012 for Bangladesh).There are no reliable estimates for other renewable energy sources, e.g. for biomass, wind and solar. A number of barriers exist, including high investment cost and scarcity of land within Bangladesh, which indicate that the output from renewable energy would still be unable to produce and supply a sufficient quantity of electricity to meet the existing demand.

A number of alternative energy generation technologies have been considered, and discounted for various reasons. The limitations associated with some of the alternative technologies considered are summarised below:

- Bangladesh is flat and therefore has a relatively limited potential for hydroelectricity;
- no active geothermal sites have yet been found; and
- no oil field worth the name has yet been discovered.

Within the scope of fossil fuelled thermal power plant technologies, the considered options have been:

- Coal fired thermal plant;
- Oil or gas fired steam turbine;
- Oil or gas fired open-cycle gas turbine; or
- CCGT.

A comparative study on emissions of greenhouse gases (GHGs) from various fossil fuel sources has been undertaken and revealed that GHG emissions from a natural gas fired power plants is significantly lower than that from coal-fired and oil-fired power plants. Combined Cycle Gas Turbine (CCGT) is the dominant gas-based technology for intermediate and base-load power generation. The electrical efficiency of CCGT is 50-62% lower heating value (LHV) compared with 35-40% LHV for Open Cycle Gas Turbine (OCGT) power plants. The estimated production costs of OCGT is typically 210 \$/MWh, compared with 72.5 \$/MWh for CCGT. In terms of environmental impact, CO_2 emissions are lower with CCGT (340-400 kg/MWh) compared with OCGT (480-575 kg/MWh). In addition NO_X emissions are roughly 40% lower with CCGT (approximately 30 g/MWh) compared with OCGT (approximately 50 g/MWh). Therefore, CCGT is considered to be the most appropriate power generating technology for the SBPCL II Power Plant.

As stated in the ToR GHG emissions have been calculated using IFC recommended CEET model.

Based on (i) type of energy to be utilized for electricity generation, (ii) type of fossil fuel-fired technologies in respect of competitive edge among them, (iii) relative consumption of fuels and (iv) climate-friendly emissions (GHG emissions), and (v) Bangladesh's sizable deposit of natural gas, the selection of CCGT technology for the SBPCL II Power Plant appears justifiable.

The Zero Option

The "Zero Option" means that SBPCL II decides not to construct a power plant at the Project Site or, to be more precise, abandons the Proposed Development altogether. As the existing power situation in Bangladesh is already in a state of significant deficit, with associated adverse impacts on industrial development and other socio-economic issues, the Proposed Development assumes considerable significance. Hence, abandoning the Proposed Development will have potentially significant consequences.

The consequences of an undersupply would harm the sustainability of the existing industrial production in the country as well as impact upon the quality of life of those affected by the power outages. Furthermore, under the zero option, the considerable advantages associated with Proposed Development and its associated power generation and creation of employment would be lost.

Alternative Sites

In preparing this ESIA there was limited scope for the consultants to consider alternative sites for the Proposed Development primarily due to the fact that BPDB had already identified the Project Site and initiated the process of land acquisition at the Project Site. However, it is considered that the Project Site represents the most suitable site for the Proposed Development on the basis of the following characteristics:

- the proximity of the Bibiyana gas field (about 6.5 km);
- the proximity of the Kushiyara River; and
- Proximity of existing national grid

The route for the gas pipeline was determined by JGFC, the Gas Supplier; SBPCL II was not consulted during the determination of the route. It is understood that in determining the route, JGFC identified the shortest possible route between the Bibiyana Gas Field and the Proposed Development, whilst avoiding residential settlements wherever possible.

The route for the access road was determined by the BPDB; SBPCL II was not consulted during the determination of the route. It is understood that in determining the route, BPDB identified the shortest possible route to the Dhaka-Sylhet (N2) highway, whilst avoiding residential settlements wherever possible.

In light of the above constraints, an analysis of site alternatives was not undertaken and as such has not been reported on within the ESIA.

Project Area of Influence

This ESIA has determined the environmental and socio-economic characteristics of the Proposed Development within an 'Area of Influence' (AoI) of 10 km for environmental and 5 km for social impacts from the Project Site (hereafter referred to as the 'Project AoI'), and assessed the potential impacts of the Proposed Development upon the existing baseline conditions.

A specific AoI of 2.5 km has been adopted for the purpose of the proposed gas pipeline route.

The Project Site refers to the site of the SBPCL II Power Plant and the construction lay down area, it does not include the land relating to the associated facilities.

Environmental Baselines

Physical Environment

Mean monthly temperatures vary from approximately 6.5°C in January to 35.8°C in April. The mean annual temperature is approximately 25°C. Approximately 92% of the annual rainfall in the Project AoI occurs in the seven months from April to October. Within the surrounding areas of the Project Site, in the Kushiyara valley and neighbouring hills, the rainfall is very high. Mean monthly relative humidity ranges from 77% in the dry season (November to February) to approximately 84% in the rainy season (June to October). The Project Site is located in the cloudiest part of Bangladesh and fog is very common in the winter months.

Air quality at the Project Site is typical of a rural environment. Ambient pollutant concentrations of Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) are relatively low to practically non-existent. Suspended particulate matter (SPM) and particulates (PM_{10} and $PM_{2.5}$) may increase intermittently in areas where winds pick up dust over unpaved roads and exposed surfaces. The primary sources of emissions, however, are traffic derived emissions from the N2 Dhaka-Sylhet National Highway running in a south-west / north-east direction approximately 2 km to the south-east of the Project Site at its nearest point.

A survey of the ambient air quality was undertaken in the vicinity of the Project Site in March, April, May and October 2011 to determine pollutant concentrations before, during and after the monsoon. As part of the validation of the ESIA, subsequent surveys of the ambient air quality were undertaken in November and December 2013 and in January and February 2014 to cover different seasons. In addition the baseline air quality data from 2008/2009 surveys has been utilized.

The monitoring results showed that baseline concentrations of NO_2, SO_2 and CO were all within the Bangladesh National Ambient Air Quality Standards as well as the World Health Organization (WHO) Guidelines. However, baseline concentrations of PM_{10}, $PM_{2.5}$ and SPM in the vicinity of the Project Site are high, near the standards set by the DoE and the IFC throughout the year; concentrations are particularly high during the Dry and Pre-Monsoon seasons.

The Kushiyara River flows from east to west adjacent to the northern boundary of the Project Site. Water flow is high during the rainy season and brings a significant quantity of silt. In other seasons, there is low water flow and water turbidity is reduced.

Monsoon floods and flash floods occur in the lower parts of the Project AoI. Accordingly, the Bangladesh Water Development Board (BWDB) has constructed an embankment on the banks of the Kushiyara River adjacent to the Project Site, to protect agriculture from flood damage. This embankment, which is also used as village roads by local transport, is elevated to 9 m above sea level (m asl) and acts as a barrier against inundation of the Project Site. However, water levels in excess of 9 m asl would cause inundation of the Project Site with the potential to cause loss of livelihoods (i.e. agricultural crops) and damage to physical infrastructure.

Water level data for the Kushiyara River was obtained from the Sherpur Bridge hydrological data collection point, located approximately2 km upstream of the Project Site. According to river flow data of Bangladesh Water Development Board (BWDB) recorded between 1982 and 2013 at the Sherpur monitoring station (refer to Figure 4.6), on average the low flow of the Kushiyara river varies between c.2100 cubic meters per second (m^3/s) during the monsoon period and c.200 m^3/s during the dry season. During the period 1982-2013, the maximum flow was 3890 m^3/s recorded in May 1991 and the minimum flow was 43.30 m^3/s recorded in March 1984.
Data has been collected by the BWDB since 1982, with data up to December 2013used as the basis of this ESIA. According to the water level data, the highest recorded water level between 1982 and 2013 was 9.68 m asl in 2004; however, based on discussions with BWDB, it is understood that the elevation of the highest flood is 10.15 m asl, which reportedly occurred in 1977.

Surface water samples were obtained from the Kushiyara River in March 2008 and October 2011. However, as part of the validation of the ESIA, an additional 5 water samples were obtained from the Kushiyara River in October 2013 and 2 samples were taken from nearby settlements and 1 sample of deep groundwater was obtained. These were sent to a certified laboratory in Dhaka for analysis. According to the analytical results, the primary impact on water quality is during the monsoon season when silt is washed into the river and the total suspended solids (TSS) and turbidity of the river water increases significantly, relative to pre-monsoon concentrations. The increased silt concentrations post-monsoon could account for the identified increase in Iron concentrations in the October 2011 (i.e. post-monsoon) monitoring results. In addition, the Fenchuganj fertilizer factory is located around 35 km upstream of the Project Site and reportedly discharges ammonia and ‘other chemicals’ into the Kushiyara River. However, it is understood that works to modernize the Fenchuganj fertizer factory have started and it is expected that Ammonia discharge will be minimized after completion.

According to a WHO web resource, elevated arsenic concentrations (above the WHO guideline value of 0.01 mg/l) in groundwater are common throughout Bangladesh and are largely naturally occurring due to the underlying arsenic-rich strata. Three groundwater samples were obtained, in October 2011, from groundwater wells located in the vicinity of the Project Site. As part of the validation of the ESIA, three additional groundwater samples were obtained, in February 2014. The analytical results confirm that arsenic concentrations in groundwater in the vicinity of the Project Site are above the WHO guideline value of 0.01 mg/l. In addition, the results indicate that arsenic concentration are particularly high (i.e. above the Bangladesh Standard of 0.05 mg/l) in the shallow hand tube well (HTW).

Existing noise levels within the project area were measured over periods of 24 hours each day and night at eight locations at the Project Site as well as in areas in the immediate vicinity. At the Project Site, the baseline noise level was measured as 47 dB during the day time and approximately 55 dB at night time. This difference may be due to the very high frequency noise generated by insects at night which does not occur during the day. As part of the validation of the ESIA, additional noise readings were taken during the day time in September 2013; the results were slightly higher than the original 2011 results, which may be attributed to the temporary generator used during construction activities and a sizable number of workers in the Project AoI. The sound level at a distance of 200m from the Project Site in all four directions were found to be approximately at the same as in 2011-12 data for the baseline study used for the third draft of this ESIA.

Bangladesh has been divided into four seismic zones. The north-eastern part of Bangladesh is in the most active seismic zone and has experienced earthquakes of moderate/high intensity. The Project AoI lies within the active seismic zone and as such all the structures related to the proposed SBPCL II will be built in such a way as to withstand earthquakes up to a magnitude of 7.5 on the Richter scale.

Biological Environment

The Project Site primarily comprises agricultural land and does not have any statutory designations or ecological protection status. Furthermore, there is no statutory designated area situated within the Project AoI. . However, the Project AoI is rich in faunal diversity; ecological surveys carried out in September and October on fauna and flora, and fisheries in selected parts of the River Kushiara in the vicinity of the Project Site and AoI. These surveys identified 18 species of reptiles, 7 types of domestic animals, 85 species of birds and 32 species of fish. Trees, shrubs and local flower trees, which are abundant in most rural areas in Bangladesh, are also located within the Project AoI. Typical fruit bearing trees include Mango, Jackfruit, Coconut, Payara, Jam, Lichi,Amra Jambura, Kamranga, Gab, Bel etc. (all local names).

A fisheries survey was conducted from 18^{th}-26^{th} October 2011 (i.e. towards the end of the monsoon season) to determine the aquatic diversity and fish habitats in the Kushiyara River. During the late monsoon season, as the waters start to recede, juvenile and adult fishes come to the main river from wetlands (Haor) and adjacent floodplain areas, and the widest range of fish are present in the river. During the survey, samples were collected from potential high, medium and low impact zones of the proposed SBPCL II Power Plant. Thereby samples were collected ± 1 km, ± 4 km and ± 8 km (upstream and downstream) from the Project Site, between the villages of Monumukh, Parkul and Jamargaon; the total length of the survey area was approximately16 km.

Of the 32 species identified during the survey, four are classified as Near Threatened (NT) according to The International Union for Conservation of Nature (IUCN) Red List of Threatened Species. No species were identified, which are defined as Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU), according to the IUCN list.

Bangladesh is particularly significant for waterbirds, including migratory waterfowl which spend the winter (dry season) in Bangladesh. Although in the 1990s other wetlands such as Kawa Dighi Haor held sizeable waterbird populations, in recent years the two main wetlands and largest haors in the district for waterbirds have been Hail Haor and Hakaluki Haor, which are located approximately 20 km south and 30 km east of the Project Site respectively. 85

species of birds have been recorded in Hakaluki and Hail Haors, including five NT species, one VU species and one EN species, according to the IUCN list.

During the 2014 validation baseline surveys, no significant changes were observed when compared to the 2011 survey data.

Socio-Economic Environment

A land use survey was undertaken during the course of ESIA process to establish the current status of the land use pattern in the Project AoI in 2011. During the validation assessment carried out in 2013 no further land use study was undertaken, since it was found that no significant change had occurred. A total of ten villages were selected for collection of household data on the basis of high, medium and low impact zones assumed at 1km, 7.5km and 10 km radius of the SBPCL II Power Plant. In line with DoE guidelines, the desired data including the location of settlements, industries, shops, growth centres, markets, agricultural lands, water bodies, bridges, educational institutions, religious institutions and other sites were recorded.

According to the results of the survey, the major land use categories comprise:

- 73% agricultural land;
- 12% residential settlements;
- 9% the Kushiyara River;
- 3% the proposed SBPCL II Power Plant including the access road;
- 2% canals, ponds and beels; and
- 1% local roads.

No significant urban centre is located within the Project AoI; however it is noted that the Union Parishad Offices, markets, educational institutes and various religious centres (Mosques, Temples and Churches) are located within the Project AoI. Sherpur, the village business centre, is located approximately 2.5 km to the east of the Project Site.

The 16 villages in the vicinity of the Project Site, excluding informal settlements on khas land, are connected with grid electricity for domestic and business uses but there are no telephone lines for use by village inhabitants. Land based biomass fuels obtained from trees, field crops and livestock play an important role in meeting cooking energy demand. At present, only biomass fuel is used for cooking food. The area is not connected with natural gas supply for domestic or industrial use.

The surrounding area is not served by a mains water supply and drinking water is provided by groundwater abstraction wells. The surrounding area does not comprise a municipal foul sewer or a storm water drainage system.

The main roads in the vicinity of the Project Site comprise the N2 Dhaka-Sylhet national highway, which is located approximately 2 km to the south-east of the Project Site at its closest point, and the R241 road, which is located approximately 3.7 km to the south-west of the Project Site. In addition to the main roads, prior to the land raising exercise a road bisected the Project Site from east to west, 2 km of which was brick surfaced with the rest comprising compacted mud. It is the main road in and around the Project Site. Besides this, there are some earth roads passing through the villages (adjacent to the Project Site) to connect the Sherpur commercial centre. Vehicle movement during the rainy season become difficult and prone to accident. Earth roads are used only in dry season and most of the time villagers use boats for their movement. Transport services in the area include regular bus and other transport services (including rental cars, auto rickshaws, rickshaw / rickshaw vans). The Sherpur Bridge is located approximately 2 km to the east of the Project Site and comprises a road bridge over the Kushiyara River.

The Kushyiara River, which forms the northern boundary of the Project Site, is one of the major waterways in the north-eastern region of Bangladesh. Different kinds and sizes of boats, launches and ferries are active in transporting people, goods, buses and trucks to both sides of the River.

Information regarding Project Affected Persons (PAPs), resettlement, livelihood restoration and compensation measures is presented in a standalone Resettlement Action Plan (RAP) report which accompanies this ESIA report.

Impact Assessment and Mitigation Measures

Visual Impact

The landscape in the vicinity of the Project Site is relatively flat and dominated by agricultural land with an absence of significant man-made structures. Therefore, the SBPCL II Power Plant will be a significant addition to the landscape. The stack of the SBPCL II Power Plant will be 60 m in height and visible at long distances. In order to mitigate the potential visual impact, the design of the cooling towers will avoid the traditional hyperbolic shape and visible plumes of uncondensed water vapour.

Exterior lighting will be provided for operating and maintaining the SBPCL II Power Plant; given the relative open and undeveloped nature of the Project Site, it is expected that some of the lighting or glow will be visible from offsite locations. In order to reduce potential light pollution impacts, the following measures would be implemented: the use of low pressure sodium lighting; minimal use of upward lighting;; and fitting hoods on light sources to direct light below the horizontal plane at angles less than 70 degrees.

Air Quality

Initial air quality baseline surveys were undertaken in 2008/2009 and 2011. The baseline validation was then undertaken in September 2013, by when the land raising (from the sand mining) at the Project Site was already completed. During the construction phase, potential air quality impacts include emissions from heavy equipment and generator sets, and fugitive dust in the immediate vicinity of the Project Site. Impacts are likely to be localised and relatively short-term in nature. Mitigation measures will include:

- periodic sprinkling of water throughout the area subject to the site preparation and land raising process to arrest dust emission;
- cover all stockpiles with canvas or plastic sheets during windy periods;
- limit the speed of heavy good vehicles over unpaved surfaces;
- cover materials during transport to the Project Site;
- clean road vehicles wheels before leaving the Project Site;

- prohibit rubbish burning within the construction site;
- in the event that vehicles are left standing for significant periods, their engines will be switched off; and
- the EPC Contractor will ensure that all plant is maintained in a satisfactory manner so as to minimise emissions.

These measures were being implemented by the EPC contractor and other sub-contractors and during the 2013 validation survey it was found that the construction phase was at the initial stage and the EPC contractor was following the above mitigation measures. .

To assess potential impacts on air quality during the operational phase, the AERMOD dispersion model was used to predict ground level concentrations (GLCs) of pollutants, including NO_X, CO, PM_{10}. As sulphur content in the natural gas input is negligible, emission of SO_2 is not included in the modelling.

Modelling results indicate that emissions around Project Site during the operation of the SBPCL II Power Plant will remain much below the DoE standards except for PM_{10}. However, exceedances of PM_{10} are considered to be due to fugitive dust generated at the Project Site (i.e. elevated baseline concentrations). The contribution of the SBPCL II Power Plant in respect of PM_{10} is negligibly small (<0.03%).

Whilst specific details of the potential Bibiyana I and III Power Plants are unknown, according to the invitation to tender document the potential Bibiyana I and III Power Plants will each comprise a '300-450 MW CCGT power plant'. Therefore, given the absence of further information, for the purposes of this impact assessment, it has been assumed that the gas turbines and other design parameters for Bibiyana I and III the Power Plants will comprise the same specification as the proposed SBPCL II Power Plant, with the same stack height. However, a cumulative air quality impacts have been assessed using ICS3P model.

The addition of two potential further power plants Bibiyana I and III Power Plants) with the assumed same emission parameters will lead to approximately a 50% increase of the predicted pollutant concentrations. This addition will lead to predicted values of 7.85 $\mu g/m^3$ for NO_X, 0.08 $\mu g/m^3$ for PM_{10} and 5.73 $\mu g/m^3$ for CO (refer to Table 5.3). These values are well within DoE and IFC and Standards.

For SBPCL II, the results using AERMOD is 8.59µg/m3 for NO_X and 3.31 $\mu g/m^3$ for CO.

Noise Impact

Noise impacts during construction are likely to be localised and temporary in nature; however construction noise has the potential to cause sleep disturbance. Therefore, the following mitigation measures will be implemented during the construction phase:

- Fit residential grade mufflers and silencers to machines;
- Use machinery with rubber tyres rather than metal tracked dozers etc. where possible.
- Limit operation of earthmoving machinery to between 9am and 6pm when residences are less sensitive to noise and ambient levels are greatest;

- Keep neighbours informed when noisy equipment is introduced to Project Site and the likely duration of its use;
- Ensure a site contact details are circulated to neighbouring residences to allow a swift response to complaints;
- Introduce a management strategy to monitor noise emissions, assess and record noise complaints and track performance in limiting and managing noise; and
- Enclose or shield engines of concrete mixers where practical.

During the ESIA validation surveys in October 2013, the noise impact due to construction was assessed. The noise level measurements showed values higher than the baseline carried out during the 2011 ESIA phase. This is due to the continuous noise generated by the temporary generator used in the construction phase and the piling works being carried out. The piling work was stopped at 6pm and the sound levels in the immediate vicinities (within 200m radius of the Project Site) were significantly lower.

According to information provided by the manufacturer, the source noise from the proposed gas turbines to be used during the operational phase of SBPCLII Power Plant is 85 dBA within 1m of the gas turbine. Whilst specific details of the potential Bibiyana I and III Power Plants are unknown, it has been assumed that they will comprise a '***300-450 MW CCGT power plant***' and therefore the gas turbines will comprise the same specification as the SBPCL II Power Plant, with a source noise level of 85 dBA.

Graphic User Interface (GUI) software was built, based upon the model using MATLAB programming language for enhancement in calculation and analysis, and the day and night time noise levels at the nearest sensitive residential reports were calculated.

Based on the results of the modelling, it is clear that the SBPCL II Power Plant will have a negligible impact on the noise environment at the nearest sensitive receptors. In all instances where the combined noise level exceeds the WHO Noise Level Guidelines of 55 dBA during the day and 45 dBA at night, this is due to high baseline noise levels. The western site boundary will be most affected by the proposed SBPCL II Power Plant, with an increase in noise during the day time of 0.31 dB (a), compared with the existing baseline. Such an increase is considered to be negligible and is significantly below the 3 dB increase which is referenced in the IFC Guidance. Furthermore, the model presents a 'worst-case scenario' as it does not take into account obstructions in the propagation path and uneven topography, which would reduce noise propagation and the model.

The Water Supply System

During operation of the SBPCL II Power Plant, a total of 10,000 m^3 per day (i.e. 0.116 m^3/s) will be abstracted from the Kushiyara River for replenishment cooling water, potable water and service/cleaning water.

Based on the baseline conditions outlined previously, an abstraction rate of 0.23m^3/s comprises approximately 0.03% of the average low flow during the monsoon season and approximately 0.23% of the mean low flow during the dry season. Even during a repeat of the minimum recorded flow the proposed abstraction would only comprise 0.80% of the total flow in the Kushiyara River.

Given the absence of further information regarding the potential Bibiyana I and III Power Plants, for the purposes of this impact assessment, it has been assumed that they will comprise the same specification as SBPCL II (i.e. a closed-loop system), with the same water requirements. Therefore, the cumulative water requirements associated with three power plants will not exceed 30,000 m^3/24hr (0.347 m^3/s). During the dry season, which is considered to be worst case, the associated water abstraction would comprise 0.17% of the total river flow; accordingly the potential cumulative impact of the water abstraction on the flow in the Kushiyara River is considered to be negligible.

Whilst the abstraction of cooling water from the Kushiyara River will not affect the river flow, as identified in the IFC Guidelines, aquatic organisms drawn into cooling water intake structures may be impinged on components of the cooling water intake structure or entrained in the cooling water system itself. In the case of either impingement or entrainment, aquatic organisms may be killed or subjected to significant harm. There is also the potential for organisms to become entrapped in the intake canals. In order to mitigate these potential impacts, barrier screens will be installed and the intake structure will be located towards the centre of the Kushiyara River to further reduce impingement and entrainment.

Wastewater Discharge

Treated effluent (treatment processes described in Section 3.5.4 of this ESIA report) will be held in an effluent tank and then discharged in to the Kushiyara River. The effluent treatment system is designed to ensure compliance with the following parameters:

Effluent Quality Parameters		
Parameter (all mg/L, except pH and Temperature)	**SBPCLII Effluent Quality**	**IFC Guidelines***
pH	6-9	6-9
TSS	50	50
Oil& grease	10	10
Total residual Chlorine	0.2	0.2
Chromium —total	0.5	0.5
Copper	0.5	0.5
Iron	1.0	1.0
Zinc	1.0	1.0
Lead	0.5	0.5
Cadmium	0.1	0.1
Mercury	0.005	0.005
Arsenic	0.5	0.5
Temperature (relative to river temp.)	±3°C	±3°C

Notes:
Effluent guidelines to be applicable to relevant wastewater stream e.g. from boiler acid washing, regeneration of demineralises and condensate polishers, oil separated water, site drainages and cooling water; Parameters are shown below.
***IFC EHS Guidelines for Thermal Power Plants**

Subject to strict compliance with these effluent quality parameters, the impact on the Kushiyara River from discharged effluent will be minimal. Furthermore, given the proposed close-loop system, cooling water will not be discharged to the river and the thermal impact will be negligible. Blow down water from the cooling tower will be sent to a basin to cool down further before discharging into the River Kushiyara. The water would be sufficiently cooled to ensure the thermal impact will be negligible.

Flood Risk

As previously stated, the proposed final elevation of the plant area is designed to be 11.2 m asl (i.e. approximately 1.05 m above the highest recorded flood level.). The construction/laydown area to the north of the SBPCL II Power Plant would also be raised to 11.2 m asl,

Whilst such land raising will protect the SBPCL II Power Plant from flash floods, it will alter the drainage pattern of the area and the surrounding land. Although a detailed impact study has not been undertaken as part of the ESIA, it is noted that no concerns regarding increased potential for flooding as a result of changes to drainage were raised during stakeholder engagement.
The Kushiyara-Surma River catchment area occupies an area of approximately1,841 km^2; the required land raising would impact approximately 67.58 acres (approximately 0.3 km^2) of land and will have a minimal impact on this scale of floodplain.

Due to progressed nature of the Proposed Development, the EPC contractors have designed the storm and possible flood water drainage system extending to the low lying seasonal beel to the south and east of the power plant approximately 1km from the Project Site. The drainage system will ensure that incidence of flooding or water logging will be avoided especially in the resettlement area and immediate low lying areas of the SBPCL II Power Plant.

Ecological Impacts

The possible impacts of the proposed SBPCL II Power Plant and associated infrastructure on birds and other wildlife are likely to comprise:

- loss of habitats through development of the Project Site/infrastructure;
- disturbance as a result of construction activities;
- changes to the flow and surface water quality of the Kushiyara River as a result of abstraction and/or discharges;
- collision with transmission cables;
- disturbance as a result of operational activities; and/or
- accidents impacting the environment.

The Project Site, approach roads and other associated infrastructure would not result in reclamation of any wetland areas.

Impacts on the surface water quality and associated fisheries have been assessed and found to be negligible. As a result, and subject to SBPCL II adhering to international safety standards and contingency planning and mitigation, it can be assumed that consequent impacts on birds and other wildlife predation on fish and using that stretch of river will be negligible as it relates to their use of the Kushiyara River.

In light of the above, the main potential risk of the SBPCL II Power Plant is bird collisions as a result of the introduction of transmission lines (power cables). The potential significance of this impact is exacerbated by the presence of Baer's Pochard (*Aythya baeri*) in Hail Haor and Hakaluki Haor, which are located approximately 20 km south and 30 km east of the Project Site respectively. According to the IUCN Red List of Threatened Species, Baer's Poachard is classified as EN owing to an apparent acceleration in the rate of its decline, as measured by numbers on the wintering grounds.

According to the Request for Proposal documents, dated 2nd September 2010 and signed by SBPCL II, PGCB is responsible for construction of T-line with approximately 70 m of T-line being associated with the Proposed. Whilst the risk of bird collisions with the 70 m section of the transmission line is considered limited, once the proposed route of the transmission line(s) has been determined, a breeding bird survey and management plan will be prepared. This will be reviewed and assessed to ensure there will be no impact on migratory birds.

Sand Mining

The two primary impacts associated with sand mining comprise river bank erosion and disturbance of fish habitats. In addition, there is potential for secondary social impact on the fishing community due to the disturbance of fish habitats and loss of agricultural land due to river bank erosion. Increased sediment loads, turbity and sedimentation, with resultant changes in river channel morphology, is a potential major impact regardless of location. As stated previously, the validation survey in October 2013 confirmed that land raising work had already been completed at the Project Site in 2012. For the excavation, sand was mined by suction sand barge as suggested in earlier versions of the ESIA report.

Due to potential significant impacts on fisheries and aquatic habitats in the vicinity of Sites 2 and 8, and social impacts in the vicinity of Site 4 (refer to Section 3.9, Map 3.9), sand mining was not permitted at these locations. Therefore sand mining was only carried out in the remaining six locations, namely:

- Dighculbagh;
- Lipi gong high school;
- New degi;
- Pawrpwr;
- Dwrgapwr; and
- Mathvorcapwr.

Approximately 300,000m^3 of sand was excavated from these locations. As reported in the third draft of the ESIA, sand was transported to the river bank at the Project Site via sand carriers before being pumped to the dedicated field, it is noted that the third draft of the ESIA assessed the associated increase in river traffic movements per day to be a negligible impact as the river is navigable throughout the year and the present river traffic is not significant.

Excavation was not permitted in certain locations due to the presence of fish sanctuaries (areas identified and mentioned in the third draft of the ESIA report). According to the EPC contractor the sand mining contractors were prohibited to carry out sand mining from these excluded locations.

. In addition, by spreading the mining across the six sites, the impacts at any one site was reduced, as over-extraction at a single location may have destabilised the river bank.

As suggested in the third draft of the ESIA report, suction dredging from sand barges was implemented for the purpose of sand mining as this methodology creates fewer disturbances to the river bed. All dredging was undertaken from a river barge to significantly reduce the potential for disturbance of the river bank.

The construction of SBPCL II Power Plant has been carried out and according to the EPC Contractor, the sand mining activities completed in 2012 have been carried out following the above recommendation.

Trans-Boundary Impacts

The border with India is located approximately 45 km to the south-east of the Project Site at its closest point. The Kushiyara flows into the Bay of Bengal approximately 250 km downstream of the Project Site and therefore due to this distant location, there is no potential for trans-boundary water pollution.

Air Quality modelling has demonstrated that air pollutants associated with operation of the SBPCL II Power Plant will reach acceptable ground level concentrations within 10 km of the SBPCL II Power Plant (i.e. the Project AoI). Furthermore, whilst SO_2 and NO_X are implicated in long-range and trans-boundary acid deposition (as stated in IFC EHS Guidelines for Thermal Power Plants), it has been demonstrated that the SO_2 emissions associated with the SBPCL II Power Plant will be negligible, and that the SBPCL II Power Plant will operate low NO_X burner emission control systems. Therefore, the potential for trans-boundary impacts is considered negligible. As such the Prior Informed Consent (PIC) requirements will not be triggered.

Risk Assessment and Emergency Response

Materials that will be used in the SBPCL II Power Plant process comprise fuels and chemicals, including natural gas and chlorine. Apart from the chemical and process characteristics of the material, the size and layout of the plant and equipment need specific consideration in order to assess the hazard potential. Similarly, the Project Site is located in an active seismic zone and as such the potential for natural hazards such as earthquakes and floods must be taken into consideration.

Identification of hazards in a power plant is of primary significance in the analysis, quantification and cost effective control of accidents involving the raw materials and/or chemicals utilized in the power generation process. The type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken. In respect to the Proposed Development, hazard identification during storage and transport are particularly relevant.

A detailed, site-specific Quantitative Risk Assessment (QRA), and hence arriving at an 'As-Low-As-Reasonably-Practicable' (ALARP) situation, as well as a site-specific Emergency Response Plan (ERP) for the SBPCL II Power Plant is not possible as pertinent information and data is not available at this stage of the project, however an initial draft QRA is included as Annex 12. The detailed, site-specific QRA will be prepared at the detailed design stage for both the construction and the operational phases of the project, in accordance with the International Electrotechnical Commission (IEC) International Standard 61822 Hazard and Operability Studies (HAZOP)Application Guide ('the IEC HAZOP Guide') and with reference to applicable guidance in the Institution of Chemical Engineers (IchemE) HAZOP Guide to Best Practice, 2nd Edition, April 2008 ('the IchemE HAZOP Guide').

The IEC HAZOP Guide states, *"the best time to carry out a HAZOP study is just before the design is frozen [finalised]"* and this view is further supported by the IchemE HAZOP Guide, which states *"a study cannot be carried out on a partly developed design"*. In the case of the proposed SBPCL II Power Plant, the design is not finalized as further pertinent information will be provided by the EPC Contractor at the detailed design stage.

In addition to the HAZOP Study, QRA and ERP, SBPCL II will work towards obtaining Occupational Health and Safety Advisory Services (OHSAS) 18001 accreditation within the first three years of operating the SBPCL II Power Plant.

Environmental and Social Management and Monitoring Plan (ESMMP)

SBPCL II is committed to constructing and operating the SBPCL II Power Plant in an environmentally and socially responsible manner and in compliance with relevant laws, regulations, and guidelines in force in Bangladesh and also those prescribed by Lenders, including the IFC, the ADB and IDB. SBPCL II will implement an Environmental Management System (EMS), including an environmental policy that states the principles and intentions of the enterprise in relation to its overall environmental performance. Such principles and intentions will be communicated to each employee as well as the nature of their individual environmental responsibilities. Where appropriate, staff training will be undertaken to ensure their continued environmental performance. In addition, the project entrepreneur will aim to obtain International Organization for Standardization (ISO) 14001 accreditation for the EMS within the first three years of operation.

Section 8 of this ESIA report comprises an Environmental and Social Management and Monitoring Plan (ESMMP) which deals at length with the measures that SBPCL II will take in response to the need for sound environmental management throughout the various phases of the Proposed Development. The ESMMP outlines measures that will be taken in relation to the management of social impacts and the need to address grievances that the various project stakeholders might have throughout the life of the Proposed Development.

The ESMMP is sub-divided into the four key phases of development: the pre-construction phase; the construction phase; the operational phase; and the decommissioning phase.

The Pre-Construction Phase

The pre-construction phase of the Proposed Development was already completed before the ESIA validation in 2013 and so will not be covered within the ESMMP.

The Construction Phase

The Construction Phase of the Proposed Development will involve the construction of the SBPCL II Power Plant, as well as associated ‘off-site’ infrastructure such as the natural gas pipeline, the access road and the transmission line. Whilst impacts during the construction phase of a development project are typically relatively localised and short term in nature, the potential exists for significant adverse environmental and social impacts due to uncontrolled dust emissions, elevated noise, sedimentation of water bodies and poor management of hazardous materials, as well as management of occupational health and safety and labour conditions. In addition, good public relations and stakeholder engagement practices are important factors during the construction phase of the Proposed Development.

The ESMMP sets out detailed mitigation and compensation measure which will be implemented during the construction phase of the Proposed Development, as well as monitoring parameters, the frequency of monitoring and responsibility for implementing mitigation measures and monitoring the effectiveness of the mitigation measures. In addition, the ESMMP details the requirements and expectations of the EPC Contractor, which will be monitored by SBPCL II throughout the construction phase.

Where data gaps are identified due to lack of detailed design information, the requirement for further studies, responsibility for undertaking the studies and an appropriate timeframe, is clearly identified in the ESMMP.

The Operational Phase

The Operational Phase of the Proposed Development is anticipated to last 22 years and the potential exists for significant adverse environmental and social impacts during the lifetime of the proposed SBPCL II Power Plant. Whilst responsibility for operation and maintenance of the access road, gas pipeline and transmission line will lie with BPDB, the Gas Supplier and the Power Grid Company of Bangladesh (PGCB) including the 70m transmission line from the national grid to the switchyard respectively, responsibility for the operation and maintenance of the SBPCL II Power Plant will remain with SBPCL II. Potentially significant environmental and social impacts have been quantified, where possible, in the impact assessment section of the ESIA and in the standalone RAP report. Mitigation and measures are proposed to eliminate, offset, or reduce adverse environmental and social impacts to acceptable levels. Where mitigation is not possible, for example with regards to permanent resettlement, appropriate compensation measures are proposed.

The effectiveness of the proposed mitigation measures will be monitoring throughout the lifespan of the Proposed Development and the required frequency of monitoring is proposed in the ESMMP. This ranges from continuous monitoring of effluent discharges to the

Kushiyara River and air emissions from the stacks, to annual health and safety audits by a suitably qualified independent consultant.

Responsibility for implementing the mitigation and compensation measures, as well as monitoring the effectiveness of the measures, is detailed in the ESMMP. This includes specific appointments that will be made by SBPCL II, including the appointment of a suitably qualified Environmental Health and Safety (EHS) Coordinator. In addition, a Community Development Officer (CDO) will be appointed to monitor social impacts on the local villages due to increased demand for goods, services and public health facilities arising out of additional workers (associated with operating the SBPCL II Power Plant) in the Project AoI. A grievance mechanism through a Joint Committee for Community Relations (JCCR) will be proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SBPCL II management and elected local representatives.

The Decommissioning Phase

Closure and decommissioning of the SBPCL II Power Plant may involve adverse impacts not perceived at this stage of the project. Therefore, the ESMMP details the requirement for a detailed decommissioning and rehabilitation plan prior to closure of the power plant. Such a plan might include: strict adherence to all appropriate waste management techniques, including the reuse and recycling of materials wherever possible; disposable of hazardous waste materials in a legal and responsible manner; remediation of soil and/or groundwater contamination (if applicable); and rehabilitation and enhancement of terrestrial habitats within the power plants footprints.

Decommissioning works will include soil and groundwater monitoring to determine subsurface impacts (if any) of the SBPCL II Power Plant operation, and restoration of the physical environment to the baseline conditions detailed in Section 4 of this ESIA report.

Integration of ESMMP with Overall Project

Implementation of ESMMP along with redress of grievances will ensure environmentally / socially sound efficient working conditions of the Proposed Development during the the construction phase and the operational phase. SBPCL II will set up an efficient institutional mechanism through deploying its own groups of personnel – the electromechanical group, the group consisting of personnel trained in environmental monitoring and compliance procedures, the social safeguard group and a group of security personnel – along with the EPC Contractor to be engaged in construction and initial phases of operation of the Proposed Development. Personnel to be deployed by SBPCL II and those of the EPC Contractor have to collaborate among themselves through a set of guidelines to be developed in line with the Environmental Management and Monitoring Programs as detailed in the ESMMP.

1. Introduction

1.1 Background of the Project

The Summit Bibiyana II Power Company Limited (SBPCL II) Project proposes to develop a Combined Cycle Gas Turbine (CCGT) power plant, with a capacity of 341 MW, at Bibiyana as per the decision of the Government of Bangladesh (GoB) in relation to awarding the task in favour of the project proponent SBPCL II(herein referred to as 'the Proposed Development' when referring to the SBPCL II power plant, construction lay down area and associated facilities or 'the SBPCL II Power Plant' when discussing the SBPCL II Power Plant and construction lay down area specifically).

The decision toward implementation of the SBPCL II Power Plant has been reached in partial fulfilment of the objectives of an award by the Government of Bangladesh through the Ministry of Energy, Power and Mineral Resources and the Bangladesh Power Development Board (BPDB) in favour of SBPCL II to mobilize its resources toward construction, ownership, management, operation and maintenance of aCCGT power plant. The SBPCL II Power Plant is proposed to be constructed in an area comprising approximately 25 acres of land (11 acres for the power plant footprint and 14 acres for the associated construction lay-down area) to the south of river Kushiyara in the village of Parkul at Bibiyana under Union[1] (Aushkandi in Nabiganj upazila of Habiganj district) with an investment of US $290m. The sponsor of the SBPCL II Power Plant, the Summit Group, is an established financial entity and is experienced in the efficient management, operation and maintenance of similar facilities in Bangladesh.

The Project Site acquired by BPDB has been leased out to SBPCL II through Land Lease Agreements and as per terms of Power Purchase Agreements signed between BPDB and the individual company SBPCL II.

The project has witnessed the following agreements and contracts signed prior to its initiation.

1.1.1 Project Implementation Agreement

The Implementation Agreement (IA) of the SBPCL II Power Plant was executed on May 12, 2011. Parties to the IA had been (i) the Project Company(s), i.e. the SBPCL II; (ii) the Government of Bangladesh (GoB); and (iii) the Power Grid Company of Bangladesh (PGCB). The IA became effective from the date of signing and will continue in full force and effect until the last day of the Power Purchase Agreement (refer to Section 1.1.2) unless extended or terminated earlier as per the provisions of IA.

1.1.2 Power Purchase Agreement

The Power Purchase Agreements (PPAs) for the SBPCLII power plant were signed on May 12, 2011, between BPDB and SBPCL II. Under the terms of the PPAs, SBPCL II agree to maintain

[1] Union is the lowest tier of local government.

the SBPCL II Power Plant and deliver electric energy produced at the plant exclusively to BPDB. In turn, BPDB agrees to purchase from SBPCL II the Net Energy Output.

1.1.3 Land Lease Agreements

The Land Lease Agreements (LLAs) for the SBPCL II Power Plant were signed on May 12, 2011. BPDB, through an agreement with the GoB, obtained title to a parcel of land comprising approximately 67.58 acres at Bibiyana earlier acquired fully in 2012. This parcel of land includes approximately 11 acres of land required specifically for the footprint of the SBPCL II Power Plant. BPDP, in turn, leased the land to SBPCL II for the implementation and operation of the project. The term of the LLA expires on the earlier of (i) the date of termination of the PPA, and (ii) the date of transfer of the Project to the Government of Bangladesh under IA.

1.1.4 Gas Supply Agreements

The Gas Supply Agreements (GSAs) for the SBPCL II Power Plant was signed on May 12, 2011, between the Jalalabad Gas Transmission and Distribution System Limited ('the Gas Supplier') and SBPCL II. In addition to the agreement to supply natural gas to serve the SBPCL II Power Plant, the GSAs include agreements for the construction of an 8.8 km gas pipeline from the south pad of the Bibiyana gas field to the SBPCL II Power Plant.

1.1.5 Engineering, Procurement and Construction Contracts

The SBPCL II project seeks to construct and operate a natural gas thermal CCGT power plant having a generation capacity of 341 MW. The SBPCL II Power Plant will be located at Bibiyana in the district of Habiganj approximately 180 km northeast of the capital city Dhaka. Engineering, Procurement and Construction (EPC) Contracts were signed between SBPCL II and a joint venture comprising the First Northeast Electrical Power Engineering Co. and Northeast China International Electric Power Corporation (herein referred to as 'the EPC Contractor') in June 2011.

1.1.6 Implementation Schedule

Prior to signing of the agreements and contracts listed in Sections 1.1.1 to 1.1.5, a Request for Proposal Document (RFP) issued by Power Cell, the Power Division of the GoB Ministry of Power, Energy and Mineral Resources. The RFP was signed between SBPCL II in September 2010 and this constituted the beginning of the Project.

1.2 Project Rationale

Bangladesh is now facing an acute electricity shortage. This has been due to lack of proper planning and acute demand growth. The GDP growth has stagnated over the years due to an absence of electricity both in terms of quality and quantity.

The policy of the GoB has been to ensure extension and stabilization of the power sector through both public and private sector undertakings toward not only meeting the existing power deficiency throughout the country but also ensuring unhindered power provision in view of the projected future demand. Current undertaking by SBPCL II toward constructing CCGTpower plant at Bibiyana has been toward implementation of this policy.

The highly efficient CCGT technology in the proposed power plant complex at Bibiyana will significantly reduce natural gas consumption compared to other conventional direct natural gas fired technologies, thereby making available capacity for use elsewhere in the country for future power plants or for industrial or other uses. It has long been recognised that emissions of certain gases such as oxides of nitrogen (NO_X) and sulphur dioxide (SO_2) can contribute to acid rain which can cause acidification and degradation of ecosystems. Power generation from natural gas using CCGT technology with higher efficiency has been widely known as amongst the cleaner forms of power generation from fossil fuels. Therefore, the Proposed Development will contribute significantly to reducing national GHG emissions than traditional coal, oil or single cycle natural gas fired thermal power stations.

In addition to the SBPCLII Power Plant, it is understood that the GoB is planning to undertake two additional phases (Bibiyana I and III Power Plants) CCGT thermal power projects, having a capacity of 300-450 MW each, located to the south and north-east of the Project Site respectively. The request for Expression of Interest (EOI) for the Bibiyana III was issued in July 2011; however, at this stage, a proposed date for construction of the Bibiyana I and III Power Plants is unknown. However the potential for cumulative environmental and social impacts associated with Bibiyana I and III Power Plants have been assessed in the relevant sections of this ESIA.

1.3 Nature and Objective of the Study

1.3.1 Broad Objectives

The broad objectives of this ESIA are:

- to assess the environmental and socio-economic impacts of the Proposed Development;
- to identify and engage with stakeholders to understand their views about the Proposed Development and understand their expectations and concerns, and to incorporate these appropriately into proposed future management plans;
- to suggest mitigation measures for minimizing adverse impacts and enhancement measures of beneficial impacts; and
- to identify requirements for future environmental and social management and monitoring plans and plans for addressing occupational and community health and safety issues.

1.3.2 Specific Objectives

Specific objectives of the ESIA comprise:

- obtaining Environmental Clearance from the Department of Environment (DoE); and
- obtaining clearances of the financing institutions: the the International Finance Corporation (IFC); the Asian Development Bank (ADB);; and the Islamic Development Bank (IDB).

1.4 Project Area of Influence

This ESIA has determined the environmental and socio-economic characteristics of the Proposed Development within an 'Area of Influence' (AoI) of 10 km for environmental and 5 km for social from the Project Site (hereafter referred to as the 'Project AoI'), and assessed the potential impacts of the Proposed Development upon the existing baseline conditions.

The Project Site refers to the location of the SBPCL II Power Plant and the construction lay down area, it does not include the land relating to the associated facilities.

1.5 Scope of Work

The scope of the Environmental and Social Impact Assessment (ESIA) includes the following:

- a brief description of the Proposed Development;
- a detailed characterization of the existing environment within the Project AoI for environmental components, including air, noise, water, land, soil and biological, as well as the socio-economic components;
- prediction and evaluation of positive and negative impacts that may result from the Proposed Development;
- consideration of alternatives;
- undertaking public consultation and disclosure of project-related information;
- grievance redress mechanism;
- formulation of an environmental and social management and monitoring plan (ESMMP) and RAP (which comprises a separate document) to eliminate or minimize the adverse impacts of the Proposed Development on the surrounding environment and affected communities; and
- to propose plans for post project monitoring, ongoing consultation and disclosure, ESMMP implementation, and institutional arrangement/organizational arrangement.

The detailed scope of work included:

- conducting a baseline environmental and social study for the Project Site;

- undertaking an Initial Environmental Examination (IEE) of the Project Site for SBPCL II having a generation capacity of 341 MW using a gas fired CCGT power plant;
- undertaking identification and analyses of socio-economic and environmental impacts during construction and post-construction as well as operational stages of the SBPCL II Power Plant at and around the Project Site through, interalia, conducting public consultations, reference to national environmental standards (emission, effluent, ambient air quality, noise) and their comparison with the respective standards prescribed by IFC;
- considering the significant differences (if any) in regulations on land acquisition and involuntary resettlement between GoB, IFC and ADB and recommending measures to address such differences to ensure compliance with the requirements of Lenders;
- suggesting mitigation measures vis-à-vis anticipated each impact along with formulating requisite Environment and Social Management and Monitoring Plan (ESMMP) and estimation of financial implications for the ESMMP through a detailed Environmental and Social Impact Assessment;
- (vi) refer to the stakeholders and the affected community's engagement wherever appropriate with an aim to focus on the various impacts due to the different project activities of the Proposed Development with emphasis on information disclosure and methodologies used;
- (vii) developing a comprehensive Resettlement Action Plan (RAP, which comprises a separate stand-alone document) including livelihood restoration plan (LRP), stakeholder engagement plan and grievance redress mechanism; and
- (viii) suggesting adequate compensation packages for the different types of project affected persons (PAPs).

Of the above aspects of the scope of work, the first two were partially completed during the IEE process and supplemented during the ESIA. The IEE Report along with necessary enclosures have been submitted to DoE and Environmental Site Clearance (refer to Annex 9) specifying various conditions to be fulfilled during the activities related to the project have also been obtained. DoE has also approved the ToR for EIA based on the draft submitted along with the IEE (provided as Annex 3). Based on the DoE approved ToR for EIA, details of the scope of work pertaining to the ESIA was as follows:

1. Establishment of the environmental and social baseline conditions of the Proposed Development;
2. Carrying out an Environmental and Social Impact Assessment (ESIA) for SBPCL II as per ToR approved and prescribed by the DoE through assessment of anticipated environmental and social impacts due to interventions, including laying of a natural gas pipeline from the nearest source to the Project Site;
3. Obtaining approval of the lending financial institutions, including IFC, ADB and Islamic Development Bank (IDB);
4. Obtaining Environmental Clearance Certificate by SBPCL II; and
5. Formulation of an Environmental and Social Management and Monitoring Plan (ESMMP) emphasizing and outlining mitigation plans for adverse impacts,

enhancement plan for beneficial impacts, compensation plan, contingency plan and monitoring plan.

1.6 Methodology

Based on the above Scope of Work, the study built upon the baseline survey carried out previously by BCAS as Environment and Social Consultant for the IFC in 2008 and 2009, and the Initial Environmental Examination (IEE) conducted by BCAS during March and April 2011. The IEE exercise resulted in a stand-alone report together with a schedule devised by and as per the requirement of DoE.

Primary data for the ESIA was originally generated during the period from February to October 2011. Secondary data was obtained from various sources and field visits. Several field visits had been undertaken to the Project Site. Subsequently validation of the surveys was undertaken in September 2013 to January 2014, with a view to updating the findings of the baseline study carried out by BCAS in 2011, where necessary. The ESIA has been prepared on the basis of all survey data collected from 2011 - 2014. During the preparation of the fourth draft ESIA, the following steps were followed:

- Confirmation of survey/monitoring data in the baseline study and IEE carried out by BCAS during, March-October, 2011 and generating primary data;
- Understanding the technical aspects of the proposed power plants through secondary literature and consultations with the recently appointed Engineering, Procurement and Construction (EPC) Contractor (refer to Section 1.1.5);
- Identification of potential environmental and social impacts and evaluating the consequences through using a checklist method;
- Identification of impacts was undertaken using Checklist Matrix and Issues forecasting tabular methods;
- Review of the adequacy and efficiency of proposed mitigation measures for the Proposed Development through public consultations;
- Development of an Environmental and Social Management and Monitoring Plan (ESMMP) for possible mitigation/enhancing measures, respectively, for negative and beneficial impacts;
- Suggestion of mitigation measures for residual impacts;
- Completion of a comprehensive social impact assessment through primary data collection;
- Primary data collection from 30% of the total households within the Project AoI included in the baseline study carried out by BCAS in 2009 and 100% survey of the Project Affected Persons (PAPs) through 100% census based on a prepared questionnaire. A number of Focus Group Discussions (FGDs) with the different categories of stakeholders were held including women;
- Preparation of a Resettlement Action Plan (RAP, which comprises a separate standalone document) including compensation packages and social development and livelihood restoration for the different categories of PAPs through consultation and engagement with stakeholders and community consultations;

- Formulation of a monitoring plan for both environmental and social issues. The plan will include the state of the alternative resettlement in terms of their tenure of compensated agricultural activities and provided alternative homesteads. This will be done through primary data collection with emphasis on the tenure of the settlement and the state of the displaced persons livelihood;
- Results of the land use survey, conducted during the period May to June 2008, was validated through a further study conducted during the ESIA process undertaken in April 2011. Detailed survey work was undertaken throughout the high impact zone (2km radius), medium impact zone (7.5km radius) and low impact zone (10km radius) of the project airshed to inform the preparation of the land use map. During the mapping exercise, in-depth consultations with local stakeholders were carried out to aide accurate identification of suitable plots. Use of maps and also utilization of the historic maps was undertaken for identifying the plots and ground level. Field verification was undertaken by the team leader after the field data collection. Updated GIS version was applied to finalize the land use map; and
- The following Primary Data was obtained during the ESIA processes:
  - Socio-Economic survey data;
  - Baseline air quality data;
  - Baseline noise data (day and night time);
  - River water quality data;
  - Groundwater data from deep and shallow tube wells;
  - Migratory birds data (survey by the Bangladesh Bird Club);
  - Fish survey data; and limnological survey data; and
  - River traffic data.

As indicated previously, the baseline surveys carried out in 2010-2011 were validated in September 2013 – March 2014 as per the requirement of the TOR for validation with the approval of IFC and ADB.

This ESIA report has been prepared with reference to, but not limited to, the following documents:

- Asian Development Bank (ADB), *Safeguard Policy Statement*, June 2009;
- International Finance Corporation (IFC), *Performance Standards on Social & Environmental Sustainability*, January 2012;
- IFC, *EHS Guidelines for Thermal Power Plants*, December 2008;
- IFC, *EHS General Guidelines,* April 2007; and
- Department of Environment (DoE), Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, *EIA Guidelines for Industries*, June 1997.

In particular, guidance in the ADB Safeguard Requirements 1 and 2 ('Environment' and 'Involuntary Resettlement') has been reviewed during the course of the ESIA process and preparation of this report.

In addition, of the above eight Performance Standards set by IFC, 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
    a. the client's management of social and environmental impacts throughout the life of the project.

The remaining seven Performance Standards, i.e. Performance Standards 2 to 8, seek to ascertain, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

All the relevant social and environmental risks and potential impacts considered under Performance Standards 2 to 8 have been addressed as part of the ESIA in compliance of Performance Standard 1 in addition to following the guidelines set-forth by DoE. Further details on the policy, legal and administrative framework which has guided the preparation of the ESIA, is provided in Section 2 of this report.

1.7 ESIA Team

The ESIA Team comprised the following:

1.	Dr. M. Eusuf, Air Dispersion Modeling Expert	Team Leader
2.	Syed Md. Iqbal Ali, EIA and Resettlement Expert	Member
3.	Dr. Moinul Islam Sharif, Energy Expert	Member
4.	Mr. Ahmed Al Farouq, IEE/EIA Expert	Member
5.	Mr. Khandoker Mainuddin, Socio-economic Expert	Member
6.	Ms. Olena Reza, Gender Expert	Member
7.	Dr. J. C. Shaha, Air Quality Monitoring Expert	Member
8.	Mr. M. A. Mahmood, Mechanical Engineer	Member
9.	Mr. Md. Osman Gani Shawkat, Field Coordinator	Member
10.	Mr. Mohammed Ikbal Hossain, PAPs and RAP Expert	Member
11.	Ms. Mirza Arifah Ahmed, Land use and GIS Expert	Member
12.	Ms. Ismot Ara, GIS Analyst	Member
13.	Mr. Sadman K Monsur, Socio-economic Analyst	Member
14.	Mr. Md. Mizanur Rahman, Field Surveyor	Member
15.	Md. Idrish Hossain, Field Surveyor	Member
16.	Syed Shaker Md. Iqbal, Noise Modelling Expert	Member

ENVIRON UK Limited ('ENVIRON') was commissioned by SBPCL II in October 2011 to undertake a review and advisory role during the preparation of the third draft of the ESIA report. All primary and secondary data collection was undertaken by BCAS, and all impact assessment/modelling work (i.e. air quality and noise modelling) was undertaken by BCAS. Furthermore, all assessment of applicable national legislation has been undertaken by BCAS. ENVIRON contributed to the ESIA report and the RAP (based on earlier versions of these documents) and where applicable advised regarding the scope of additional data collection and impact assessment/modelling works to be undertaken following ENVIRON's instruction in October 2011. Primarily ENVIRON has acted in undertaking technical review of the ESIA, and in the limited time available has undertaken a technical review of this sixth draft of the ESIA.

2. Policy, Legal and Administrative Framework

2.1 Relevant Policies, Laws and Regulations

Regulatory requirements in relation to the protection and conservation of the environment and various environmental resources, as well as the protection of the social environment from adverse impacts associated with project activities have been set out by the GoB as well as ADB and IFC. These requirements are summarized below.

2.1.1 Bangladesh Environmental Policy, Regulations, and Guidelines

2.1.1.1 National Environmental Policy, 1992

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

- Maintaining ecological balance and ensuring sustainable development of the country through protection and conservation of the environment;
- Protecting the country from natural disasters;
- Identifying and regulating all activities that pollute and destroy the environment;
- Ensuring environment-friendly development in all sectors;
- Ensuring sustainable and environmentally sound management of the natural resources; and
- Maintaining active association, as far as possible, with all international initiatives related to environment.

The Policy, *inter alia*, seeks to ensure that transport systems, including roads and inland waterways, do not pollute the environment or degrade resources. The Policy states that an Environmental Impact Assessment (EIA) should be conducted before projects commence.

2.1.1.2 National Environment Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) is a wide-ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements during the period 1995 to 2005, and sets out the framework through which various decisions, plans, legislative measures, rules and regulations toward safeguarding the environment and natural resources including those of biological diversities are to be implemented. NEMAP was developed based on the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural environment;

- Conservation of habitats and bio-diversity;
- Promotion of sustainable development; and
- Improvement of the quality of life of the people.

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

According to the NEMAP, the GoB environmental policy makes specific statements on energy and fuel, including the aim to *"Reduce and discourage the use of those fuels that pollute the environment and encourage the use of fuels that are environmentally sound and less harmful."*

2.1.1.3 The Environment Conservation Act, 1995 (subsequent amendments in 2000 and 2002)

The provisions of the Act authorize the Director General (DG) of Department of Environment to undertake any activity he deems fit and necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The main highlights of the act are:

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certificate;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Regulation of development activities from an environmental perspective;
- Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Promulgation of acceptable limits for discharging and emitting waste; and
- Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment.

2.1.1.4 Environment Conservation Rules, 1997 (subsequent amendments in 2002 and 2003)

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. These Rules provide for, *inter alia*, the following:

- 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 actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load;
- Procedure for obtaining environmental clearance;
- Requirement for undertaking IEE and EIA as well as formulating EMP according to categories of industries/development projects/activities; and
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

Depending upon location, size and severity of pollution loads, projects/activities have been classified in the Environmental Conservation Rules (ECRs) into four categories: Green, Orange A, Orange B and Red, respectively, to nil, minor, medium and severe impacts on important environmental components (IECs). The corresponding category related to power plants and associated infrastructure (e.g. the construction of a natural gas pipeline from the nearest distribution point to the power plant) is included under:

Schedule-1, Red Category:

- Item 6: power plants; and
- Item 64: includes construction / replacement / extension of natural gas pipelines.

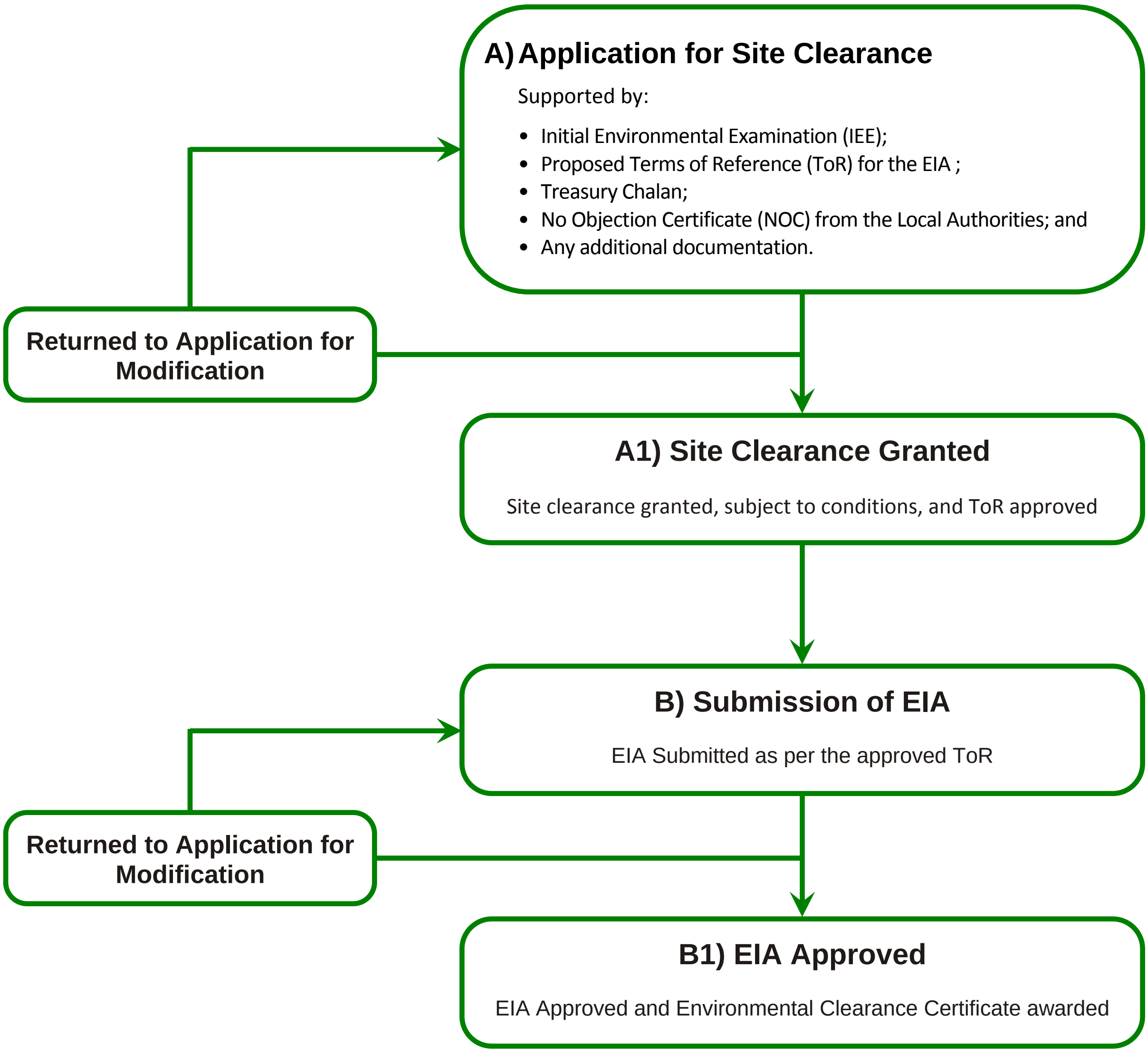
The Rules also incorporate “inclusion lists” of projects requiring varying degrees of environmental investigation e.g. all new projects under the ‘red’ category generally will require a two-step assessment procedure. Firstly, an Initial Environmental Examination (IEE) will be required for site clearance, and secondly, if warranted, a full Environmental Impact Assessment (EIA) for technical clearance. This ESIA validation has been carried out following the previous ToR approved by IFC and ADB in August 2013 (refer to Annex 1).

2.1.1.5 The EIA Guidelines for Industry, 1997

The EIA Guidelines is a handbook comprising procedures for preparing an EIA and for reviewing an EIA for the benefit of the development partners, EIA Consultants, reviewers, and academics. While preparing these guidelines, the present environmental status as well as the need for rapid economic development of Bangladesh has been considered. These considerations have essentially resulted in simpler procedures to be followed for preparing and/or reviewing an EIA.

The process for EIA approval and obtaining an Environmental Clearance Certificate (ECC) from the DoE is illustrated in Figure 2.1, below. Copies of the No Objection Certificate and Site Clearance Certificate are provided in Annex 9.

Figure 2.1: Process of EIA Approval and ECC at DoE



Application for Environmental Clearance at A requires 60 working days to reach A1 with Site Clearance. Submission at B of EIA as per ToR approved at AI needs another 90 working days to reach B1 with EIA approval and Environmental Clearance Certificate (*60 working days for EIA approval and 30 working days for ECC after the applicant/project sponsor completes the formalities as specified in the EIA approval letter and reports to DoE*). ECC issued through such a process remains valid for 1 (one) year, after which renewal is necessary. *During stages between A and A1 and between B and B1, observations are made and the applicant may be asked for modification of his/her information/data/reports submitted to DoE for necessary clearance.*

2.1.2 Environmental and Social Requirements of the Asian Development Bank

The ADB Safeguard Policy Statement ('the SPS') 2009 sets out the requirements for ADB's operations to undertake an environmental assessment for projects funded by the bank. The goal of the SPS is to promote the sustainability of project outcomes through protecting the environment and people from potential adverse impacts. The overall objectives of the SPS are to:

- avoid adverse impacts of projects on the environment and affected people, where possible;
- minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is impossible; and
- help borrowers/clients strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The SPS sets out the ADB policy objectives, scope and triggers, and principles for following three key safeguard areas:

- Environmental Safeguards;
- Involuntary Resettlement Safeguards along with those vis-à-vis Land Acquisition; and
- Indigenous Peoples Safeguards.

ADB implements the SPS through the safeguard review procedures as outlined in Section F1/OP of its Operation Manual (OM) and the documents cited therein. However, the third area of the above three areas is beyond the scope of ESIA consideration for this particular project (SBPCL II) as the project area does not involve any *indigenous peoples*[2].

According to ADB Operation Manual activated since 2010, a proposed project is assigned to one of the following categories depending on the significance of the *potential environmental impacts and risks:*

> **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 environmental impact assessment (EIA), including an environmental management plan (EMP), 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 initial environmental examination (IEE), including an EMP, is required.

[2] As defined by the Asian Development Bank policy on Indigenous Peoples, April 1998.

Category C – a proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.

Category FI – a proposed project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary (***refer to paragraphs53–58,*** *Safeguard Review Procedures, Operational Procedures, ADB Operations Manual*).

A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Each proposed project is scrutinized as to its type, location, scale, sensitivity and the magnitude of its potential environmental impacts. The level of detail and comprehensiveness of the EIA or IEE are commensurate with the significance of the potential impacts and risks.

The proposed SBPCL II Power Plant falls under Category A according to ADB environmental categorization of projects, as the potential exists for significant adverse environmental impacts. An environmental impact assessment (EIA) is, therefore, an essential element of this project.

ADB requires public consultation in the environmental assessment process. For Category A projects, the borrower needs to consult with groups affected by the proposed project. The consultation needs to be carried out as early as possible in the project cycle so that views of affected groups are taken into account in the design of the project and its environment mitigation measures. For category A projects, ADB ensures that the borrower or private sector sponsor carries out public consultation at least twice, during the development of the EIA and then to present the conclusions of the report. One category wise consultation was carried out during the validation of the 2012 baseline conditions and it expected that SBPCL II will carry out consultations during the rest of the construction period.

The EIA must include an Environmental Management Plan (EMP) that outlines specific mitigation measures, environmental monitoring requirements, and related institutional arrangements, including budget requirements. Loan agreements include specific environmental covenants that describe environmental requirements, including the EMP. The provisions for the EMP must also be fully reflected in the project administration memorandums. To ensure proper and timely implementation of the EMP and adherence to the agreed environmental covenants, ADB requires borrowers or executing agencies to submit semi-annual reports on implementation of EMP, and that this requirement be reflected in the loan agreements.

With regards socio-economic impacts, ADB screens all projects to determine whether or not they involve Involuntary Resettlement or have potential impacts on Indigenous Peoples. A project's involuntary resettlement category is determined by the category of its most sensitive component in terms of involuntary resettlement impacts. The Involuntary Resettlement Impacts of an ADB-supported project are considered significant if ***"...200 or more persons*** experience ***major impacts***, which are defined as ***(i) being physically displaced from housing, or (ii) losing 10% or more of their productive assets (income generating)."*** The level of detail and comprehensiveness of the Resettlement Action Plan (RAP) are commensurate with the significance of the potential impacts and risks. A proposed project is assigned to one of the following categories depending on the significance of the probable involuntary resettlement impacts:

> **Category A –** a proposed project is classified as category A if it is likely to have significant involuntary resettlement impacts. A resettlement plan, including assessment of social impacts, is required.
>
> **The SBPCL II Power Plant Project is classified Category A**
>
> **Category B –** a proposed project is classified as category B if it includes involuntary resettlement impacts that are not deemed significant. A resettlement plan, including assessment of social impacts, is required.
>
> **Category C –** a proposed project is classified as category C if it has no involuntary resettlement impacts. No further action is required.
>
> **Category FI –** a proposed project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary.

For a project involving involuntary resettlement, a RAP, commensurate with the extent and degree of the impacts, is required. The degree of impacts shall be determined by the scope of physical and economic displacement, and the vulnerability of the affected persons.

With regards the Land Acquisition process, Safeguard Requirement 2 of the SPS does not apply to negotiated settlements, unless expropriation results upon the negotiation failure. Negotiated settlements help avoid expropriation and eliminate the need to use government authority to remove people forcibly. The borrower is, hence, encouraged to acquire land and other assets through a negotiated settlement wherever possible, based on meaningful consultation with Project Affected Persons (PAPs), including those without legal title to assets. A negotiated settlement will offer an adequate and fair price for land and/or other assets. The borrower will ensure that any negotiations with displaced persons openly address the risks of asymmetry of information and bargaining power of the parties involved in such transactions. For this purpose, the borrower will engage an independent external party to document the negotiation and resettlement processes. The borrower will agree with ADB on consultation processes, policies, and laws that are applicable to such transactions; third-party validation; mechanisms for calculating the replacement costs of land and other assets affected; and record-keeping requirements.

In line with ADB's Public Communications Policy, relevant information (whether positive or negative) about social and environmental safeguard issues is to be made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and to other stakeholders, including the general public, so they can provide meaningful inputs into project design and implementation.

2.1.3 Performance Standards of the World Bank Group

In accordance with OP 4.03, the World Bank has adopted the eight IFC Performance Standards as 'WB Performance Standards'. These standards are to be used in lieu of the

World Bank Safeguard Policies. The eight IFC Performance Standards are outlined in section 2.1.4.

2.1.4 International Finance Corporation Performance Standards and Environmental, Health and Safety Guidelines

The International Finance Corporation (IFC) has set out 8 Performance Standards, as listed below, in respect of various parameters pertaining to a proposed project.

Performance Standard 1:	Assessment and Management of Environmental and Social Risks and Impacts;
Performance Standard 2:	Labor and Working Conditions;
Performance Standard 3:	Resource Efficiency and Pollution Prevention;
Performance Standard 4:	Community Health, Safety, and Security;
Performance Standard 5:	Land Acquisition and Involuntary Resettlement;
Performance Standard 6:	Biodiversity Conservation and Sustainable Management of Living Natural Resources;
Performance Standard 7:	Indigenous Peoples; and
Performance Standard 8:	Cultural Heritage.

Of the above eight Performance Standards set by IFC, 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 remaining seven Performance Standards, i.e., Performance Standards 2 to 8 seek to ascertain establish requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

In addition to the eight Performance Standards, the IFC General Environmental, Health and Safety (EHS) Guidelines are considered pertinent to the Project. The EHS Guidelines comprise technical reference documents with general industry-specific examples of Good International Industry Practice. The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, which provide guidance to users on EHS issues in specific industry sectors. During preparation of this ESIA for the SBPCL II Power Plant project, the General EHS Guidelines were applied and relevant guidance in the Industry Sector Guidelines for *Thermal Power Plants* (dated December 19, 2008) and *Gas Distribution Systems* (April 30, 2007) was followed (where applicable).

The IFC *Policy on Disclosure of Information,* The Access to Information Policy is effective as of January 1, 2012 supersedes the IFC Disclosure of Information Policy of April 2006. The policy seeks to provide accurate and timely information regarding its activities to clients, partners and stakeholders including the Affected Communities and other interested parties. With regards to Environmental and Social information, the IFC makes public:

For each proposed Category A and B project, IFC discloses a summary of its review findings and recommendations, the Environmental and Social Review Summary (ESRS).The ESRS includes:

i) reference to the Performance Standards and any applicable grievance mechanisms, including the CAO;
ii) the rationale for IFC's categorization of a project;
iii) a description of the main environmental and social risks and impacts of the project;
iv) key measures identified to mitigate those risks and impacts, specifying any supplemental actions that will need to be implemented to undertake the project in a manner consistent with the Performance Standards, or where required by IFC, the Environmental and Social Action Plan (ESAP);
v) where greater than 25,000 MT CO2 equivalent, the expected GHG emissions of the project;
vi) electronic copies or web links, where available, to any relevant Environmental and Social Impact Assessment (ESIA) documents prepared by or on behalf of the client; and
vii) for those projects where the verification of the Free, Prior, and Informed Consent (FPIC) of indigenous peoples is required, a description of the status of that consent process;

2.1.5 Safeguard Requirements of Equator Principle Financial Institutions

The ten requirements of the Equator Principle Financial Institutions (EPFIs) correspond to the following parameters:

- *Principle 1 (Review and Categorization)*: When a project is proposed for financing, the EPFI will, as part of its internal environmental and social review and due diligence, categorise it based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorisation process of the International Finance Corporation (IFC). Projects are classified, relating to social or environmental impacts, in Category A (significant impacts), Category B (limited impacts) and Category C (minimal or no impacts).

- *Principle 2 (Environmental and Social Assessment)*: For all Category A and Category B Projects, the EPFI will require the client to conduct an assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed project (which may include the illustrative list of issues found in Exhibit II to the EPs). The Assessment Documentation should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.

- *Principle 3 (Applicable Environmental and Social Standards)*: The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. The EPFI will require that the assessment process evaluates compliance with the applicable standards as follows:

- For projects located in Non-Designated Countries, the assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines); and

- *Principle 4 (Environmental and Social Management System and Equator Principles Action Plan)***:** For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards;

- *Principle 5 (Stakeholder Engagement):* For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders. For projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to the risks and impacts of the project, the project's phase of development; the language preferences of the Affected Communities, their decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation.
  To facilitate Stakeholder engagement, the client will, commensurate to the project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner.
  The client will take account of and document, the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts, disclosure should occur early in the assessment process, in any event before the project construction commences, and on an ongoing basis.
  EPFIs recognise that indigenous peoples may represent vulnerable segments of project affected communities. Projects affecting indigenous peoples will be subject to a process of informed Consultation and Participation, and will need to comply with the rights and protections for indigenous peoples contained in relevant national law, including those laws implementing host country obligations under international law. Consistent with the special circumstances described in IFC Performance Standard 7 (when relevant as defined in Principle 3), projects with adverse impacts on indigenous people will require their Free, Prior and informed Consent (FPIC)[3].

- *Principle 6 (Grievance Mechanism)*: For all Category A and, as appropriate, Category B projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.
  The grievance mechanism is required to be scaled to the risks and impacts of the project and have Affected Communities as its primary user. It will seek to resolve concerns

promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process

- *Principle 7 (Independent Review)*: For all Category A and, as appropriate, Category B projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance. The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible.

- *Principle 8 (Covenants)*: For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. Furthermore for all Category A and Category B Projects, the client will covenant the financial documentation:
  - to comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and
  - to provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and
  - to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan

  Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.

- *Principle 9 (Independent Monitoring and Reporting)*: To assess project compliance with the Equator Principles and ensure ongoing monitoring and reporting after Financial Close and over the life of the loan, the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI..
- *Principle 10 (Reporting and Transparency)*: For all Category A and, as appropriate, Category B Projects:
  - The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online; and

- The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually.

2.1.6 International Conventions

Quite a significant number of international conventions have relevance to activities related to power plant projects and associated facilities. Bangladesh is a party to almost all of such conventions. Such conventions include those on biological diversities, endangered species, desertification, climate change, hazardous wastes, persistent organic pollutants, wetlands, ozone layer depleting substances, nuclear test ban, etc.

Among the above, the following have a greater degree of relevance to SBPCL II, and include policies that have been acknowledged as well as accepted throughout the world as applicable to projects including those related to power generation of the types similar to the proposed one at the Project Site.

a) *Basel Convention*: Signed and ratified by 170 Parties, the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. The Convention aims to protect human health and the environment against the adverse impacts of generation, management, trans-boundary movements and disposal of hazardous and other wastes. The Basel Convention came into force in 1992.

   Although policies and rules are yet to be adopted, in Bangladesh the Department of Environment pursues the spirit of Basel Convention and undertakes, more than often, actions toward indiscriminate use and disposal of such wastes and substances throughout the country.

b) *Kyoto Protocol*: Defined by the United Nations Environment Programme, the Kyoto Protocol treaty is a legally binding agreement providing for industrialized countries to reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this target represents a 29% cut). The goal of the Protocol has been to lower overall emissions of six greenhouse gases — carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, HFCs, and PFCs — over the five-year period of 2008-12. National targets range from 8% reductions for the European Union and some others to 7% for the US, 6% for Japan, 0% for Russia, and permitted increases of 8% for Australia and 10% for Iceland (Kyoto Protocol website, 2014).

   Although the protocol is not binding on developing countries, such countries have to ensure that they act responsibly and avoid greenhouse gas emissions at levels that have been found to be undesirable. The Proposed Development forms part of an overall development of power stations, transmission lines, natural gas fields and related infrastructure.

(c) *Stockholm Convention on Persistent Organic Pollutants*: The Governing Council of the United Nations Environment Programme (UNEP), in 1995, had made a call for global action on the Persistent Organic Pollutants (POPs), which it defined as "*chemical* *substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment*".

This was followed by assessment of the 12 worst offenders, known as the *dirty dozen*, made by the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme on Chemical Safety (IPCS). The negotiations for the Convention were completed on 23 May 2001 in Stockholm. The convention entered into force on 17 May 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agree to outlaw nine of the *dirty dozen* chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans.

Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and trans-boundary threat. The first set of new chemicals to be added to the Convention was agreed at a conference in Geneva on May 8, 2009.

Whilst the use of electrical transformers containing Polychlorinated biphenyls (PCBs) – a chemical substance belonging to the above dirty dozen that have been banned under the Stockholm convention – is an issue at some power generating facilities, it has been confirmed by the equipment supplier that PCB containing oils and equipment will not be used at the proposed SBPCL II Power Plant.

2.2 Land Acquisition Policies

2.2.1 IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement

Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Performance Standard 5 identifies that involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition[3].

According to Performance Standard 5, resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that results in displacement. This occurs in cases of:

- (i) lawful expropriation or restrictions on land use based on eminent domain[4]; and
- (ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

Performance Standard 5 states that involuntary resettlement should be avoided or at least minimized as it has the potential to result in long-term hardship and impoverishment for affected persons and communities, as well as environmental damage and social stress in areas to which they have been displaced.

[3] Land acquisition includes both outright purchases of property and purchases of access rights, such as rights of way.

[4] Such restriction may include restrictions of access to legally designated nature conservation areas.

Where involuntary resettlement is unavoidable, Performance Standard 5 indicates that it should be minimized and appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented.
The objectives of Performance Standard 5 are identified to be:

- To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs;
- To avoid forced eviction;
- To improve, or restore, the livelihoods and standards of living of displaced persons;
- To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites;
- To improve, or restore, the livelihoods and standards of living of displaced persons; and
- To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

The applicability of Performance Standard 5 is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of Performance Standard 5 is managed through the client's Environmental and Social Management System, the elements of which are outlined in IFC Performance Standard 1.

Where project impacts on land, assets, or access to assets become significantly adverse at any stage of the project, IFC states that the client should consider applying requirements of Performance Standard 5, even where no land acquisition or land use restriction is involved.

Performance Standard 5 sets out various general requirements including:

- Consideration of feasible alternative project designs to avoid or minimize physical and/or economic displacement, while balancing environmental, social, and financial costs and benefits, paying particular attention to impacts on the poor and vulnerable;
- When displacement cannot be avoided, the client will offer displaced communities and persons compensation for loss of assets at full replacement cost and other assistance to help them improve or restore their standards of living or livelihoods;
- The client will engage with Affected Communities, including host communities, through the process of stakeholder engagement described in Performance Standard 1;
- The client will establish a grievance mechanism consistent with Performance Standard 1 as early as possible in the project development phase;
- Where involuntary resettlement is unavoidable, either as a result of a negotiated settlement or expropriation, a census will be carried out to collect appropriate socio-economic baseline data to identify the persons who will be displaced by the project, determine who will be eligible for compensation and assistance, and discourage ineligible persons, such as opportunistic settlers, from claiming benefits.
- When cases where affected persons reject compensation offers that meet the requirements of this Performance Standard and, as a result, expropriation or other legal procedures are initiated, the client will explore opportunities to collaborate with the responsible government agency, and, if permitted by the agency, play an active role in resettlement planning, implementation, and monitoring; and
- The client will establish procedures to monitor and evaluate the implementation of a Resettlement Action Plan or Livelihood Restoration Plan and take corrective action as

necessary. The extent of monitoring activities will be commensurate with the project's risks and impacts. Implementation of a Resettlement Action Plan or Livelihood Restoration Plan will be considered completed when the adverse impacts of resettlement have been addressed in a manner that is consistent with the relevant plan as well as the objectives of Performance Standard 5.

In regard to displacement, Performance Standard 5 classifies displaced persons as those

(i) who have formal legal rights to the land or assets they occupy or use;

(ii) who do not have formal legal rights to land or assets, but have a claim to land that is recognized or recognizable under national law; or

(iii) who have no recognizable legal right or claim to the land or assets they occupy or use. The census will establish the status of the displaced persons.

Performance Standard 5 acknowledges that project related land acquisition and/or restrictions on land use may result in the physical displacement of people as well as their economic displacement. Consequently, requirements of Performance Standard 5 in respect of physical displacement and economic displacement may apply simultaneously. The key requirements of Performance Standard 5 in regard to physical and economic displacement are set out below:

Physical Displacement

- the client will develop a Resettlement Action Plan that covers, at a minimum, the applicable requirements of Performance Standard 5 regardless of the number of people affected. This will include compensation at full replacement cost for land and other assets lost. The client will document all transactions to acquire land rights, as well as compensation measures and relocation activities;
- the client will (i) offer displaced persons choices among feasible resettlement options, including adequate replacement housing or cash compensation where appropriate; and (ii) provide relocation assistance suited to the needs of each group of displaced persons. New resettlement sites built for displaced persons must offer improved living conditions.
- the client will offer the choice of replacement property of equal or higher value, security of tenure, equivalent or better characteristics, and advantages of location or cash compensation where appropriate. Compensation in kind should be considered in lieu of cash;
- the client will offer displaced persons a choice of options for adequate housing with security of tenure so that they can resettle legally without having to face the risk of forced eviction. Where these displaced persons own and occupy structures, the client will compensate them for the loss of assets other than land, such as dwellings and other improvements to the land, at full replacement cost, provided that these persons have been occupying the project area prior to the cut-off date for eligibility;
- the client is not required to compensate or assist those who encroach on the project area after the cut-off date for eligibility, provided the cut-off date has been clearly established and made public;
- forced evictions will not be carried out except in accordance with law and the requirements of Performance Standard 5.

Economic Displacement

- In the case of projects involving economic displacement only, the client will develop a Livelihood Restoration Plan to compensate affected persons and/or communities and offer other assistance that meet the objectives of Performance Standard 5;
- Economically displaced persons who face loss of assets or access to assets will be compensated for such loss at full replacement cost.
  - In cases where land acquisition or restrictions on land use affect commercial structures, affected business owners will be compensated for the cost of reestablishing commercial activities elsewhere, for lost net income during the period of transition, and for the costs of the transfer and reinstallation of the plant, machinery, or other equipment;
  - In cases affecting persons with legal rights or claims to land which are recognized or recognizable under national law, replacement property (e.g., agricultural or commercial sites) of equal or greater value will be provided, or, where appropriate, cash compensation at full replacement cost;
  - Economically displaced persons who are without legally recognizable claims to land will be compensated for lost assets other than land (such as crops, irrigation infrastructure and other improvements made to the land), at full replacement cost. The client is not required to compensate or assist opportunistic settlers who encroach on the project area after the cut-off date for eligibility
- In addition to compensation for lost assets, if any, economically displaced persons whose livelihoods or income levels are adversely affected will also be provided opportunities to improve, or at least restore, their means of income-earning capacity, production levels, and standards of living.
- Transitional support should be provided as necessary to all economically displaced persons, based on a reasonable estimate of the time required to restore their income-earning capacity, production levels, and standards of living.

Performance Standard 5 also sets out private sector responsibilities under government-managed resettlement. The Standard states that where land acquisition and resettlement are the responsibility of the relevant government, the client will collaborate with the responsible government agency, to the extent permitted by the agency, to achieve outcomes that are consistent with Performance Standard 5. In addition, it states that where government capacity is limited, the client will play an active role during resettlement planning, implementation, and monitoring.

Where government resettlement measures do not meet the relevant requirements of Performance Standard 5, the client will prepare a Supplemental Resettlement Plan that, together with the documents prepared by the responsible government agency, will address the relevant requirements of Performance Standard 5. The Supplemental Resettlement Plan would include at a minimum

(i) identification of affected people and impacts;
(ii) a description of regulated activities, including the entitlements of displaced persons provided under applicable national laws and regulations;
(iii) the supplemental measures to achieve the requirements of Performance Standard 5; and
(iv) the financial and implementation responsibilities of the client in the execution of its Supplemental Resettlement Plan.

Where government compensation measures do not meet the relevant requirements of Performance Standard 5, the client will develop an Environmental and Social Action Plan to complement government action. This may include additional compensation for lost assets, and additional efforts to restore lost livelihoods where applicable.

2.2.2 Legal Framework under which GoB Acquired the Land

2.2.2.1 Acquisition and Requisition of Immovable Property Ordinance, 1982

This Ordinance provides the Deputy Commissioner (DC) with the power to initiate the acquisition of any property in any locality within his district that is likely to be needed for a public purpose or in the public interest. In this event, the DC shall cause a notice to be published at a convenient place in or near the property to be acquired. Any person having interest in such property may object to the proposed acquisition to the Deputy Commissioner in writing within 15 days. The DC will prepare a report and refer the case to higher authorities for decision. If the property exceeds 10 standard bighas (approximately 1.34 ha) of land, the final decision will be made by the Government. In case of property up to 10 bighas, the final decision will be made by the Divisional Commissioner. However, if no objections are raised within the 15 day time limit, the final decision may be made by the DC in case of properties up to 10 standard bighas of land, otherwise the Divisional Commissioner will take the decision in case of dispute.

After a decision of acquisition of a property has been made, the DC issues a second notice, again to be published at convenient places at or near such property. The public notice shall state the intention of the authorities to take possession of the property. It shall also invite all persons with interests in the property to appear in person or by agent before the DC not later than 15 days after the publication of the notice to state the nature of their interest in the property and submit claims to compensation.

In determining the amount of compensation, the DC shall take into consideration the market value of the property on the date of the publication of the first notice. In this process, the DC shall take into account the average value of similar properties (which was determined by collecting the current cost of land at which being sold and registered from the local land registry office) in the vicinity during the preceding twelve months. In addition to the market value of the property, the DC shall in every case award a sum of fifty percent on such market value in consideration of the compulsory nature of the acquisition.

Among the matters to be considered in determining compensation are the following:

1. The damage that may be sustained by the person interested, by reason of the taking of standing crops or trees which may be on the property at the time of taking possession thereof by the Deputy Commissioner,
2. The damage that may be sustained by reason of the acquisition injuriously affecting his other properties, movable or immovable, in any other matter, or his earnings;
3. If in consequence of the acquisition of the property, the person interested is likely to be compelled to change his residence or place of business, the reasonable expenses, if any, incidental to such change;

In terms of compensation, the Ordinance explicitly states that the DC, when determining compensation, shall neither consider any disinclination of the person to part with the property, nor any increase in the value of the property to be acquired likely to accrue from the use of it after it has been acquired.

Payments of compensation must be made before the authorities take possession of the property.

The property acquired under the ordinance must not, without prior approval of the Government, be used for any purpose other than the purpose for which it has been acquired. After compensation has been paid or deposited in the Public Account, the property shall stand acquired and vest absolutely with the Government free from all encumbrances. The DC can take possession of the property after a declaration has been made in the Official Gazette (refer to Annex 9). Compensation must be paid or deposited within a period of one year from the date of decision of acquisition. All proceedings shall stand abated on the expiry of that period. In addition, the Deputy Commissioner may, with the approval of the competent authorities, revoke all proceedings in respect of the acquisition of any property at any time before the payment of compensation.

The Ordinance also covers the case of temporary acquisition of property for a public purpose or in the public interest. (Often these are areas only temporarily needed for construction purposes.) With prior approval of the Government, the DC can decide on the requisition of any property for a period of two years or more. However, no prior approval will be required for emergency requisition for the purpose of maintaining a transportation or communication system.

The DC may take possession of the requisition after serving the requisition order. The amount of compensation will be equal to the estimated rent (based on the loss of crop production and mutually agreed upon rent)which would have been payable for the use and occupation of the property if it has been taken on lease for that period, plus compensation for estimated expenses for vacating and re-occupying the property. If a person is not satisfied with the amount of compensation, or there is a dispute over ownership, the DC may deposit the money in the Public Account.

A person who does not accept the award made by the DC, in any case under the Ordinance, may submit an application seeking revision of the award to the Arbitrator, within 45 days from the date of notice of the award. The Arbitrator is a government appointed Judicial Officer, not below the rank of Subordinate Judge. A determination by the Arbitrator takes precedence over that of the DC.

An appeal against the decision by the Arbitrator can be made to an Arbitration Appellate Tribunal which consists of a member appointed by the Government from among persons who are or have been District Judges. A decision of the said Tribunal shall be final (Sec. 34). 6.2 Property (Emergency) Acquisition Act, 1989

In the wake of the devastating floods of 1987 and 1988, the government decided to promulgate a new Land Acquisition Act entitled: Property (Emergency) Acquisition Act (Act IX of 1989). The Act was formulated to expedite the emergency acquisition of land to enable the Government 'to control inundation, flood and upsurge caused by natural calamity and to prevent river erosion." The 1989 Act was not meant to replace the 1982 Ordinance, but to complement it for special circumstances. Normally, acquisition of land for development purposes would not come under the 1989 Act. Use of this Act to acquire land for development would require extremely compelling reasons.

2.2.2.2 Administrative and Regulatory Guidelines and Instructions

In addition to the provisions in the law, the land acquisition process is regulated by certain administrative instructions and procedural requirements. The most important of these are summarised below.

In 1976, the Government constituted land allocation committees at the district, divisional and central levels to control what was regarded as too lavish taking of land for public purposes. The committees were charged with ensuring *'the most rigid measures of economy in the use of land for purposes other than agriculture.'*

2.2.2.3 Land Acquisition Procedures

Land acquisition requires interaction between, on the one hand, the Requiring Body (RB), which usually is a national infrastructure development agency, such as the Water Development Board, Power Development Board, Titas Gas, etc., and, on the other, the Acquiring Body (AB), which normally is the Ministry of Land. The Ministry of Land usually delegates its authority to the Deputy Commissioner or the Divisional Commissioner, depending on the magnitude of the land taking, or other considerations. The division of responsibilities between the RB and the AB consists in that the RB provides the technical input and the AB the legal input in the land acquisition process. The Requiring Body must ensure that the Project, for which the land must be acquired, is approved by the competent authorities and that funds are available. The RB must also justify the need for land and other property on the basis of field surveys, including detailed engineering design, and must prepare all necessary documents required for decision making. At this stage, the AB undertakes to process the land acquisition case.

The procedural aspects of land acquisition begin when the RB submits an application to the Deputy Commissioner with a request to acquire land for a specific public purpose. The procedures for dealing with land acquisition matters are laid out in a Government Memorandum, dated October, 1985. With respect to proposals in the water resources sector, additional guidelines are issued by the Water Development Board. The proposal must contain the following items:

- A Proforma indicating the amount of land required, a timetable for the acquisition of land and a purpose for which the land is to be acquired;
- A Layout Plan, which shows the location of the project on a map;
- A Site Plan, showing the alignment in red ink on a Mouza Map;
- A Land Schedule, showing the classification of the land and the ownership of the plots to be acquired (refer to Land Lease Agreement);
- A Certificate of Minimum Requirement, issued by the Requiring Body, stating that the quantity of land proposed for acquisition is the absolute minimum for a proper implementation of the Project (refer to Land Lease Agreement); and
- Administrative Approval, comprising a copy of the approved Proforma.

After receiving the proposal, the DC will arrange for field verifications jointly with the staff of the Requiring Body. This includes a classification of the land to be acquired and an identification of trees and standing crops, which are involved.

The Requiring Body's application is then submitted to the appropriate Land Acquisition Committee (LAC). After clearance by the LAC, the DC issues the preliminary notice and, if required, hears objections against the proposed acquisition. If there is no objection, and if the area is less than ten standard bighas, the DC may give the formal approval for land acquisition. If there are objections, and if the area is greater than ten standard bighas, the DC submits the application to the Commissioner or the Ministry of Land for final approval. The DC's submission shall include the clearance by the relevant LAC, a report on the objection petitions, and information on the likely number of households to be affected.

After the final approval of the President, Commissioner/Deputy Commissioner (as the case may be), the case is referred back to the DC for the assessment of compensation and the identification of the owners of the plots to be acquired. With the final approval to acquire the land, the RB must place the required funds for payment of compensation with the DC. If the RB fails to do that within one year of the date of final approval, all proceedings shall stand abated and a declaration to that effect by the DC will be published in the Official Gazette.

Compensation is paid by the DC's office. There are no specific rules on where and in what form compensation should be paid. Normally, smaller amounts appear to be paid in cash, whereas larger amounts are paid by cheques to persons who are identified by the Chairman or members of the Union Parishad or by gazetted officers. In the event the rightful owner of the land cannot be found, or there is a conflict over ownership, or the distribution of compensation, funds are deposited in the Public Account.

In the event the owner of the land does not accept the award of compensation, the person can go for Arbitration according to the provisions of the 1982 Ordinance. After payment of compensation, the ownership of the land is formally transferred to the Requiring Body by mutation in 'dmini of the RB in the government's revenue record, which is maintained at the concerned Thana Land Office. The transfer also is published in the Government Gazette.

2.2.2.4 Institutional Arrangements

The administrative set up for land acquisition has two tiers under the Ministry of Land Administration. At the Division level, there is an Additional Commissioner dealing with land administration under the Commissioner. At the district level, there is an Additional Deputy Commissioner in charge of land administration. Under him, there is at least one Land Acquisition Officer and several Assistant Land Acquisition Officers. The number of officers depends on the size of the District. Non-gazette officers in the land administration include Kanungos and surveyors.

2.2.2.5 Time Frames

Time Frame for Payment of Compensation

The following are time frames relevant to the payment of compensation:

- Payment of compensation must be made before the authority takes possession of the property (Ordinance of 1982).

- Compensation must be paid or deposited within a period of one year from the date of final decision of acquisition by the DC. All proceedings shall stand abated on the expiry of that period (Ordinance of 1982).
- Persons with an interest or right over the property to be acquired have 10 days in the1989 Act and 15 days in the 1982 Ordinance to submit claims for compensation.
- The 1989 (Emergency) Act provides for quicker compensation by introducing the concept of 'provisional compensation' which is to be determined within 10 days of the order of acquisition. Land can be acquired on payment of provisional compensation. However, the final compensation is to be determined within three months from the date of acquisition.

Time Frames for Legal Procedure and Appeal

The following are time frames applying to the legal process:

- The aggrieved party may raise objection in writing against the decision of acquisition within 15 days from the date of serving the notice of acquisition. It may take about a month to make a final decision.
- If a land owner is dissatisfied with the amount of compensation offered, he may apply for arbitration to an Arbitrator not less than the level of a Subordinate Judge within 45 days of the award.
- Subject to the decision of the arbitration, either party may appeal against the decision to the Arbitration Appellate Tribunal within the stipulated period allowed by the court.

2.2.2.6 Framework for Leasing of Government (Khas) Agricultural Land

The rules for managing and leasing Government-owned (khas) land are framed in two notifications in the Bangladesh Gazette: (1) Notification: Bhumo/Sha-8/Kha-jo-bo/46/84/261, Bangladesh Gazette Extra Edition, May 12, 1997, pp 1527-1536; and (2) Notification: Shuno/Sha-4/Kri-kha-jo--bo-1/98-264, Bangladesh Gazette, September 15, 1998.

Under these regulations, the Government leases cultivable agricultural land in the rural areas to landless farming households. The allotments cannot be more than one acre, except in the southern districts where up to 1.5 acres of char land[5] can be allotted. A landless family is defined as one that works in agriculture and may own a homestead, but has no arable land of its own.

The regulations provide for a three-tiered structure, with Committees for the Management and Leasing of Khas Land at the National, District, and Thana levels (police station and subdistrict level adminstration which covers Upazila/subdistrict levels). While the upper committees have oversight and appeal functions, the key operations occur at the Thana level. The Thana Committee for the Management and Leasing of Khas Land is charged with recovering Khas land that is out of Government management, dividing it into plots, and informing the population in the mouza (a village where land owners pay land tax to the Government) about the leasing programme. Once applications have been submitted and the fee of one Taka paid by the applicants, the committee vets the applicants, collates a priority

[5] Char Land - riverine sand and silt landmasses.

list and passes its recommendations to the District level committee. Applicants have 30 days to make an appeal in relation to the composition of the list. Normally, the District committee finalises the list of land lease beneficiaries (allottees). However, in case of disputes, the National level committee examines the circumstances and makes the final determination.

The actual leasing of the land is carried out under the jurisdiction of Assistant Commissioner for Land at the Thana Level, where leaseholders are required to sign a lease agreement. The lease is for the number of years stipulated by the Thana Committee for the Management and Leasing of Khas Land. Normally, rural agricultural or homestead land is leased on a temporary basis for a period of 3 years. There are instances, however, where land lease can be extended for 15 years, whereupon the lease becomes 'permanent" to last for 99 years. Upon retirement, disability or death of a leaseholder, the transfer of the lease is allowed only to their descendants. The leaseholders pay a small annual fee to the Government of Tk 5/per decimal. No land tax is collected in Bangladesh on any agricultural land up to 8.25 acres.

The current reworking of the leasing system in the regulations of 1997 and 1998 is not meant to cover Khas land leased under previous rules. It covers only that Khas land which has been occupied illegally or has been out of government management control for some other reason.

The Government has the right to cancel leases allocated and to recover the land, if that is required for a public purpose. All Khas land that is held under a long-term lease (99 years), if recovered by the Government before the expiry of a lease, is compensated on a premise as if the leaseholder were the owner of the land. There is no provision for the payment of compensation in the event of the involuntary resumption of temporary leases. Under requirements of the 1982 Ordinance, the administration is liable to pay for the loss of standing crops to leaseholders cultivating on the Government-owned Khas land.

3. Description of the Project

3.1 The Project Site

The Project Site is located adjacent to the southern bank of the Kushiyara River, at 91°39′37″ E longitude and 24°38′18″ N latitude. The Project Site is located approximately 3 km to the west of the Sherpur Bridge, approximately 45 km south-west of Sylhet (the district headquarters) and approximately 180 km north-west of Dhaka. Administratively, the Project Site is located in the village of Parkul is Aushkandi Union under Nabiganj Upazila of Habiganj district (refer to Maps 3.1 to 3.4). The SBPCL II Power Plant will be served by natural gas from the Bibiyana gas field, which is located approximately 6.5 km to the west of the Project Site at Karimganj. The proposed route of the gas pipeline is illustrated in Map 3.3.

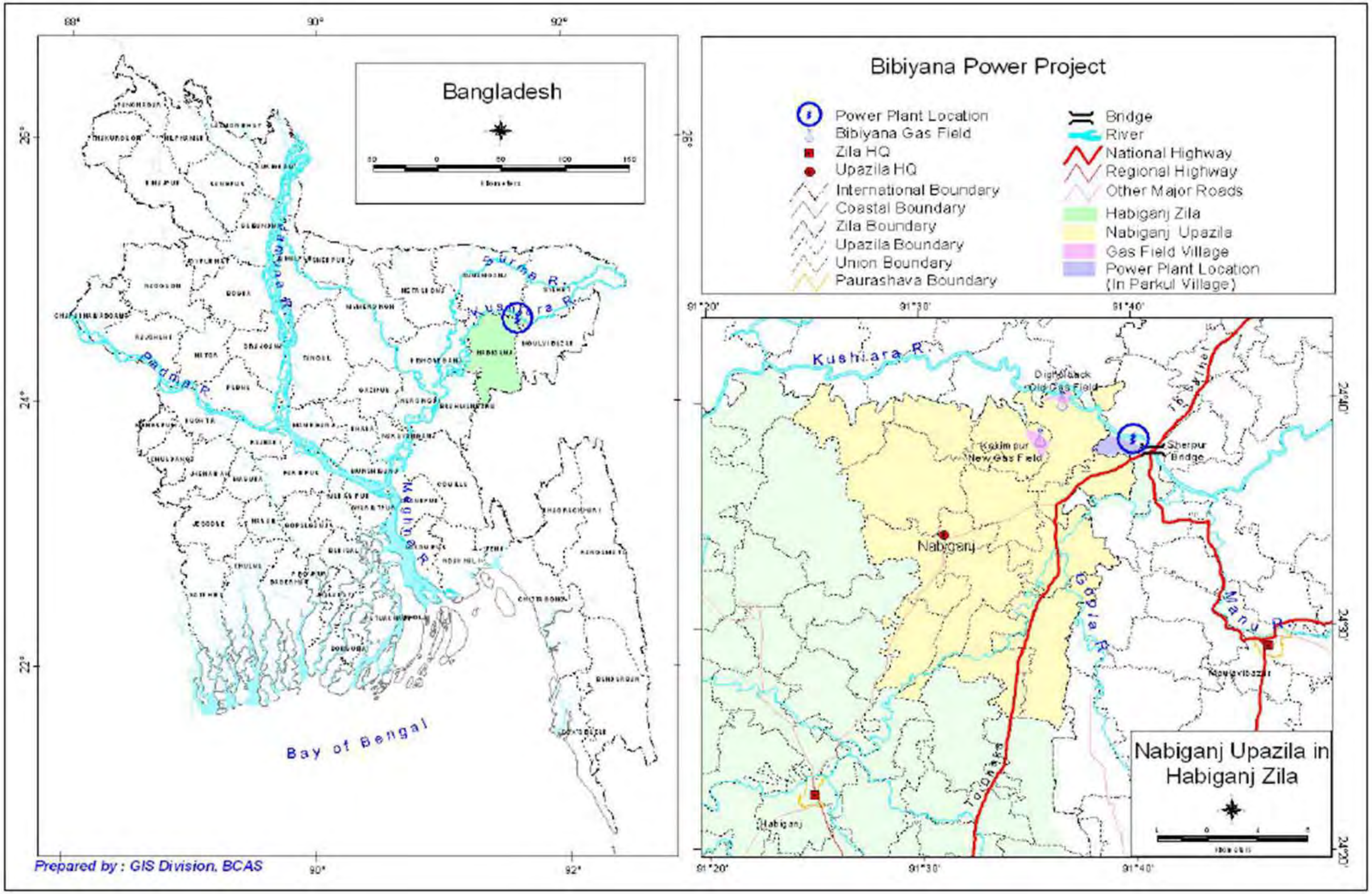
The Project consists of the following primary components and associated facilities:

- Primary Components of SBPCL II Power Plant:
  - Development of the main plant for the SBPCL II project;
  - Development of a construction laydown area;
- Associated Facilities (not to be constructed by SBPCL II):
  - Development of a switch yard for the installation of an electricity sub-station;
  - Development of a 2 km long access road to connect the Proposed Development to the Dhaka-Sylhet (N2) highway (refer to Section 3.8);
  - Development of a 8.8 km Gas Pipeline from the SBPCL II Power Plant to the Bibiyana Gas Field at the Karimpur distribution point (refer to Section 3.6);and
  - Development of a 70 m transmission line from the switch yard to the nearest tower of the national grid.

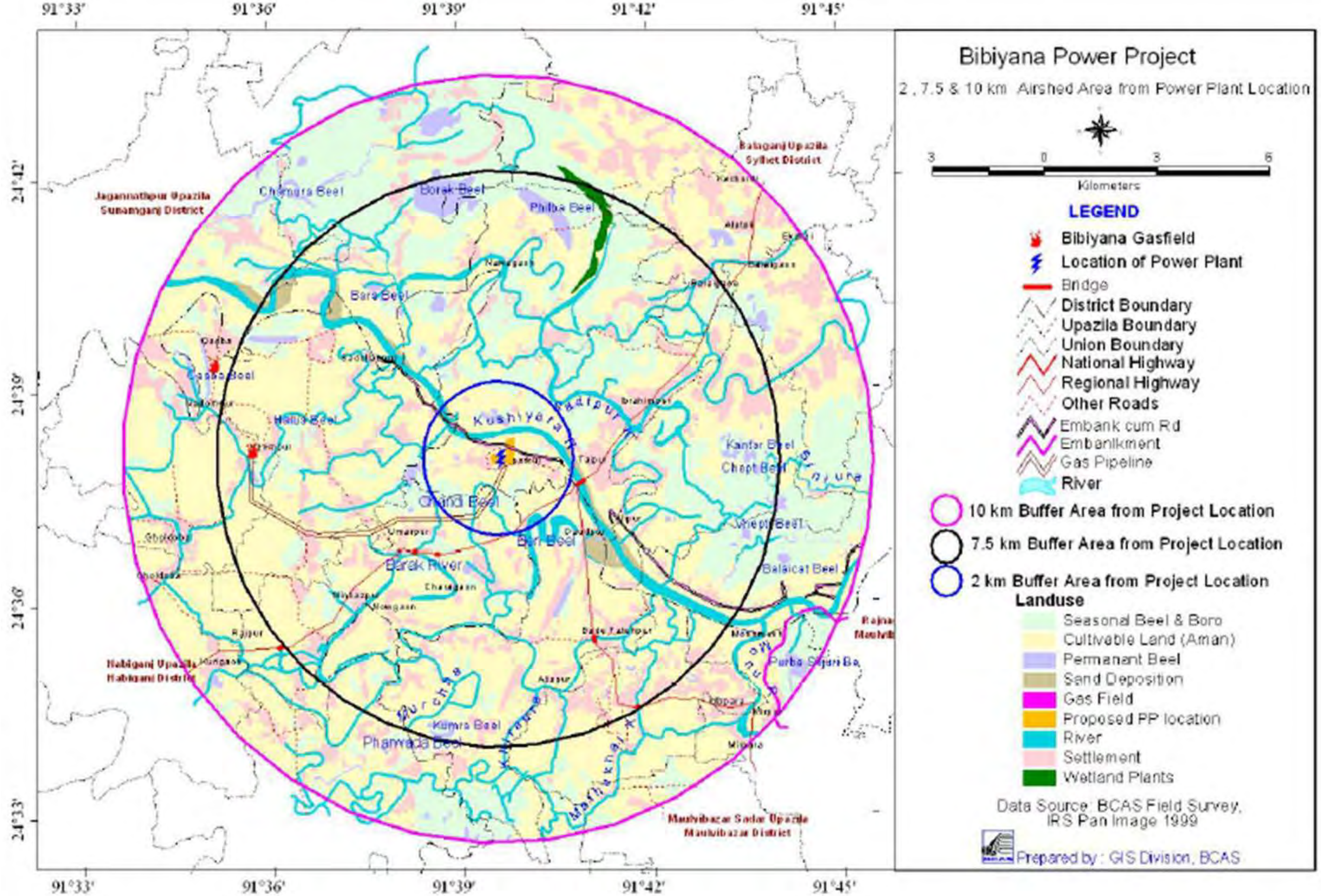
It is noted that the water required for the Proposed Development will be pumped from Kushiyara River through a pumping station to the water treatment plant. No barrages will be necessary.

The Project Site occupies an area of approximately 25 acres, which includes a 14 acre construction ‘lay-down’ area in the northern section of the Project Site. The proposed switch yard, which is to be developed and built by PGCB under the GoB’s own financing and not by SBPCL II, occupies an area of approximately 26 acres (approximately 105,000 m^2). The access road and gas pipeline alignment, which are also to be developed by a third party, occupy an area of approximately 4.20 acres (approximately 17,000 m^2) and 14.4 acres (approximately 58,200 m^2) respectively. The land for the 70 m transmission line from the power plant to the substation will be acquisitioned and requisitioned by PGCB, the exact area is not yet known. An aerial photograph of the Project Site is included in Map 3.5 and the layout of the Project Site is presented in Figure 3.2.

Map 3.1: Location of the Project Site

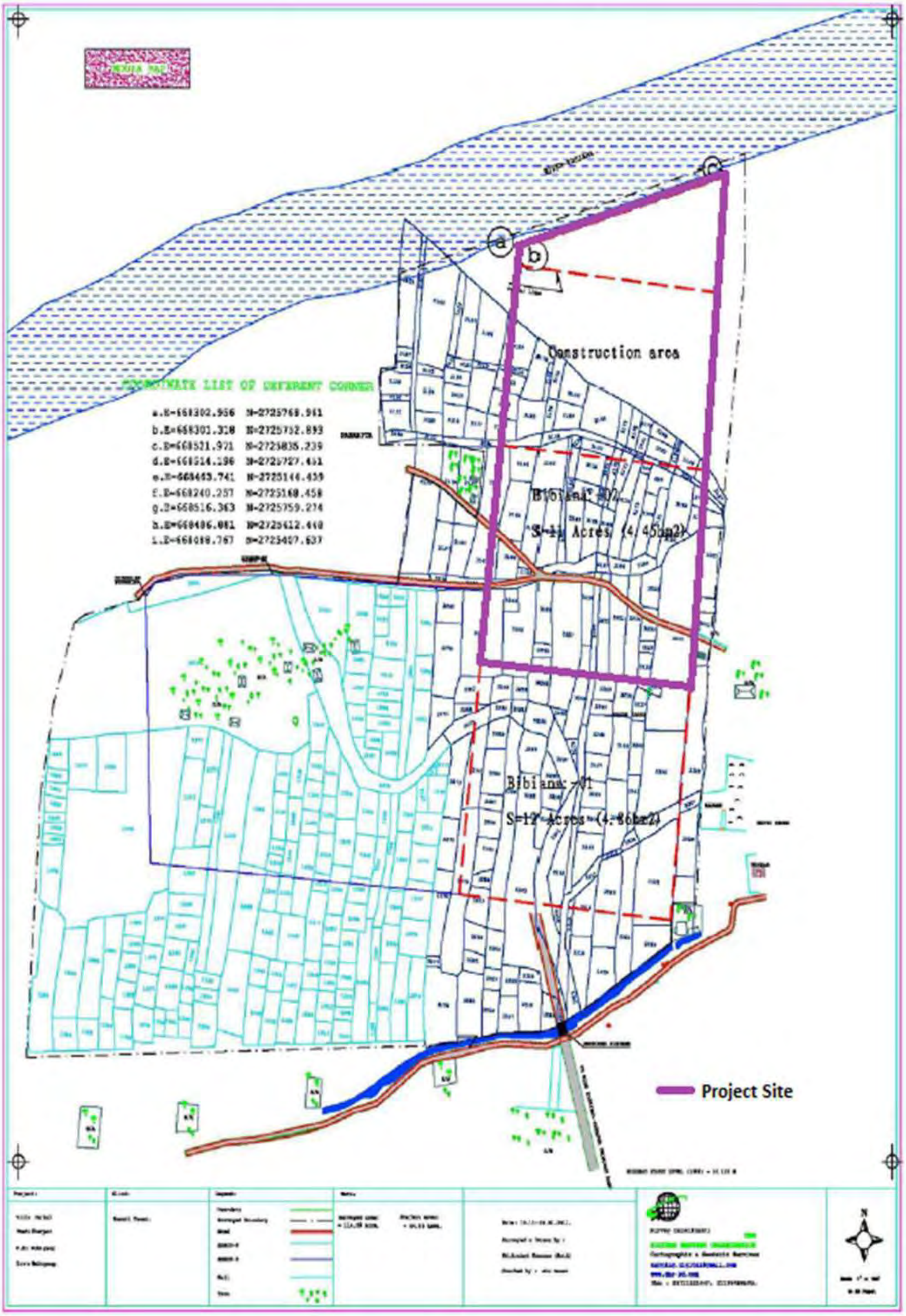


Map 3.2: Location of the Major Project Components



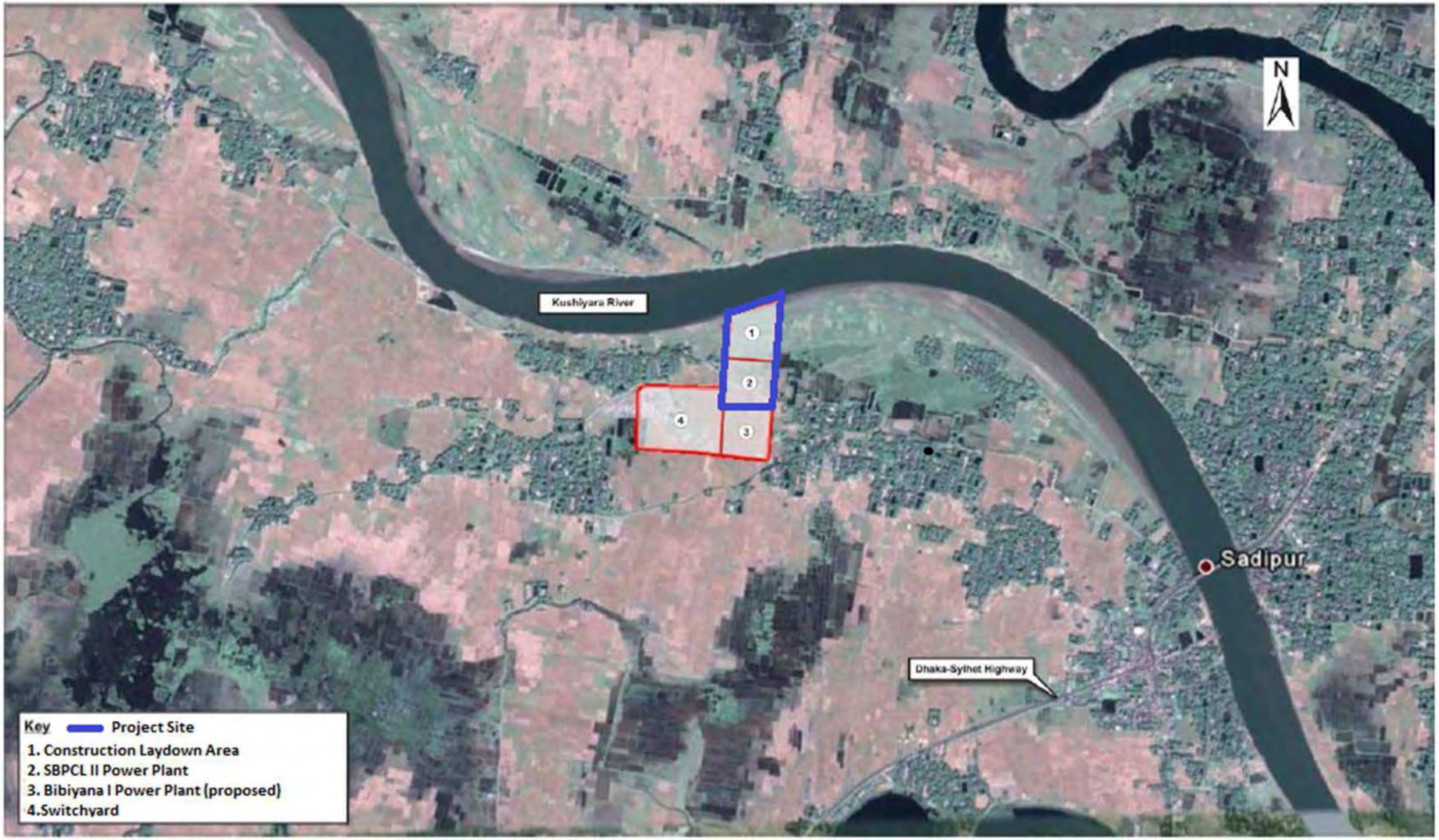
Map 3.3: Plots of Mouza within the Project Site

Mouza is the smallest unit of Land Administration in Bangladesh



Map 3.4: Aerial Photograph of the Project Site, Switchyard and potential, future Bibiyana I Power Plant

© 2011 Google; © 2011 Mapabc.com; Image © GeoEye



3.2 Technological Description

The SBPCL II Power Plant will employ multi-shaft combined cycle technology based on two gas turbine generator units and one steam turbine generator unit, each having a separate power connection to the grid.

3.2.1 Combined Cycle Gas Turbine (CCGT) Technology

The gas turbines will have a capacity of about 222 MW while the capacity of the steam turbines will be 119 MW. The GE ‘PG 935 IFA’ Gas turbine with hydrogen cooled generators will be installed. It will have Dry Low NOx (DLN) combustors with 18 stage axial compressors, 3 stage axial turbines and a common rotor.

As informed by SBPCL II, the type of gas turbine suitable for the SBPCL II Power Plant should be:

i. sound and have a successful track record for use in an environment typical of the project area;

ii. capable of meeting the international standards, specifically those of the IFC guidelines with 50 milligrams (mg) per Nm^3 at 15% excess oxygen in flue gas for NOx emissions; and

iii. capable of reducing the consumption of natural gas to a significant extent compared to that in other technologies available for power generation. In addition, the turbine supplier needs to be capable of offering a long-term spare parts and services agreement for their turbines. The CCGT technology which is being considered to be adopted for the SBPCL II Power Plant, would be capable of meeting the above three requirements. A simplified schematic of a typical CCGT unit and the plant layout are shown in Figure 3.1 and 3.2. The proposed layout for the SBPCL II Power Plant is also presented in Annex 11.

Figure 3.1: Simplified schematic of a typical CCGT unit

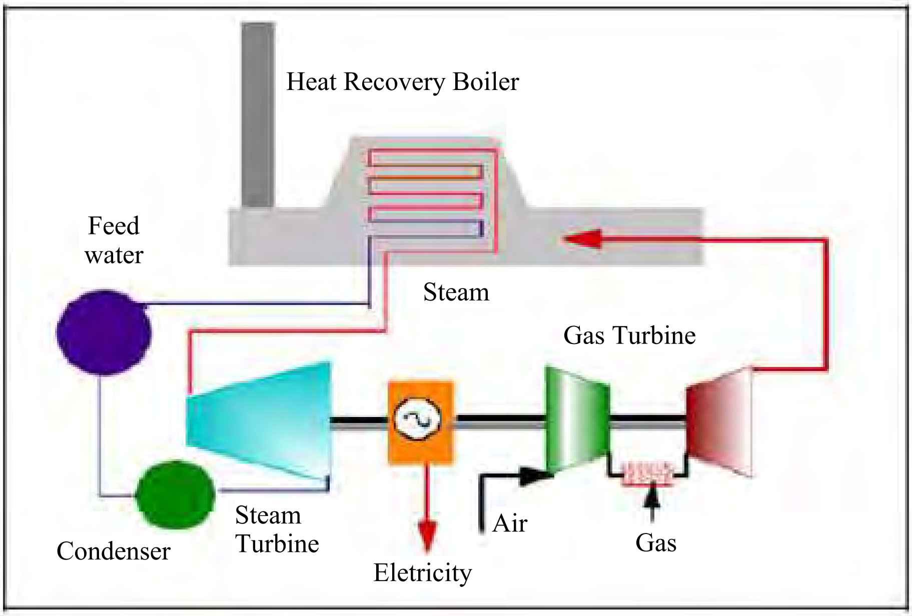
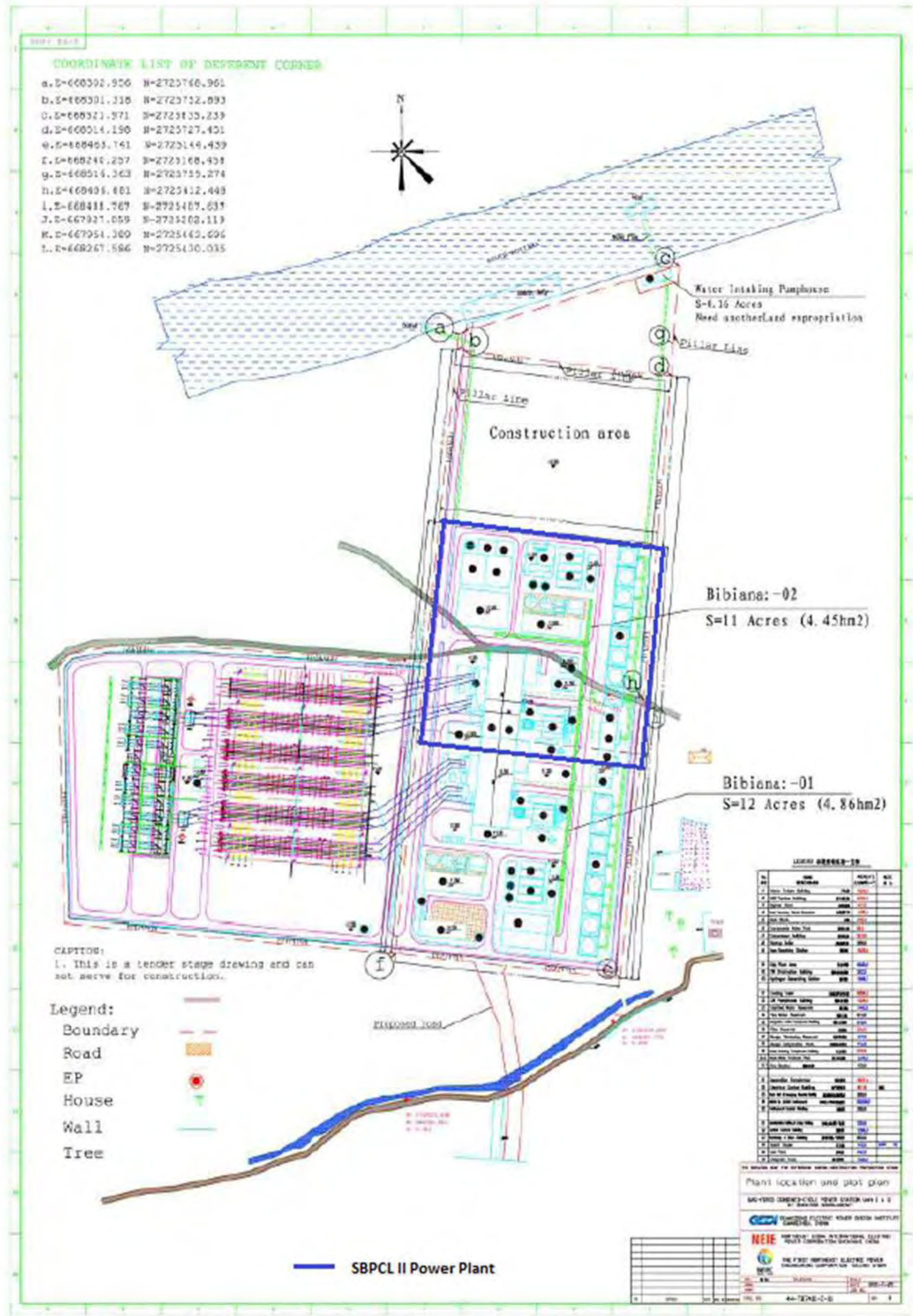


Figure 3.2: Plant layout for SBPCL II Power Plant



The turbine consists of an inlet air system, a compressor, a combustion chamber, turbines, an exhaust system, an auxiliary (backup) system, a control system, and other auxiliaries. In such a turbine system, air enters the compressor through inlet air filters and sound attenuators and enters the combustion chamber from the compressor after getting mixed with fuel. Such a mix of fuel and compressed air undergoes combustion producing high pressure and temperature, and then the gas undergoes expansion in the turbine, releasing energy. After expansion, the exhaust can enter the recovery boiler or be released into the atmosphere through the exhaust system. Tables 3.1 and 3.2 summarize respectively, the expected gas turbine functional specifications and the gas turbine main design parameters.

Table 3.1: Expected Gas Turbine Functional Specifications

Parameter	Detail
Contracted facility dependable capacity	341MW net electrical capacity of the facility at Reference Site Conditions (specified below), without auxiliary firing and with a power factor at the high voltage side of the main step-up transformer of 0.85 lagging, 0.95 leading at a frequency of 50 hertz.
Contracted simple cycle dependable capacity	222 MW net electrical capacity of the facility at Reference Site Conditions (specified below), with a power factor at the high voltage side of the main step-up transformer of 0.85 lagging, 0.95 leading at a frequency of 50 hertz.
Reference site conditions	
Ambient air temperature, °C	32
Relative humidity	85%
River cooling water temperature, °C	28.5
Barometric pressure, bar	1.013
Design conditions for the facility	
Ambient air temperature range, °C	7 to 42
Relative humidity range	40% to 100%
River cooling water temperature range, °C	18 to 32
Minimal gas pressure, bar	24.0
Maximum wind speed, km/h	200
Seismic zone: per Bangladesh Building Code, 1976	Zone III
Basic Seismic coefficient	0.25g
Gasturbine nominal capacity of electric power,MW	124.6
Gas turbine gross efficiency %	33.46%
NO_X, (as NO_2), $\mu g/m^3$	15.01
CO, $\mu g/m^3$	19.21
C = Celsius, MW = megawatt, NO_X = nitrogen oxide, NO_2 = Nitrogen dioxide, CO = carbon monoxide, mg = milligram per cubic meter.	

Source: SBPCL II

In operating conditions the main parameters would likely be as follows:

Table 3.2: Gas Turbine Main Design Parameters

Construction of Turbines	Standard
Fuel	Gas
Output power	126,100 kW

Fuel consumption	10,650 kJ/kWh
Heat	1,343 × 106 kJ
Exhaust gas temperature	618°C
Gas leakage	$1{,}505 \times 10^3$ kg/s
Turning speed cycle/minute	3,000

Source: BCAS.

3.2.2 Unit Performance of Power Plant on Natural Gas Fuel

Guaranteed unit performance of the natural gas fuel to be supplied to the proposed SBPCL II Power Plant is provided in Table 3.3:

Table 3.3: Guaranteed Unit Performance on Natural Gas Fuel

Measurement	Value
Net output (base)	228,692 KW
Net heat rate (base)	9,953 kJ/kWh
Exhaust energy (base)	1,408.5 GJ/h
Exhaust temperature (base) (+/- 6 °C)	618 °C

The unit performance guarantees listed above are based on the scope of equipment supplied and as stated for the following operating conditions and parameters (Table 3.4):

Table 3.4: Basis for Unit Performance Guarantee

Measurement	Value
Elevation	10m
Ambient pressure	1,013mbar
Ambient temperature	32°C
Ambient relative humidity	85%
Inlet system pressure drop	76.2mm H_2O
Exhaust system pressure re. ISO	381mm H_2O
Natural gas fuel heating value (LHV)	49,278kJ/kg
Combustion system type	Dry Low NO_X
Turbine shaft speed	3,000 rpm
Generator terminal power factor	0.80 Lagging

3.2.3 Heat Recovery Steam Generator

The unfired heat recovery steam generator (HRSG) will be either horizontal or vertical design, with natural circulation, and will be operated at sliding pressure rather than constant pressure.

Vibrations caused by the flue gas flow in the structures will be prevented by suitable Construction.

The HRSG will be capable for the operation on continuous partial and base load and the design will assure that the following requirements are met:

- Low thermal inertia to allow a fast start-up;
- High resistance to thermal shocks;
- The design provided will meet the specified noise limits;
- The height of the HRSG flue gas stack will be sufficient to meet all applicable environmental regulations;
- The flue gas stack will be equipped with emission monitoring connections, aviation lights, ladders, and service platforms;
- The HRSG will be equipped with a flue gas damper[6]located between the HRSG and the flue gas stack to keep the HRSG warm during shutdown; and
- A noise silencer will be provided to reduce noise to the required level.

The HRSG construction may be of “outdoor or semi-outdoor” installation type. However, local circumstances will be taken into account when designing dust, noise, and weather protection; in particular, icing conditions when the turbine is not operating will be considered by the EPC Contractor. The façade of the HRSG house will fulfil the requirements of local authorities. The key components and equipment, and main gateways and stairs around the HRSG will be protected from any adverse weather conditions, including freezing and rain.

3.2.4 Steam Turbine Unit

The SBPCL II Power Plant will include steam turbine generator units. The steam turbines will be capable of operating in both fixed and sliding-pressure modes, and in a modified sliding-pressure mode.

During normal operation the steam turbine operates without throttling the main steam flow (sliding-pressure mode).

Overloading requirements specified in International Electro-technical Commission standard (IEC) 60045 will be taken into account.

3.2.5 Configuration of the SBPCL II Power Plant

A combined-cycle facility could consist of four main components: control, auxiliary components, gas turbine, and generator. The plant can work both in open and in locked configuration. 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, 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 and/or for co-generation.

Combined steam-gas cycle has the following advantages:

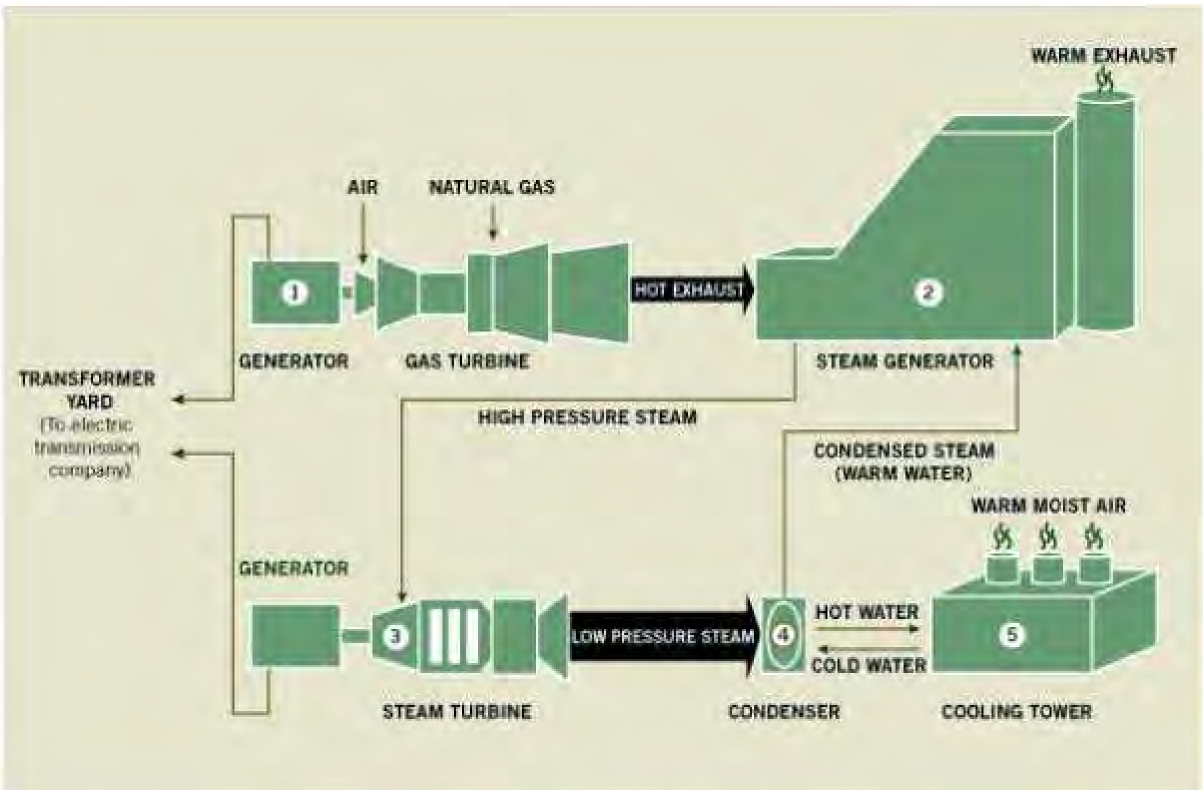
[6]Dampers are used to control the flow of air.

- Energy generation is relatively 'clean', in terms of GHG emissions, when compared with other combustion technologies.
- High efficiency factor, more than 50%.
- Minimal land requirement.
- Minimal water requirements.
- Fast operations: The station starts and shuts downs quickly, so it is possible to operate the facility both for base and peak load.
- Facility construction time is short.
- High level of automation and smaller number of staff required.
- A wide range of fuels can be used, including natural gas, diesel oil, and fuel oil.

3.2.6 Process Flow Diagram

A generic process flow diagram of the proposed SBPCL II Power Plant process is provided in Figure-3.3.

Figure 3.3: Indicative Process Flow Diagram for the Proposed SBPCL II Power Plant



3.2.7 Combined-Cycle Power Plant Cooling Water System

The SBPCL II Power Plant will operate a closed-loop cooling water system. A volume of 17,500 cubic meters (m^3) will be pumped from the river once during start-up for use in the cooling system unit. During operation there will be a need, due to evaporation losses, for replenishment of cooling water ('make-up' water) as well as other operational uses which will be abstracted from the Kushiyara River a rate not exceeding 10,000 cubic meters per hour (m^3/day).

3.2.8 Parameters of the Saturated Steam Cycle

Selection of main parameters depends on the main standards of the supplier's equipment available for the SBPCL II Power Plant.

- High and Low Pressure Steam System:
  - The system design using both high and low pressure allows the steam generator and steam turbine to function without any limitations under full load.
- Feed water System and Main Condensate System:
  - The feed water pumps will be designed according to the boiler code. The SBPCL II Power Plant will be used as base-load to the grid thus it will be possible to use the main condensate pumps and feed water pumps with constant speed.

The capacity of the feed water tank will be sufficient to provide error-free operation.
Performance of steam generator installation is provided even if the quantity of returning condensate and make-up water (feed water) changes. The plant will be supplied with a condensate filter.

- Auxiliary Boiler and Auxiliary Steam Supply System:
  - The auxiliary boiler will be of standard type and will be completely automated. The boiler will be controlled from the control room.
- Feed water Treatment System:
  - The facility for treatment of feed water will consist of, but not be limited to the following systems and equipment: (i) raw-water pumps, (ii) demineralization lines, (iii) raw-water tanks, and (iv) feed water pumps.
- Tests for Water and Steam Cycle:
  - Samples will be taken from different plants of the system and tested to control the water and steam circulating system. Continuous and periodic sampling will be performed and tested in the laboratory. Samples in the cooling chamber must be kept in a building near the laboratory.
- Chemical Dosimeters System:
  - The main function of the chemical dosimeters system is to maintain the power station's water chemistry mode to standard levels.
  - The project will use chemicals that are economical, and safe. Fully automatic measuring system will be used to monitor levels.
- Treatment and Discharge of Wastewater:
  - The plant will have an Effluent Treatment Plant (ETP) to treat wastewater generated from plant activities and a separate Sewerage Treatment plant.

3.2.9 Generators and Systems for Power Output

The project will be based on one gas turbine generator and one steam turbine generator. Each gas turbine will have an approximate capacity of 240 MW and steam turbine will have a capacity of approximately 100 MW.

Each generator will have an air-conditioning system and an air-water cooling system.

3.2.10 Control of Gas Turbine Generators, Steam Turbine Generators and Electrical System

The control of gas and steam turbine generators and plant electrical systems will be performed by the automation system of the plant via its digital control system (DCS), i.e., the man-machine interface will be through the monitors and keyboards of the DCS in the control room of the plant. Each of the transmission line switchgears will have separate control systems with monitors in the control room. These control systems will be linked to the DCS for information exchange.

The daily control of the electrical system during normal operation primarily comprises generator plant operations such as synchronizing and adjusting the reactive output and voltage.

3.3 Technological Specification

The proposed SBPCL II Power Plant will consist of CCGT plant with a gross capacity of 341MW power generation. The plant will run on natural gas from the Bibiyana gas field situated approximately 6.5 km to the west the Project Site at Karimganj (refer to Section 3.6 for details regarding the gas pipeline). Several configuration options are available to achieve an output of 341 MW. The option preferred by SBPCL II is:

Stack Height: .... 60 meters
Effective Stack Height: .... 60 meters
Stack diameter .... 3 meters
Exit gas velocity: ....not less than 15 m/sec.
Fuel consumption per unit power production .... 4021 BTU/kWh
Mass of pollutant emission per unit power production: .... 0.697 g/kWh
Mass of pollutant emission per unit time: .... 87 g/sec NOx
Emission control system used if any: .... Low NOx burners (<25 ppm)

Main cooling system will be closed and a cooling tower will be used to cool the water. Blow down water from the cooling tower will be sent to a basin to cool down further before discharging into the River Kushiyara at its average ambient temperature.

As detailed in Chapter 1, the proposed SBPCL II Power Plant will play a significant role in addressing the present shortfalls in electricity requirements in Bangladesh. The extent of load shedding has reached such a stage that build-up of additional capacity has become a matter of urgent necessity.

3.4 Basis of Operation

The CCGT process is recognized as being the most environmentally benign system of power generation from fossil fuels. Such a system utilizes the following process.

Step 1: Air is drawn into a compressor and, thereafter, is fed to a gas turbine.

Step 2: The compressed air is mixed with natural gas (fossil fuel) in the combustion chamber and subjected to ignition.

Step 3: The hot gas produced is passed through a gas turbine and, as it expands, causes the turbine to rotate at high speed.

Step 4: The rotating turbine is coupled to an electrical Generator, which as it spins produces electricity.

Step 5: The hot gases from the gas turbine are directed to a HRSG where high pressure steam is produced.

Step 6: The high pressure steam is passed through a steam turbine and as it expands causes the turbine to rotate at high speed.

Step 7: The rotating turbine is again coupled to an electrical generator which, as it spins, produces electricity.

Step 8: The spent steam is condensed to water in a condenser at the end of the turbine and recycled to the HRSG.

Step 9: The waste gases from the HRSG are discharged through a chimney in to the air.

Step 10: The electricity generated is fed to an electrical transformers where the voltage is adjusted to allow the transmission to the national grid.

Figure 3.4: A typical flow diagram for a CGGT for SBPCL II Power Plant

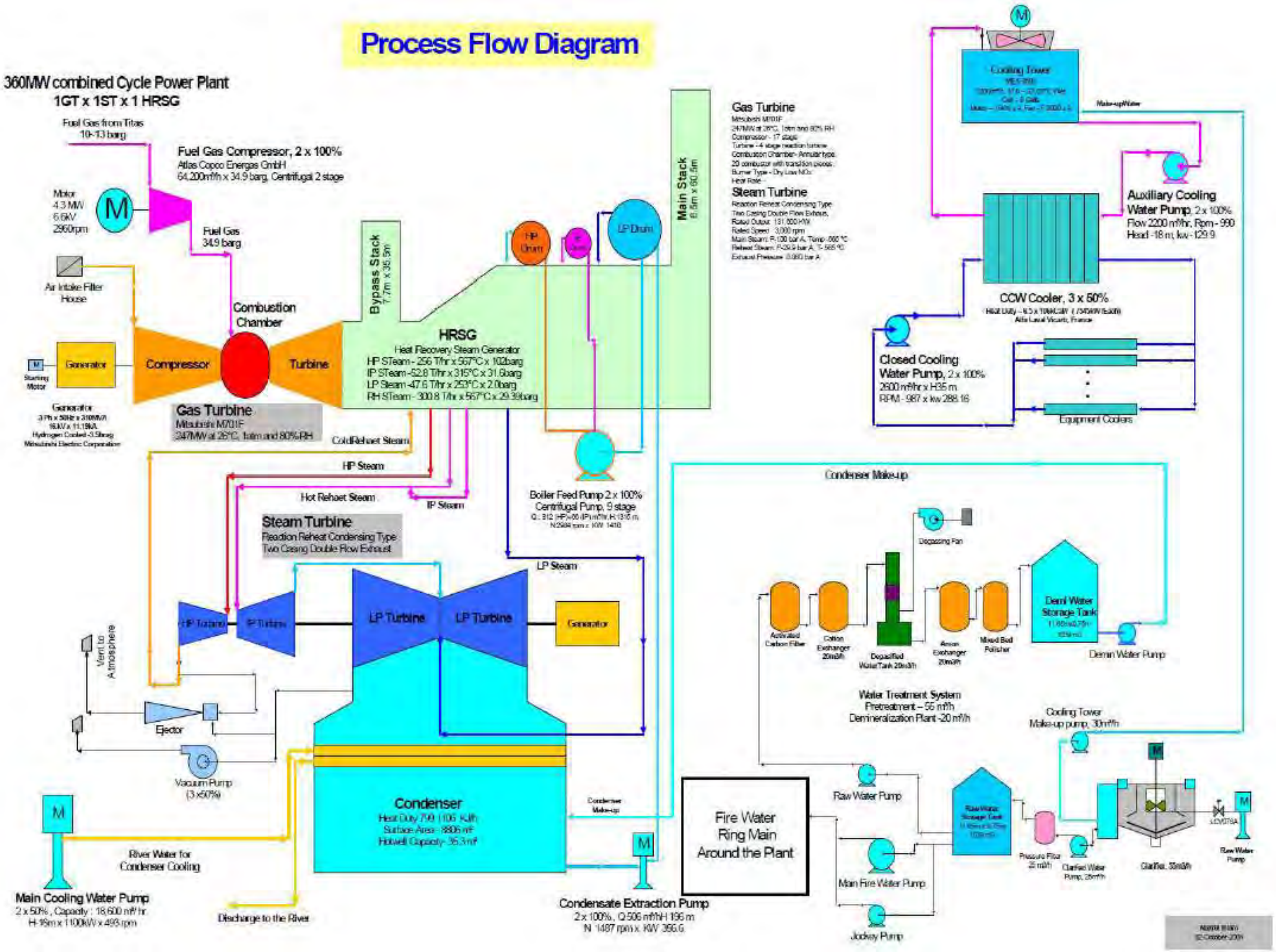


Figure 3.5: Water balance for the SBPCL II Power Plant

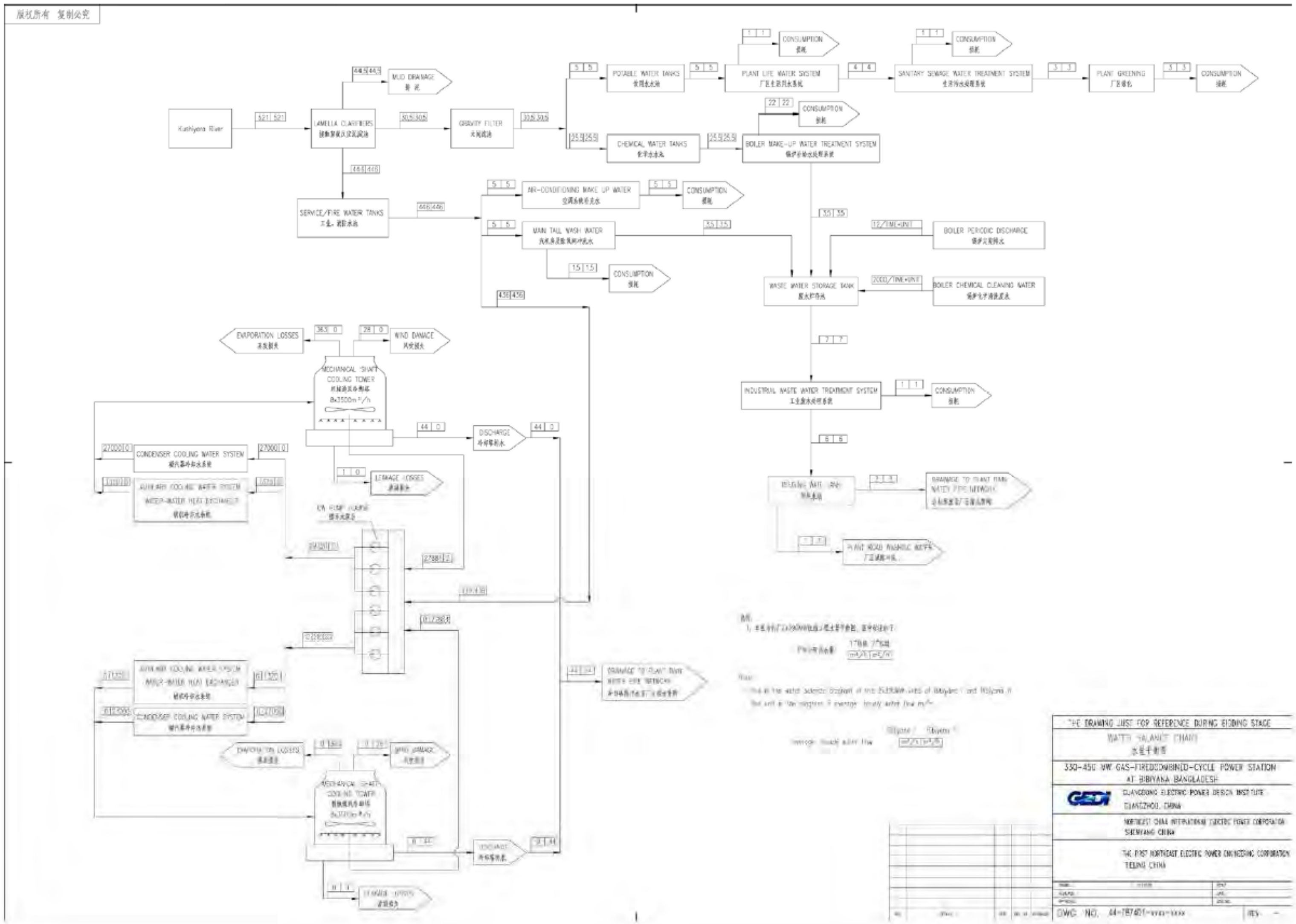
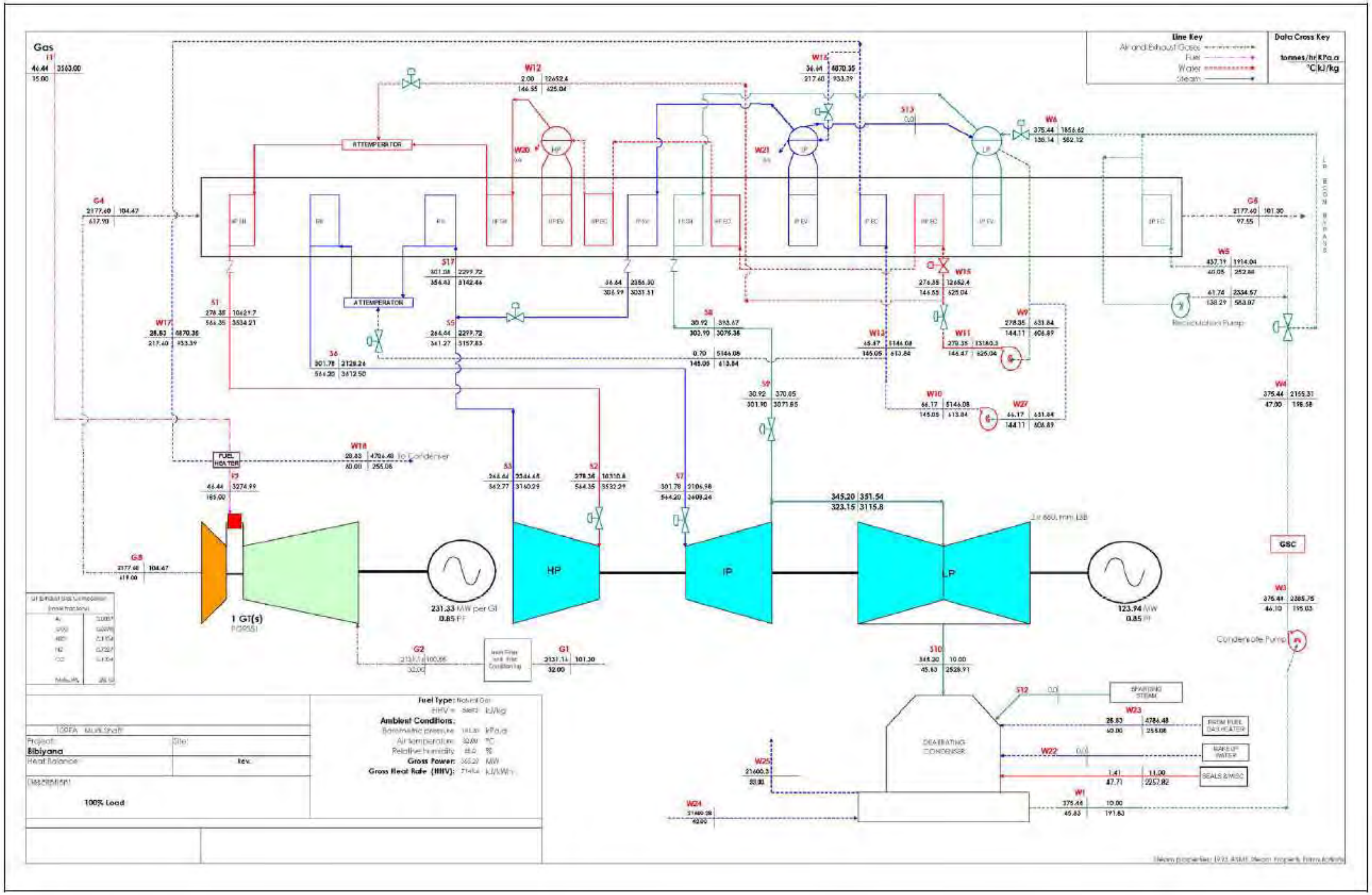


Figure 3.6: Heat Balance for the SBPCL II Power Plant



3.5 Water Supply System

The total water requirement of the SBPCLII Power Plant will be met from the nearby Kushiyara River. Water will be used in two phases, initially during Construction Phase and then during Operation phase.

3.5.1 Water Use: Construction Phase

During the construction phase two major water uses will include use of water for the civil construction of the SBPCL II Power Plant and water use by construction workers ('Potable water'). In addition, wastewater streams will be generated by contractor's and construction workers.
The total anticipated water use during the construction phase is 80 m^3/day. Water will be pumped from the Kushiyara River and a deep tube well may be installed in the area and then treated to potable standards. During the survey it was found that there were no significant adverse impact due to the tube well except for the water flow decreasing during the dry period when the water table goes down. This is a general phenomena in Bangladesh as a whole. This rectifies itself as the recharge resumes in the wet season. The sanitary wastewater will be drained into temporarily built septic tanks and then retained in sumps for later uses such as spraying over the construction area and other vacant areas of the project area to suppress dust, without discharging effluent to the outside.

Storm water will be drained to a sump to let the sediments settle and then clear water from the sump will be separated for various uses in the construction area activities but not as potable water.

3.5.2 Water Use: Operational Phase:

The SBPCL II Power Plant will operate a closed-loop cooling water system. A volume of approximately 10,000 m^3/day will be pumped from the Kushiyara River once during start-up for use in the cooling system unit. During combined cycle operation there will be a need, due to evaporation losses, for replenishment of cooling water ('make-up' water) which will be abstracted from the river a rate not exceeding 1,200 m^3/hr.

3.5.3 Water Use: Other

During operation there is requirement of steam water closed loop cycle of demineralised water which will be produced from demineralised water system stored in a separate demineralised tank of size 2×1000 m^3 in each unit.

Service water, firefighting water, potable drinking water etc. are to be obtained from the Kushiyara River for required treatment. Treatment procedures are outlined separately in this report.

Therefore total water use can be summarised as follows:

- General cooling water (make-up water) and demineralised water for HRSG, ventilation, and air conditioning system.

- Potable water for the staff for drinking and kitchen use purpose, for shower, basin and sink use including other use by staff.
- Service water for battery limit cleaning, washing filters for ventilation system and other equipment. This service water may be hot in nature.

During the operational phase the source of all water will be the Kushiyara River pumped through the cooling water intake system which will be treated as per specification and then will be used for various purposes as mentioned above. The water from the Kushiyara River will be pumped to the Project Site through a pumping station located approximately 15 m from the river bank, though no barrage will be built. The total water requirement for various uses during the combined cycle operational phase will be approximately 10,000 m^3 per day.

3.5.4 Water Treatment

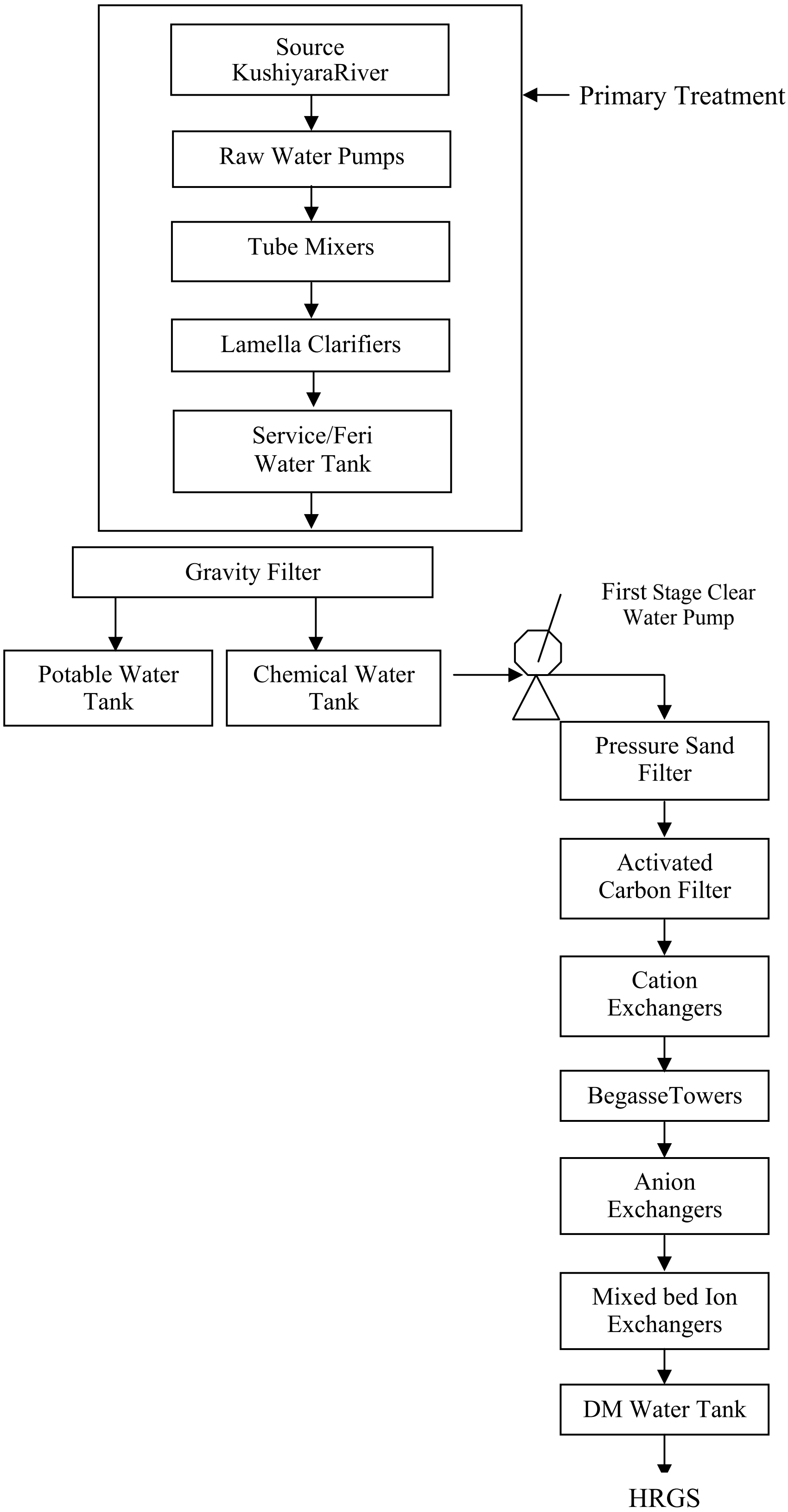
Different water treatment procedures will be adopted, according to the end-use/purpose, and water will be stored in different tanks. The system will have a separate network with a separate monitoring system.

3.5.4.1 Demineralised Water for HRSG

Water for use in the HRSG will be treated in the on-site water treatment plant to achieve a high purity. The water treatment process will consist of activated carbon filter, cation, anion and mixed bed ion exchanger including a degasser tower in between cation and anion exchangers. Regeneration of the ion exchange resins will utilize Hydrochloric (HCl) /sulphuric acid (H_2SO_4) and caustic soda (NaOH). The HRSG feedwater must be de-aerated (removal of oxygen) and pH controlled to prevent corrosion. It will be dosed with ammonia (NH_3), caustic (NaOH) or Phosphate (Na_3PO_4). In addition, oxygen scavenging chemical, dilute hydrazine ($H_2N\text{-}NH_2$) may be required during commissioning to achieve the required water quality.

To obtain the demineralised water for the HRSG, primary treatment of river water is also required where water will be drawn from Kushiyara River into the clarification system shown in the flow sheet below. During primary settling and aeration, lime, aluminum chloride/aluminium sulphate are used as primary coagulant and polyacralide is used as aide coagulant. Total clarified water volume will be 10,000 m^3/day. From this clarified water 1200cubic meter per hour per unit will be utilised for replenishment of cooling water. 1,000 cubic meter of demineralised water is required for HRGS. The sequence of treatment is shown below (Figure 3.7)

Figure 3.7: Flow Chart for Demineralised Water



The demineralised water storage tank will then be the main source of water wherever used during operation of the SBPCL II Power Plant. The storage capacity of each tank will be 2 $\times$1000 m^3. The following plant will be required:

- *Raw water Pumps*: Five raw water pumps will be installed to pump the total required water from the Kushiyara River. Two of the pumps will run at a time with the remaining pumps on standby.

- *Tube Mixers*: The raw water will be drawn to Tube Mixers where suspended solids will be separated out. The clear water will then enter the Lamela clarifier.

- *Clarifier*: Lamella Clarifier will be used in the system. Raw water from Kushiyara River will be pumped into the clarification system after primary settling and aeration. Before entering the clarifier tank, treatment chemicals such as lime, alum, and coagulant aid will be added to the water, as necessary, to aid filtration of the suspensions and partially reduce water hardness.

  Several chemicals will be used in the clarification system. Its handling, storage procedure, degree of toxicity etc. are covered in safety procedures in the ESMMP mitigation chapter.

  1. Lime: A lime solution may be added to partially reduce the hardness of raw water. Lime reacts with the dissolved calcium and magnesium carbonates and forms insoluble calcium carbonates and magnesium hydroxide that precipitates from the water. These are removed as sludge along with other solids.
  2. Aluminium chloride: Basic aluminium chloride will be used in coagulant tank to quicken the precipitation of suspended solids in water.
  3. Coagulant Aid: It is an organic polymer to be added as an aid to aluminium chloride to accelerate filtration of the suspensions which otherwise will not precipitate.

  Any sludge generated by the clarification and filtration process will mainly contain suspended solids settled in the lamella clarifier and the precipitated sludge is non-hazardous.

- *Service / Fire water tanks*: Water available after the clarifier is suitable for Power station maintenance and different service and Fire Fighting systems. Therefore a tank of capacity 4,000cubic meter/unit will hold the required water for service and firefighting purposes.

- *Gravity Filter*: Some amount of water from the Clarifier is taken to gravity filter to treat further in order to make it suitable as drinking water. This water is made bacteria free by applying sodium hypochlorite / liquid chlorine and then becomes suitable for drinking.

- *Demineralization plant:* A demineralised water storage tank and a distribution system will be installed as a part of the Water Treatment System. Resin exchangers incorporated will produce water quality of following specification:
  - Conductivity : < 0.5 micro S/cm at 20°C;
  - Total dissolved solids : <0.5 mg/l (including silica); and
  - Total silica : <0.05 mg/l as SiO_2.

The demineralisation plant will consist of two lines. One line will remain in operation while another will be under regeneration for the next operation.

The demineralization plant will use both diluted hydrochloric acid and sodium hydroxide solution for the regeneration of ion exchanger resin. Hydrochloric acid will be delivered at 35% strength while sodium hydroxide will be delivered in liquid form at 46% strength.

Chemical storage tanks will be situated within a secondary containment area capable of containing and spillage during usage.

Sulphuric/Hydrochloric Acid will be used to regenerate the cation–exchange resin employed in removal of cations from the water. Acid restores the active anionic sites of the exhausted resin by replacing the hydrogen ion for calcium, magnesium and sodium ions absorbed in the resin during the ion exchange process. These metal ions are removed with the regeneration waste in the form of their respective soluble sulphates/chlorides. Any surplus acid leaving with regeneration wastes will be neutralized by adding the equivalent amount of Alkali in the neutralization basin of the wastewater.

Caustic soda will be used to regenerate the exhausted anion exchange resins employed in removal of anions from water. The soluble sodium salt reaction products will be removed with the regeneration waste. Any excess alkali leaving the system will be neutralized in the waste treatment plant by adding the equivalent amount of acid.

Table 3.5: Water Quality Requirements

Purpose	Water type	Water quality
Cooling Water	River water (Kushiyara)	Free from floating object, low hardness and salinity
Make up water	Demineralized water	Total dissolved solids <0.5 mg/l; total silica <0.5 mg/l as SiO_2; Conductivity :<0.5microS/cm at 20 deg. C

3.5.4.2 Wastewater Treatment Facilities

The SBPCL II Power Plant will operate a single effluent treatment plant where effluent from the following sources will be treated:

- Effluent contaminated with chemicals from chemical storage area and laboratory;

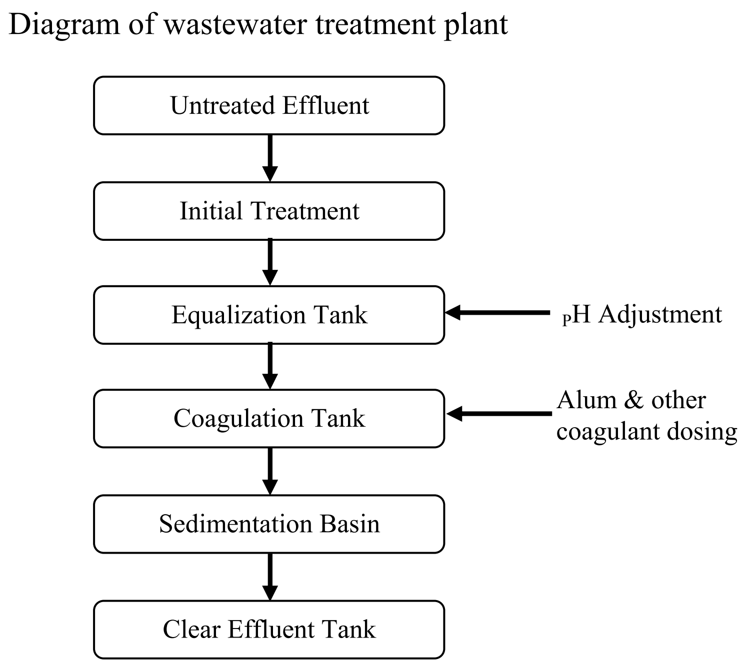
- Regeneration waste from the demineralisation Plant;
- Cleaning wastewater containing grease and oil from the power house, transformer area, and workshop and maintenance house;
- Sanitary wastewater from the office building; and
- HRSG Blow down.

Cleaning waste from the HRSG will be collected in the special wastewater pond for preliminary treatment and will then be directed to the chemical wastewater pond located within the SPBCL II Power Plant.

Wastewater containing oil and grease will be collected in an oily wastewater pond and then passed through a Corrugated Plate Interceptor (CPI) to skim the oil from the wastewater. The oil free wastewater will be transferred to the chemical wastewater pond and the skimmed oil will be stored for disposal. The CPI oil separator functions on the principle of differences of specific gravity of oil and water.

The wastewater from the chemical wastewater pond will be pumped to a pH adjustment tank for neutralization either by acid or by alkali depending on pH. A coagulant will be added to a coagulation tank to aid settlement of the suspended particles in the wastewater. The wastewater will then be directed to a sedimentation basin where the sludge will gradually settle to the bottom of the tank to be collected by a rotating scrapper. The sludge collected from the bottom of the sedimentation basin will be mixed with a polymer for further thickening and the concentrated sludge will be dewatered with a belt filter press. It will be collected in a hopper for disposal after drying. The wastewater from belt filter press is sent back to the chemical wastewater pond. The treatment process shown in Figure 3.8 will be followed at the Project Site.

Figure 3.8: Diagram of wastewater treatment plant



The treated clear effluent passing over the sedimentation basin will be held in an effluent tank and then discharged in to the Kushiyara River. The effluent treatment system is designed to ensure compliance with the following parameters:

Table 3.6: Effluent Quality Parameters

Parameter (all mg/L, except pH and Temperature)	**SBPCL II Effluent Quality**	**IFC Guidelines***
pH	6-9	6-9
TSS	50	50
Oil & grease	10	10
Total residual Chlorine	0.2	0.2
Chromium-Total	0.5	0.5
Copper	0.5	0.5
Iron	1.0	1.0
Zinc	1.0	1.0
Lead	0.5	0.5
Cadmium	0.1	0.1
Mercury	0.005	0.005
Arsenic	0.5	0.5
Temperature (relative to river temp.)	±3°C	±3°C

* IFC EHS Guidelines for Thermal Power Plants

Notes:

Effluent guidelines to be applicable to relevant wastewater stream e.g. from boiler acid washing, regeneration of demineralises and condensate polishers, oil separated water, site drainages and cooling water; Parameters are shown below.

Wastewater Disposal System

An on-site effluent disposal system will be installed to effectively treat and dispose of project effluents. Ultimately all effluents like wastewater treatment system (WTS) effluent, HRSG blow down, treated sewerage, oily drains, and chemical spillage will be discharged after treatment in the wastewater treatment plant.

Boiler Blowdown

Water used in the HRSG will be supplied from the Kushiyara River via the demineralization system installed at the plant premises. Prior to use all water impurities will be removed in the demineralization plant. To maintain steam quality, spent water in the HRSG will be blown down and discharged with the wastewater. It is anticipated that approximately 40 -50 MT/day of boiler blown down will be produced to maintain efficient operational levels. The temperature of boiler blow down is expected to be within the range of 75-80 deg. C. The blow down will then be transferred to the neutralization tank where it will be mixed with regeneration waste from the demineralization system.

Chemicals used in the treatment of boiler water are described below.

1. Hydrazine: (N_2H_4 or $H_2N\text{-}NH_2$): Both diluted and concentrated hydrazine will be utilized for treatment of boiler water. It is anticipated that approximately 1.6 kg /day will be required for plant operation;
2. Diluted Hydrazine : diluted Hydrazine (containing as 1% $N_2H_4(H_2O_2)$ will be applied at the outlet of the condensate pump (CP) to remove the dissolved oxygen in the condensate and control the pH of the feed water during the normal operation of the power station. Hydrazine reacts with the dissolved Oxygen O2 to form water and nitrogen. Complete de-oxygenation is required to minimize corrosion caused by high temperature and pressure in the boiler;
3. Concentrated Hydrazine containing 38% as N_2H_4, H_2O will be applied at the outlet of the CP and the make-up line to remove the dissolved oxygen in the condensate during start up from a vacuum break condition and after a long period of shut down;
4. Ammonia: Ammonia water (2% as NH_4OH) will be applied at the outlet of the CP to control the pH of the boiler feed water during start-up of the plant. During normal operation, part of the injected Hydrazine turns into ammonia, and therefore no additional ammonia injection is required to control the pH. An estimated 25.6 kg/day of ammonia will be required during normal operation;
5. Sodium phosphate (Na_3PO_4): trisodium phosphates (1% as phosphate) will be applied at the inlet of the High Pressure, Intermediate Pressure, and Low Pressure (LP) drums of the boiler to control the pH of water and to remove hardness. The phosphate precipitates whatever small amount of calcium ions reach the boiler water through the treatment system or leakage from the condenser. It is anticipated that 6.7 kg/day of sodium phosphate will be required for the normal operation of the SBPCL II Power Plant.

Blow down water from the cooling tower will be sent to a basin to cool down further before discharging into the Kushiyara River.

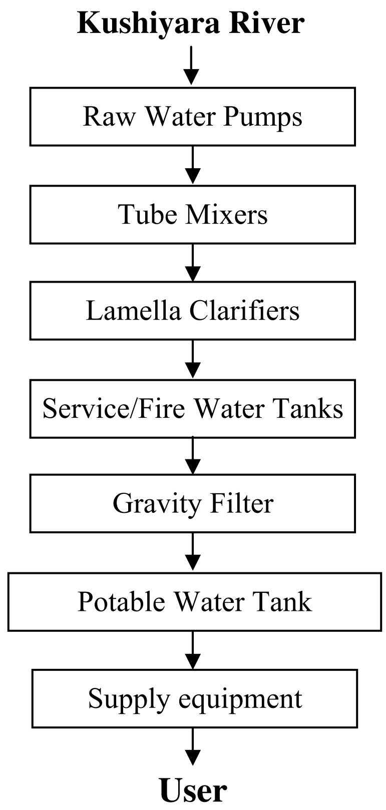
Potable Drinking Water

Approximately 80 $m^3$of potable water is required per day for the SBPCL II Power Plant. The potable water will be drawn from the Kushiyara River during the operational phase of the Proposed Development along with the water for treatment for other use in the SBPCL II Power Plant. Initially river water will go through primary treatment and then after gravity filter it will be made bacteria free and held in a tank denoted as potable water tanks. From this tank through supply equipment will be sent to different plant area through separate network for human consumption.

Recommended dose of Sodium hypochlorite / liquid chlorine solution will be fed after the Gravity filter and before the Potable water tank.

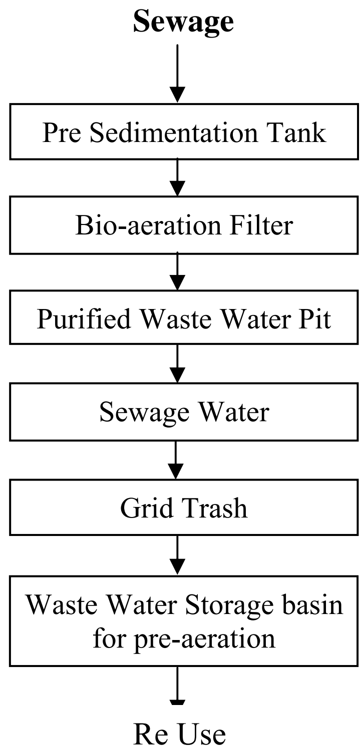
Flow chart of the Potable water system treatment system is shown in Figure 3.9.

Figure 3.9: Potable Drinking Water Flow Diagram



The sewerage water discharged from toilets will be directed to a sewerage water pump well by gravity and then pumped to the sewerage water station for treatment. The Capacity of such unit will be 30 m^3/hr. This will be a combination of domestic sewerage, sludge dewatering etc. Specifically domestic sewerage may comprise approximately 10 m^3. Figure 3.10 shows a schematic of the Sewerage Drainage System.

Figure 3.10: Sewage Disposal System



Description of Hazardous Waste Management

During construction phase different type of paints, thinners can potentially be hazardous if not handled properly. There will be insignificant generation of hazardous waste during the construction phase.

During operational phase the fuel itself can be hazardous if gas pipe lines are not maintained properly. Transportation of different chemicals should be made in appropriate anti-corrosion materials in accordance with the chemical properties of the solutions. Proper loading and unloading facilities shall be built for handling and storage of chemicals. Measures such as vacuum extraction pump transfer or gravity flow transfer shall be used for loading and unloading of concentrated acid and caustic solution. During the operational phase there will be generation of oily water which will be removed in the ETP by emulsifying the liquid waste. The separated oil will be collected by a dedicated contractor.

A steel fuel storage tank having a capacity of 1,000-litres has been built within the Project Site for storing diesel to operate the temporary diesel generator which is required during the construction phase.

List of Chemicals to be used in water treatment system

The following chemicals are used in the water treatment system:

- In the chemical wastewater treatment system, hydrochloric acid and sodium hydroxide is used in the pH adjustment tanks, and liquid basic aluminium chloride is used as a coagulant in coagulation tanks.

- In sewage water treatment system, sodium hypochlorite is used as disinfection for the wastewater after treated.
- In sludge dewatering process, liquid Polyacrylamide is used as a coagulant aid sludge dewatering Dehydrating agent.
- Diluted hydrochloric acid and sodium hydroxide solution are used for the regeneration of ion exchanger resin.
- Outsourced product sodium hypochlorite solution is used for chlorination of cooling water.
- Sulphuric acid and scale inhibitor are used in the cooling water Treatment System.
- Ammonia is fed to the condensate pump discharge header to maintain high pH levels of the feed water.
- Hydrazine is fed to the suction of feed water pumps and suction header of closed loop pumps to maintain and minimize dissolved oxygen rate less than limitation level for the protection of the system from corrosion.
- Phosphate is fed into the boiler drums for removal of hardness through the blow down process and to inhibit corrosion.

3.6 The Gas Pipeline

As per the gas supply agreements (refer to Section 1.1.4), natural gas for the SBPCL II Power Plant will be supplied from the nearby Bibiyana gas field at Karimganj, which is operated by Jalabad Gas Field Company Ltd. (JGFC). The gas will be transmitted through a 20 inch high-pressure pipeline, approximately 8.8 km in length. The Right of Way (ROW) for the pipeline was determined by JGFC and is shown in Map 3.6 below.

The proposed pipeline stretches from the gas-field at Karimganj up to the connecting point of the proposed SBPCL II Power Plant. The pipeline will predominantly pass through agricultural land. It will also pass through seasonal beels where boro rice cultivation is practiced.
The proposed 8.8 km natural gas pipeline will pass through Mouzas Tajabad (Union: Sadipur, Upazilla: Balaganj, District: Sylhet), Karimpur and Uttar Chandpur (Union: Inathganj, Upazilla: Nabiganj, Ditrict: Habiganj); Boaljor, Royghar Bade, Karkhana and Royghar (Union: Digalbak, Upazilla: Nabiganj, District: Habiganj); and Chaitanyapur. Mangalapur, Uttar Umarpur, Bata, Ajalpur and Pitua (Union: Aushkandi, Upazilla: Nabiganj, District: Habiganj).
The type of land use within a 2.5km AoI is detailed in Table 3.7.

Table 3.7: 2.5 km AoI of proposed gas pipeline route

Sl. No.	Type	Area in km^2
1	Cultivable Land	3.53
2	Boro/Seasonal Beel	0.62
3	Settlement	0.38
4	Waterbody	0.05
5	Gas Field	0.02

Whilst the route for the pipeline was determined by JGFC, it is understood that key considerations included minimal disruption to homesteads and water bodies. Inevitably there will be some disruption to agricultural land and the potential impacts are considered further in Section 6.2 of this report and in the Resettlement Action Plan (RAP).

3.6.1 Technological Specification

As stated above the gas pipeline will comprise a 20 inch pipeline to be operated at a maximum pressure of 1440 psig. The pipeline will be constructed on a strip of land of 8 m width (i.e. 4 m either side of the pipeline) and the land will be identified and marked as required by the *National Gas Safety Rules, 1991, as amended up to 2003*. In addition to the 8 m width, an additional 15 m width (i.e. 7.5 m either side of the pipeline) will be provided for construction and laydown. Whilst the Bibiyana gas field is located approximately 6.5 km to the east of the site, the total length of the pipeline will be 8.8 km in order to minimize disruption to homesteads and water bodies. A detailed map of the proposed pipeline route, provided by JGFC and detailed in the gas supply agreements, is included as Map 3.5 and Map 3.6 shows the detailed reconnaissance map of the pipeline.

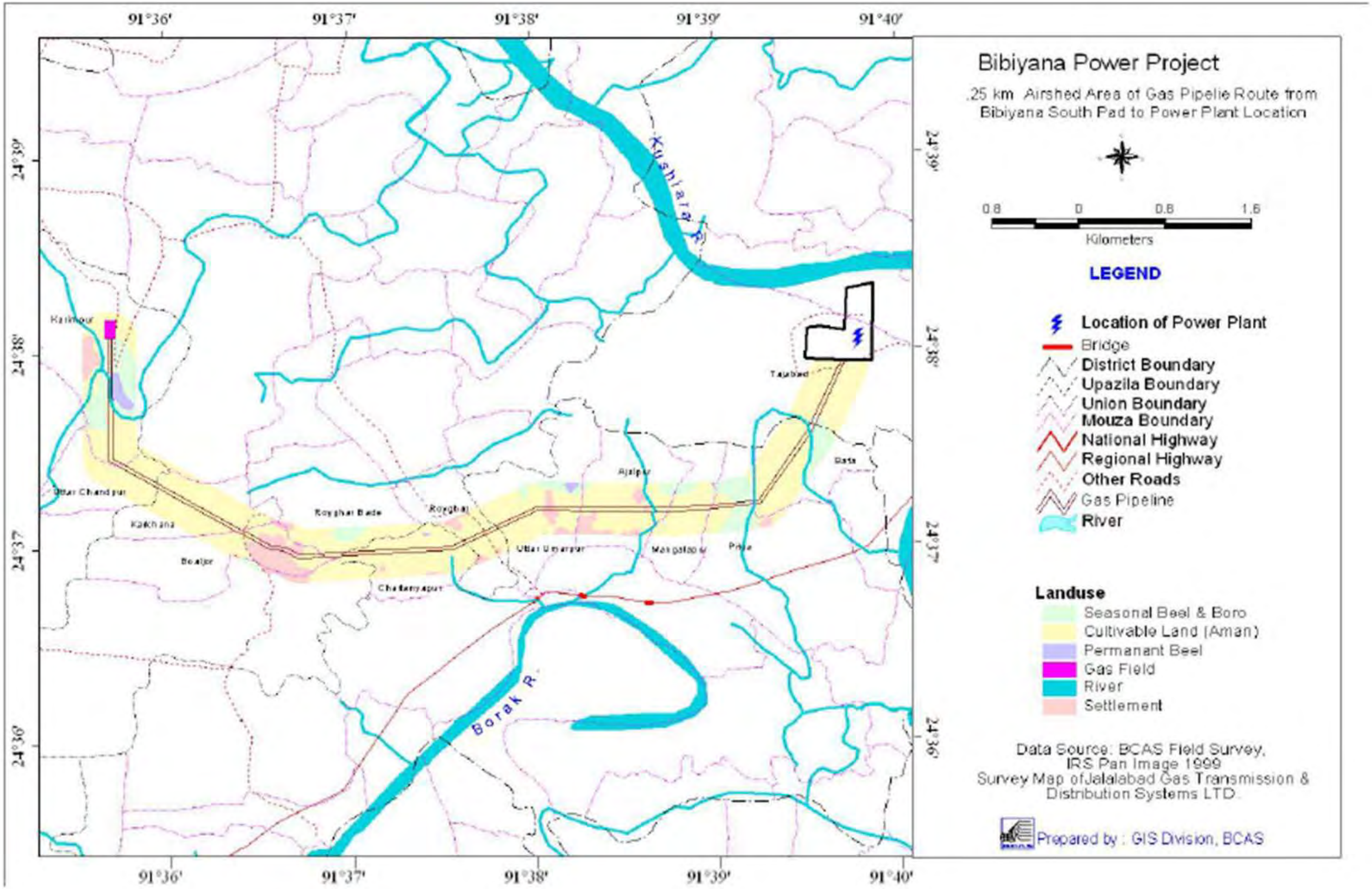
The design of the pipeline shall be as per ANSI B 31.8: Gas Transmission & Distribution Systems. The class rating shall be as per ANSI class 600 and the welding of the pipeline shall be as per API Standard 1104. In addition, the following conditions will apply:

- The pipeline will be installed below ground with a minimum of 1.0 m cover;
- Watercourses shall be crossed by open-cut method or horizontal directional drilling method, depending on the actual site/watercourse condition;
- The pipeline shall be cathodically protected and the design of the cathodic protection system shall be on the basis of soil resistivity measured in the field. The minimum corrosive allowance shall be 3 mm; and
- The steel pipeline will be manufactured as per API Specification SL. The grade of the pipe shell shall be API ALX60, PSL-2 LSAW, and the coating of the pipe shall be3LPE and factory coated.

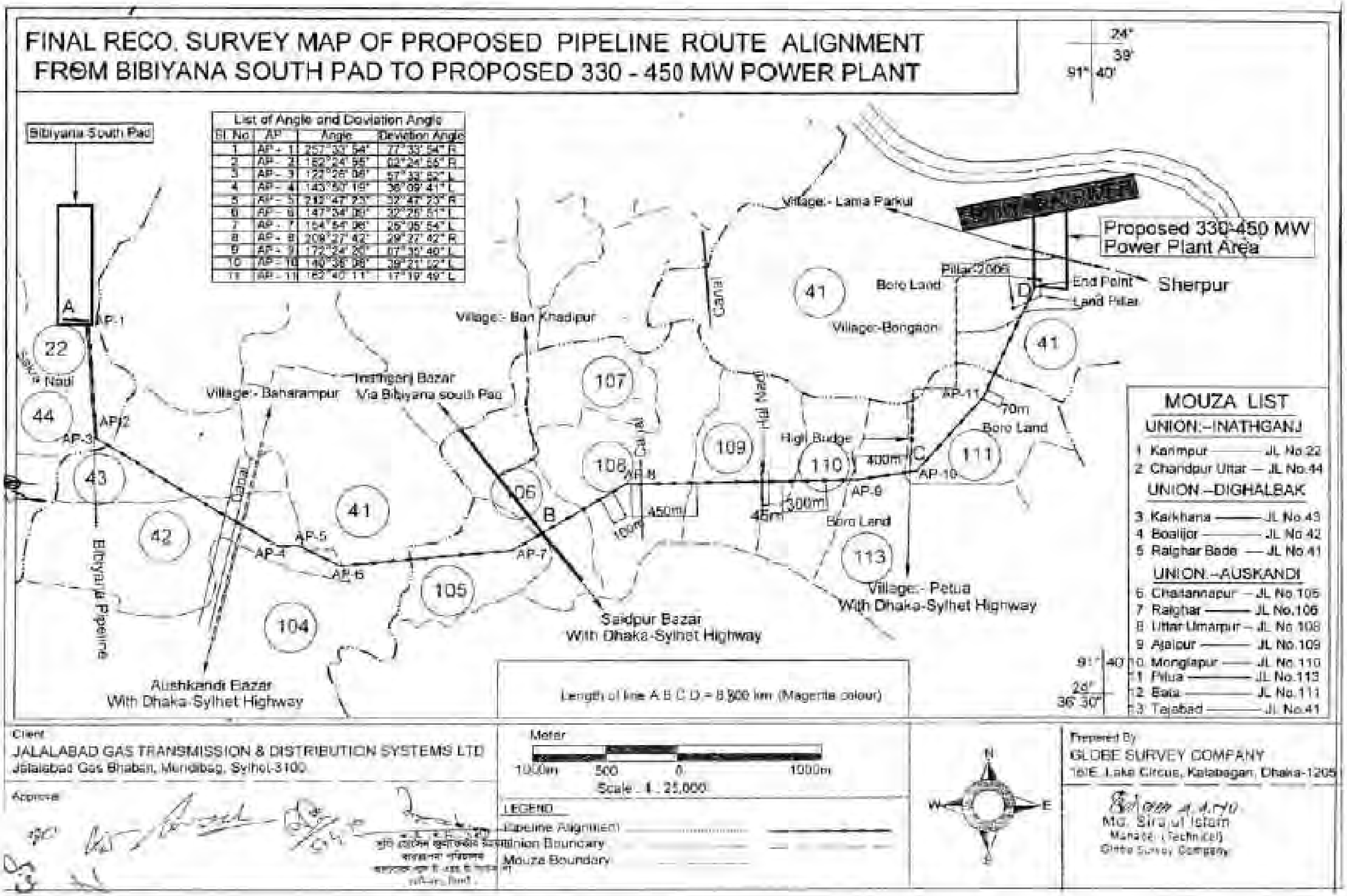
As per the gas supply agreements, responsibility for the supply of natural gas from the south pad of the Bibiyana gas field to the Project Site lies with JGFC. This includes the excavation and operation of new gas wells (if required) to supply the SBPCL II Power Plant. The requirement or otherwise for new gas wells will be determined by JGFC and no further information is available at this stage of the project.

In addition to the pipeline, one Regulating Metering Station (RMS), also known as a Gas Receiving Station, will be installed in the southern section of the Project Site. This is the responsibility of SBPCL II and it is included this within the scope of work of the EPC Contractor and has been included as a component of the Proposed Development.

Map 3.5: Proposed Pipeline Route



Map 3.6: Detailed Map of the Proposed Pipeline Route



3.7 The Transmission Line

The electricity produced from the SBPCL II Power Plant will be transmitted by the PGCB through a high tension transmission line (hereafter referred to as 'T-line'), which will ultimately connect with the national grid. According to the Request for Proposal documents, dated 2nd September 2010 and signed by SBPCL II, PGCB is responsible for construction and operation of the T-line.

At present, the detailed route of the T-line has not been confirmed, it is understood that approximately 70 m of T-line will link the switchyard to the national grid. The transmission line, as illustrated in Map 3.7:

i) The T-line route extends east from the substation and connects with the National Grid via an existing substation at Fenchuganj;

ii) The T-line route extends south from the substation and connects with the National Grid via an existing substation at Comilla North; and

iii) The T-line route extends south-west from the substation and connects with the National Grid via an existing substation at Kaliakair.

Map 3.7: Existing Power Grid Network in Bangladesh

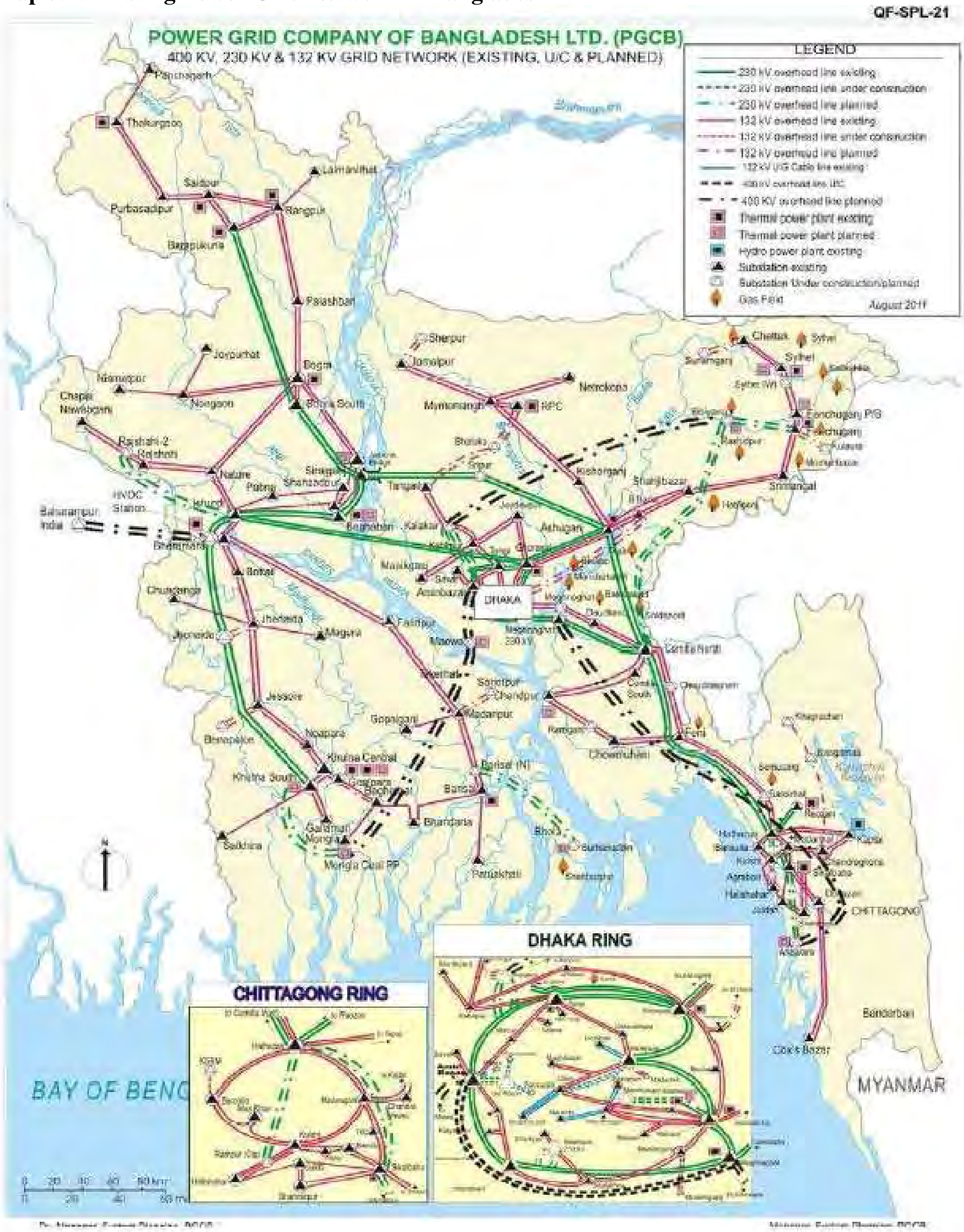
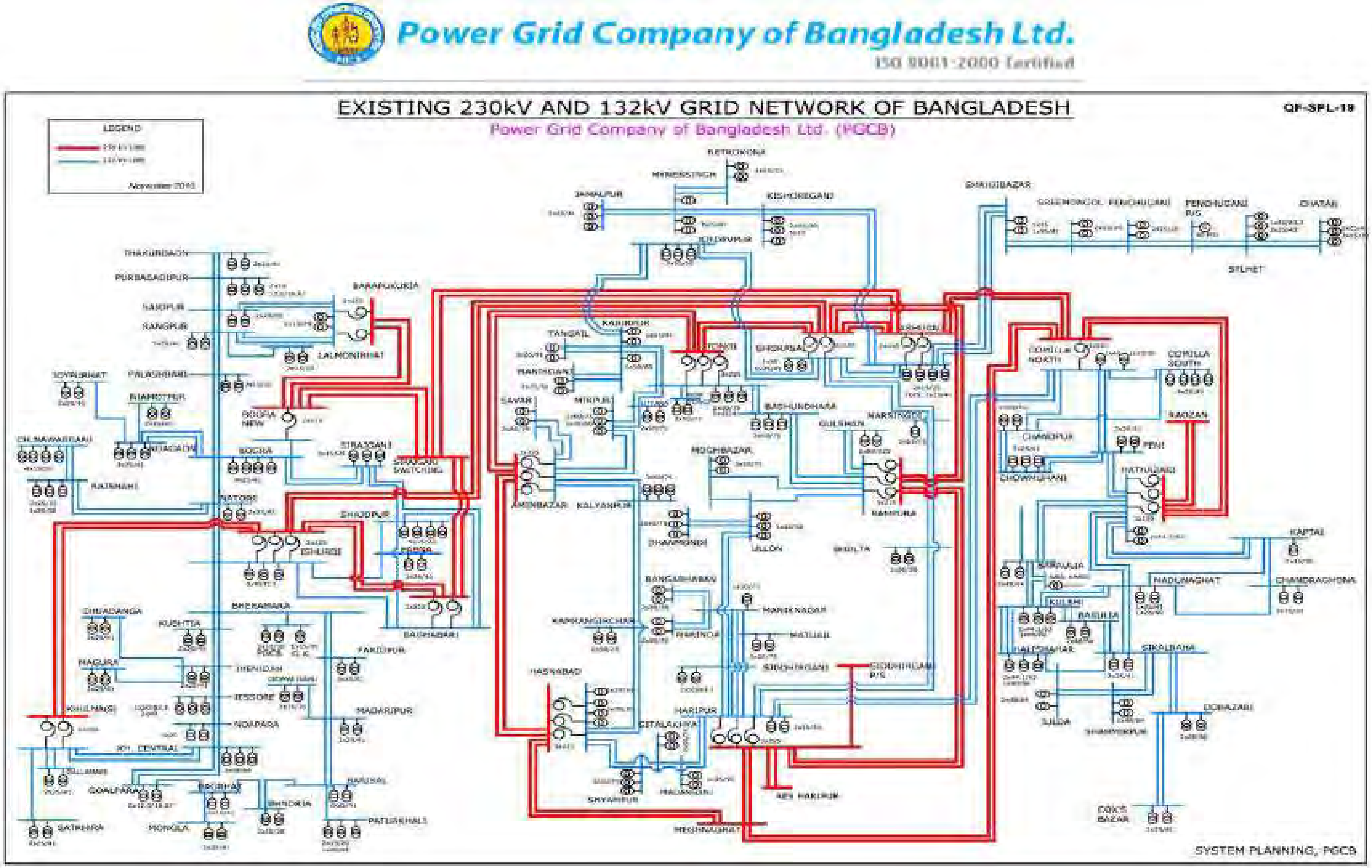


Figure 3.11: Existing, Under-construction and Planned Power Grid



3.8 The Access Road

Vehicular access to the Project Site will be provided by the development of a 2 km long access road to connect the Proposed Development to the Dhaka-Sylhet (N2) highway.

The route of the access road (illustrated in Map 3.8) will be from the south-eastern boundary of the Proposed Development and head southwards, passing through agricultural land and a seasonal beel, and connecting with the N2 highway, approximately 1.7 km to the south of the southern Proposed Development boundary.

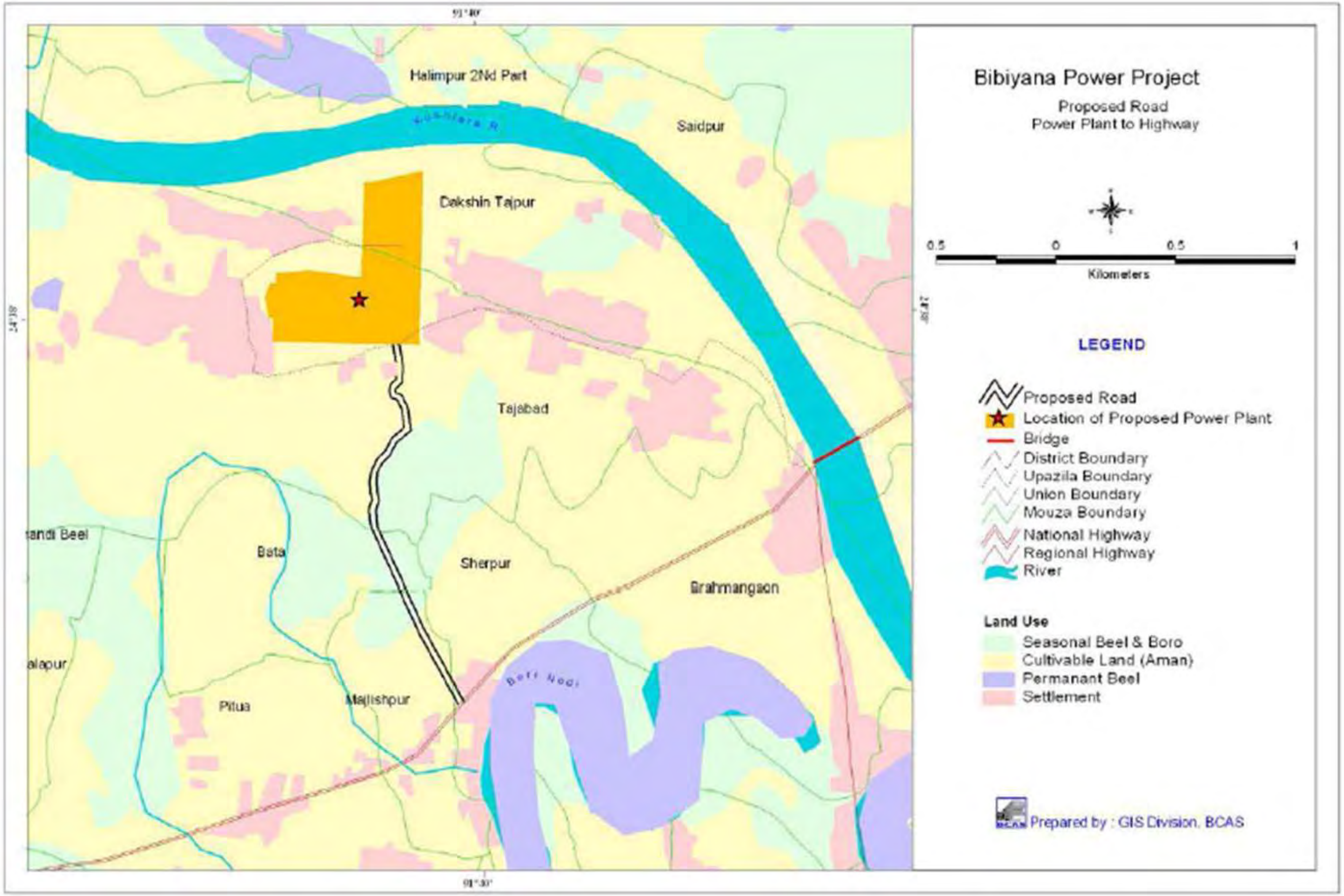
As detailed in Schedule III of the Land Lease Agreement, the road will comprise a bitumen-paved road built to the following design criteria:

- Overall width shall be 7.0 m (i.e. 5.0 m carriageway width and 1.0 m shoulder width);
- Design speed shall be 70 km/hr;
- The elevation of the access road embankment shall be at a minimum elevation of 1.0 m above the highest flood level (HFL) and the maximum gradient will be 10%;
- Road lighting shall not be required;
- Road markings and signs shall be provided in accordance with the requirements of Bangladesh Highways Authority; and
- A chain-link security fence shall be provided along both sides of the access road.

Drainage for the access road shall be installed to protect the road from erosion. The drainage shall comprise:

- Crossfall: crossfall for the road surface shall be 3% (including the shoulders of the access road) to provide adequate drainage whilst not being so great as to make steering hazardous;
- Road Culverts: five road culverts consisting of precast concrete pipes of 0.9 municipalities diameter will be installed to let surface water flow away from the road; and
- Drainage Ditches: drainage ditches will be provided on the slopes of both sides of the access road at a 30 m interval. The ditches will have a minimum cross section of 0.3 m × 0.3 m, and shall be constructed by mortar stone pitching.

Map 3.8: Alignment of the Proposed Access Road



3.9 Sand Mining

As previously stated, the Project Site is located adjacent to the southern bank of the Kushiyara River. The majority of the Project Site, which occupies an area of approximately 25acres, is situated at an elevation of 7.8 masl. The elevation of the highest recorded flood is 10.15 m asl and, consequently, the Project Site has been designed to be 11.2 m asl (i.e. 1 m above the highest recorded flood). In order to raise Project Site levels by 3.4 m, approximately 300,000 m^3 of sand was required. During the validation survey carried in September/October 2013 it was found that the land raising has already been completed at the Project Site in 2012.

A description of the operations undertaken is provided here and the potential impacts are assessed in Section 6.4.

3.9.1 Background

Sand is deposited in the streambeds or low plains as channel fill or fan deposits at the foothills of Meghalya in the northern region of Bangladesh. The sand is deposited as loose detritus materials. It is found dry and loose above water level and saturated non-cohesive mass below stream water.

In Bangladesh, the District Commissioner (DC) gives permission for sand mining from rivers, based on the Bangladesh Water Development Board (BWDB) Hydrographic Chart, which details where potential sand mining areas are located. The contractor appointed by SBPCL II to carry out the sand mining in relation to the Project Site had prior permission from the DC (permission attached as Annex 9).

3.9.2 Distribution and Quantity of Sand

A Bathometric Survey was conducted by contractors to determine the distribution and quality of sand deposits at nine areas in the vicinity of the Project Site, which are allocated by the DC for sand mining. The locations and volume of sand which were identified as potential locations for sand mining is presented in Table 3.8 and the locations, numbered 1 to 9, are illustrated from east to west in Map 3.9.

Table 3.8: Distribution and Quantity of Sand

Reference	River	Nearest Settlement	Estimated Vol. of Sand Available (m^3)
Site 1	Kushiyara	East of Monumukh	10,000
Site 2	Kushiyara	West of Monumukh	10,000
Site 3	Monu	South of Monumukh	3,000
Site 4	Kushiyara	Paharpur	30,000
Site 5	Kushiyara	Kamarkhada	40,040
Site 6	Kushiyara	Mathurapur	57,500
Site 7	Kushiyara	Galimpur	57,500

Reference	River	Nearest Settlement	Estimated Vol. of Sand Available (m^3)
Site 8	Kushiyara	Hatidighi	100,000
Site 9	Kushiyara	Chatrafut	1,000,000

3.9.3 Methodology

During the validation survey carried out in September/October 2013, it was found that sand mining had been undertaken at six of the nine sites identified, with a total excavation of approximately 300,000 m^3. This is summarised in Table 3.9.

Table 3.9: Excavation of Sand

Reference	River	Nearest Settlement	Estimated Vol. of Sand Excavated (m^3)	Distance from the Project Site (in KM)
Site 1	Kushiyara	East of Monumukh	40,000	8.8
Site 3	Monu	South of Monumukh	60,000	8.3
Site 5	Kushiyara	Kamarkhada	50,000	2.0
Site 6	Kushiyara	Mathurapur	60,000	3.0
Site 7	Kushiyara	Galimpur	60,000	4.0
Site 9	Kushiyara	Chatrafut	30,000	9.0
Total			**300,000**	

The sand mining contractors were prohibited to carry out sand mining in certain locations due to the presence of fish sanctuaries (as shown on Map 3.9).

Sand was mined by suction dredging as suggested in earlier versions of the ESIA report. Suction dredging was used because an agitating device is not necessary to draw material from the bottom surface[7], which creates fewer disturbances to the river bed. In addition, in order to avoid heavy plant causing river bank erosion, dredging was undertaken from a river barge. The sand was then transported to the river bank at the Project Site by sand carrier, before being pumped to the dedicated field. The impacts of sand mining and proposed mitigation measures are discussed further in Section 6.4.

3.10 Materials and Waste Management

Supply of construction materials, including construction sand, bricks, cement and stones is being supplied by outside companies and contractors.
During the construction and operational phases, the solid wastes which are produced (such as packing material and construction debris) will be transferred to local contractors who will reuse these for various purposes. The management of wastewater and sewerage is discussed elsewhere in the report.

[7] Dredge Source; http://www.dredgesource.com/dredgeinfo.aspx

3.11 Labor Accommodation

During the construction phase, no labor accommodation has been provided by SBPCL II, instead construction workers live in nearby localities to the Project Site. Due to the nature of the construction industry, construction and demolition related employment is relatively mobile, as such it is considered reasonable to assume that once construction is complete, construction workers would vacate nearby localities.

During the operation phase, no labor accommodation is likely to be provided within the Project Site, and as such it is anticipated that operation workers would live in nearby localities (i.e. within the Districts, Upazilas and Unions, and Mouzas in the Project AoI shown in Table 3.10).

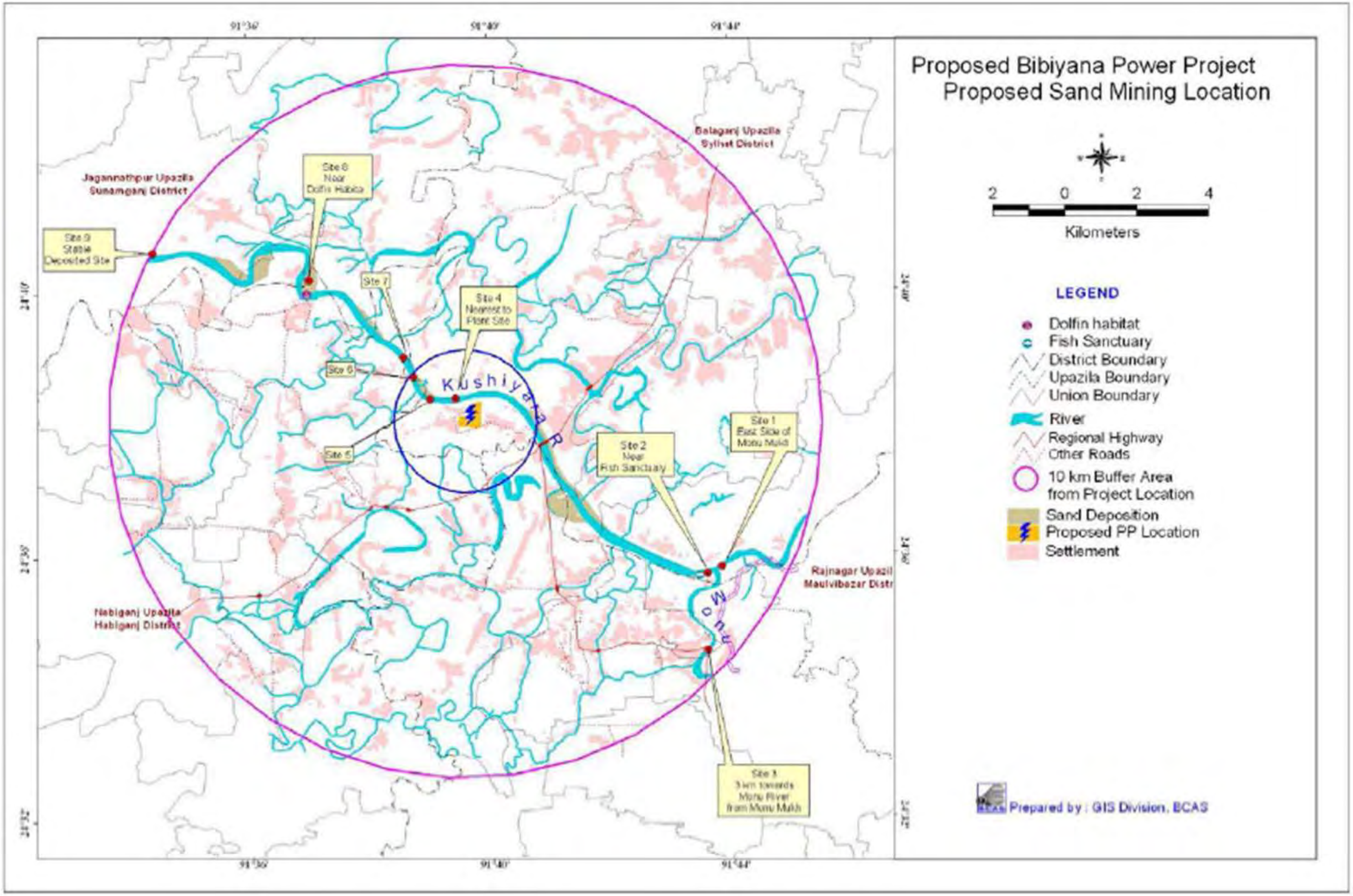
Table 3.10: Name of Districts, Upazilas and Unions, and Mouzas in the Project AoI

District	Upazila	Union	Number of Mouzas
Sylhet	Balaganj	Burunga	5
		Goula Bazar	11
		Omarpur	11
		Sadipur	21
		PaschimPailanpur	14
		PurboPailanpur	5
Sunamganj	Jagannatpur	Asharkandi	32
		Paligaon	8
Habiganj	Nabiganj	Digholbak	24
		Auskandi	22
		Inathganj	16
		Devpara	8
		Kargaon	1
		Kurshi	9
Maulvibazar	MaulvibazarSadar	Khalilpur	20
		Manumukh	8
		Upper Kagabala	2
		Akhailkura	7
		Kamalpur	2
	Rajnagar	Fatehpur	1
Estimated total number of Mouzas (villages) within the Project AoI			**225**

3.12 Jetty

As part of the construction works, a pontoon jetty has been built solely for the construction phase of SBPDCL II Power Plant, with a length of 40 m and a width of 20 m. The jetty is located to the north-west of the Project Site. Following completion of the construction phase the jetty will be dismantled.

Map 3.9: Preferred Sand Mining Locations



3.13 Consideration of Alternatives

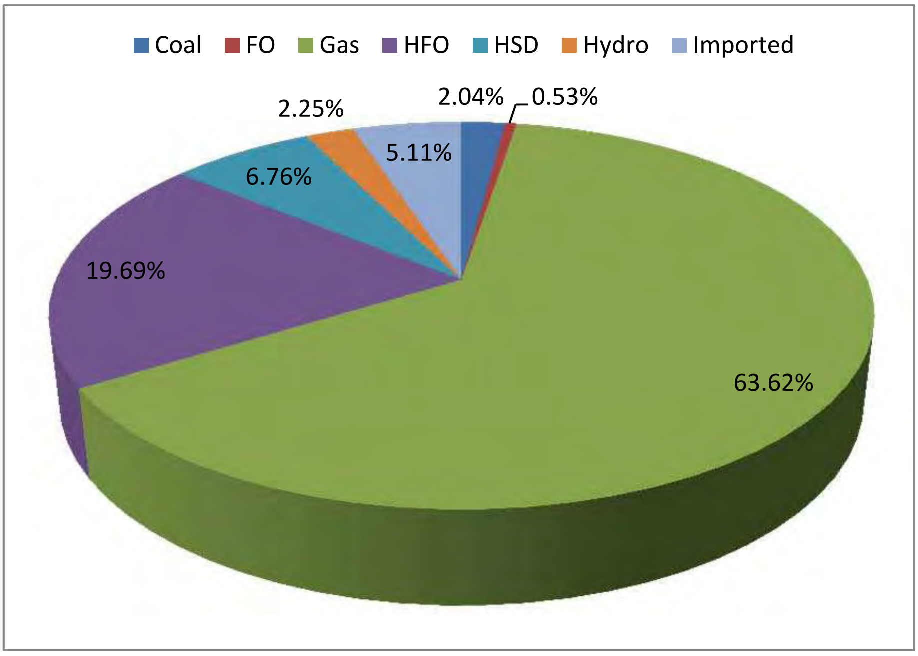
3.13.1 Technology Options

According to the Bangladesh Power Development Board (BPDB) the fuels used for the 9,783 MW of installed power generation capacity in Bangladesh (as of May 2014) comprises Coal, FO, Gas, HFO, HSD, Hydro and Imported power. Table 3.11 and Figure 3.12 shows the relative contributions of each source:

Table 3.11: Capacity of BPDB Power Plants May 2014 (source: BPDB website)

Unit Type	Capacity(Unit)		Total % in May 2014
Coal	200.00	MW	2.04 %
FO	52.00	MW	0.53 %
Gas	6224.00	MW	63.62 %
HFO	1926.00	MW	19.69 %
HSD	661.00	MW	6.76 %
Hydro	220.00	MW	2.25 %
Imported	500.00	MW	5.11 %
Total	9783.00	MW	100 %

Figure 3.12: Installed capacity of BPDB Power Plants (as on July 2014)



BPDB has taken a massive capacity expansion plan to add approximately| 10,500 MW Generation capacity in next 5 years to achieve 24,000 MW Capacity according to PSMP-2010 by 2021 with the aim to provide quality and reliable electricity to all the people of Country for desired economic and social development. The power system has been expanded to keep pace with the fast growing demand.

According to the BPDB website, there was a significant increase in power generation capacity between 2010 to 2014. Furthermore the generation capacity as of May 2014 (shown in Table 3.10) indicates that there has been a significant increase in the use of HFO for power generation mainly due to adequate availability of natural gas whose share has reduced compared to the situation in 2010.

Renewable energy currently attracts significant political and media attention. However, outside of large scale hydro-electric schemes, the power generation of which has already reached its limiting value in respect of meeting the ever-expanding power deficit in the country, it remains a niche area that does not have the capacity to provide the power delivery at the scale and reliability in view of the existing power deficit scenario. There are no reliable estimates for other renewable energy sources, e.g. for biomass, wind and solar. However, it is felt that the output would still be unable to produce and supply sufficient quantity of power toward meeting the existing enormous demand and high initial investment cost and scarcity of land are further barriers to renewable energy potentials in the country. The Government has recently announced its plans to introduce 500 MW from renewable energy sources to remote and inaccessible areas but details in relation to the technologies and the costs involved are not yet available. In any case the need to use efficient gas turbine technology and greater efforts to increase gas exploration is the first priority for Bangladesh.

A number of alternative energy generation technologies have been considered, and discounted for various reasons. The limitations associated with some of the alternative technologies considered are summarised below:

- Bangladesh is flat and therefore has a relatively limited potential for hydroelectricity;
- no active geothermal site has been found; and
- no oil field worth the name has yet been discovered.

Within the scope of fossil fuelled thermal power plant technologies, the considered options have been:

- Coal fired thermal plant;
- Oil or gas fired steam turbine;
- Oil or gas fired open-cycle gas turbine; or
- CCGT.

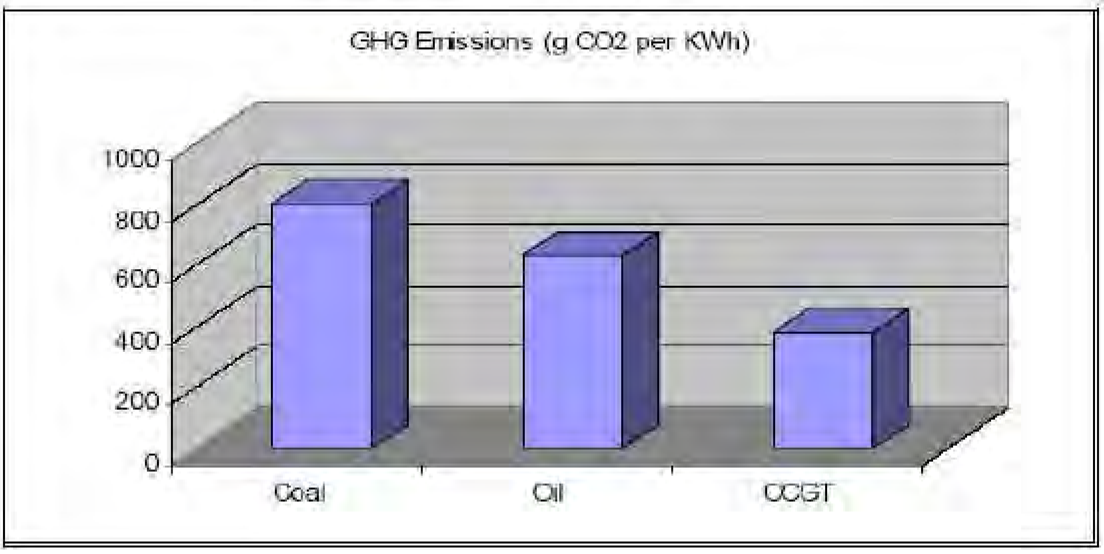
The country has about 1,700 million tons of bituminous coal, most of which lie buried at depth of over 900 meters thus making extraction relatively expensive. Coal fired technology could not be thought of as being a pragmatic option for the proposed project, in view of the associated high GHG emissions in addition to flue gas cleaning and ash disposal requirements, when compared with gas fired power generation technology. Environmental and safety issues of coal mining are of considerable concern in Bangladesh for the only coal mine in Boropukiria in northern Bangladesh. Due to concerns in relation to gas reserves in Bangladesh in the long term, policy makers are considering open pit mining of coal from deposits in Dinajpur district in the northern part of Bangladesh to ensure long term energy security and a coal policy is under preparation. Environmental and social issues in connection with open pit mining are the major issues under review in formulation of the coal policy.

Oil fired technology is less favoured than gas fired technology as the former leads to higher emissions of particulates, nitrogen oxides, sulphur dioxide and carbon dioxide. The technology preferred for the proposed project includes oil to be used only as a back-up fuel. Steam turbine plants, such as the existing thermal blocks built in the 1960s, are only competitive economically when there is a user for the waste heat, such as a very large district heating system.

A comparative study (Figure 3.13) on emissions of greenhouse gases (GHGs) from various fuel sources reveal that GHG emission from a power plant with CCGT system is significantly lower than that from coal-fired, oil and gas fired steam turbine steam turbine, and oil and gas fired open cycle gas turbine systems which will enable the project to be included in the CDM mechanism of the United Nations Framework Convention on Climate Change (UNFCCC).

Based on (i) type of energy to be utilized for electricity generation, (ii) type of fossil fuel-fired technologies in respect of competitive edge among them, (iii) relative consumption of fuels and (iv) climate-friendly emissions (GHG emissions), and (v) Bangladesh's sizable deposit of natural gas, the selection of CCGT technology for the SBPCL II appears justifiable. The composition of Bibiyana gas is given in Annex 8. This gas will generate very low quantities of particulates and, with a suitable burner, significantly low volumes of oxides of nitrogen.

Figure 3.13: Comparison of GHG Emissions from Various Power Generation Options



Source: World Nuclear Association, 'Greenhouse gas emissions from power generation'
http://world-nuclear.org/why/greenhouse_gas_from_generation.html

3.13.1.1 CCGT vs OCGT[8]

Open Cycle Gas Turbine (OCGT) plants consist of a single compressor/gas turbine that is connected to an electricity generator via a shaft. They are used to meet peak-load demand and offer moderate electrical efficiency of between 35% and 42% (lower heating value, LHV) at full load. Their efficiency is expected to reach 45% by 2020. CCGT is the dominant gas

[8] Energy Technology Systems Analysis Programme, Technology Brief E02 'Gas Fired Power', April 2010.

based technology for intermediate and base-load power generation. CCGT plant have basic components the same as the OCGT plants but the heat associated to the gas turbine exhaust is used in a heat recovery steam generator (HRSG) to produce steam that drives a steam turbine and generates additional electric power. Large CCGT plants may have more than one gas turbine. Over the last few decades, impressive advancement in technology has meant a significant increase of the CCGT efficiency by raising the gas-turbine inlet temperature, with simultaneous reduction of investment costs and emissions. The CCGT electrical efficiency is expected to increase from the current 52–60% (LHV) to some 64% by 2020. CCGT plants offer flexible operation. They are designed to respond relatively quickly to changes in electricity demand and may be operated at 50% of the nominal capacity with a moderate reduction of electrical efficiency (50–52% at 50% load compared to 58–59% at full load).

The estimated production costs of OCGT is typically 210 \$/MWh, compared with 72.5 \$/MWh for CCGT. In terms of environmental impact, CO_2 emissions are lower with CCGT (340-400 kg/MWh) compared with OCGT (480-575 kg/MWh). In addition NO_X emissions are roughly 40% lower with CCGT (c.30 g/MWh) compared with OCGT (c.50 g/MWh).

3.13.2 Design Options

The primary design criteria in choosing the generation technology for the Proposed Development is the cost of generation and the impact on the environment. For a power plant of this capacity the choice of CCGT was made based on these criteria. The economies of scale and the higher thermal efficiency was the principal factor in choosing this technology as opposed to direct fired single cycle thermal power plant based on natural gas which has a much lower efficiency than CCGT technology. Combine Cycle systems are efficient low cost systems that provides assurances of performance and operating objectives. Combine Cycle systems can be customized to the utility needs and preferences.

Cooling systems for such power plant are designed according to the local conditions. The lower the temperature that can be obtained in the cooling system, the greater is the resulting efficiency of the power plant. This is best realized when requisite quantity (initially a maximum of 17,500m^3 to the system with make-up water requirement of 600 m^3/hour of cold water, e.g., that of the nearby KushiyaraRiver. A closed loop cooling water will be used utilising cooling towers.

3.13.3 Zero Option (the “No-Go Alternative”)

The “Zero Option” means that SBPCL II decides not to construct any power plants at the Project Site or, to be more precise, abandons the Proposed Development altogether. As the existing power situation in Bangladesh is already in a state of significant deficit, with associated adverse impacts on industrial development and other socio-economics issues, the Proposed Development assumes considerable significance. Hence, abandoning the Proposed Development will have potentially significant consequences.

The consequences of an undersupply would harm the sustainability of the existing industrial production in the country as well as impact upon the quality of life of those affected by the power outages. Furthermore, under the zero option, the considerable advantages associated with Proposed Development and its associated power generation and creation of employment would be lost.

Bangladesh is now facing acute electricity shortage. This has been due to lack of proper planning and acute demand growth. The GDP growth has stagnated over the years due to absence of electricity both in terms of quality and quantity. The medium to large industries have been using standby generators because of the present crisis which uses DG sets thereby creating an extra load on the foreign exchange reserves because of import of diesel. The possibility of using dirtier fuels to overcome this shortage will have a negative impact on the environment as whole in the country.

3.13.4 Consideration of Site Location and Related Other Facts

In preparing this ESIA, there was limited scope for the consultants to consider alternative sites primarily because of the fact that BPDB had already identified the site and initiated the process of land acquisition at the Project Site for SBPCLII. Additionally, the project needed to be located in the hub of gas production and electricity evacuation. The other such sites having similar accesses could be Meghnaghat and Haripur and Shazibazar were considered but for reasons mentioned above, the BPDB's decision to locate the SBPCL II power plant at Bibiyana restricted the consultants to investigate further into alternative sites.
Notwithstanding this the suitability of the Project Site has been considered on the basis of the following:

i. The proximity of the Bibiyana gas field (about 6.5km) offers a big advantage in that the length of the gas pipeline can be minimized and the associated cost will not be significant.
ii. The Project Site is less than 1 km from the Kushiyara River, allowing use of the river for transport. The project activity during the construction phase will require safe transportation of heavy equipment, e.g., cooling towers, steam generators, etc., through river routes to the Project Site. Therefore, the proximity of the Project Site to the river will allow the use of river transportation, which is also a most cost-effective option.
iii. The proximity of the Project Site to the Kushiyara River (<1 km) also offers a big advantage due to the fact large volumes of cooling water are required to be withdrawn for use during the construction and operation of the SBPCL II Powr Plant. This proximity also makes the process of transporting the require water volumes more cost-effective.

In consideration of the above facts, the selection of the Project Site for the SBPCL II Power Plant appears justifiable.

Figure 3.14: Photograph of the Boundary of the Project Site looking South

3.13.5 Gas Pipeline and Access Road Alternatives

The route for the gas pipeline was determined by the Gas Supplier and SBPCL II was not consulted during the determination of the route. It is understood that in determining the route, the Gas Supplier identified the shortest possible route between the Bibiyana gas field and the Project Site, whilst avoiding residential settlements wherever possible.

Similarly, the route for the access road was determined by the BPDB and SBPCL II was not consulted during the determination of the route. However, it is understood that in determining the route, BPDB identified the shortest possible route to the Dhaka-Sylhet (N2) highway, whilst avoiding residential settlements wherever possible.

4. Baseline Environmental Conditions

4.1 The Project Site

Administratively, the Project Site is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of Habiganj district. A number of villages are located in close proximity of the Project Site and the gas pipeline route. The distance and direction of the villages, relative to the Proposed Development and the proposed gas pipeline route, are presented in Table 4.1.

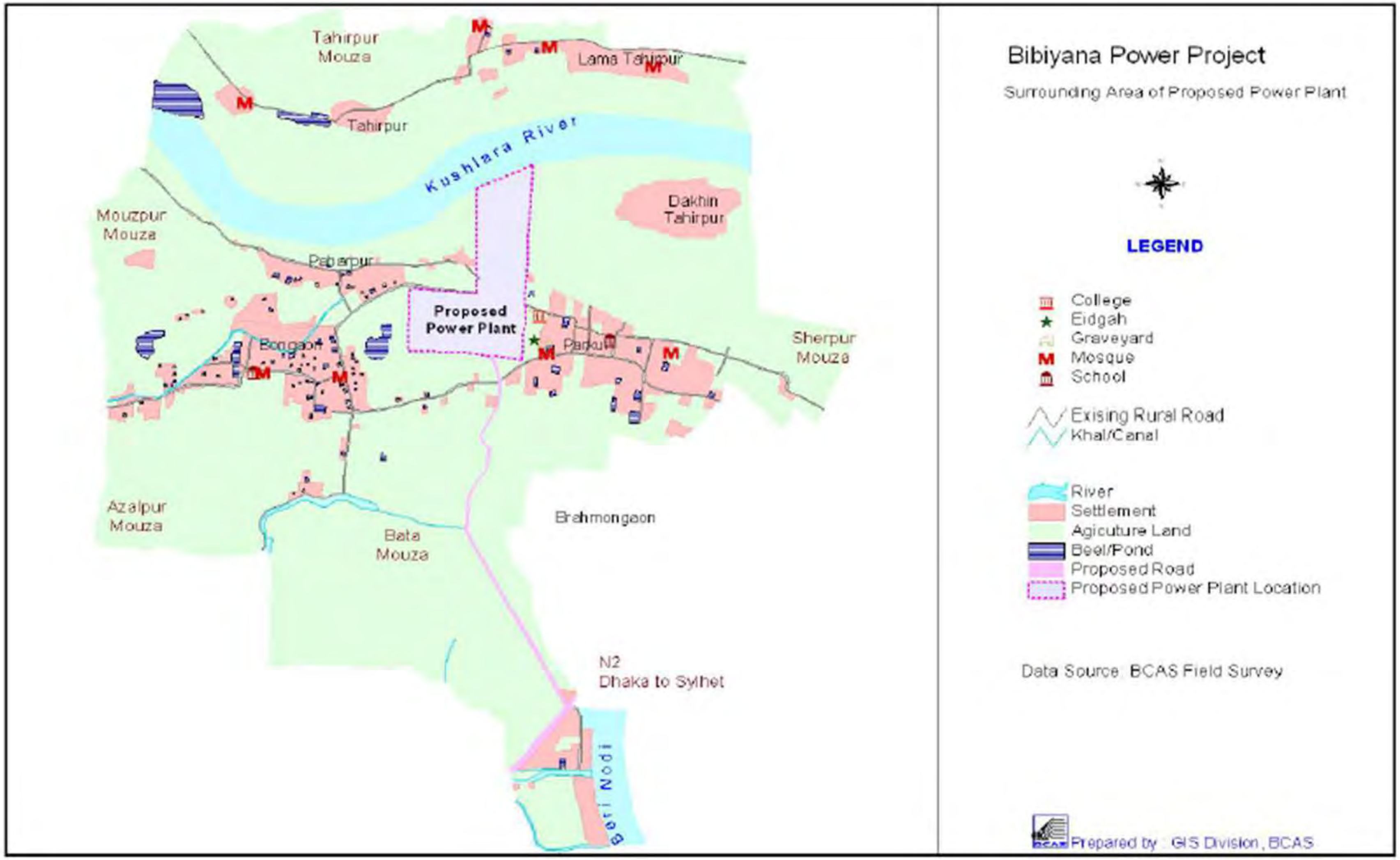
Table 4.1: Villages in the Vicinity of the Power Plant and Gas Pipeline

Power Plant			**Gas Pipeline**		
Village	**Distance (km)**	**Direction**	**Village**	**Distance (km)**	**Direction**
Parkul	0.29	South-East	Parkul	0.29	East
Bongaon	0.60	West-South-West	Paharpur	0.35	North-West
Paharpur	0.22	West-South-West	Bongaon	0.30	West
			Bata	1.20	South-East
			Pitua	1.10	South
			Ajalpur	1.20	North
			Majlishpur	1.50	South
			Uttar Umarpur	1.50	South
			Raygharbade	1.50	North
			Chaitannapur	1.80	South
			Boailjoir	0.25	Middle
			Karkhana	0.50	South-West
			Chanpur	0.50	South-West
			Karimpur	0.25	Middle

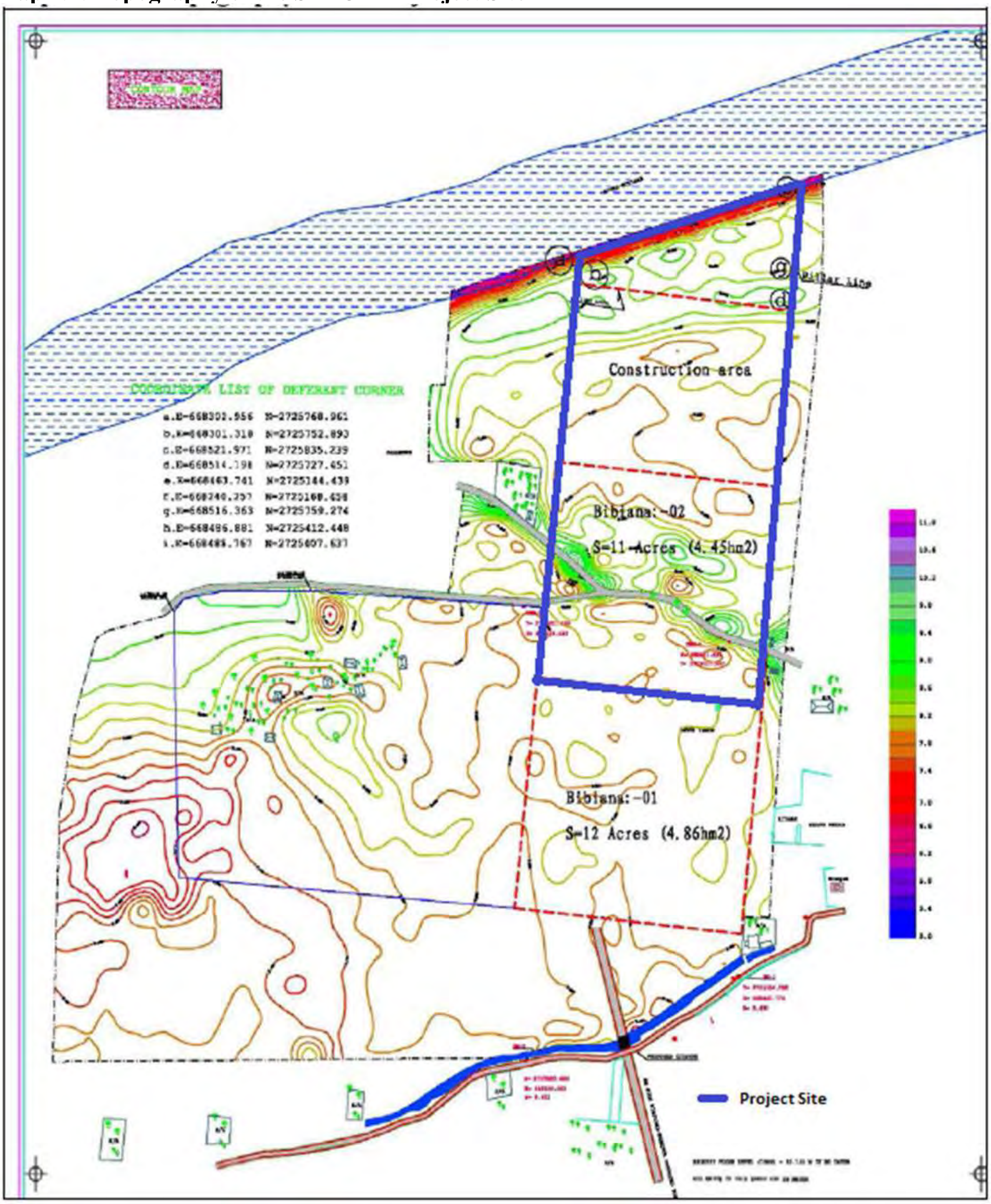
4.1.1 Topography

The land within the Project AoI is part of the Surma floodplain with almost no annual deposition of new sediment, instead it is composed of older and more developed soil. The landscape is very gently undulating or nearly level. The main soils consist of grey silty to loamy top soils along with black structured grey-silty to clayey sub-soils. The Project AoI comprises agricultural land, homestead land, dykes, mud roads, the River Kushiyara, and its principal tributaries, i.e. the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang. Map 4.1 shows features in the vicinity of the Project Site and Map 4.2 shows the Project Site's topography.

Map 4.1: Surrounding area of proposed SBPCL II Power Plant, Switchyard and potential future Bibiyana I Power Plant



Map 4.2: Topography of the SBPCL II Project Site



4.2 Physical Environment: Climate

The Project Site has a pronounced tropical monsoon climate. There are three main seasons:

1. **Monsoon Season** (or rainy season) from **May to October** during which about 92% of the total annual rainfall is received;
2. **Dry Season** (or winter) from **November to February** which has the lowest temperature and humidity of the year; and
3. **Pre-Monsoon Season** (or hot season) from **March to April**.

Based on climatic data for the period 2006 to 2010, obtained from the Srimangal atmospheric monitoring station in Moulvi Bazar, located 37 km to the south of the Project Site (which is the nearest monitoring station), the following climate applies:

- Temperature: Mean monthly temperatures vary from about 6.5°C in January to 35.8°C in April. The mean annual temperature is about 25°C;
- Rainfall: About 92% of the annual rainfall occurs in the seven months from April to October in the Project AoI. Within the surrounding areas of the project site in the Kushiyara valley and neighbouring hills, the rainfall is very high. At Srimangal, the annual average rainfall is 242 cm;
- Humidity: Mean monthly relative humidity ranges from 77% in the dry season (November to February) to about 84% in the rainy season (June to October). In the area, fog is very common in winter and also it is the cloudiest part of Bangladesh; and
- Wind: as demonstrated by the wind roses presented in Figures 4.1 - 4.3 (based on meteorological data from the Srimangal monitoring station for the period 1948- 2005) the prevailing wind direction varies throughout the year. During the hot season there is a southerly prevailing wind, during the monsoon season there is a south-easterly prevailing wind and during the dry season the prevailing wind is from the north.

Figure 4.1: Average Climate (2006 – 2010)

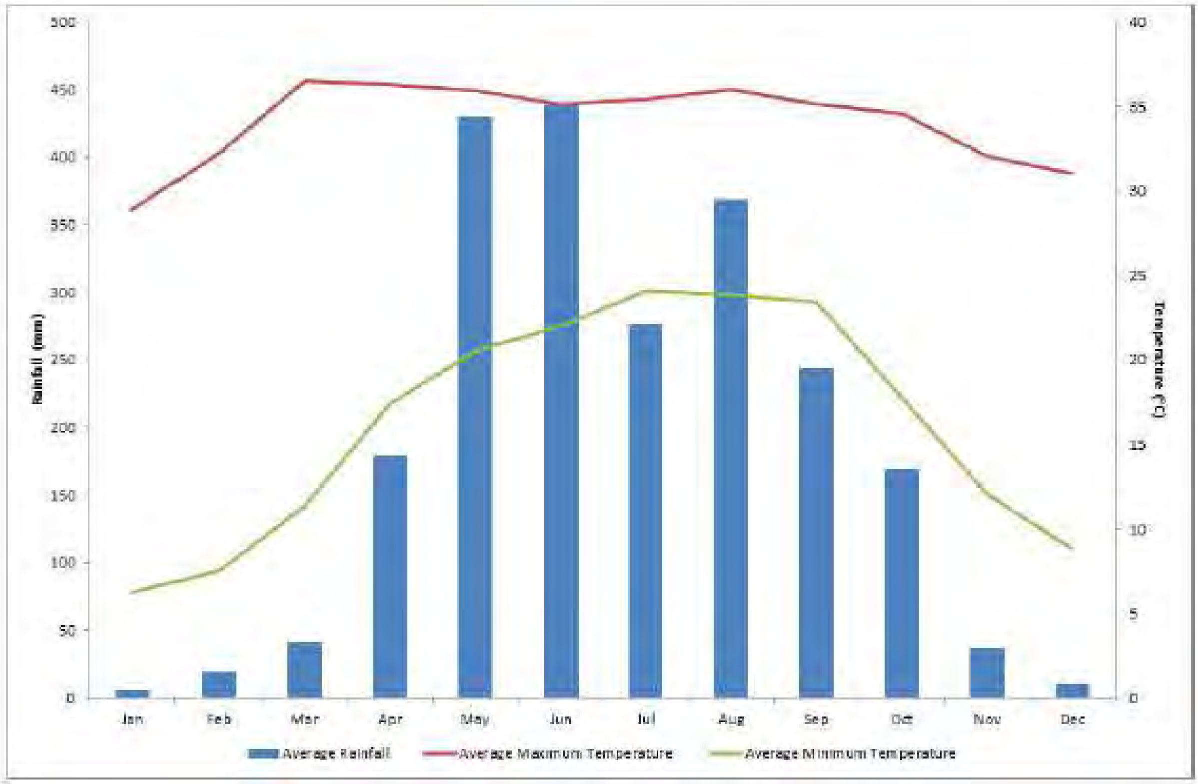


Figure 4.2: March Wind Rose – Hot Season

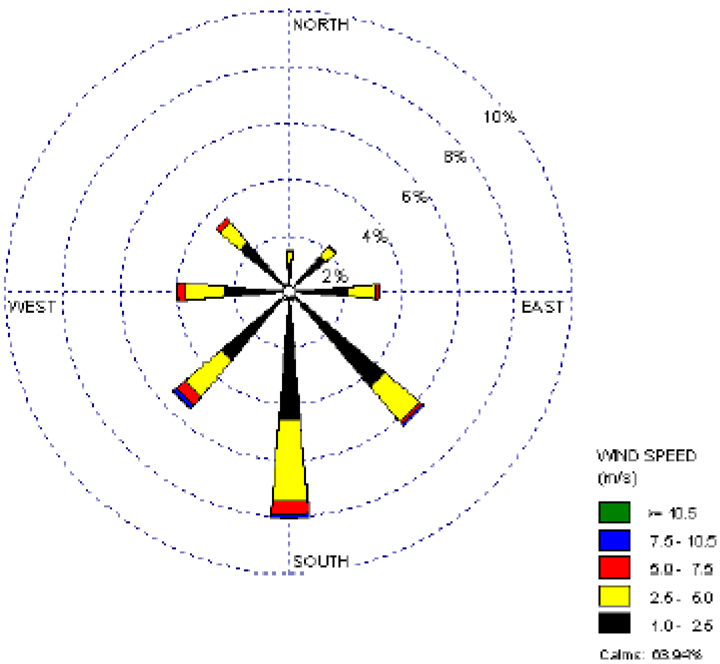


Figure 4.3: August Wind Rose – Monsoon Season

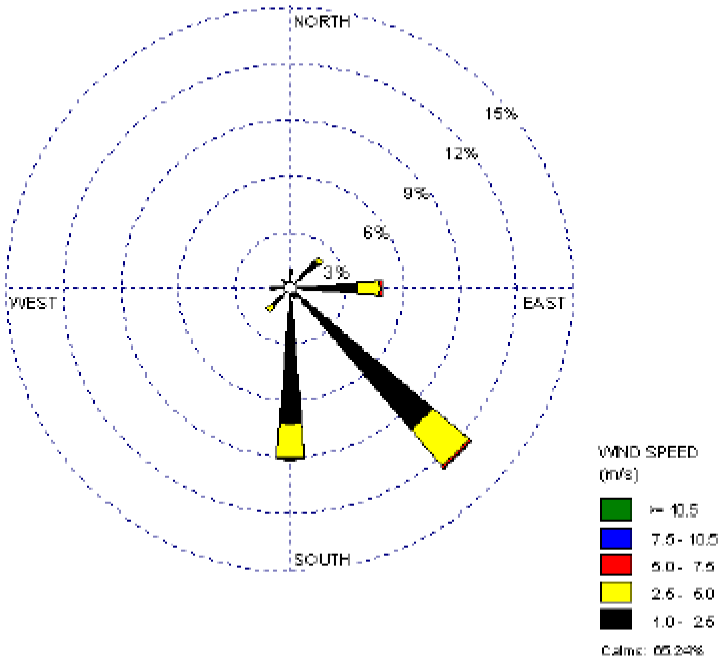
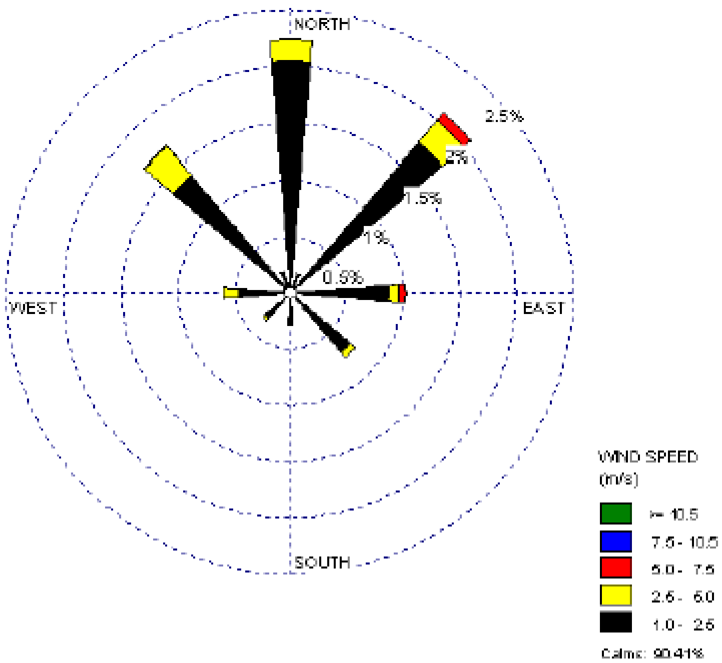


Figure 4.4: December Wind Rose – Dry Season



4.3 Physical Environment: Air Quality

Air quality at the Project Site is typical of a rural environment. Ambient pollutant concentrations are relatively low to practically non-existent. Suspended particulate matter (SPM) increases intermittently in areas where winds pick up dust over unpaved roads and exposed surfaces. The primary sources of emissions, however, are traffic-derived emissions from the N2 Dhaka-Sylhet National Highway running in a south-west / north-east direction approximately 1.4 km to the south-east of the Proposed Development at its nearest point.

A survey of the ambient air quality was undertaken in the vicinity of the Project Site in March, April, May and October 2011 to determine pollutant concentrations before, during and after the monsoon. The surveys undertaken in March, April and May 2011 sampled seven locations, the results are shown in Table 4.2a:

Table 4.2a: Test Results of Existing State of Ambient Air Quality in the Project Area

Date of sample collection	Location	Ambient Air Pollutants Concentration in µg/m^3 (annual)					
		PM_{10}	$PM_{2.5}$	SPM	SO_2	NO_2	CO
March 2011	Clinic	102.13	No Data	144.28	4.01	9.74	ND
		104.14		149.22	3.28	10.65	ND
		106.37		157.42	2.69	10.54	ND
		104.24		149.21	4.36	9.95	ND
		94.51		146.45	3.18	7.08	ND
		92.29		146.5	3.80	8.24	ND
		112.74		156.32	3.43	13.47	ND
		124.77[1]		169.85	4.08	15.01[2]	ND
April 2011	Clinic	156.93	No Data	201.52	4.03	10.05	ND
		122.84		179.32	3.73	14.20	ND
		82.54		126.13	4.33	9.11	ND
		96.47		142.41	3.83	9.72	ND
		101.22		146.73	3.77	8.84	ND
		104.30		150.44	4.16	10.66	ND
		98.72		139.60	3.48	10.38	ND
		48.00		68.85	0.66	2.53	ND
May 2011	Clinic	78.72	No Data	135.69	0.72	2.75	ND
		89.98		137.60	1.07	7.88	ND
		66.93		132.71	4.65	8.22	ND
		58.84		88.04	4.44[1]	7.51	ND
		72.49		101.68	4.10	15.01	ND
		63.35		108.2	2.98	11.08	ND
		42.00		85.56	2.99	11.08	ND
		46.67		88.73	2.80	10.01	ND
October 2011	North side of site	77.12	39.41	213.54	14.12	27.17	21.62
	East side of site	72.30	37.21	210.35	12.86	23.54	19.21
	West side of site	75.25	35.50	211.60	14.18	25.70	22.70
	South-east of the site	81.76	41.35	220.50	13.28	25.62	20.45

Date of sample collection	Location	Ambient Air Pollutants Concentration in µg/m³ (annual)					
		PM_{10}	$PM_{2.5}$	SPM	SO_2	NO_2	CO
National Ambient Air Quality Standards (Bangladesh)		150 (24hr) 50 (annual)	65 (24hr) 15 (annual)	200[3] (8hr)	365 (24hr) 80 (annual)	100 (annual)	10,000 (8hr) 40,000 (1hr)
IFC EHS Guidelines / WHO Guidelines		70 (annual) 150 (24hr)	35 (annual) 75 (24hr)	60-90 (annual) 150-230 (24hr)	125 (24hr) 500 (10 min)	40 (annual) 200 (24hr)	10,000 (8hr)
Method of Analysis		**Gravimetric**	**Gravimetric**	**Gravimetric**	**West-Geake**	**Jacob& Hochheiser**	**CO Meter**

Source: BCAS Survey, March-October, 2011.

Notes:

PM_{10} - Respirable Dust Content <10µm
SPM - Suspended Particulate Matter
NO_2 - Nitrogen Dioxide
SO_2 - Sulphur Di-oxide
CO - Carbon Monoxide
ND - Non-Detect (i.e. below the instruments limit of detection)
1 - 94th percentile
2 - 96th percentile
3 - the standard for 'residential and rural' areas.

As shown in Table 4.2a, concentrations of NO_2 were not found to exceed National Standards or IFC/WHO Guidelines annual concentration standards. Furthermore, baseline concentrations of PM_{10} in the vicinity of the Project Site are high throughout the year, regularly exceeding both National Ambient Air Quality Standards (Bangladesh) and IFC EHS Guidelines /WHO Guidelines between March – October 2011. Table 4.2a indicates that the baseline concentrations of SPM exceed IFC EHS Guidelines / WHO Guidelines in all but four of the recorded concentrations.

As part of the validation of the ESIA, subsequent surveys of the ambient air quality were undertaken at ten locations situated to the north, south, east and west of the Project Site (7 days in each location) in November, December 2013 and in January, February 2014 (Table 4.2b). The sampling locations are illustrated in Map 4.6 and further details are provided in Annex 4.

The analytical results of the air quality sampling are presented in Table 4.2b.

The results of the validation surveys broadly correlate with the 2011 results, indicating that baseline concentrations of PM_{10}, $PM_{2.5}$ and SPM in the vicinity of the Project Site are high throughout the year, regularly exceeding National Ambient Air Quality Standards (Bangladesh) and IFC EHS Guidelines / WHO Guidelines. Concentrations were found to be particularly high during the Dry and Pre-Monsoon seasons. As shown in Table 4.2b, the concentrations of NO_2 were found to be similar to those recorded in 2011, and were not found to exceed National Standards or IFC/WHO Guidelines annual concentration standards.

Table 4.2b: Test Results of Existing State of Ambient Air Quality in the Project Area

Date of sample Collection	Location	Ambient Air Pollutants Concentration in µg/m^3 (annual)					
		PM_{10}	$PM_{2.5}$	SPM	SO_2	NO_2	CO
November 2013	1000 meter south-east from the SBPCL II Power Plant	95.13	44.51	124.28	4.01	8.74	6.79
		94.14	42.52	139.22	3.28	9.65	7.52
		96.37	43.53	127.42	3.69	8.54	7.43
		94.24	42.5	129.21	4.36	7.95	6.96
		92.51	37.73	126.45	3.18	5.08	4.66
		91.29	36.61	126.5	480	6.24	5.59
		95.74	46.93	126.32	3.43	9.47	8.78
November 2013	100 meter east from the SBPCL II Power Plant	100.15	49.41	134.22	4.05	9.84	8.65
		99.16	46.72	146.27	4.25	8.45	8.72
		99.38	55.54	137.52	3.66	10.14	9.53
		100.24	52.5	149.21	4.33	8.85	8.86
		100.51	47.53	146.45	3.14	6.05	6.67
		97.26	55.51	136.50	3.80	5.24	6.54
		99.64	43.93	126.22	3.63	6.45	8.79
November 2013	200 meter south from the SBPCL II Power Plant	99.14	45.41	144.25	4.03	7.44	7.75
		84.16	46.72	149.23	3.24	8.55	8.53
		95.34	44.55	147.43	2.65	7.53	7.45
		84.25	52.50	133.11	3.34	7.85	6.83
		82.41	35.83	136.44	3.19	6.07	5.65
		93.20	38.51	129.42	4.10	7.25	5.54
		100.14	45.63	136.42	3.43	8.45	7.74
November 2013	Project Site	120.15	65.41	154.22	5.45	10.84	6.35
		112.16	56.62	156.27	5.35	9.42	9.32
		114.33	65.54	157.52	4.66	10.14	6.53
		120.24	62.5	169.21	4.33	9.85	6.16
		123.21	53.52	132.41	4.14	7.05	7.63
		120.22	52.41	156.60	3.80	6.24	5.53
		117.44	44.73	166.22	3.73	7.43	6.75
December 2013	Southern boundary of the SBPCL II Power Plant	130.23	58.11	164.28	3.04	6. 43	6.70
		121.12	52.52	169.23	3.27	7.61	6.32
		132.27	44.53	157.12	2.42	6.11	5.93
		125.24	46.5	136.25	3.34	7.05	6.86
		122.51	34.33	146.35	3.14	6.09	4.36
		121.20	36.41	146.52	3.60	6.23	4.57
		129.24	47.83	136.12	2.63	7.44	6.77
December 2013	320meter south from the SBPCL II Power Plant	150.21	68.15	154.26	3.14	6. 53	6.60
		141.15	65.73	149.23	3.24	6.65	6.32
		142.25	54.33	156.16	3.52	6.17	5.83
		136.24	56.5	166.26	3.44	6.25	5.66
		144.51	54.33	166.33	3.11	6.02	4.33
		151.30	56.45	156.54	3.50	6.22	5.11
		139.24	54.83	166.12	4.63	7.44	6.75
December 2013	150meter south-west from the SBPCL II Power Plant	139.13	57.31	144.22	3.02	5.75	5.33
		141.14	52.55	143.25	3.24	6.55	6.54
		144.35	55.53	157.22	3.65	6.57	6.22
		133.21	44.50	159.41	4.32	6.35	6.46
		123.11	57.74	156.43	3.48	5.48	5.64
		133.22	66.41	156.5	3.70	6.25	5.56
		149.75	66.23	156.34	3.53	8.67	6.74

Date of sample Collection	Location	Ambient Air Pollutants Concentration in µg/m³ (annual)					
		PM_{10}	$PM_{2.5}$	SPM	SO_2	NO_2	CO
December 2013	250 meter west from the SBPCL II Power Plant	160.13	58.53	154.24	3.51	8.24	5.73
		144.13	64.52	159.24	2.24	8.23	6.44
		152.36	66.53	157.12	3.64	8.24	5.45
		155.23	52.57	159.21	2.34	6.55	6.10
		139.53	54.72	156.45	2.16	5.22	5.74
		154.29	56.61	146.5	2.50	6.26	5.53
		139.34	56.95	156.34	2.33	6.41	6.18
January 2014	Clinic point road side adjacent to eastern boundary of Project Site	142.13	61.51	154.28	5.01	9.54	6.79
		144.14	62.52	159.22	4.28	10.65	6.52
		146.37	63.53	167.42	5.69	10.64	6.43
		154.24	62.5	169.21	5.36	9.65	6.96
		148.51	67.73	166.45	5.18	7.38	6.66
		139.29	66.61	166.5	5.80	8.44	6.59
		152.74	66.93	156.32	4.43	13.47	6.78
January 2014	1000 meter west from the SBPCL II Power Plant	122.13	51.51	124.28	4.03	7.54	6.33
		124.14	52.54	129.22	3.22	11.64	6.32
		116.37	53.54	127.42	4.62	11.63	6.23
		124.24	52.65	139.21	4.36	8.62	6.46
		128.51	57.43	146.45	4.13	7.34	6.56
		119.29	56.41	146.5	4.83	7.43	6.49
		112.74	46.43	136.32	3.43	11.42	6.48
National Ambient Air Quality Standards (Bangladesh)		15 (24hr) 50(annual)	65 (24hr) 15 (annual)	200[3] (8hr)	365(24hr) 80(annual)	100 (annual)	10,000 (8hr) 40,000 (1hr)
IFC EHS Guidelines / WHO Guidelines		150 (24hr) 70 (annual)	75 (24hr) 35 (annual)	150-230 (24hr) 60-90 (annual)	500 (10 min) 125 (24hr)	200 (24hr) 40 (annual)	10,000 (8hr)
Method of Analysis		**Gravimetric**	**Gravimetric**	**Gravimetric**	**West-Geake**	**Jacob& Hochheiser**	**CO Meter**

Source: Adroit International Laboratory and ECL baseline survey, November 2013 – Janurary 2014.

Notes:

PM_{10} - Respirable Dust Content <10µm
SPM - Suspended Particulate Matter
NO_2 - Nitrogen Dioxide
SO_2 - Sulphur Di-oxide
CO - Carbon Monoxide
ND - Non-Detect (i.e. below the instruments limit of detection)
[1] - 94th percentile
[2] - 96th percentile
[3] - the standard for 'residential and rural' areas.

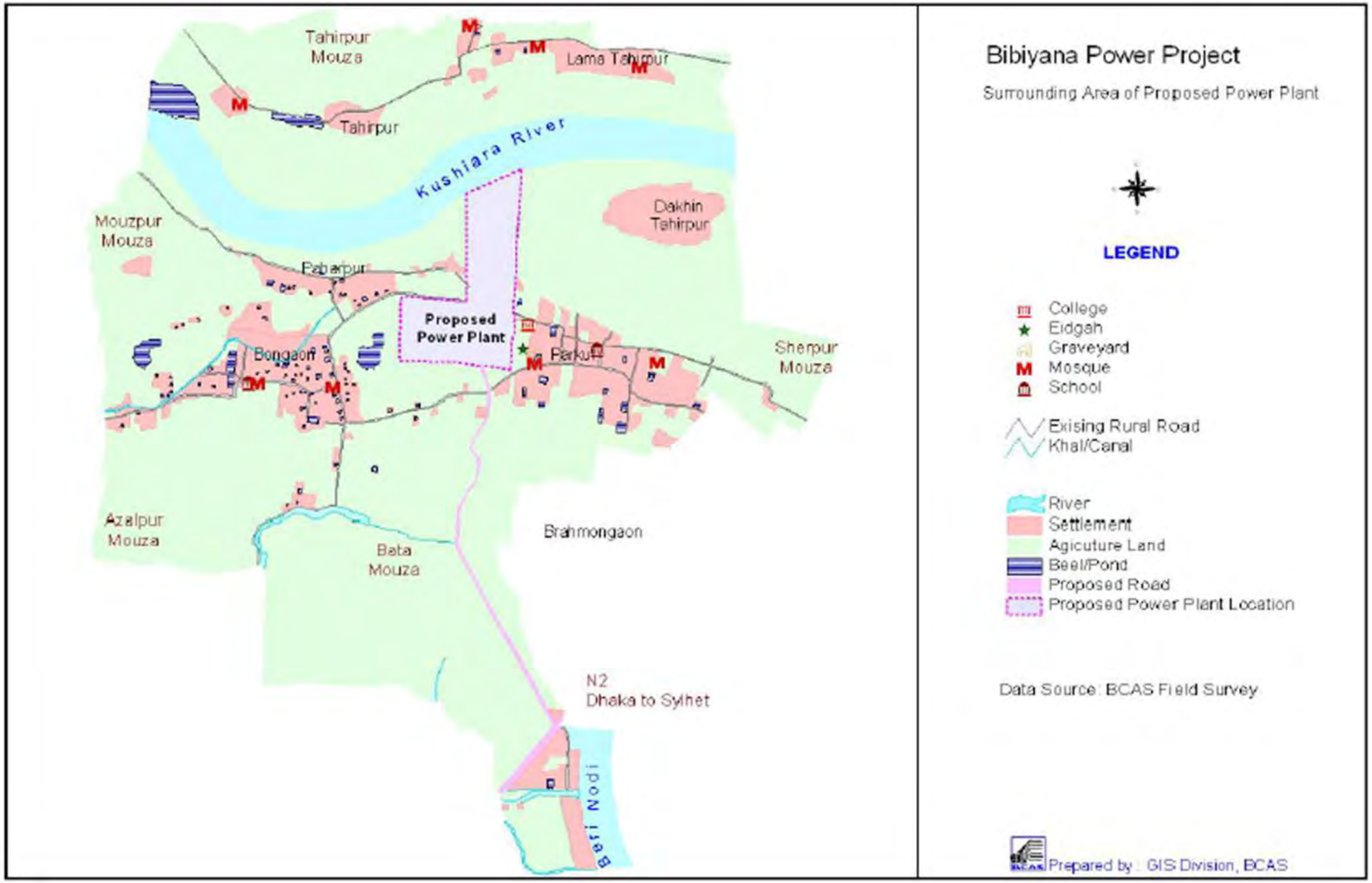
4.4 Physical Environment: Hydrology, Hydrogeology and Drainage

4.4.1 Background

The Barak River divides itself into two branches (Surma and Kushiyara) within Cachar district of Assam (India). The second branch of the Barak is known as the Kushiyara River, which flows in a westerly direction then towards the south and south-west to Fenchuganj where it is joined by the Juri River originating from the Tripura hills, having a catchment area of1,841 km^{2}with rainfall of between 229 cm - 305 cm per year. Continuing on a south-westerly course, the KushiyaraRiver passes Balagonj, once the largest trading mart in the Sylhet district.

The Kushiyara River flows from east to west adjacent to the northern boundary of the Project Site. The flood period is generally from the last week of May to the middle of October. The principal tributaries of this locality are the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang, all originating from Tripura hills. The Kushiyara River is navigable almost throughout the year although sand bars often create difficulties for smooth navigation.

Map 4.3: Beels, Ponds, Rivers and Canals in the Vicinity of the SBPCL II Power Plant, Switchyard and potential future Bibiyana I Power Plant



Map 4.4: Shifting of Kushiyara River

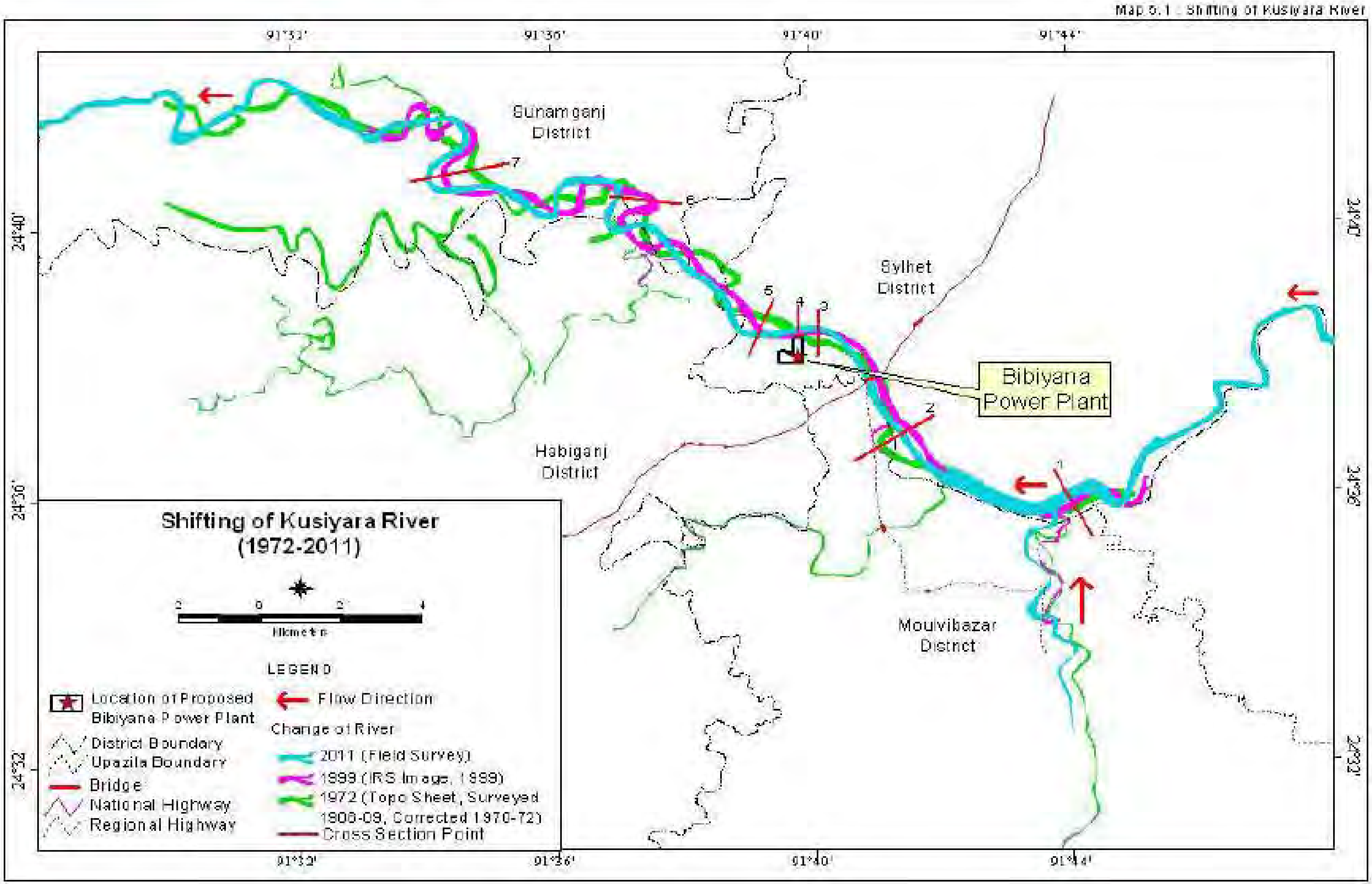


Figure 4.5: Silt Deposition Upstream and Downstream of the Project Site, Switchyard and proposed Bibiyana I Power Plant

4.4.2 Surface Water Features in the Vicinity of the Project Site

The following surface water features are located in the vicinity of the Project Site and are illustrated in Map 4.2 (above):

(a) Kushiyara River: The Kushiyara River flows from east to west adjacent to the northern boundary of the Project Site. Water flow is high during the rainy season and brings a significant quantity of silt. In other seasons, there is low water flow and water is more or less 'clear'. According to river flow data from BWDB recorded between 1982 and 2013 at the Sherpur monitoring station (refer to Figure 4.6), on average the low flow of the Kushiyara river varies between approximately 2,100 m^3/s during the monsoon period and approximately 200 m^3/s during the dry season. During the period 1982-2013, the maximum flow was 3890 m^3/s recorded in May 1991 and the minimum flow was 43.30 m^3/s recorded in March 1984.

As illustrated in Map 4.4, the Kushiyara River which flows from east to west in the vicinity of the Project Site has shifted continuously between 1972 and the present day. In particular, sections of the river located approximately5 km upstream (illustrated by cross-section 2), 1.5km downstream (cross-section 5), 6km downstream (cross-section 6) and 10km downstream (cross-section 7) of the Project Site have shifted noticeably. However, the shifting of the section of the river which forms the northern boundary of the Project Site (illustrated by cross-section 4) has been negligible during the last 29 years. Figure 4.3 indicates that siltation is evident on the inside meander of the river, both upstream and downstream, however minimal siltation is evident adjacent to the Project Site, which indicates that shifting of the river is less likely in this section of the river in the near future.

(b) Canals: Water bodies including canals, ponds and beels occupied only 2% of the total Project AoI. Most of the canals in the vicinity of the Project Site are seasonal (i.e. dry up in the dry season), have a narrow drainage system and negligible salinity. The canals are typically used for irrigation and habitat for local fish resources. However, according to anecdotal information, due to the low daily flow of water from upstream, siltation has increased in the canal beds and the depth of water is reducing at an alarming rate. In addition, bank erosion is also widely reported as a cause of siltation of canals. There is a big water body located approximately 5 km from the Project Site, on the eastern side of the village Majlispur. Originally this water body known as Buro river flowed into the Kushiyara River; however at present, both sides are closed bounded to the West the N2 Dhaka Sylhet highway and to be North to Sherpur-Moulvibazaar road. The water body is approximately 10-12 meters deep and the DC office currently issues leases for the use of the water body to local fishermen.

(c) Beels: A beel is a type of wetland with static water; they comprise comparatively large cultivable areas of land without any settlement. There are three degraded beels namely Bagber beel, Ari beel and Dakriar beel (shown in map 4.5.1) in the Project AoI. Most of the area becomes dry during the winter.

(d) Ponds: There are a number of ponds located within the residential areas, with most families having one or two ponds used for aquaculture and household purposes. The ponds range in size from approximately 0.1 to 1 acre.

Map 4.5.1 Degraded beels near to Project Site

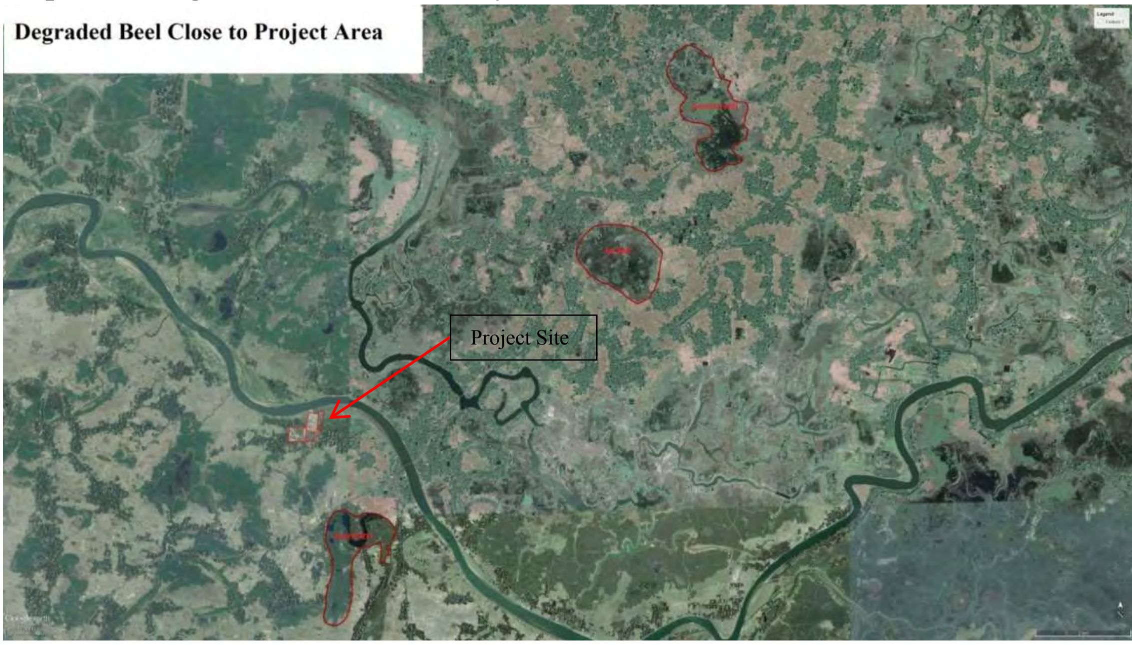


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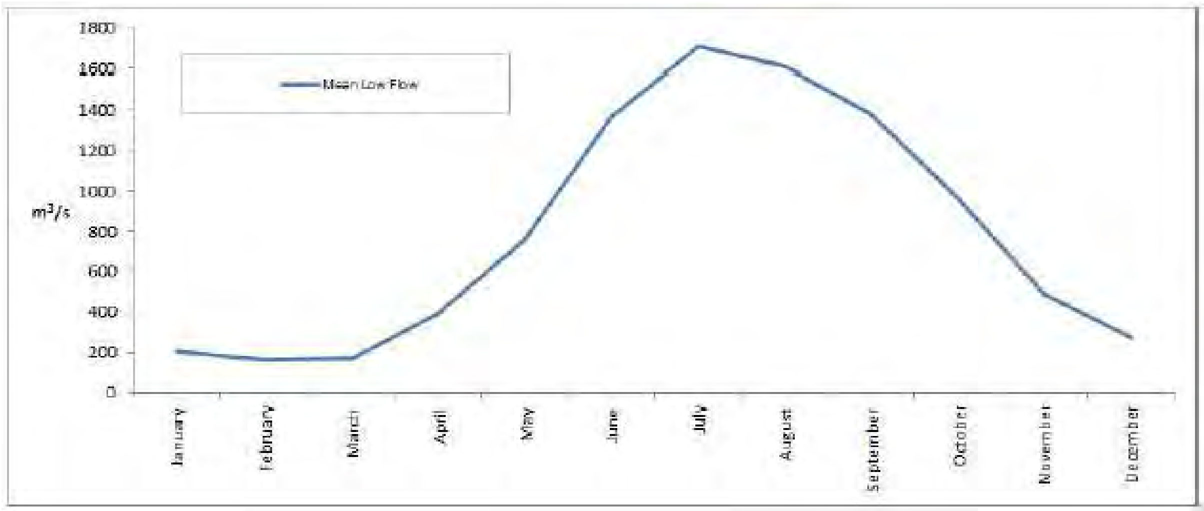
Figure 4.6: River Kushiyara – Mean Low Flow (1995-2010)



Source: Sherpur monitoring station

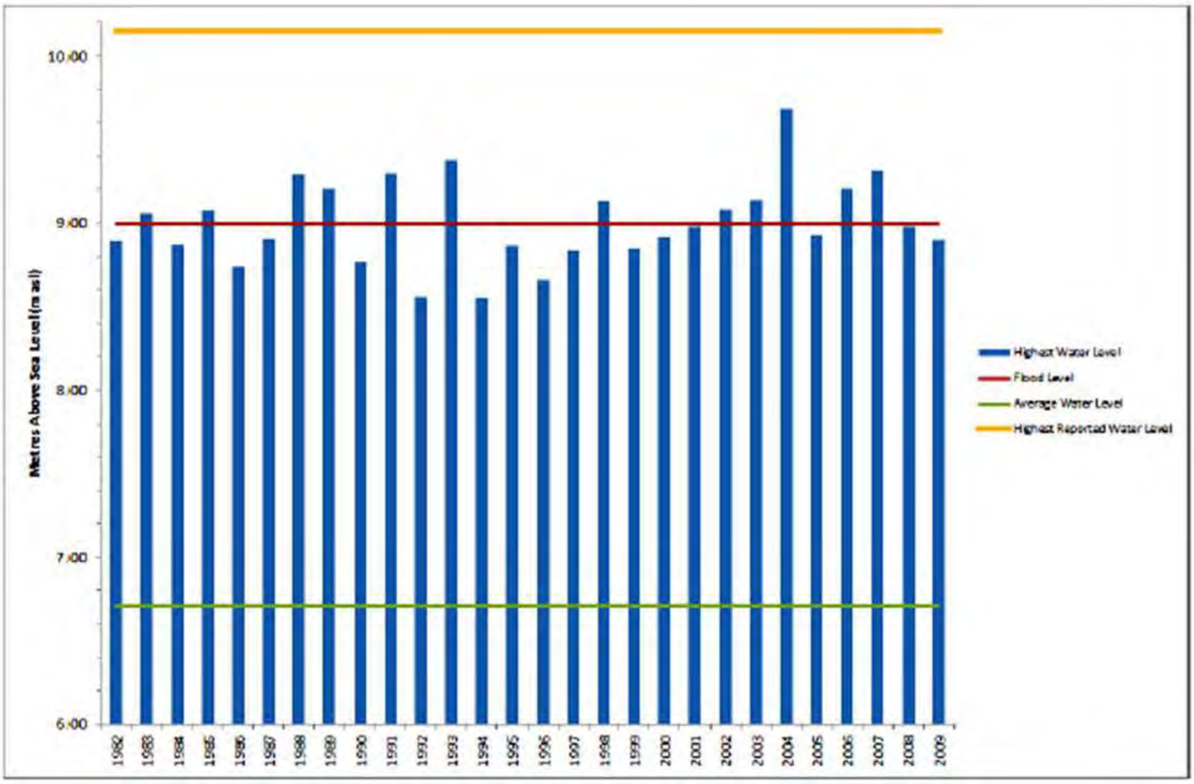
4.4.3 Flooding

Monsoon floods and flash floods occur in the lower parts of the Project AoI during April to May. There is a small water body adjacent to the western side of the Project AoI which floods the Project Site. In addition to this small water body, there are beels and canals around the Project Site that add to the floods during monsoon season.

The Bangladesh Water Development Board (BWDB) has constructed an embankment on the banks of the Kushiyara River adjacent to the Project Site, to protect agriculture from flood damage. This embankment, which is also used as village roads by local transport, is elevated to 9 m asl and acts as a barrier to normal floods against inundation of the Project Site. However, water levels in excess of 9 m asl cause inundation of the Project Site with the potential to cause loss of livelihoods (i.e. agricultural crops) and damages to physical infrastructure.

Water level data for the Kushiyara River was obtained from the Sherpur Bridge hydrological data collection point, located approximately 2 km upstream of the Project Site. Data for the period 1982 - December 2013 was provided by BWDB. According to the data, illustrated in Figure 4.7, the highest recorded water level between 1982 and 2013 was9.68 m asl in 2004; however, based on discussions with BWDB, it is understood that the elevation of the highest flood is 10.15 m asl, which reportedly occurred in 1977.

Figure 4.7: River Kushiyara – Highest Water Level (1982-2009)



4.4.4 Water Quality

4.4.4.1 Surface Water

As part of the validation of the ESIA, water samples were obtained from the Kushiyara River in February 2014 (Table 4.3) and sent to a certified laboratory in Dhaka for analysis (analytical certificates provided in Annex 6).

Samples were taken from five locations within the Kushiyara River, sample locations are shown in Map 4.6 and comprised:

- adjacent to the northern boundary of the Project Site;
- 1 km upstream of the Project Site;
- 3 km upstream of the Project Site;
- 2 km downstream of the Project Site; and
- 4 km downstream of the Project Site.

The results of the surface water analysis (average concentrations of the five locations) are presented in Table 4.3 and compared with Bangladesh water quality standards.

Table 4.3: Kushiyara River Water Quality

Parameter	**Units**	**Concentration** March 2008	**Concentration** October 2011	**Concentration** February 2014	**Bangladesh standards**
COD	mg/L	14.0	29.2	14.1	200
Dissolved Oxygen	mg/L	4.0	3.98	3.5	4.5-8
Ammonia Nitrogen	mg/L	< 0.05	2.51	< 0.97	50
Nitrites	mg/L	< 0.07	< 0.1	< 0.08	-
Nitrites	mg/L	3.0	0.87	3.2	10
Mercury	mg/L	< 0.01	< 0.005	< 0.03	0.01
Manganese	mg/L	< 0.05	0.098	< 0.07	5
Phosphate	mg/L	0.52	1.39	0.06	-
Phosphorus	mg/L	0.55	0.45	0.6	1
Iron	mg/L	0.80	6.05	0.90	2
Chlorine	mg/L	ND	ND	ND	0.2*
Calcium	mg/L	11.6	6.78	12.0	75
Arsenic	mg/L	< 0.01	< 0.005	<0.02	0.05
Total acidity as $CaCO^3$	mg/L	47	4.36	49.0	-
Alkalinity as $CaCO^3$	mg/L	70	30.3	73.0	200-500
Total Hardness as $CaCO^3$	mg/L	65	-	69.0	-
Lead	mg/L	< 0.01	< 0.01	<0.02	0.05
Potassium	mg/L	2.4	1.54	2.5	12
Sodium	mg/L	11.01	8.91	10.02	200
pH at 24.5°C	-	7.66	5.79	6.72	6-9
TSS	mg/L	13.8	100	12.4	10
TDS	mg/L	150	58.4	143	1000
Sulphate	mg/L	7.0	2.71	5.77	400
Turbidity	NTU	17	193	19	10
Conductivity	µS/cm	160	64.3	145	-
Notes: ND Non-Detect (i.e. below the laboratory limit of detection) * Drinking Water Standard					

Source: Bangladesh Council of Scientific and Industrial Research (BCSIR)

Although the area is characterized by fresh water anecdotal evidence suggests that the river water upstream of the Project Site is polluted from a fertilizer plant (Fenchuganj Fertilizer

Factory). The Fenchuganj Factory is located around 35 km upstream of the Project Site and reportedly discharges ammonia and 'other chemicals' into the Kushiyara River. It is noted that although the Fenchugani Factory is still in operation, a modernised fertilizer facility is now under construction at the site and it is expected that once this goes into operation the existing facility will be closed down. It is noted that the baseline water quality analysis shows that the ammonia nitrogen concentration in all samples are below the DoE standards.

According to the analytical results presented in Table 4.5, there is no indication that chemicals from the fertilizer factory are impacting water quality in the vicinity of the Project Site. The primary impact on water quality is during the monsoon season when silt is washed into the river and the Total Suspended Solids (TSS) and Turbidity of the river water increases significantly, relative to pre-monsoon concentrations. Although the TSS and turbidity levels in the Kushiyara River were found to exceed Bangladeshi Standards in all three sampling periods, the magnitude of the exceedance was considerably higher in the October 2011 (i.e. post-monsoon) period. The increased silt concentrations post-monsoon could also account for the identified increase in Iron concentrations in the October 2011 (i.e. post-monsoon) monitoring results, which exceed Bangladeshi Standards. No other exceedances of Bangladeshi Standards were identified in the analysis.

4.4.4.2 Groundwater

As with other parts of Bangladesh, there is a good availability of groundwater in the Project AoI that is being used by hand pumps for drinking and domestic purposes. Some industries such as Flour Mill, Bakery, Tobacco, Tea, Bricks, Pottery, Manufacture of wood products, Rice husking use shallow tube wells within their premises to meet the requirement of good quality water for various purposes. Scattered homesteads in the vicinity of the Project Site use hand tube wells (HTWs) to meet their domestic demand. In October, 2011 and December, 2013it was observed that a sufficient quantity of water was coming out from the HTWs and there is no specific complaint about non-availability of groundwater. There are two sources of groundwater in Bangladesh; the HTWs having a depth varying between 10m – 15m bgl while the deep tube wells (DTWs) can have depths between 100m – 150m bgl in the region.

Three groundwater samples were obtained, in February 2014, from groundwater wells located in the vicinity of the Project Site as well as to the north and south of the Kushiyara River (refer to Map 4.6). Samples 1 and 3 were obtained from DTWs, whilst Sample 2 was obtained from a shallow HTW. All groundwater samples were analyzed by certified laboratory in Dhaka (analytical certificates provided in Annex 6), and the analytical results are presented in Table 4.4.

Table 4.4: Groundwater Quality

Parameter	Units	**Sample 1** The Project Site	**Sample 2** South of the River	**Sample 3** North of the River	**Bangladesh Groundwater Quality Standards**
Mercury	mg/l	< 0.005	< 0.005	< 0.005	0.01
Phosphorous	mg/l	5.66	4.03	6.98	6
Calcium	mg/l	6.33	40.05	6.33	75
Total acidity as $CaCO_3$	mg/l	18.2	42.88	15.01	No Standard (NS)
Alkalinity as $CaCO_3$	mg/l	280	361	281	200-500
Total hardness as $CaCO_3$	mg/l	25.99	193	32	NS
Lead	mg/l	0.012	< 0.01	< 0.01	0.05
Potassium	mg/l	1.40	7.06	2.06	12
Sodium	mg/l	101	45.01	106	200
Dissolved Oxygen	mg/l	1.45	1.62	1.21	4.5-8
Temperature	°C	25	25	26	20-30
TSS	mg/l	69.06	57.6	5.01	10
TDS	mg/l	289	288	293	1000
Cadmium	mg/l	< 0.001	< 0.001	< 0.001	0.005
Chromium	mg/l	< 0.01	< 0.01	< 0.01	NS
Copper	mg/l	< 0.01	< 0.01	< 0.01	1
Zinc	mg/l	0.04	0.03	0.03	5
Nickel	mg/l	< 0.01	< 0.01	< 0.01	0.1
Boron	mg/l	0.51	1.55	0.17	1
Ammonium Nitrogen	mg/l	10.01	65.03	9.02	50
COD	mg/l	19.4	59.04	12.07	NS
BOD	mg/l	13.0	12.3	6.5	NS
Oil & Grease	mg/l	11.5	2.10	5.92	0.01
Manganese	mg/l	0.042	0.105	0.033	5
Phosphate	mg/l	20.06	11.18	21.20	NS
Iron	mg/l	1.79	4.45	1.83	2
Arsenic	mg/l	0.057	0.187	0.050	0.05
Chloride	mg/l	1.05	10.03	0.95	150-600

Source: Bangladesh Council of Scientific and Industrial Research (BCSIR)

According to a WHO web resource, elevated arsenic concentrations (above the WHO guideline value of 0.01 mg/l[9]) in groundwater are common throughout Bangladesh and are largely naturally occurring due to the underlying arsenic-rich strata[10]. The analytical results presented in Table 4.4 confirm that arsenic concentrations in groundwater in the vicinity of the Project Site are above the WHO guideline value of 0.01 mg/l. In addition, the results indicate that arsenic concentration are particularly high (i.e. above the Bangladesh Standard of 0.05 mg/l) in the shallow HTW.

Concentrations of Phosphorous and Iron were found to exceed Bangladeshi Standards at one of the three sample sites (Sample 3 and Sample 2 respectively). Furthermore, concentrations of oil and grease were found to exceed Bangladeshi Standards. No other exceedances of Bangladeshi Standards were identified in the analysis.

[9] World Health Organisation (WHO), 2008, Guidelines for drinking-water quality, third edition.

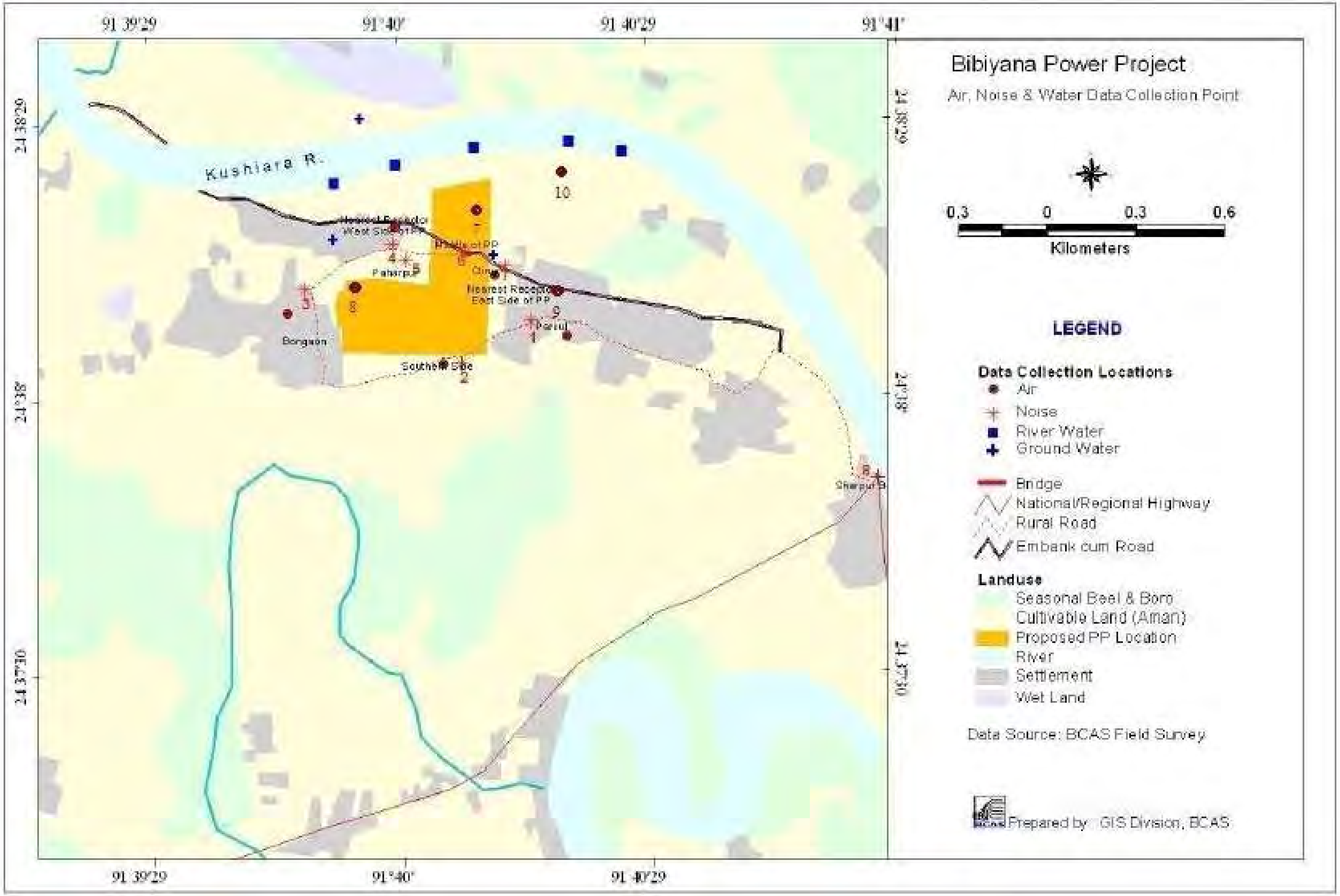
[10] http://www.who.int/water_sanitation_health/dwq/arsenic/en/, accessed 15/03/2011

4.5 Physical Environment: Noise

Existing noise levels within the Project Site were measured over day-time and night-time periods throughout the project area as well as in areas in the immediate vicinity and beyond-The monitoring was undertaken in November 2013 at the locations shown in Map 4.6. These noise levels are depicted in Annex 4.

Noise pollution is not a widely mentioned problem in the Project Site; some respondents have attributed noise pollution to different types of vehicles that use the roads in the study area. Map 4.6 below shows the noise level monitoring locations in the vicinity of the SBPCL II Power Plant.

Map 4.6: Map showing the locations of Air, Noise and Water data collection



4.5.1 Measurements and Results

Existing noise levels within the Project AoI were measured in March – April 2011, over periods of 24 hours each day throughout the Project Site and in areas in immediate vicinity and beyond (Sample sites shown in map 4.6). As part of the validation of the ESIA, additional sound readings were taken during the day time in October and November 2013.

The results are shown in Figures 4.8 and 4.9, with detailed data are presented in Annex F.

Figure 4.8: Baseline Noise Levels (Day Time)

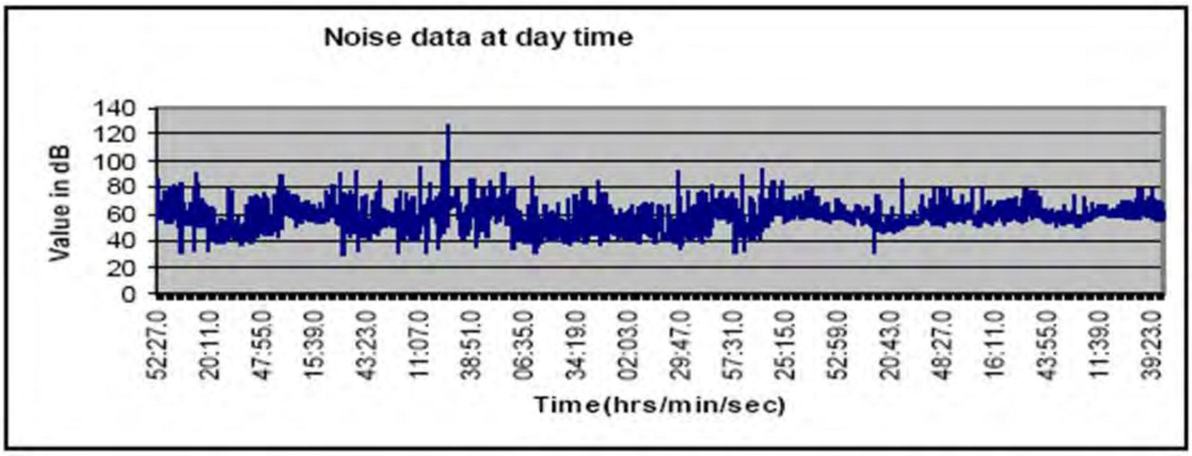
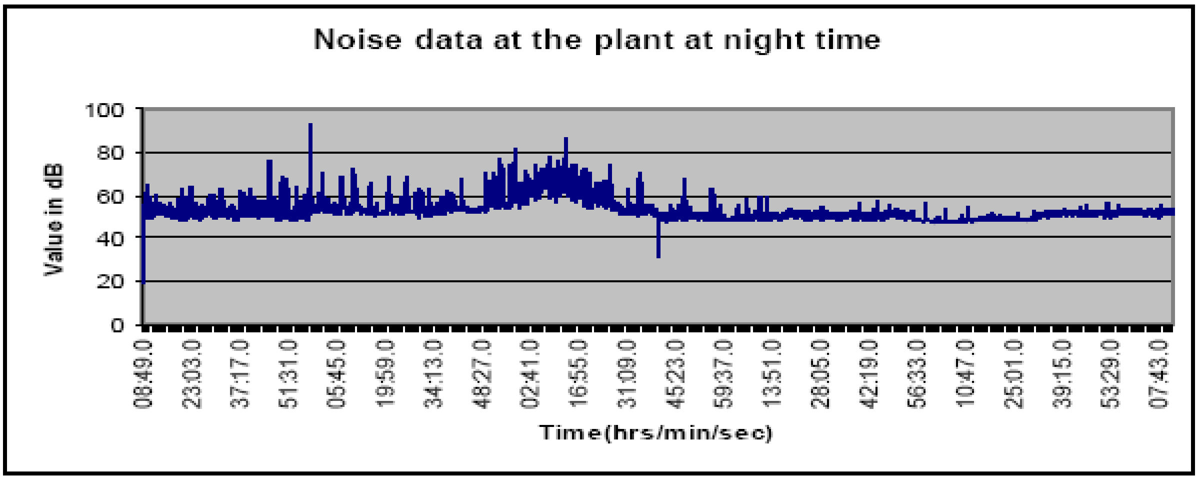


Figure 4.9: Baseline Noise Levels (Night Time)



The above figures show that noise level data varies between day time and night time, with higher levels generally recorded during the day. Data provided in Annex 4 indicates that the Sherpur point (Point 8) is the most vulnerable, where the baseline noise level was recorded as 60 dB at day time and 70 dB at night (measured near highway bus stops). The baseline noise level of the Project Site (Point 6) was recorded as 45 dB during the daytime and approximately 55 dB at night. This difference may be due to the very high frequency noise generated by insects at night which does not occur during the day.

The noise levels from the validation survey in 2013 were generally found to be higher than the original 2011 results, which may be attributed to the temporary generator used during construction activities and a sizable number of workers in the Project AoI.

The noise levels recorded are characterised by the increased traffic at Sherpur point, which is the entry to the road connecting the Project Site. The sound level at the north-eastern part of the Project Site, where a number of settlements are located, is anticipated to be intermittently loud during the day time due to increase in traffic supplying construction materials. However, during the night time, when there would be restrictions on these movements, the sound level would be reduced.

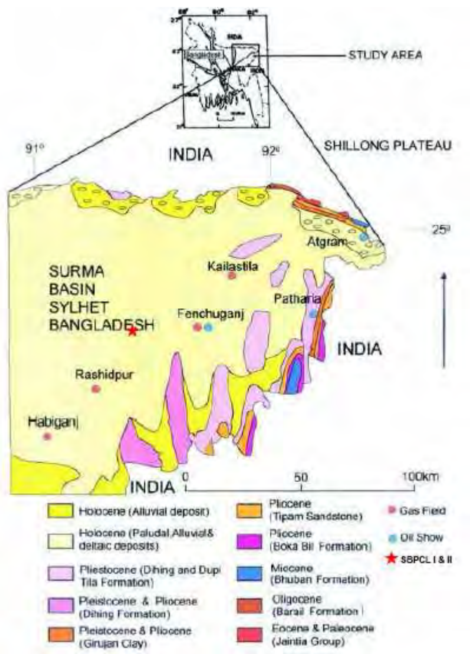
4.6 Physical Environment: Geology and Seismicity

4.6.1 Geology

The Project Site is located in the Surma basin in the Sylhet Trough comprising a sub-basin of the Bengal Basin lies in the north-eastern flank of Bangladesh. It is bound on the west by the Indian platform, on the north by the Indian Shillong plateau, on the east and southeast by the Chittagong-Tripura fold belt of the Indo- Burman Ranges, and to the south and southwest by the main part of the Bengal Basin. This east–west trending trough is 120 km (75 mi) long, 50 km (31 mi) wide and 13 to 17 km (8.1 to 11 mi) thick.

The basin gradually deepens toward the centre, and undergoes active subsidence. Deposition of the Sylhet Trough sediments has been in a large, mud-rich delta system that had drained the eastern Himalayas. The north-eastern part of the basin was affected by tectonic loading, both from the northeast – eastern Himalayas – and east – Indo–Burman Ranges – causing nearby parts of the basin to subside further which accommodated the thick Surma Group sediments. The above could be represented through stratigraphic sequence as follows illustrated in Map 4.7.

Map 4.7: Stratigraphy of Surma Basin

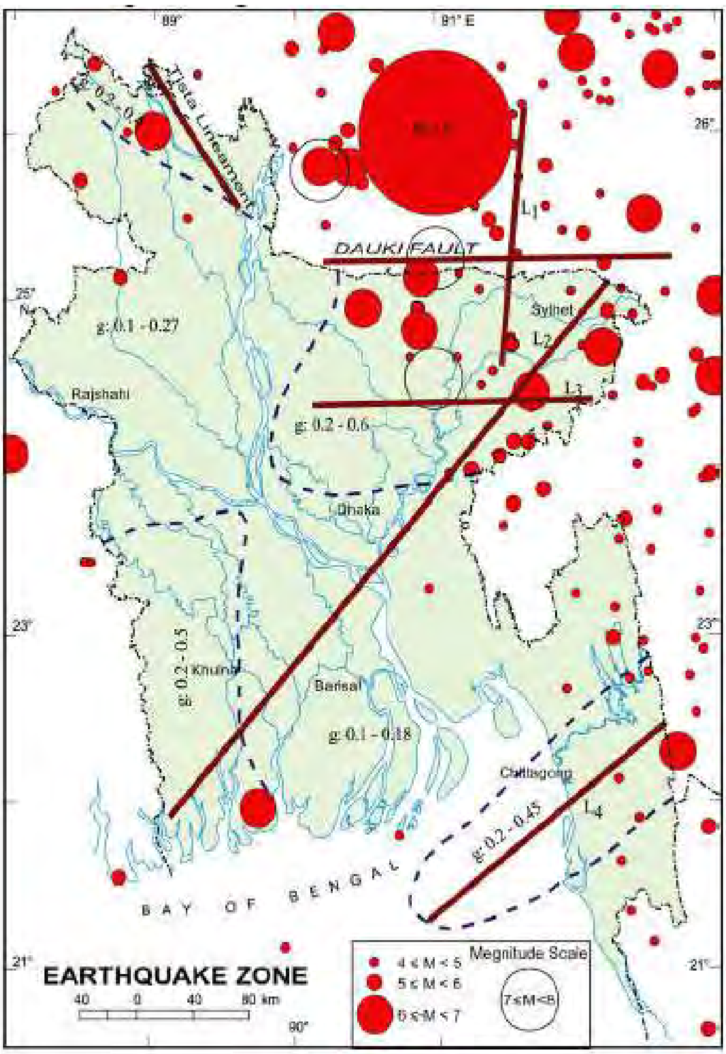


In most of the Surma flood plain, there is no annual deposition of new sediment; however, the soils are older and more developed, and in rainy season, flood water is clear. The landscape is very gentle undulating or nearly level. The main soils on the high flood areas and flood plain rides have grey silty to loamy top soils and grey silty to clayey sub-soils with black structure. The basin soils are very similar, but more clayey. Most soils overlie stratified material at 2 – 5 feet depth. Almost all of the soils are seasonally flooded, and dry out by the middle of the dry season.

4.6.2 Seismicity

Bangladesh has been divided into four seismic zones. The north-eastern part of Bangladesh is in the most active seismic zone and has experienced earthquakes of moderate/high intensity. The great earthquake of 1897, which had its epicentre in Shilong Plateu in India, caused widespread damage. Two major earthquakes – the Bengal earthquake of 1885 and Srimangal earthquake of 1918 – caused severe damage in limited areas surrounding their epicenters. Earthquakes with magnitudes between 7.0 and 8.7 on the Richter scale have been experienced, but they are rare events.

Map 4.8: Seismic Map of Bangladesh



The Project AoI lies within the active seismic zone and as such is prone to earthquakes. Therefore all the structures related to the SBPCL II Power Plant will, hence, be built in such a way as to withstand earthquakes up to magnitude of 7.5 on the Richter scale.

4.7 Biological Environment: Vegetation and Floral Diversity

Human intervention and extension of the settlement areas have had a compounding effect resulting in a rapid depletion of the natural resources in the Project AoI. The following macro ecosystem types have been identified within the Project AoI:

- cultivated land;
- roadside vegetation;
- exotic wood plantation;
- local species;
- homestead vegetation; and
- wetland areas.

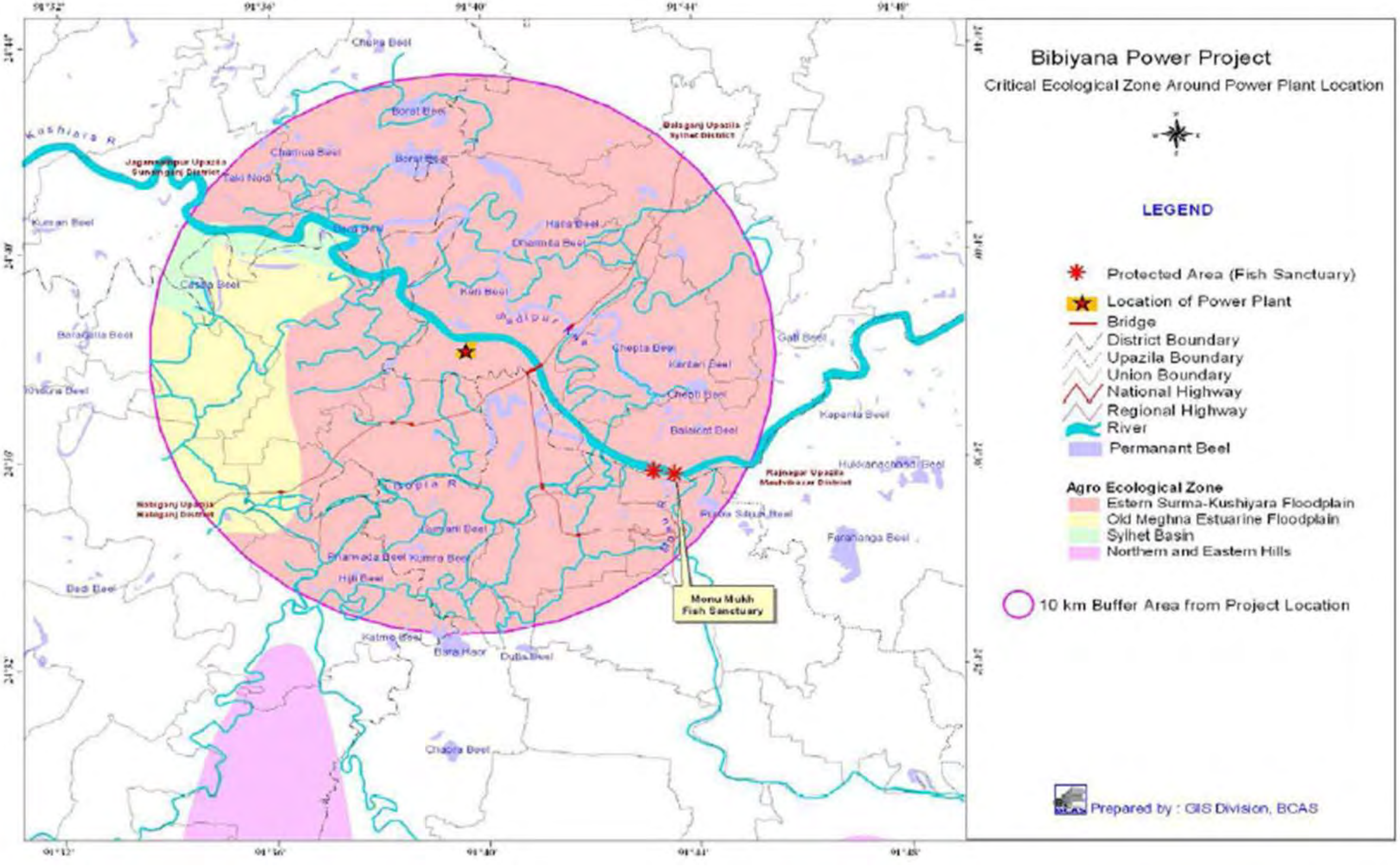
4.7.1 Ecologically Critical Areas

There is no area, declared as an ecologically critical area, situated within the Project AoI. Ecosystems within the Project AoI are set out in Table 4.5, and are indicated in Map 4.9.

Table 4.5: Ecosytems within the Project AoI

Ecologically Critical Area Types	Name	Distance from Project Site (km)	Direction
Beel/Wetland Areas	Beri	1.67	South-East
	Kumaril	6.31	South
	Kumra	7.10	South
	Pharwad	7.83	South
	Bara Haor	10	South
	Kamto	5.82	South
	Chandi	2	West
	Halua	5.82	West
	Casba	8.2	West
	Kery	1.5	North
	Dharmita	4.46	North- East
	Haila	5.34	North- East
	Bara	4.3	North-West
	Chamura	8	North-West
	Borak	6.4	North-West
	Borat	8.8	North-West
	Philba	5.5	North
	Chapta	6	East
	Chepti	7	East
	Kanter	6.6	East
	Balaichat	7.6	East
River	Kushiyara	0	North
	SadipurKhal	1.4	North- East
	Gopla	5	South
	Monu	7.75	South- East

Map 4.9: Critical Ecological Zone



4.8 Biological Environment: Faunal Diversity

The Project Site primarily comprises agricultural land and does not have any statutory designations or ecological protection status. However, the Project AoI is rich in faunal diversity. Two Protected Fish Sanctuaries (MonuMukh) are located to the south-east of the Project Site. There are 18 species of reptiles, 7 types of domestic animals, 85 species of birds and 32 species of fish.

4.8.1 Fisheries Survey

A fisheries survey was undertaken in October 2011 (refer to Annex 13) to determine the aquatic diversity and fish habitats in the Kushiyara River, adjacent to the northern Project Site boundary.

During the survey, the following data was collected:

- Fish population dynamics (species composition, length and weight measuring, migration behaviour, etc.) through fish sampling from catches at different locations of the Kushiyara River. To validate the results, surveys were carried out and anecdotal information gathered at fish landing sites, marketing network and within the general fishermen community in the Project AoI; and
- Limnological and water quality survey to identify and quantify aquatic habitat characteristics to determine the aquatic habitat conditions as well as water pollution load.

4.8.1.1 Methodology

Fish Population Study

As set our above, this study was undertaken towards the end of the monsoon season). During the late monsoon season, as the waters start to recede, juvenile and adult fishes come to main river from *Haor* and adjacent floodplain areas, and the widest range of fish are present in the river.

During the survey samples were collected from potential high, medium and low impact zones of the SBPCL II Power Plant. Samples were collected from six locations which were± 1 km, ± 4 km and ± 8 km (upstream and downstream) from the Project Site, between the villages of Monumukh, Parkul and Jamargaon. The total length of the survey distance upstream (up to 8km, North) and downstream (8km, South) from the Project Site.

Table 4.6: Sample Locations with respect to Project Site

Sample Location	Distance from the Project Site (km)	Upstream/Downstream
Monumukh	8	Upstream
Brahmingaon/ Alipur	4	
Char Tajpur	1	
Parkul	0	Base Point
Lama Tajpur	1	Downstream

Atghoria/Padullah	4	
Jamargaon	8	

Total catch by species was recorded for all gill nets, seine nets, lift net, drift net and shanglajal, long lines operating during the survey period. Furthermore, the mesh size, owner status and number of units used by the fishermen were recorded. The number of nets surveyed were 30% of the net types being used at the time of survey. Catch monitoring data was collected by physically weighing the catch at the landing sites

Limnological Survey

1) Benthos

Benthos were collected by Ekman dredge at about 3m depth (shallow region) at Monumukh, Brahmangaon, Lamatajpur, Paharpur, Atgoria and Digholbak of Kushiyara river on 23rd October 2011 between 09:00 AM to 04:00 PM. Duplicate samples were collected from the same sampling site. The sample was transferred from the Ekman dredge into a plastic bag on the boat. The sample bags were watertight and transferred to the laboratory in a thermally isolated container cooled with icepacks.

The sample was then sieved with sprinkle water directly onto the mud sample with a low-pressure nozzle. The sieving was performed very carefully in order to avoid any damage to the fragile organisms and to ensure that all animal present in the sample were collected. A sieve of 0.5 mm mesh was used to isolate macro-fauna. Aquatic vegetation present in the sample was cautiously removed from the surface of the sample, rinsed apart and the resulting water sieved.

All material retained on the sieve, including organisms, shell fragments, vegetal debris and coarse sediment grains were transferred to appropriate containers making sure that no other smaller animals were attached to these elements. Containers were labeled indicating the station code, the sample code and sampling date.

The sieved material was then fixed, to prevent the adverse effects of light and temperature which might cause rapid decay of organisms. Preservation of the samples was done by the addition of a 10% formalin solution until the samples were transported to Sylhet around 40km away for immediate lab analysis in October 2013. The volume of the fixative was approximately three times the volume of the sample.

Rose Bengal strain at 200mg/l was used carefully to accelerate the sorting procedure. A small quantity of unsorted material was placed on a tray for an initial general sorting for larger organisms with the help of a magnifying lens. . Fine sorting was performed under a dissection microscope. During this phase a small quantity of the sample was spread onto a Petri dish and carefully examined to identify the organisms. Organisms were identified according to the main taxonomic groups, usually bivalves, gastropods, crustaceans, insects etc.

2) Phytoplankton

Phytoplankton samples were collected at Monumukh, Brahmangaon, Lamatajpur, Paharpur,Atgoria and Digholbak of Kushiyara river on 23rd October 2011 between 09:00 AM to 04:00 PM and validated in October 2013. Monofilament nylon plankton net of 25 μm mesh size was used for this survey. For qualitative study, net hauls were made at the surface and at desired depth on the river of the sampling sites. For quantitative analysis, phytoplankton was collected by the plankton net by passing 10 liters of water through it and finally concentrated to 50 ml.

The phytoplankton was fixed as soon as the collection was over to prevent the adverse effects of light and temperature which might cause rapid decay of organisms. Preservation of the samples before analyses was done by addition of 10% buffered formalin in small plastic bottles.

Analyses involved transfer of 1 ml sub-sample from each of the samples to the Sedgewick-Rafter counter and counting of cells within 10 squares of the cells, chosen randomly under a compound binocular microscope. The cell counts were used to calculate the cell density using the Stirling (1985) formula where theplankton density is estimated by-

$N = (A \times 1000 \times C)/(V \times F \times L)$

Where,

N = No. of phytoplankton cells or units per litre of original river water.

A = Total No. of phytoplankton counted.

C = Volume of final concentrate of the samples in ml.

V = Volume of a field in cubic mm.

F = No. of fields counted.

L = Volume of original river water in liters.

The phytoplankton were then identified up to the genus level and enumerated with reference to APHA(1992) and Bellinger, (1992). The number of plankton was recorded and expressed numerically per litre of river water. Qualitative studies were undertaken in accordance with Peenak (1953), Ward and Whipple (1954), Needham and Needham (1962), Prescott (1964), Bellinger (1992) and APHA (1992).

3) Zooplankton

Three Zooplankton samples were collected at each of the following locations: Monumukh, Brahmangaon, Lamatajpur, Paharpur, Atgoria and Digholbak in October 2013. PM. Monofilament nylon plankton net of 50 µm mesh size was used for this survey. For qualitative study, net hauls were made at the surface and at desired depth on the river of the sampling sites. For quantitative analysis, zooplankton was collected by the plankton net by passing 10 liters of water through it and finally concentrated to 50 ml.

An approach similar to that described for Phytoplankton was then followed. In summary, the zooplankton was fixed by addition of 5% buffered formalin in small plastic bottles, before analyses of 1 mL sub-samples on a Sedgewick-Rafter counting cell, under a compound binocular microscope (counting of cells within 10 squares of the cells, chosen randomly). The cell counts were used to calculate the cell density using the Striling (1985) formula where the zooplankton density is estimated by:

N = (A×1000×C)/(V×F×L)
Where,
N = No. of zooplankton cells or units per litre of original river water.
A = Total No. of zooplankton counted.
C = Volume of final concentrate of the samples in ml.
V = Volume of a field in cubic mm.
F = No. of fields counted.
L = Volume of original river water in liters.

The zooplankton were then identified up to the genus level and enumerated with reference to APHA (1992) and Bellinger(1992). The number of zooplankton was recorded and expressed numerically per litre of river water. Qualitative studies were undertaken in accordance with Peenak(1953), Ward and Whipple (1954), Needham and Needham (1962), Prescott (1964), Bellinger(1992) and APHA (1992).

4.8.1.2 Results

Fish Population Study

During the study, no species were identified, which are defined as Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU), according to The International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

The results of the Fish Population Study are presented in Table 4.7.

Table 4.7: Results of the Fish Population Study

Local Name	Scientific Name	% of population	Status[1]
Boal	*Wallagoattu*	11.7	NT
Rita	*Rita rita*	10.1	LC
Ghagot	*Aoichthysaor*	8.2	LC
Kalbashu	*Labeocalbasu*	8.1	LC
Lahu	*Cirrhinusreba*	7.9	LC
Bacha	*Eutropiichthysvacha*	6.3	LC
Chela	*Salmophsiaphulo*	5.9	LC
Gharua	*Clupisomagarua*	5.5	LC
Rani	*Botia Dario*	4.1	LC
Chanda	*Ambassisranga*	3.7	LC
Kajoli	*Ailiacoila*	3.5	NT
Chapila	*Gudusiachapra*	3.1	LC
Catla	*Gibelioncatla*	2.8	LC
Puti	*Puntiussophore*	2.3	LC
Hilsha	*Tenualosailisha*	2.1	NE
Eel	*Mastacembelusarmatus*	2.0	LC
Mrigel	*Cirrhinusmrigala*	1.5	LC
Icha	*Prawn sp.*	1.4	NE
Tengra	*Mystusvittatus*	1.3	LC
Potka	*Tetraodoncutcutia*	1.1	LC
Kakila	*Xenentooncancila*	0.7	LC

Local Name	Scientific Name	% of population	Status[1]
Poa	*Otolihoidespama*	0.6	NE
Rui	*Labeorohita*	0.5	LC
Mola	*Amblypharyngodonmola*	0.4	LC
Shing	*Heteropneustesfossilis*	0.3	LC
Shol	*Channastriata*	0.3	LC
Pabda	*Ompokpabo*	0.2	NT
Taki	*Channapunctata*	0.2	LC
Gunia	*Labeogoninus*	0.2	LC
Kaski	*Scatophagusargus*	0.1	LC
Koi	*Anabas testudineus*	01	DD
Chitol	*Chitalachitala*	<0.1	NT
Others	NA	3.9	-

Notes:

[1] Status according to The International Union for Conservation of Nature (IUCN) Red List of Threatened Species, using the following categories:

Not Evaluated (NE): a taxon is Not Evaluated when it is has not yet been evaluated against the criteria;

Data Deficient (DD): a taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status;

Least Concern (LC): a taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category; and

Near Threatened (NT): a taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

During the study, no Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) species were identified.

The Kushiyara River and its adjacent floodplains and *haor* areas have the potential to support the spawning and grazing of many fish species, although no spawning ground was identified during the surveys. The small indigenous and self-recruiting species (SIS and SRS) spawn in different places of the river where the current is fast. Formerly, the Fry migrated to the adjacent beels, floodplains or haors for grazing and also grazed in the shallower part of the river. Nowadays, the opportunities to migrate to the floodplains and haors have drastically reduced due to limiting the fish migration routes by constructing embankments. Yet feather back (*Chitalachitala*) breeds in the deeper portion of the river where current velocity is high and lay eggs and stick them with an underwater substrate. There is no identified breeding ground for Indian major carps in the Kushiyara River, though it is noted that secondary data indicates that small fishes (e.g. Bacha, Gharua, Kazoli, etc.) start breeding here from mid-February and continue up to September.

In response to the community household surveys, local fishermen indicated that fish migration from the Kushiyara River to haor areas in the monsoon seasons and from haor areas to the Kushiyara River during late monsoon were previously well known. However, anecdotal information collected from the fisherman also indicated that in more recent times the chances of fish migration have reduced significantly.

In 2007 the GoB established a fish sanctuary near Monumukh (approximately 8 km upstream of the Project Site) in the main Kushiyara River to increase the fish production. It was effective for the first two years and increased fish production significantly. However, due to poor construction of the sanctuary and lack of monitoring, it is reported that the fish sanctuary has been less effective (according to The Department of Fisheries).. The local DoE offices organize an awareness campaign every year to ban fishing during the breeding period (mid-March to mid-May); however, it is understood from the Department of Fisheries that the fishermen rarely follow these restrictions.

A large haor (‘Kaowadighirhaor’) is located adjacent to the Kushiyara River, approximately 10 km upstream of the Project Site, where a wide variety of fish species are reportedly present according to anecdotal information collected from the local fishermen. The GoB constructed a fish pass and sluice gates here in 1996 to connect the haor to the main River; however this is reportedly poorly maintained.

Limnological Survey

The physico-chemical parameters of different sampling points are shown in Table 4.8. The standard value for Dissolved Oxygen (DO) for sustaining aquatic life is 4 ppm and for drinking purposes it is 6 ppm (Ahmed and Rahman, 2000). The survey has indicated that DO ranges from 5.4 ppm to 8.0 ppm, which is reasonable for the fish community in the Kushiyara River. Where the DO is comparatively high, it is reasonable to assume this would indicate accelerated photosynthesis by the phytoplankton communities.
The survey has indicated that water transparency value ranges from 19 cm to 28 cm. The minimum value of water transparency was observed at Monumukh, where there was a continuous water supply from the Monu River, which generated turbid water at the sampling point.
As shown in table 4.8, the survey indicated that the pH was fairly stable across all sampling points, ranging from 7.0 at Monumukh and Digholbak to 7.3 at Lamatajpur and Atgoria. Temperature was also fairly consistent at all sampling points ranging from 29°C to 31°C.

Table 4.8: The Physico-Chemical Parameters of the Kushiyara River

Sampling Point	DO(ppm)	pH	Temp.(°C)	Transparency (cm)	Upstream/Downstream
Monumukh	6.9	7.0	30	19	Upstream (average of 3 samples)
Brahmangaon	8.0	7.2	31	28	Upstream(average of 3 samples)
Lamatajpur	7.6	7.3	30	24	Upstream(average of 3 samples)
Paharpur	8.0	7.2	30	27	Downstream(average of 3 samples)
Atgoria	7.2	7.3	30	22	Downstream(average of 3 samples)
Digholbak	5.4	7.0	29	24	Downstream(average of 3 samples)

Source: BCAS Survey, 2013

A total of 5 groups of benthos were recorded during the study (see Table 4.9). The dominant group was *Lamellidensmarginalis* found in all sampling sites followed by *Chironomus* larvae. The abundance of *Chironomus* larvae and gastropod (*Pilaglobosa, Unio*) indicate the good condition of the water body. Species diversity of benthos in the study was relatively low, which may be due to unfavorable condition for organisms in the sampling sites i.e. Dragnet fishing was being undertaken in the Kushiyara River near the sampling site, which may adversely affect the total benthos population.

Benthic invertebrates play an important role in transitional ecosystems, by filtering phytoplankton and then acting as a food source for larger organisms such as fish, thereby linking primary production with higher trophic levels. They also structure and oxygenate the bottom by reworking sediments and play a fundamental role in breaking down organic material before bacterial re-mineralization.

Table 4.9: Benthos content in Kushiyara River

Sampling point	Benthos (Number)				
	*Chironomus*larvae	*Lamellidensmarginalis*	*Pilaglobosa*	*Unio*	Stonefly nymph
Monumukh	11	18	7	-	-
Brahmangaon	17	24	5	-	-
Paharpur	-	10	4	3	1
Atgoria	6	8	2	3	2
Lamatajpur	9	11	5	2	-
Digholbak	2	9	3	-	-

Five phytoplankton groups of 20 genera were observed during the study (as set out in Table 4.10 and Table 4.11) with Chlorophyta presenting as the dominant group followed by Bacillariophytes. ***Ulothix,*** under the Chlorophyta group, was identified as the most dominant genus ranging from 220 unit/L at Monumukh to 840 unit/L at Brahmangaon, followed by ***Melosira,*** under Bacillariophytes group. The presence of diverse phytoplankton is indicative of good ecological conditions in the Kushiyara River. There were few Cyanophytes identified within the study; if found in larger numbers, this species can be indicative of excessive nutrient in the river water (i.e. as a result of industrial effluents and runoff from agricultural lands that are excessively fertilized).

Table 4.10: Qualitative study of Phytoplankton Population in the Kushiyara River

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Chlorophyta	*Ankistrodesmus*	P	P	A	P	P	P
	Tetraedron	A	A	A	A	P	A
	Scenedesmus	P	P	A	A	P	A
	Spirogyra	A	P	A	A	P	A
	Ulothix	P	P	P	P	P	P
	Microspora	A	P	A	A	P	A
	Closterium	P	A	A	A	P	A
	Stigeoclonium	P	P	P	P	A	P
Desmis	*Clostridium*	A	A	A	A	P	A
Bacillariophytes	*Milosira*	P	P	P	P	A	P
	Tabellaria	P	A	A	P	P	A
	Synedra	A	P	A	P	A	A
	Navicula	P	P	P	P	P	A
	Cymbella	A	A	A	P	P	A
	Gyrosigma	A	A	A	A	P	P
Euglenophytes	*Euglena*	P	P	P	P	A	A
	Trachellomonas	P	P	A	A	A	P
	Lemanea	P	A	A	A	A	A

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Cyanophytes	*Gleocapsa*	P	A	A	P	A	P
	Oscillatoria	P	P	A	A	A	A
Note: P= Present; A= Absent							

Table 4.11: Phytoplankton population (unit/L) in the Kushiyara River

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Chlorophyta	*Ankistrodesmus*	0	0	0	10	10	0
	Tetraedron	0	0	0	0	10	0
	Scenedesmus	0	10	0	20	90	0
	Spirogyra	0	10	0	0	10	0
	Ulothix	220	840	0	550	240	0
	Microspora	0	0	0	0	10	0
	Closterium	0	0	0	0	10	0
	Stigeoclonium	20	10	0	0	0	0
Desmis	*Clostridium*	0	0	0	0	20	0
Bacillariophytes	*Milosira*	170	40	0	60	0	30
	Tabellaria	20	0	0	30	20	0
	Synedra	0	0	0	10	0	0
	Navicula	0	0	10	50	40	0
	Cymbella	0	0	0	10	0	0
	Gyrosigma	0	0	0	0	10	0
Euglenophytes	*Euglena*	0	0	0	10	0	0
	Trachellomonas	10	10	0	0	0	0
	Lemanea	10	0	0	0	0	0
Cyanophytes	*Gleocapsa*	0	0	0	100	0	0
	Oscillatoria	30	10	0	0	0	0

Three groups of zooplankton were recorded during the study consisting of 3 genera of Rotifer, 2 genera of Copepods and 4 genera of Cladocera (as set out in Tables 4.12 and Table 4.13). The most dominant group was Cladocera. *Moina*of the Cladocera group was found to be the most abundance genus ranging from 10 unit/L at Brahmangaon and Atgoria to 25 unit/L at Monumukh. Cladocera, commonly known as “water flea”, lives primarily in deep water and constitutes a major item of food for fish; thus they hold a key position in the food chain and energy transformation (Uttangi, 2001). The Rotifer group also play a significant role in the aquatic food chain and are often used as an important aquatic faunal component for biomonitoring. Taxonomic dominance of Rotifers was reported in several water bodies (Neves*et al.* 2003). Freshwater copepods constitute one of the major zooplankton communities occurring in all types of water bodies, they serve as a food source to several fish species and play a major role in ecological pyramids.

Table 4.12: Qualitative study of zooplankton population in Kushiyara River

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Rotifer	*Asplanchna*	P	P	P	A	A	A
	Brachionus	A	A	A	A	P	P
	Keratella	A	A	A	P	A	A
Cladocera	*Sida*	P	P	P	P	P	A
	Moina	P	P	P	P	P	P
	Daphnia	P	A	P	A	P	P
	Diaphanosoma	A	A	P	A	A	A
Copepods	*Cyclops*	P	P	P	P	P	A
	Diaptomus	P	P	A	P	P	P

Notes:
P – Present; A – Absent

Table 4.13: Zooplankton population (unit/L) in Kushiyara River

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Rotifer	*Asplanchna*	5	10	10	10	0	10
	Brachionus	15	5	0	0	10	5
	Keratella	10	5	5	10	0	0
Cladocera	*Sida*	5	5	5	10	15	0
	Moina	25	10	20	10	15	20
	Daphnia	10	0	5	5	10	5
	Diaphanosoma	20	10	5	5	10	0
Copepods	*Cyclops*	5	5	10	5	10	0
	Diaptomus	5	10	5	15	10	10

4.8.2 Migratory Birds

Over 650 species of birds have been recorded in Bangladesh and of these just over 200 species are either waterbirds or birds of prey, the groups considered to be potentially most vulnerable to collision with power transmission lines according to IUCN red list. In total 40 species are globally threatened or near-threatened with extinction, and 19 of these are dependent on freshwater wetlands. Bangladesh is particularly significant for waterbirds, including migratory waterfowl which spend the winter (dry season) in Bangladesh.

Map 4.10: Key Breeding and Staging Areas for Migratory Birds

The Surma-Kushiyara floodplain, which occupies approximately 3,900 km^2, comprises rivers draining from the north-eastern border of Bangladesh through greater Sylhet. Apart from hills along the international border with India, much of this area comprises very low-lying lands – the haor basins, which coalesce into extensive inland "seas" in the monsoon – while in the dry season large numbers of diverse wetlands and water bodies (beels and channels) remain. In the dry season, these extensive wetlands host large numbers of water birds both long distance migratory waterfowl and other fish eating birds that make short distance movements.

Although in the 1990s other wetlands such as Kawa Dighi Haor held sizeable water bird populations, in recent years the two main wetlands and largest haors in the district for water birds have been Hakaluki Haor and Hail Haor (refer to Table 4.14). Data provided by Bangladesh Bird Club (summarized in Table 4.14) indicates that over the last six years the average midwinter population of water birds in Hakaluki Haor has been about 68,000 birds, although the peak counts for individual species indicate that the site has been used by many more birds over this period. Moreover these counts cover the main wetlands in the haor; other smaller water bodies have not been counted. Water birds have not been counted over the whole of Hail Haor, but the main concentration in the community managed100 ha sanctuary of Baikka Beel have been regularly monitored, the sum of average winter peak counts by species indicate over 10,000 water birds are present/use this small area each year. A majority of these birds will fly across the Moulvi Bazar-Sylhet district boundary on migration (and possibly at other times for feeding movements), even species such as Fulvous Whistling-duck make such movements, as their breeding area is in Assam. In addition it is notable that for threatened species such as Baer's Pochard (EN) (likely to be upgraded in risk category), Hakaluki is one of the main wintering areas (with past counts of 600 or more). In addition these areas are also important for several large species of birds of prey, including threatened species such as Pallas's Fish Eagle, Greater Spotted Eagle and White-rumped Vulture.

Table 4.14: Bird Species recorded in Hakaluki and Hail Haors

Species	IUCN Red List Status[1]	1% flyway population level	HakalukiHaor		BaikkaBeel (Hail Haor)	
			Peak count (2006-11)	Average (2006-11)	Peak count (2006-11)	Average (2006-11)
Fulvous Whistling-duck	LC	500	28,518	9,751	4,500	2,342
Lesser Whistling-duck	LC	10000	18,554	6,655	3,500	2,417
Lesser White-fronted Goose	VU		1	0	0	0
Greylag Goose	LC		16	6	2	0
Bar-headed Goose	LC		4	1	5	1
Ruddy Shelduck	LC		1,991	1,212	5	1
Common Shelduck	LC		11	4	0	0
Comb Duck	LC		1	0	0	0
Cotton Pygmy-goose	LC	1000	440	152	115	57
Gadwall	LC	3000	14,938	6,248	300	177
Falcated Duck	NT		6	3	2	0
Eurasian Wigeon	LC		4,906	1,198	18	8
Mallard	LC		48	8	0	0
Spot-billed Duck	LC		50	8	0	0
Northern Shoveler	LC		4,076	1,689	136	42
Northern Pintail	LC		23,294	10,238	1,150	596
Garganey	LC	3500	4,518	891	1,600	800
Common Teal	LC	4000	2,547	1,385	1,600	827
Red-crested Pochard	LC		34	6	0	0
Common Pochard	LC		10,029	2,552	1	1
Ferruginous Pochard	NT	1000	4,545	1,966	89	59
Baer's Pochard	EN		14	6	2	0
Tufted Duck	LC		10,565	5,415	41	7
Slaty-breasted Rail	LC		0	0	1	0
Water Rail	LC		1	0	1	0
White-breasted Waterhen	LC		2	0	1	0
Ruddy-breasted Crake	LC		0	0	2	1
Watercock	LC		2	1	1	0
Purple Swamphen	LC		183	86	1,102	615
Common Moorhen	LC		18	8	168	141
Common Coot	LC		4,519	1,652	48	24
Pintail Snipe	LC		2	1	1	1
Common Snipe	LC		24	5	24	13
Black-tailed Godwit	NT		6	1	139	45

Species	IUCN Red List Status[1]	1% flyway population level	HakalukiHaor		BaikkaBeel (Hail Haor)	
			Peak count (2006-11)	Average (2006-11)	Peak count (2006-11)	Average (2006-11)
Spotted Redshank	LC	250	267	45	357	161
Common Redshank	LC		398	79	0	0
Marsh Sandpiper	LC	1000	110	28	289	87
Common Greenshank	LC		98	26	1	1
Green Sandpiper	LC		42	14	0	0
Wood Sandpiper	LC		91	52	90	23
Common Sandipiper	LC		73	16	2	0
Ruddy Turnstone	LC		8	1	0	0
Little Stint	LC		336	83	11	2
Temminck's Stint	LC		602	110	26	10
Curlew	LC		1	0	1	1
Ruff	LC	1000	522	87	874	456
Greater Painted-snipe	LC		0	0	0	0
Pheasant-tailed Jacana	LC	1250	182	61	111	50
Bronze-winged Jacana	LC		2	1	30	10
Black-winged Stilt	LC	1750	1	0	430	258
Pied Avocet	LC		40	8	0	0
Pacific Golden Plover	LC		740	227	500	90
Grey Plover	LC		8	1	0	0
Long-billed Plover	LC		0	0	0	0
Little Ringed Plover	LC		308	93	30	11
Kentish Plover	LC		39	10	0	0
Lesser Sand Plover	LC		13	4	0	0
Northern Lapwing	LC		11	2	0	0
Grey-headed Lapwing	LC	1000	125	61	257	106
Red-wattled Lapwing	LC		8	3	0	0
Oriental Pratincole	LC		0	0	0	0
Small Pratincole	LC		13	2	2	0
Brown-headed Gull	LC		323	163	4	1
Black-headed Gull	LC		1,671	468	8	2
Common Tern	LC		0	0	0	0
Whiskered Tern	LC		81	14	15	1
Little Grebe	LC		88	70	5	2
Great Crested Grebe	LC		118	52	0	0
Oriental Darter	NT		13	3	8	3
Little Cormorant	LC	2500	2,933	1,229	521	180
Great Cormorant	LC		119	46	3	1
Little Egret	LC		1,263	472	369	126
Grey Heron	LC		1,430	436	41	26
Purple Heron	LC		8	4	7	5
Great Egret	LC	1000	2,152	820	300	228
Intermediate Egret	LC	1000	1,105	475	180	63
Cattle Egret	LC		771	264	700	289
Indian Pond Heron	LC		149	83	272	114

Species	IUCN Red List Status[1]	1% flyway population level	HakalukiHaor		BaikkaBeel (Hail Haor)	
			Peak count (2006-11)	Average (2006-11)	Peak count (2006-11)	Average (2006-11)
Chinese Pond Heron	LC		0	0	1	0
Black-crowned Night Heron	LC		550	92	1	0
Yellow Bittern	LC		0	0	5	3
Cinnamon Bittern	LC		1	0	0	0
Black Bittern	LC		0	0	1	0
Black-headed Ibis	NT		19	4	24	8
Asian Openbill	LC		3150	1948	60	12
Total number of birds			**153,845**	**68,587**	**20,089**	**10,504**
Total species			**76**	**76**	**63**	**63**

Sources: *Bangladesh Bird Club, Enamul Haque and Paul Thompson pers. obs.*

Notes:

1 Status according to The International Union for Conservation of Nature (IUCN) Red List of Threatened Species, using the following categories:

Least Concern (LC): a taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category;

Near Threatened (NT): a taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future; and

Endangered (EN): A taxon is Endangered when it is considered to be facing a very high risk of extinction in the wild.

During the study, no Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR) or Vulnerable (VU) species were identified.

4.9 Socio-Economic Environment: Land Use Survey

4.9.1 Objectives

A land use survey was undertaken during the course of ESIA process toward establishing the current status of the land use pattern in the project area in March 2011 and September 2013 for the validation exercise. Objectives of the land use survey were as below:

- To understand the present baseline pattern in the Project AoI;
- To show the settlements, agricultural lands, markets, roads, bridges and other important infrastructures in the maps along with present land use pattern and development of environmental base map; and
- To identify location of the proposed access road and Project Site and identify any future development plan or any historic or protected sites in and around the Project Site.

4.9.2 Methodology

The number villages surveyed were identified on the basis high, medium and low impact zones. The high impact zone was considered to be within 1 km radius from the Project Site. The medium impact zone was within 7.5 km of the Project Site and low impact was considered from 7 km radius up to 10 km from the Project Site. A total of ten villages, five villages from high impact area, three villages from medium impact zone and three villages from low impact areas were selected for collection of household level information. The villages studied are listed in Table 4.15 below:

Table 4.15: Name of study villages by Union, Upazila and District

<table>
<tr><th>Villages</th><th>Mouza</th><th>Union</th><th>Upazila</th><th>District</th><th>Impact Zone</th></tr>
<tr><td>Parkul</td><td rowspan="3">Tajabad</td><td rowspan="3">Aushkandi</td><td rowspan="3">Nabiganj</td><td rowspan="3">Habiganj</td><td rowspan="3">High</td></tr>
<tr><td>Paharpur</td></tr>
<tr><td>Bangaon</td></tr>
<tr><td>Mazlishpur</td><td>Mazlishpur</td><td>Aushkandi</td><td>Nabiganj</td><td></td><td>Medium</td></tr>
<tr><td>Bhabanipur</td><td>Bhabanipur</td><td>Aushkandi</td><td>Nabiganj</td><td></td><td>Medium</td></tr>
<tr><td>Swastipur</td><td>Swastipur</td><td>Dighalbag</td><td>Nabiganj</td><td></td><td>Low</td></tr>
<tr><td>Lama Tajpur</td><td rowspan="2">Tajpur</td><td rowspan="2">Sadipur</td><td rowspan="2">Balaganj</td><td rowspan="2">Sylhet</td><td rowspan="2">High</td></tr>
<tr><td>DakhinTajpur</td></tr>
<tr><td>Purba</td><td rowspan="2">Sanmanpur</td><td rowspan="2">Sadipur</td><td rowspan="2">Balaganj</td><td rowspan="2">Sylhet</td><td rowspan="2">Low</td></tr>
<tr><td>Kalnichar</td></tr>
<tr><td>Brahmangaon</td><td>Brahmangaon</td><td>Khalilpur</td><td>MaulvibazarSadar</td><td>Maulvibazar</td><td>Medium</td></tr>
</table>

4.9.2.1 Coverage of Survey Area

A survey was carried out in September and October 2013 for validation purposes in the Project Site and within the Project AoI (i.e. High, Medium and Low impact zones) showing the features on the ground like homesteads, rivers, brick roads, mud roads, shops, religious institutes, educational institutions, agricultural lands, the proposed power plant, access road and other environmentally significant features occupying space on the ground.

4.9.2.2 Land use – Methodology

Before mobilization of the team in the field, an orientation course was organized and pre-testing was performed to ensure the methodology could be successfully applied. A field reconnaissance survey was also performed.
Efforts in the field were prioritized towards identifying important features, landmarks and other objects and subsequently plotting them on base maps.

In line with DoE guidelines, the location of settlements, industries, shops, growth centres, markets, agricultural lands, water bodies, bridges, educational institutions, religious institutions and other sites were plotted on the final land use map (Map 4.9) with the aid of modern cartographic instruments i.e. GIS section by BCAS.

4.9.3 Major Land Use Categories

Major land use categories as identified during the survey are depicted in Table 4.16:

Table 4.16: Present Land use Pattern of Surveyed Areas

Landuse Pattern	Number	% of Total
Agricultural lands	-	73%
Settlement area	-	12%
River Kushiyara	-	9%
Power plant site (Acquired land)	-	2.5%
Canals, Ponds, Beels, etc.	-	2%
Road (earthen/Semi pacca)	-	1%
Proposed approach road	-	0.5%
School	3	-
Clinic	2	-
Shops	15	-
Mosque	9	-
Moqtab	4	-
Eidga	2	-
Graveyard	4	-
Mazar (Spiritual graves)	4	-
Rice mill	5	-

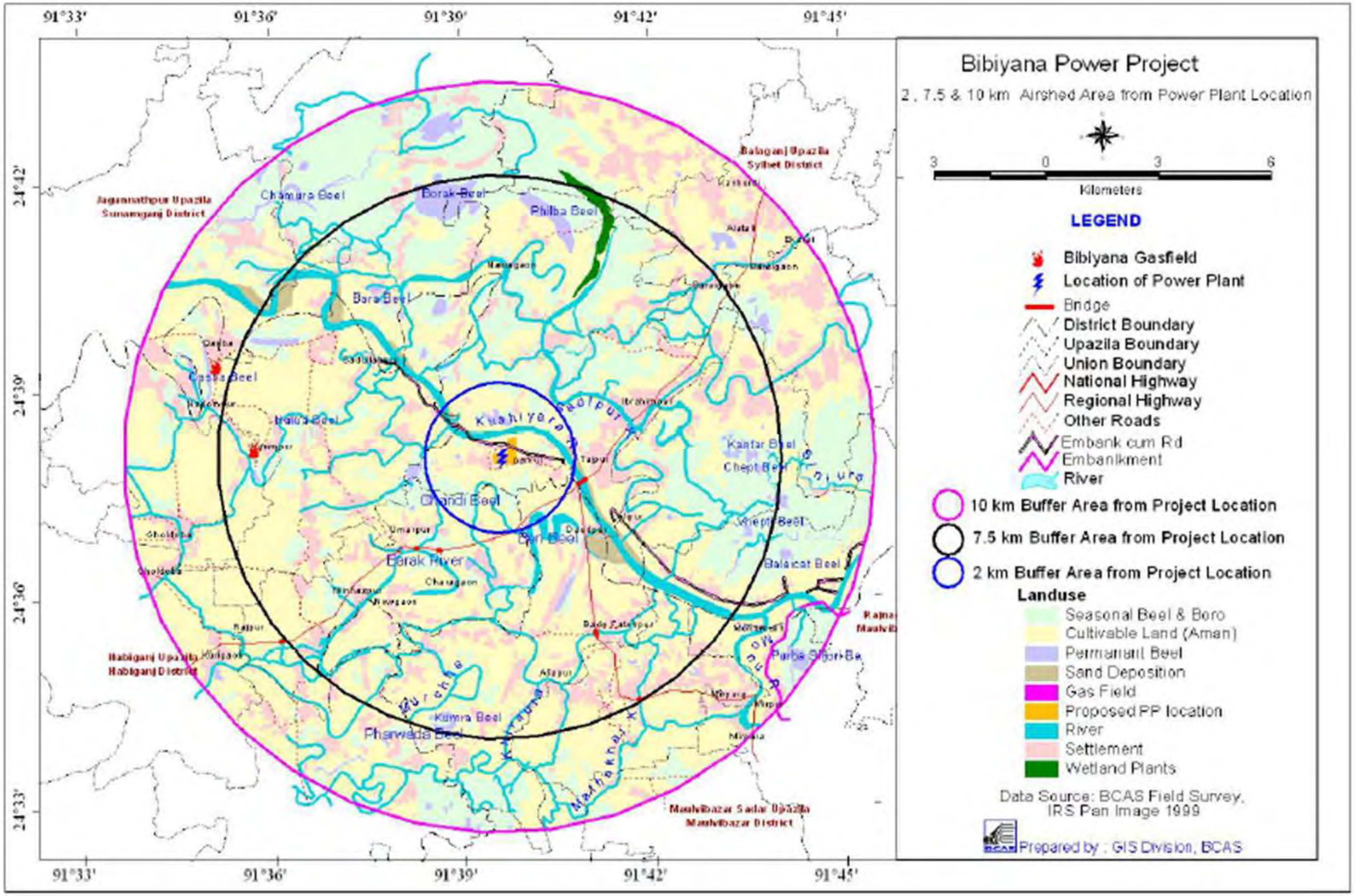
4.9.3.1 Agricultural Lands

The Project AoI has agricultural cultivable land (73%, Table 4.16). There are three main crops grown in a year depending on the water availability. Irrigation water is taken from the Kushiyara River, surface water and nearby water bodies. Paddy (aus, aman and boro rice), potato and vegetables are the main crops. A small amount belongs to fallow land in the surveyed area which is left unutilized. There is no mineral or forest coverage reserve in the close vicinity of Project Site.

4.9.3.2 Settlement Area

Settlement area occupies 12% (Table 4.16) of the surveyed area and consists of homesteads and vegetation with local, indigenous fruit bearing trees. Each homestead is associated with a kitchen garden where seasonal vegetables and spices are grown for domestic consumption. Some exotic species and medicinal plants could also be observed during the survey process. Various occupation groups comprising farmers, share croppers, day labourers, business men, service holders, rickshaw/van pullers, transport workers live in the area. A major settlement enclave has been developed in the north–eastern part of the Project AoI with easy access to the Sherpur town.

Map 4.11: Land use map



4.9.3.3 Project Site

The Project Site has acquired 25 acres.

4.9.3.4 Access Road

The access road will pass through Majlispur, Pitua, Bata, Tajpurmouza and Parkul villages, approximately 2 km from the highway (N2). A partial homestead, including a pond (socially recognized) falls within the proposed access road route.

4.9.3.5 General Findings of the Land Use Survey

In the wider Project AoI, villages lie to the east and the west, with farmland and Sherpur town situated further to the east, and the river Kushiyara (one of the major rivers in the north-eastern zone of Bangladesh) is located adjacent to the north. To the South of the Project AoI is primarily farmland.

Land use within the Project AoI is dominated by use for agricultural purposes with most crops harvested two to three times per year. In monsoon season, the Project AoI (particularly the central area) is favourable for cultivation of Aman paddy, which is the principal cereal crop. After the harvest of paddy, the entire paddy field is kept fallow.

The Project AoI is located entirely within the river basin, which is in the foot-hills of Tripura. Most of the land is under crop cultivation. People are cultivating mainly rice in Boro and Aman seasons. In Rabi season, people mainly cultivate different vegetables only in some portions of their crop fields. Homesteads, perennial water bodies like river, beels and haors, roads & embankment and markets are other categories of land use in the airshed.

Significant changes have, however, occurred in the land use pattern in the recent past and some agricultural lands have been converted into settlement areas. The Sherpur town is extending its periphery at a higher rate now than in the past, extending towards the Project Site. Furthermore, there has been an increase in local people purchasing land on the road side to build houses. As a result of increased demand, the land price is also getting higher; in 2000, land price was approximately 7,000 Tk/decimal according to the LAO of the area, only now the price per decimal of land that was discussed and agreed with the PAPs (refer to the RAP) stands as 29,200 Tk/decimal.

4.10 Socio-Economic Environment: Infrastructure & Industry

4.10.1 Road Network

The main roads in the vicinity of the Project Site comprise the N2 Dhaka-Sylhet national highway, which is located approximately 2 km to the south-east of the Project Site at its closest point; and the R241 road, which is located approximately 3.7 km to the south-west of the Project Site.

In addition to the main roads, a road bisects the Project Site from east to west, 2 km of which is brick surfaced with the rest comprising compacted mud. It is the main road in and around the Project AoI. Besides this, there are some earth roads passing through the villages (adjacent to the Project Site) to connect the Sherpur commercial centre. Vehicle movement during the rainy season becomes difficult and prone to accident. Earth roads are used only in dry season and most of the time villagers use boats for their movement. Transport services in the area include regular bus and other transport services (including rental cars, auto rickshaws / rickshaw vans). Manual recording of the number and type of vehicles were undertaken in two 12 hours shifts. The Sherpur point was chosen for the survey as it is the the main access road to the SBPCL II Power Plant. It is considered that no other roads in the vicinity of the Project Site would be suitable for large vehicles which may be used for the construction of the Proposed Development. Furthermore Most of the transportation of construction material and machinery and equipment has been or will be transferred via the waterways.

As shown in Table 4.17a and 4.17, a traffic survey undertaken in September 2013 at Sherpur Point recorded approximately2,938 road vehicles crossing Sherpur bazaar from both ways during a 24hrs period.

Table 4.17a: Sherpur Point Road Traffic Survey

Road Vehicle Type	6-7 pm	7-8 pm	8-9 pm	9-10 pm	10-11 pm	11-12 pm	12-01 am	1-2 am	2-3 am	3-4 am	4-5 am	5-6 am	Total
Direction of Travel: Up													
Bus	22	21	15	19	17	20	31	21	11	6	4	6	193
CNG automobiles	74	48	35	36	30	18	7	4	5	3	2	6	268
Battery driven auto rickshaw	28	28	15	41	33	42	23	44	53	22	33	42	404
Truck	38	84	121	104	104	99	73	80	61	55	38	29	886
Pickup van	4	1	6	5	10	1	5	9	6	3	2	1	53
Private car / Micro	37	39	39	33	26	26	12	13	15	8	6	14	268
Cover van	11	10	8	4	2	5	9	3	1	1	2	3	59
Motor cycle	25	19	20	13	11	4	2	1	2	2	2	3	104
												Daily Total : =	**2235**

Source: *BCAS Road Traffic Survey, September 2013*

Notes: The majority of people access Sherpur Bridge to cross the river; however, approximately 70 motorized passenger vehicles were observed crossing the river during the 12hr period.
* The Sand loaders were not related to land raising activities at the ProjectSite as these works had already been completed prior to the survey.

Table 4.17b: Sherpur Point Road Traffic Survey

Road Vehicle Type	6.00 am	7.00 am	8.00 am	9.00 am	10.00 am	11.00 am	12.00 pm	1.00 pm	2.00 pm	3.00 pm	4.00 pm	5.00 pm	Total
Direction of Travel: Down													
Bus	17	12	13	10	11	11	8	9	6	3	4	2	104
Mini bus	6	5	3	2	1	0	0	0	0	0	0	0	18
Human Hauler	2	3	2	0	0	0	0	0	0	0	0	0	07
CNG automobiles	17	15	33	22	12	12	11	8	6	5	4	3	148
Truck	14	12	16	15	19	18	25	19	26	23	22	21	230
Pickup van	10	11	6	5	7	2	3	1	1	2	0	0	48
Container	12	12	18	14	12	15	9	3	1	1	0	0	97
Micro	5	7	5	4	6	4	2	1	2	3	2	3	44
Private car	1	0	0	0	0	0	2	0	0	1	2	1	07
												Daily Total :	**703**

BCAS Road Traffic Survey, September 2013 The majority of people access Sherpur Bridge to cross the river; however, approximately 70 motorized passenger vehicles were observed crossing the river during the 12hr period. * The Sand loaders were not related to land raising activities at the Project Site as these works had already been completed prior to the survey.

Figure 4.10: Road Transport in the Vicinity of the Project Site

A local road adjacent to the Project Site

The N2 Highway and the Sherpur Bridge

Map 4.12: Road Network in the Vicinity of the Project Site

4.10.2 River Transport

As Bangladesh is a riverine country, river transport is the most popular and common mode of transport. The navigable waterways of the Surma-Kushyiara river system vary between approximately 3,372 km during the monsoon to approximately 1,200 km during the dry season. Inland transport is mainly operated by the Bangladesh Inland Water Transport Corporation (BIWTC), which operates the large car ferries, launches and steamers.

There are seasonal difficulties in the navigability of rivers and canals for the traditional country boats that constitute the great bulk of the merchant fleet, but geography and history have made these craft the preferred means of moving goods between the ports on the Bay of Bengal and the interior of the country.

The Kushyiara River, which forms the northern boundary of the Project Site, is one of the major waterways in the north-eastern region of Bangladesh. Different kinds and sizes of boats, launches and ferries are active in transporting people, goods, buses and trucks to both sides of the River.

A river traffic survey was undertaken at the ferry ghat[11] on 10th and 11th November 2013 between 6am and 6pm, and the results are present in Table 4.17c. The survey was undertaken during daylight hours because the river traffic is negligible at night. There is only one ferry ghat located appromiately 2 km from the Project Site, Sherpurghat. About 1000 people are directly or indirectly dependent on the different economic activities in and around the ferry ghat. Most of the boats and loaders pass the Sherpurghat during day time.

As shown in Table 4.17c, approximately 179 river traffic movements were recorded travelling upstream and downstream, on the Kushiyara River between 6 am and 6 pm. Non-motorized fishing boats were the most common vehicle type recorded in the survey, accounting for approximately 43 % of all river traffic movements.

[11] A series of steps leading down to the River, used to board ferries.

Table 4.17c: Kushiyara River Traffic Survey

River Vehicle Type	6-7 am	7-8 am	8-9 am	9-10 am	10-11 am	11-12 am	12-1 pm	1-2 pm	2-3 pm	3-4 pm	4-5 pm	5-6 pm	6.00 pm	Total
Direction of Travel: Upstream														
Launch		1	1											02
Motorized fishing boat				2									1	03
Non-Motorized fishing boat	5	2		1	11	4	4	4		4	2	4		41
Motorized passenger boat			1	1	2	1	1		1					07
Non-Motorized passenger boat	7	2	5	2			1			2	2	2	3	26
Sand loader*	1		1	1	3	1	2		1			2	1	13
Goods loader		2						1	1	1				05
Direction of Travel: Downstream														
Launch			1											01
Motorized fishing boat		2	1											03
Non-Motorized fishing boat	1	2	3	1	3	4	4		2	4	1	7	3	35
Motorized passenger boat					1	1		2				1	3	08
Non-Motorized passenger boat	10	3	5		1				1		3			23
Sand loader*					2							1	1	04
Goods loader	1	1	1	1				1		1		2		08
Daily Total :179														

Source: BCAS River Traffic Survey, October 2013

Notes: The survey was undertaken during daylight hours as there is negligible river traffic at night.

The majority of people access Sherpur Bridge to cross the river; however, approximately 70 motorized passenger vehicles were observed crossing the river during the 12hr period.

* The Sand loaders were not related to land raising activities at the ProjectSite as during ESIA validation in September –January the sand mining was already completed and the land raising activity was finished.

4.10.3 Urbanization

No significant urban centre is located within the Project AoI. However, Union Parishad Offices, markets, educational institutes and religious centres (Mosques, Temples and Churches) are located within the Project AoI and Sherpur, the village business centre, is about 2.5 km to the east of the Project Site.

4.10.4 Utilities

The villages in the vicinity of the Project Site, excluding informal settlements on khas land, are connected with grid electricity for domestic and business uses but there are no telephone lines for use by village inhabitants. Land based biomass fuels obtained from trees, field crops and livestock play an important role in meeting cooking energy demand. At present, only biomass fuel is used for cooking food. The area is not connected with natural gas supply for domestic or industrial use.

The e Project AoI is not served by a mains water supply and drinking water is provided by groundwater abstraction wells. The surrounding area does not comprise a municipal foul sewer or a storm water drainage system.

4.10.5 Industry

The existing industries were identified through a survey carried out in December 2013. Types of industries that are at present in operation in the Project AoI are shown Table 4.18, types of fuel used and probable nature of pollution caused are also provided.

Table 4.18: Industries within the Project AoI

Sl. No.	Type of industry	Biomass fuel		Conventional Fuel		Distance and Approximate Direction from the Project Site	Probable nature of pollution caused
		Wood	Non-woody biomass	Diesel/ Coal	Electrical	North East 3.0km	
1	Rice husking	-	Rice husk	Diesel	-	West and NW 3-5km	NO_X, SO_2, P.M. Noise
2	Flour Mill	-	-	Diesel	-	North East 3km	NO_X, SO_2, P.M. Noise
3	Bakery	√	-	-	-	North East 3.0km	Smoke from wood firing
4	Manufacture of wood products	-	-	-	√	North East 3.0km	P.M.
5	Tobacco (cottage level rolled tobacco)	√	√	-	-	North East 3.0km	P.M.
6	Bricks	√	-	Coal	-	Nort and East 5-8km	NO_X, SO_2, P.M.

As summarised in Table 4.18, there are small scale industries such as bakeries, rice mills, furniture making and saw mills within the Project AoI. The nearest fertiliser factory is approximately 40km from the Project Site and is therefore outwith the Project AoI.

4.11 Soil Analysis

Regional Description of Soil: Soil Resources Development Institute (SRDI) under the Ministry of Agriculture, Government of Bangladesh has been prepared Land & Soil Resources use Guideline for all the Upazillas (sub-districts) of Bangladesh.
The Project Site is located in Parkul Village of Auskandi Union, within Nabiganj Upazilla under Habiganj district.

A description of the physical environment of Nabiganj Upazilla is provided below.
Three physiographic units are recognized in the Nabiganj Upazilla area: (a) Hilly area, (b) Piedmont alluvial plain and (c) Surma – Kushiyara Floodplain.

a) ***Hilly area:*** This region consists of 2,397 ha, which is 5.5 % of the Upazilla. Hilly areas are under low hill categories and average height of approximately 150 m from Mean Sea Level (MSL). These valleys of hills are divided by low lying terrace and act as drainage during monsoon. The area is usually in the range of 30%-50% slope category with soil type dominated by red, clay loam to clay types (high acidic to medium acidic);
b) **Piedmond fertile land:** This region consists of 3,095 ha, which is 7 % of the Upazilla. This land is located under foot of the hilly area, generated from denudation and erosion of the hill and slopes continuously downward towards to low lying area, especially in the Haor and Bill. Soil categories are radish sandy loam to clay loam nearer to foothill. Soil of medium low land under clay loam to clay categories.
c) **Surma – Kushiara Fertile land:** This region consists of 34,731ha which is 79 % of the Upazilla. This area is generated from alluvial river process of River Surma and Kushiyara. This fertile land (palimati) is under above plain land to plain land categories. Gray loam to clay loam soil has been identified in high to medium land of the area, and clay loam to clay soil has been identified in the medium to low land of the area. Soil is medium to high acidic.

The Project Site is located in Surma–Kushiyara flood plain region.

4.11.1 Analysis of Soil Samples

Four soil samples were collected from four locations. Two samples were collected from the Project Site and two from the switchyard which is approximately 100 m from Project Site. during the first week of September, 2013. Soil Samples were collected and Analyzed by Analytical lab of Soil Research and Development Institute (SRDI), Dhaka.
The results of the analysis is shown in Table 4. 19.

Table 4.19: Analytical results of soil samples

Location	Lab Code	ANALYTICAL RESULT										
		Ph	OM (%)	Total N (%)	Microgm /gm	militullanko /100gm soil			Microgram/ gm soil			
					P	K	Ca	Mg	B	Pb	Zn	Al
Switch yard	18541	4.7	1.28	0.09	0.09	1.80	24.59	0.26	1.04	24.56	1.40	1.4
Switch yard	18542	3.9	1.53	0.08	0.08	0.98	36.58	0.22	2.04	36.58	2.04	2.04
Project Site	18543	5.4	0.70	0.02	0.02	1.00	16.85	0.34	1.04	16.85	1.04	1.04
Project Site	18544	5.4	0.77	0.01	0.01	1.35	18.99	0.20	1.24	18.99	1.24	1.24
Analytical data provided by *Analytical Laboratory, Soil Resources Development Institute (SRDI), Khamarbari, Farmgate Dhaka*												

Generally, soils are developed under unconsolidated to consolidated sandstone, siltstone, and shales. The soils are excessive moderate drained, strong brown to yellowish brown in color, sandy loam to sandy clay loam in texture. Deep soil occurs in hill slope and shallow soil occurs in summit and slope shoulder. The adjacent valley soils are usually impartially to poorly drained, gray to pale in color, Loamy to clayey in texture. The soils are acidic in reaction. Soils are moderately to rapidly permeable and low moisture holding capacity. Organic matter content is low. According to general soil types soils are classified as brown hill soil. In soil taxonomy terms soils in this part of the Surma Basin, where the Project Site is located) belongs to mostly alfi soils, Vlti soils and some are Enti soils and Ineepti soils.

The average rainfall in the area is 4,278 mm and average temperature is about 25.3°C. Location 1 & Location 2 (Switchyard site) are natural soil condition, with a pH ranging from 3.9 to 4.7 (acidic), a low N content and very low P, K and Mg content. Ca, B and Zn content at the Switchyard site is very high.

The soil sample of Location 3 & Location 4 (Inside the Project Site) were mostly foreign materials, i.e. sediments carried to the Project Site from the adjacent River Kushiyara. The soil is less acidic than the Switchyard site, with a pH 5.4. Organic matter content is very low, as is N, P and Mg content. Other material content is medium to high. In regard to agricultural suitability these results indicate that the land comprises low to medium fertile soil.

5. Impact Assessment and Mitigation Measures: SBPCL II Power Plant

5.1 Introduction

This chapter sets out the predicted impacts anticipated due to activities in connection with the Proposed Development considering the existing environmental and social baseline of the Project AoI.
An effective environmental and social impact assessment (ESIA) of a proposed project calls for establishing background data on various environmental and social components through reconnaissance survey, sampling, available literature sources etc.; identifying project features which are likely to have impacts on the environment; predicting impacts; superimposing impacts on the existing baseline scenario and developing a suitable Environmental and Social Management and Monitoring Plan (ESMMP). The impact identification of each of the environmental and social parameters is the first step of assessment. In order to identify the impact comprehensively, all the activities associated with the Proposed Development during the construction, post-construction as well as operational and decommissioning phases need to be taken into consideration.

In the context of the Proposed Development, it is noted that all pre-construction activities have been completed within the Project Site. The validation survey in October 2013 also confirmed that land raising work had already been completed at the Project Site in 2012.

This chapter describes the anticipated significant environmental impacts of the Proposed Development upon the Project AoI. Identification of such impacts has been followed by measures toward mitigating them. Enhancement measures of beneficial impacts and compensation to project affected persons have also been proposed. Specific attention and importance have been laid, *inter alia*, upon *(i) avoidance of adverse impacts due to the proposed project on the environment and the affected people of the project area, where possible; (ii) minimizing, mitigating and compensating for adverse project impacts on the environment and affected people, where avoidance is impossible;* and *(iii) suggesting measures toward strengthening the project proponents' capacity in enforcing safeguard systems and managing environmental and social risks*. It also addresses issues of involuntary resettlement associated with the Proposed Development on various people currently staying in the Project AoI. This chapter, hence, complies with the policy objectives, scope and triggers and the principle of the key environmental areas as set out in *IFC Performance Standards, ADB SPS(2012)*and *Section F1/BP of ADB Operations Manual (2010)*.

5.2 Anticipated Impacts

5.2.1 Visual Impact

As illustrated in Figure 5.1, the landscape in the vicinity of the Project Site is relatively flat and dominated by agricultural land with an absence of significant man-made structures. Therefore, the SBPCL II Power Plant will be a significant addition ton the landscape. The stacks of the SBPCL II Power Plant will be 60 m in height and visible at long distances.

The design of the cooling towers is induced draft counter flow cooling towers with Reinforced Cement Concrete (RCC) frame and casing, including Polyvinyl Chloride (PVC) tower fill, fill supports, air inlet louvers and drift eliminators. In order to mitigate the potential visual impact, this design of the cooling towers will avoid the traditional hyperbolic shape and visible plumes of uncondensed water vapour.

Figure 5.1: Views in the Vicinity of the Project Site

During the pre-construction stage, land raising and land development activities will have impacted upon and brought about changes in landscape and topographic features of the Project AoI. As set out previously, all pre-construction activities have been completed, however for completeness the impact assessment is presented in this ESIA. Impacts will have included (i) visual impacts associated with the process of land raising and compaction; (ii) overland deposition of sand-water slurry and resultant effluence of mud and muddy water; (iii) dust generation from the dried-up overland deposited slurry; (iv) movement of soil compaction vehicles along the land development area; and (v) removal of trees and vegetation throughout the land development area.

During the construction stage, the anticipated visual impact will be (i) visual impacts associated with earth excavation; (ii) dust generation from excavated spoils during dry periods; and (iii) effluence of mud, mud-water and other liquid wastes during both dry and wet periods.

During the operational stage, the visual impacts will comprise a new skyline in the Project AoI which was previously unfamiliar in the locality. Exterior lighting will be provided for operating and maintaining the SBPCL II Power Plant; given the relative open and undeveloped nature of the Project Site, it is expected that some of the lighting or glow will be visible from offsite locations. In order to reduce potential light pollution impacts, the following measures would be implemented:

- low pressure sodium lighting;
- Minimial use of upward lighting; and
- fitting hoods on light sources to direct light below the horizontal plane at angles less than 70 degrees.

5.2.2 Air Quality:

It is proposed that the SPBCL II Power Plant will use natural gas with incorporation of Dry Low NO_X (DLN) burners; accordingly, NO_X emission from the stacks and resulting increments of ground level concentration of this pollutant will be less, when compared with other fuels, and there will be no emission of sulphur dioxide (SO_2) from the stacks. For the effluent streams, suitable treatment is to be provided for compliance with prescribed norms.

Use of the AERMOD (Version: 09292) model is only applicable to assessment of the SBPCL II Power Plant using 2012 meteorological data. However, assessment of the cumulative impact of proposed, future Bibyana I and III Power Plants has been undertaken using the ICS3P model based upon 2012 meteorological data. For point source of emissions the difference in prediction values varies within 2%-4% and the meteorological data does not vary significantly on a year to year basis. Therefore, for cumulative impact the ICS3P model is considered to predict the emissions with reasonable accuracy. Moreover, the assumptions are oversimplified in terms of the configuration of Bibiyana I and III Power Plants to be built in the future.

USEPA recommended AERMOD (Version: 09292) has been used in this modeling exercise, although AERMOD and ISC-PRIME (ISC3P) had a similar evaluation outcome for the full year Bowline Point data, featuring buoyant steam electric plant releases, with no significant differences in model performance. AERMOD requires more than twice as much data as ISC3P. For predicting potential cumulative impact of Bibiyana I, SBPCL II and Bibiyana III Power Plants the ISC3P model has been used as at this stage there are uncertainties about the specific nature of these future, potential power plant projects (Bibiyana I and III Power Plants) and therefore significant assumptions are required.

5.2.2.1 Background

As per the updated ToR for ESIA validation approved by IFC and ADB in 2013, air dispersion modelling was completed to predict ground level concentrations (GLCs) of pollutants, including NO_X, CO, PM_{10}, for the required averaging period across the modeled domain (a 7.5 km×7.5 km grid around the stacks). The predicted GLCs were assessed in isolation and also the cumulative impact of emissions from additional proposed future power plants (Bibiyana I and III Power Plants), and from the background values recorded in the Project Area between March and October 2011 and validated in 2013.

5.2.2.2 Air quality dispersion modeling

AERMOD dispersion models provide the ability to mathematically simulate atmospheric conditions and behavior. They are used to calculate spatial and temporal sets of concentrations and particle deposition due to emissions from various sources. Dispersion models can be used to determine the affected zone around an emitter by producing results that can be compared against impact assessment criteria.

Dispersion models can provide concentration or deposition estimates over an almost unlimited grid of user-specified locations, and can be used to evaluate both existing and forecast emission scenarios. In this capacity, air dispersion modeling is a useful tool in assessing the air quality impacts associated with existing and proposed emission sources. The results of the dispersion modeling analysis can be used to develop control strategies that should ensure compliance with the assessment criteria. Dispersion models can also be used to estimate the cumulative impacts of various industries that are located close to one another.

Dispersion models are widely used by environmental regulators in almost all the countries. The results have been shown, through numerous model evaluation studies, to be sufficiently robust to be relied on to calculate concentration limits for point-source stack emissions.

5.2.2.3 Background

Air dispersion modeling was completed to predict ground level concentrations (GLCs) of different pollutants (NOx, CO,) for the required averaging period across modeled domain (7.5km × 7.5 km around the stack). The predicted GLCs for NOx, and CO were assessed in isolation and also the cumulative impact of emissions from the proposed SBPCL II Power Plant and from the background values determined at the Project Site location. Stack emission rates for PM10 and $PM_{2.5}$ were not available and as such modeling for these pollutants was not done.

It is proposed that the SPBCL II Power Plant will use natural gas with incorporation of Dry Low NOX (DLN) burners; accordingly, NO_X emission from the stacks and resulting increments of ground level concentrations of this pollutant will be less, when compared with other fuels, and there will be no emission of sulphur dioxide (SO_2) from the stacks. For the effluent streams, suitable treatment is to be provided for compliance with prescribed norms.

5.2.2.4 Model Selection

Though, according to USEPA (www.epa.gov/scram001/7thconf/aermod_mep.pdf), AERMOD and ISC-PRIME had a similar evaluation outcome for the full year Bowline Point data, featuring buoyant steam electric plant releases, with no significant differences in model performance, AERMOD model, version 09292, has been selected for this study as it is currently the preferred model

AERMOD is a steady-state plume model. In the stable boundary layer (SBL), the concentration distribution is assumed to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function (p.d.f.). Additionally, in the CBL, AERMOD treats "plume lofting," whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate.

5.2.2.5 Modeling Methodology

1. Model Setup

   AERMOD was used with the following setup:

   a) A model domain of 7.5 km by 7.5 km centred on the stack (0.0, 0.0) and 500m grid spacing using Cartesian Co-ordinates.
   b) Assumption of no terrain as the site surrounding the proposed plant is essentially flat with no hilly areas.
   c) Surface roughness lengths between 0.1m and 0.3m depending on the seasons were used to account for the primary flows of concern across relatively flat areas.
   d) Building wake effects were not included as the heights of the nearest buildings were not sufficient to influence emissions.

2. Meteorological data requirement

The meteorological data used in the dispersion model is of fundamental importance as it drives the transport and dispersion of the air pollutants in the atmosphere. The most critical parameters are wind direction, which determines the initial direction of transport of pollutants from their sources; wind speed, which dilutes the plume in the direction of transport and determines the travel time from source to receptor; and atmospheric turbulence, which indicates the dispersive ability of the atmosphere.

All meteorological stations used to collect data for dispersion modeling purposes must use an anemometer that has a stall speed of 0.5 m/s or less.

For the AERMOD dispersion model, two meteorological files (surface file and profile file) are needed. The meteorological parameters required for the surface file are:

- *H* = sensible heat flux (W/m2)
- u* = surface friction velocity (m/s)
- w* = convective velocity scale (m/s)
- VPTG = vertical potential temperature gradient in the 500 m layer above

PBL

- Zic = height of convectively-generated boundary layer (m)
- Zim = height of mechanically-generated boundary layer (m)
- L = Monin-Obukhov length (m)
- zo = surface roughness length (m)
- Bo = Bowen ratio
- r = Albedo
- Ws = wind speed (m/s)
- Wd = wind direction (degrees)
- zref = reference height for Ws and Wd (m)
- temp = temperature (K)
- ztemp = reference height for temp (m)

The meteorological parameters required for the profile file are:

- height = measurement height (m)
- top = 1, if this is the last (highest) level for this hour, or 0 otherwise
- WDnn = wind direction at the current level (degrees)
- WSnn = wind speed at the current level (m/s)
- TTnn = temperature at the current level (°C)
- SAnn = F2 (degrees)
- SWnn = Fw (m/s)

The data files (both) should include hourly average values for the above parameters.

Wind speed, wind direction, ambient temperature, cloud cover, solar radiation, pressure, relative humidity and precipitation rate can be directly measured, but other parameters need to be determined indirectly using other meteorological parameters with empirical formulae.

5.2.2.6 Preparation of meteorological data

1. Friction velocity, Monin-Obukhov length and surface roughness length

Surface characteristics in the form of albedo, surface roughness and Bowen ratio are standard values depending on the season. Standard meteorological observations (wind speed, wind direction, temperature, and cloud cover) for the Project Site have been procured from the Bangladesh Meteorological Department (BMD) and are used to calculate the PBL parameters: friction velocity (u*), Monin-Obukhov length (L), convective velocity scale (w*), temperature scale (*), mixing height (z i), and surface heat flux (H) These parameters are then used to calculate vertical profiles of wind speed (u), lateral and vertical turbulent fluctuations (v, w), potential temperature gradient (d/dz) (www.weblakes.com/guides/aermod/sec3/3_1_4.html).

Meteorological data period: 1st December 2011 – 30 November 2012.

5.2.2.7 Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) for Bangladesh are given in Table 1. In the 4th column, World Bank (WB) standards are also given.

Table 5.1 National Ambient Air Quality Standards (NAAQS) for Bangladesh

Pollutant	DOE (Bangladesh) Standards	Averaging period	WB Standards
CO	10 mg/m^3	8 hours(a)	-
	40 mg/m^3	1 hour(a)	-
Pb	0.5 µg/m^3	Annual	-
NO_2	150	24 hours	150
	100 µg/m^3	Annual	100
PM10	50 µg/m^3	Annual (b)	50
	150 µg/m^3	24 hours (c)	150
PM2.5	15 µg/m^3	Annual	-
	65 µg/m^3	24 hours	-
O_3	235 µg/m^3	1 hour (d)	-
	157 µg/m^3	8 hours	-
SO_2	80 µg/m^3	Annual	80
	365 µg/m^3	24 hours (a)	150

Notes:

(a) Not to be exceeded more than once per year
(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 µg/m^3
(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 µg/m^3 is equal to or less than 1 (d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 235 µg/m^3 is equal to or less than 1 (Source: AQMP, DOE). per calendar year with the maximum hourly average of 235 µg/m^3 is equal to or less than 1 (Source: AQMP, DOE).
d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 235 µg/m^3 is equal to or less than 1 (Source: AQMP, DOE).

5.2.2.8 Background air quality data and windroses for 4 months

To facilitate collection of background air quality data taking wind direction into consideration, four wind roses for the year 2012 are given in figures 5.2 (January), 5.3 (April), 5.4 (July), and 5.5 (October).

Figure 5.2. NOx Windrose for January 2012

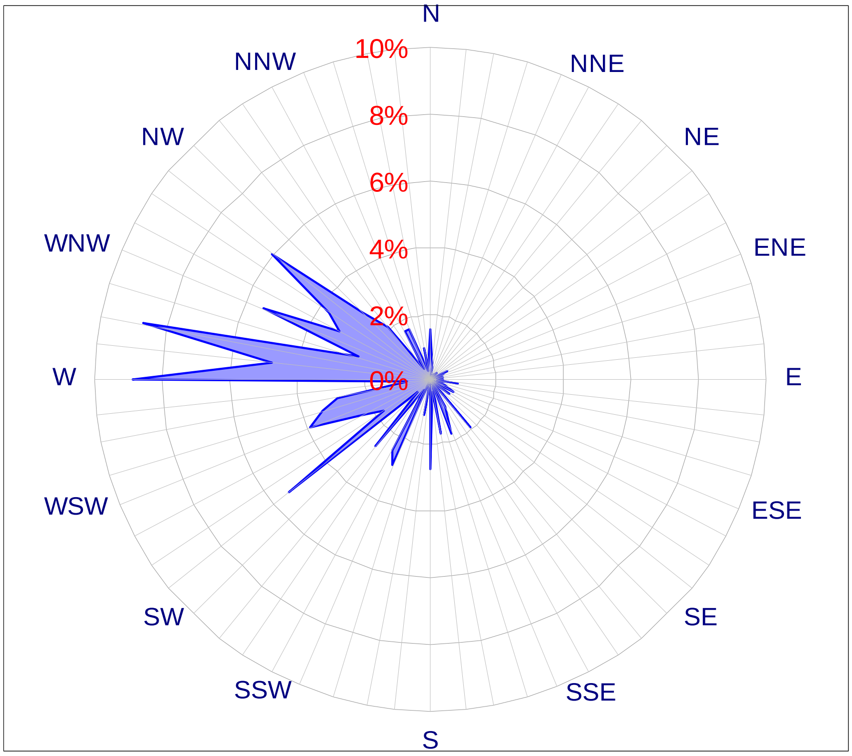


Figure 5.3. Windrose for April 2012

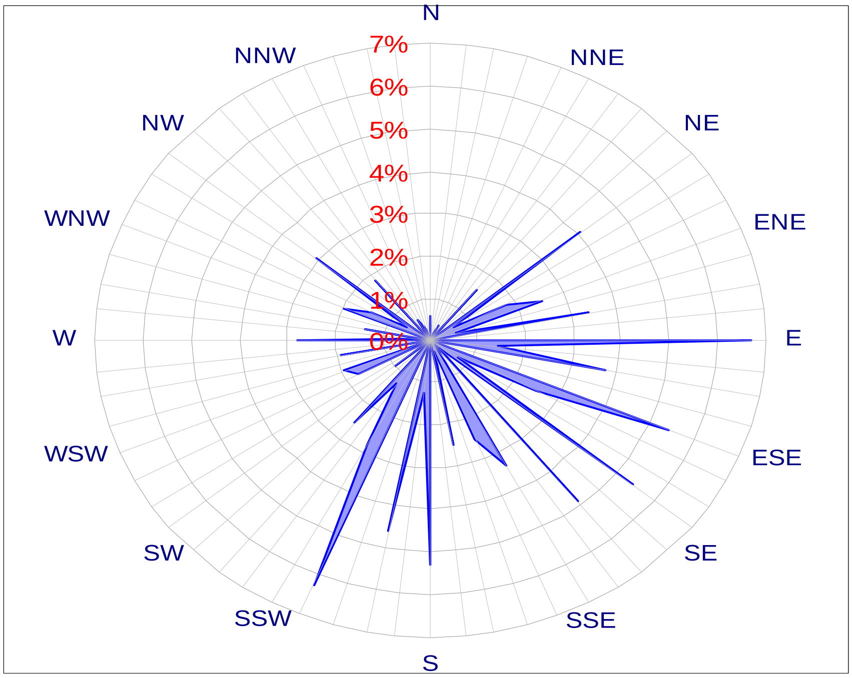


Figure 5.4. Windrose for July 2012

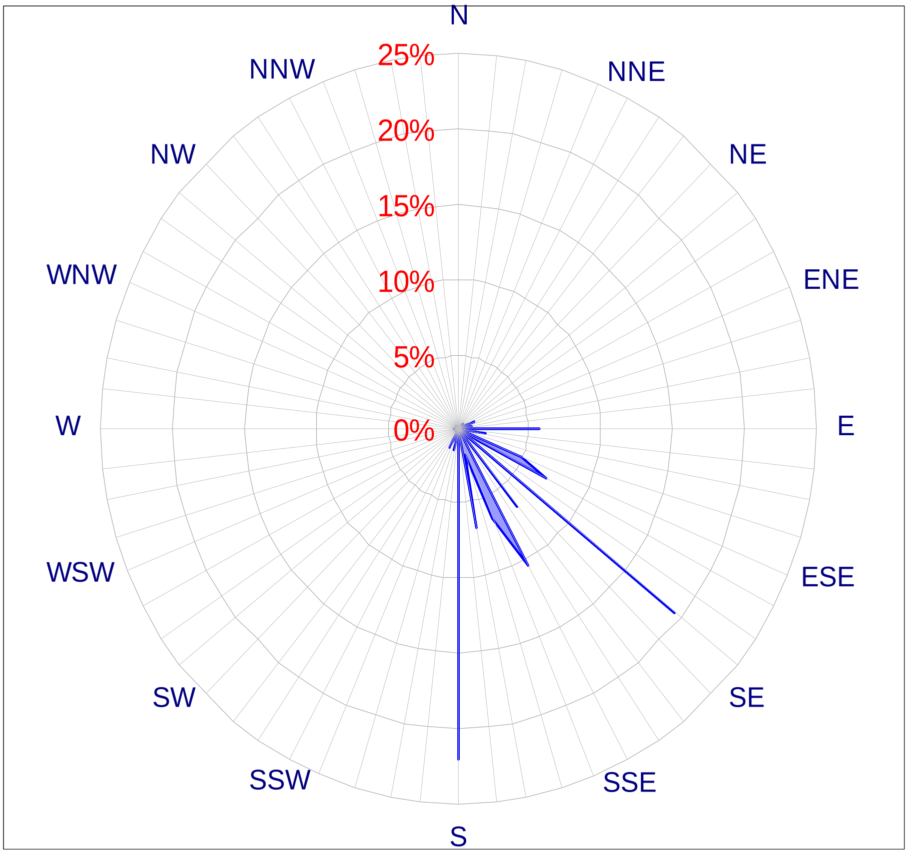
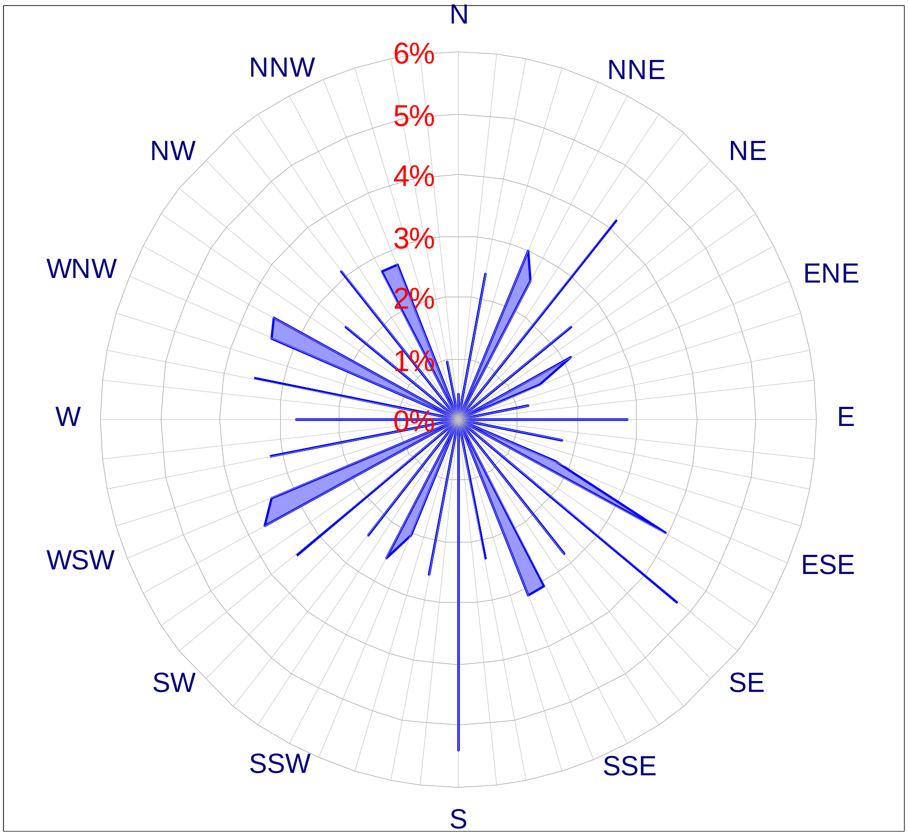


Figure 5.5 Windrose for October 2012



Air dispersion modelling was completed to predict ground level concentrations (GLCs) of pollutants, including NO_X, CO, PM_{10}, for the required averaging period across the modelled domain. As sulphur content in the natural gas input is negligible, emission of SO_2 was not included in the modelling (refer to Gas composition data included in Annex 8).

The measured background concentrations (maximum) are given in Table 5.3.

Table 5.3 Measured background concentrations of Pollutants.

Pollutant	Concentration($\mu g/m^3$)
NO_2	11.99
CO	131*
PM_{10}	156.93
* As measured data is not available, literature value is used.	

5.2.2.9 Emission estimates and stack parameters for the SBPCL II Power Plant

Emission estimates and stack parameters used in the present modeling are presented in Table 5.4.

Table 5.4 Emission rates and stack parameters

Source	Stack height (m)	Stack diameter (m)	Exhaust temp K)	Exit velocity (m/sec)	Emission rates (g/sec)					
					NO_X as NO_2	SO_2	PM_{10}	$PM_{2.5}$	CO	O_2
NG Unit	50	3.0	418	25	8.59	-	-	-	3.31	15%
Source: SPBCL II										

5.2.2.10 Modelling results

The predicted highest values for NO_X and CO and PM10 contributed by the SPBCL II Power Plant are presented in Table 5.5.

Table 5.5: Predicted Highest Values for NO_X and CO and PM_{10} contributed by SPBCL II Power Plant

Pollutant	SBPCL II Power Plant highest concentration ($\mu g/m^3$)
NOx	1.58
CO	1.81
PM10	156.974

Summary of maximum GLCs over the model domain is given Table 5.6:

Table 5.6 Summary of predicted maximum GLCs over the model domain

Pollutant	Averaging period	Air Quality Standard (μg/m^3)	Background Concentrations (μg/m^3)	Predicted Maximum Contribution by the SBPCL II power plant (μg/m^3)	Combined Value (μg/m^3)	% of Air Quality Standard
NO_2	24hr	150	11.99	1.58	13.57	9.10
	8hr	10.000	131*	1.81	132.81	1.33

Notes:

* As a local value is not available, a literature value is used.

** PM_{10} emission is dominated by the baseline concentrations in the Project Area. Emissions from the SBPCL II Power Plant are predicted to be less than 0.03% and therefore not reported..

*** 1. Modelled results were obtained by using the stack parameters provided by SBPCL II.

5.2.2.11 Impact assessment and conclusion for SBPCL II Power Plant using AERMOD

Modeling results indicate that air emissions around the Project Site during the operation of the SBPCL II Power Plant will remain much below the DOE and WB standards. There will therefore be no environmental and health hazard due to the operation of SBPCL II Power Plant.

Figure 5.6 Isopleths of NOx around the Project Site for the SBPCL II Power Plant

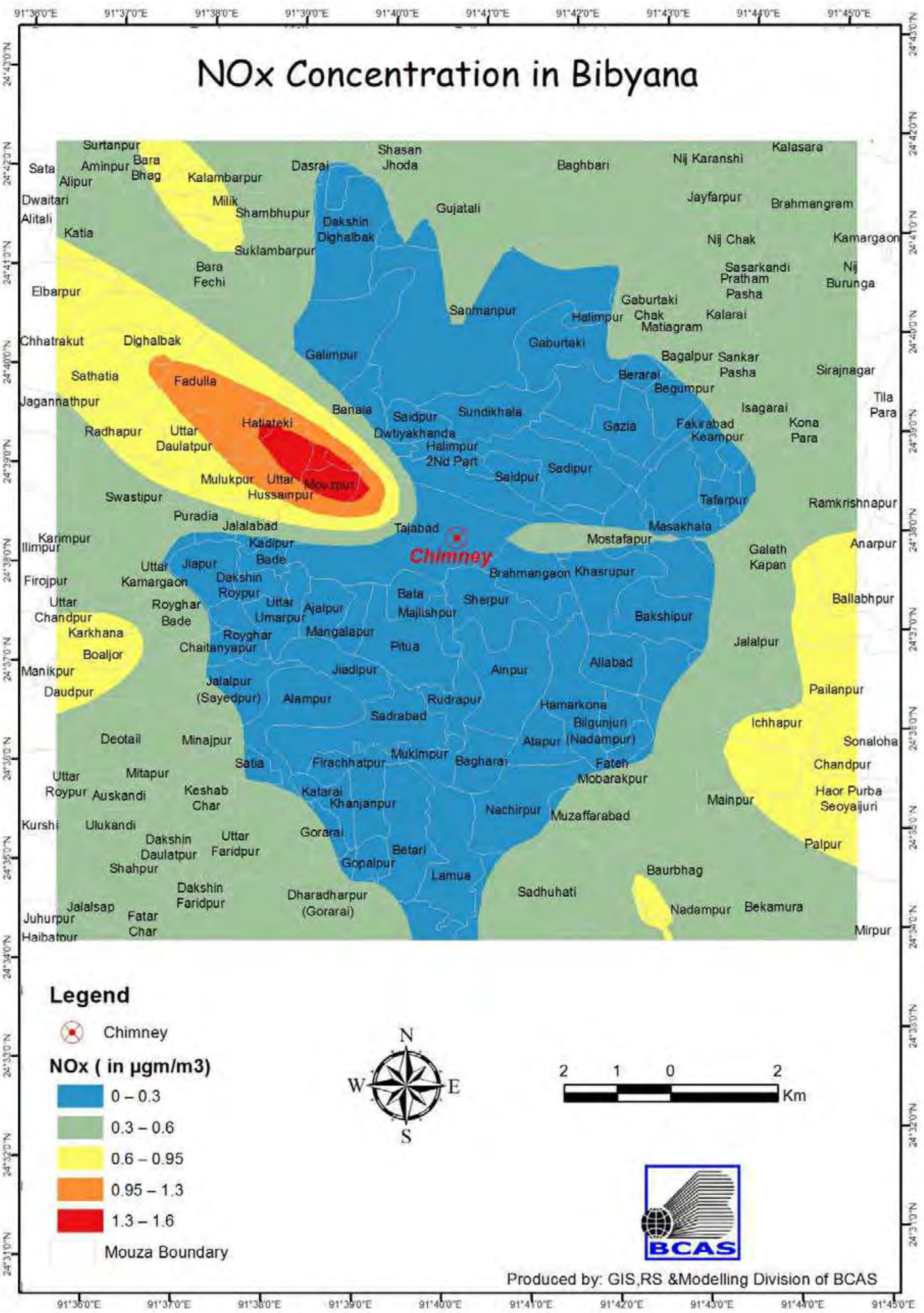
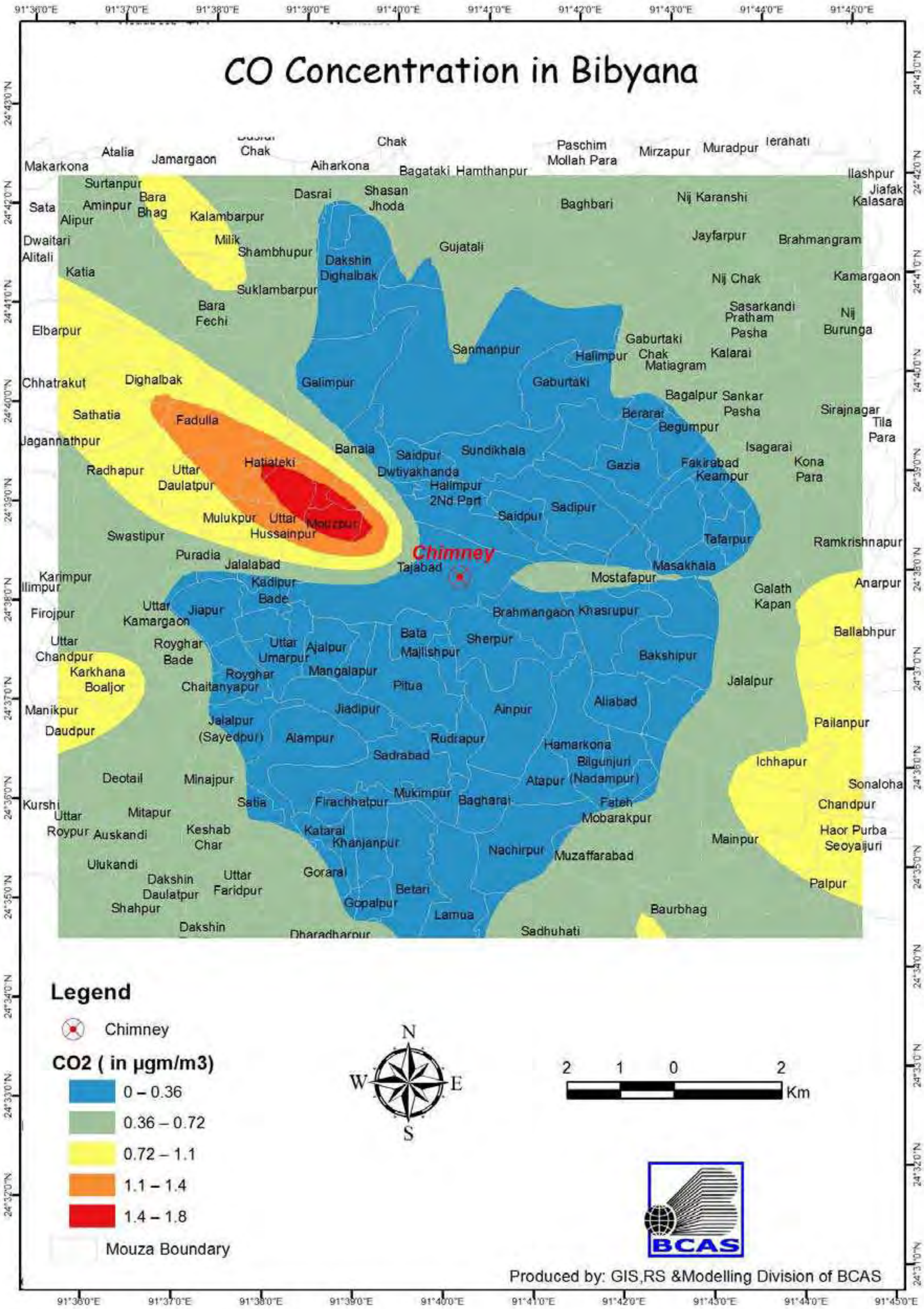


Figure 5.7 Isopleth of CO around the Project Site for the SBPCL II Power Plant



5.2.2.12 Cumulative Impact

The following section presents the modelling results for assessment of potential cumulative impact of SBPCL II Power Plant in conjunction with proposed potential future power plants (Bibiyana I andIII Power Plants) using the ISC3P model.

As sulphur content in the natural gas input is negligible, emission of SO_2 is not included in the modeling (refer to Gas composition data included in Annex 8). Maximum values for NO_X, PM_{10} and CO are presented in Table 5.3. The predicted highest values with one stack for NO_X, PM_{10} and CO are 5.23 $\mu g/m^3$, 0.053 $\mu g/m^3$ and 3.82 $\mu g/m^3$ respectively.

The measured background concentrations (maximum) for NO_X, PM_{10} and CO are 15.01 $\mu g/m^3$ (24hr), 156.93 $\mu g/m^3$ (24hr) and 4.36 $\mu g/m^3$ (8hr), respectively. Background CO concentrations were not measured. Summary of maximum GLCs over the model domain is given in Table 5.7.

Table 5.7: Summary of predicted maximum GLCs over the model domain

Pollutant	Averaging period	Air Quality Standard ($\mu g/m^3$)	Background Concentrations ($\mu g/m^3$)	Predicted Maximum Contribution by the plant ($\mu g/m^3$)	Combined Value ($\mu g/m^3$)	% of Air Quality Standard
NO_X	24hr	100	15.01	4.620	19.63	19.63%
PM_{10}	24hr	150	156.93	0.044	156.97***	104.65%**
CO	8hr	10,000	131*	3.370	134.37	1.35%

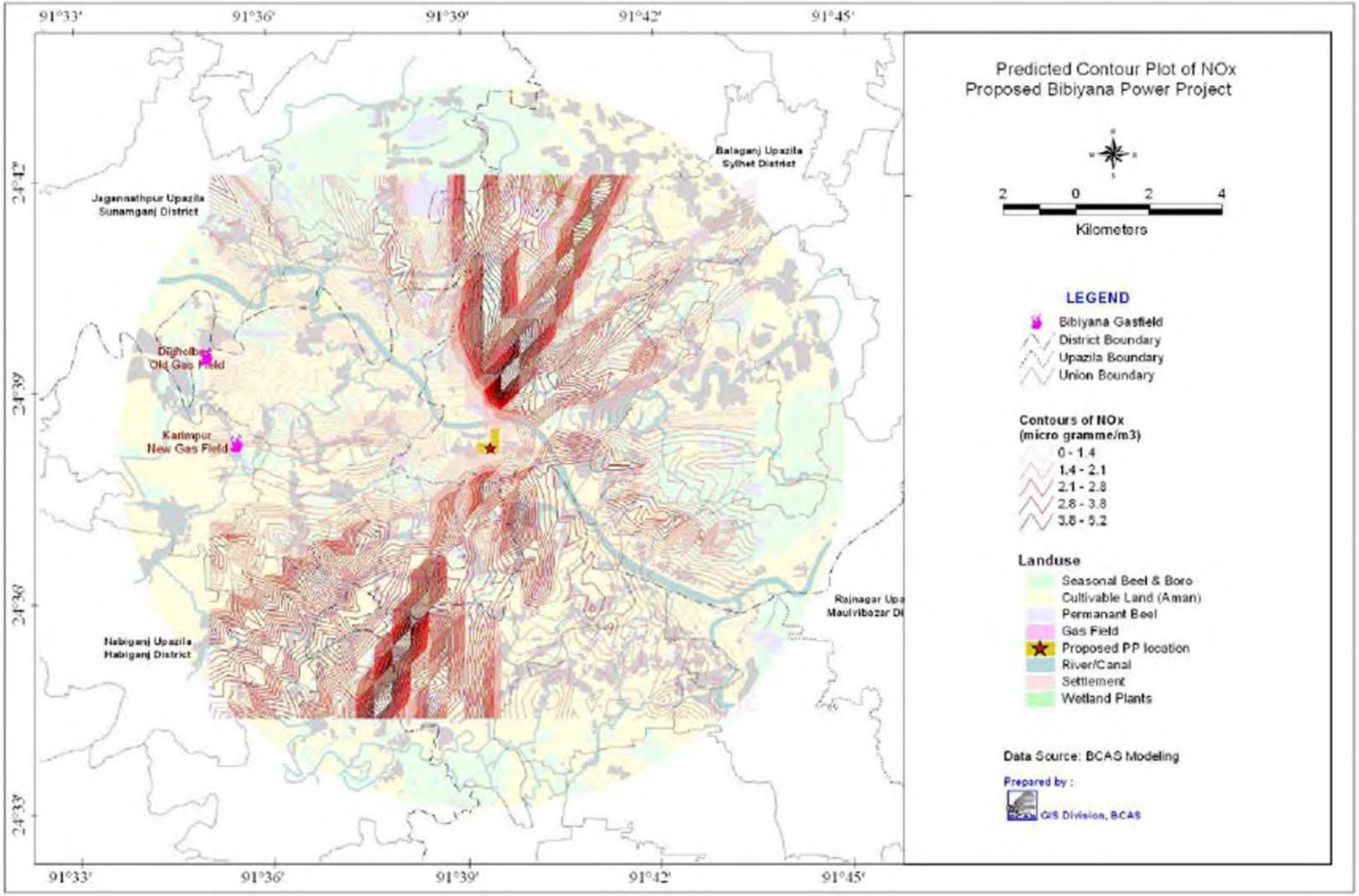
Notes:

* As a local value is not available (refer to Table 4.2), a literature value is used.

** PM_{10} emission is dominated by the baseline concentrations in the Project Area. Emissions from the 3 power plants are predicted to be less than 0.03%.

***
1. Modelled results were obtained by using the stack parameters provided by SBPCL II.
2. The NO_X value is based on a NO_X emission rate of 9.4 g/sec. Later, a revised NO_X emission rate of 32 g/sec was supplied by SBPCL II. Based on this revised value, the predicted maximum contribution is 17.87 $\mu g/m^3$. Adding the background concentration of 15.01 $\mu g/m^3$, the combined value is 32.88 $\mu g/m^3$ which is 32.88% of Bangladesh Standard and 21.92% of the IFC guideline value of 150 $\mu g/m^3$.
3. As the highest process contribution is somewhere near the emission source (stack), increasing the radius of the airshed from 7.5km to 10km will not affect the extent of predicted maximum emissions.

Figure 5.8: Wind Isopleths Overlaid on Project Area Map for SBPCL II Power Plant and potential Bibiyana I and III Power Plants



Air quality modeling using the ISCS3P model for the cumulative impacts of the SBPCL II Power Plant in addition to the proposed potential Bibiyana I and III Power Plants indicates that air emissions around the Project Site during the operation of all three power plants will remain much below the DoE standards except for PM_{10}. However, exceedances of PM_{10} are considered to be due to fugitive dust generated at the Project Site (i.e. elevated baseline concentrations). The contribution of all three power plants in respect of PM_{10} is negligibly small (<0.03%).

Simulation results of maximum ground-level concentrations of NO_X against stack heights at all proposed three power plants:

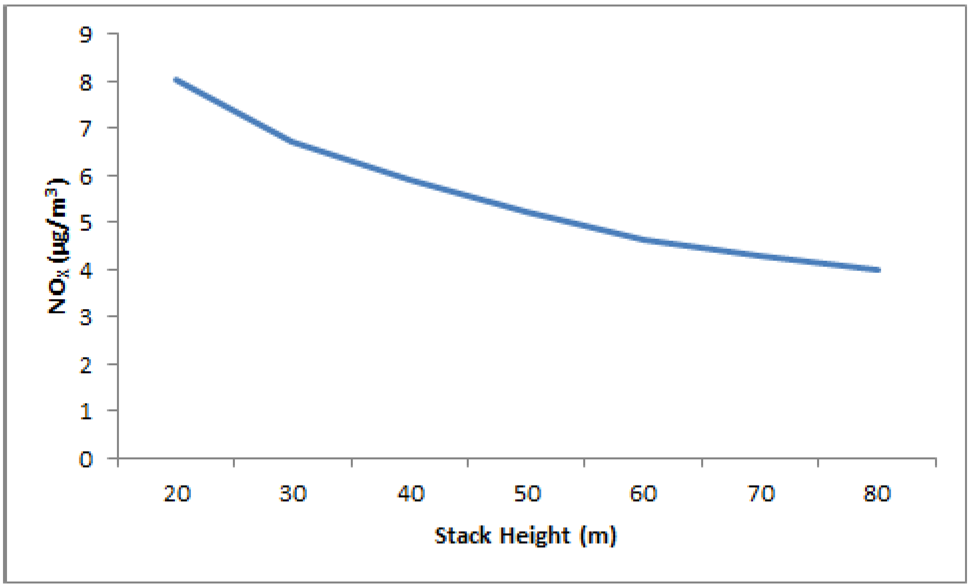
Type of Plant: .... CCGT
No. of stacks: 3
Volumetric flow rate: .... 275 m^3/sec (each stack)
Stack diameter: .... 3.0 m (each stack)
NO_X emission discharge rate: .... 9.4 g/sec (each stack)

Using the above inputs, ISC3P air dispersion model (USEPA approved) indicated the following simulation results for ground-level NO_X concentrations with different stack heights:

Stack height (m)	**Ground level NO_X Concentration ($\mu g/m^3$)**
20	8.05
30	6.73
40	5.90
50	5.23
60	4.62
70	4.28
80	4.01

The results are plotted graphically in Figure 5.3. It is seen from the figure that ground-level concentrations of the pollutant decrease significantly with increasing stack height – at lower heights sharply and at higher heights showing a leveling off tendency. A 10m rise from 20m to 30m reduces the ground level concentration by 16.4%; however, a 10m rise from 70m to 80m will only reduce the ground level concentration by 6.3%. A comparison of ground level pollutant concentration with stack heights above 60m shows that a 10m increase in height lowers the ground concentration from 7.3% to 6.3% i.e. only 1%. Therefore, a stack height of 60 m is recommended for the project.

Figure 5.9: Ground Level NO_X Concentrations



5.2.2.6 Conclusions of Cumulative Impact Assessment

Whilst specific details of the proposed future Bibiyana I and III Power Plants are unknown, the proposed SBPCL II Power Plant , the Bibiyana I and will comprise a '*300- 450 MW CCGT power plant*'. Therefore, given the absence of further information, for the purposes of this impact assessment, it has been assumed that the gas turbine for the Bibiyana I and III Power Plant will comprise the same specification as SPBCL II Power Plant, with the same stack heights.

The addition of another two power plants (e.g. Bibiyana I and III Power Plants) with the same emission parameters will lead to approximately a 50% increase of the predicted pollutant concentrations. This addition will lead to predicted values of 7.85 $\mu g/m^3$ for NO_X, 0.08 $\mu g/m^3$ for PM_{10} and 5.73 $\mu g/m^3$ for CO (refer to Table 5.3). These values are well within DoE, IFC and WB Standards.

5.2.3 Noise Modelling

According to information provided by the manufacturer, the source noise from the proposed gas turbines to be used in the SPBCL II Power Plant is 85 dBA at 1m..

The noise modelling is based upon the method documented by the International Energy Agency. It is a simple model which assumes spherical spreading from a point source either in free space (spherical) or over a reflective plane (hemi-spherical). For this case, spherical spreading has been used because sound wave is propagating uniformly in all directions and the crests and troughs of the sound waves can be pictured as spheres centred on the source location.

The model presents a 'worst-case scenario' as it does not take into account factors which would reduce noise propagation, such as:

- Uneven topography
- Large obstructions in the propagation path, e.g. barriers etc
- Refraction of noise, e.g. due to atmospheric effects such as temperature inversion
- Wind speed or direction effects
- Any change in the propagation with changing frequency

The mathematical formula for the noise model is shown below:

$$L_P = L_W - 10Log_{10}(2\pi r^2) - ar$$

Where:

r is the distance from source to receiver;

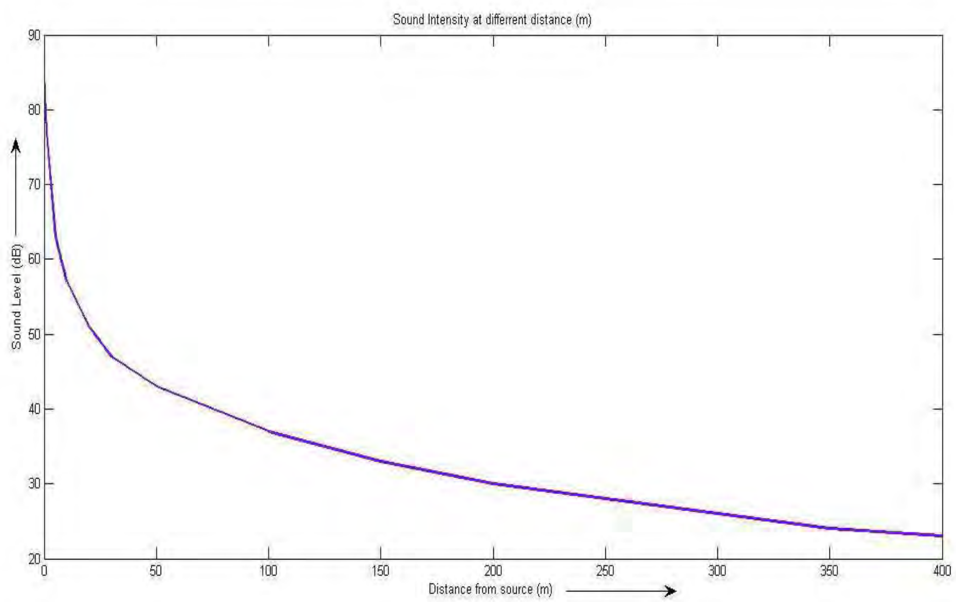
a is the absorption due to the atmosphere (dB/m),which is most commonly used as 0.005dB/m;

L_W the sound power level of the turbine; and

Lp the output sound power level of the turbine at different radius away from the source.

Graphic User Interface (GUI) software was built based upon the model using MATLAB programming language for enhancement in calculation and analysis. The screenshot for and the sample MATLAB code is given in Figure 5.10.

Figure 5.10 Screenshot for the Noise Modelling Simulator

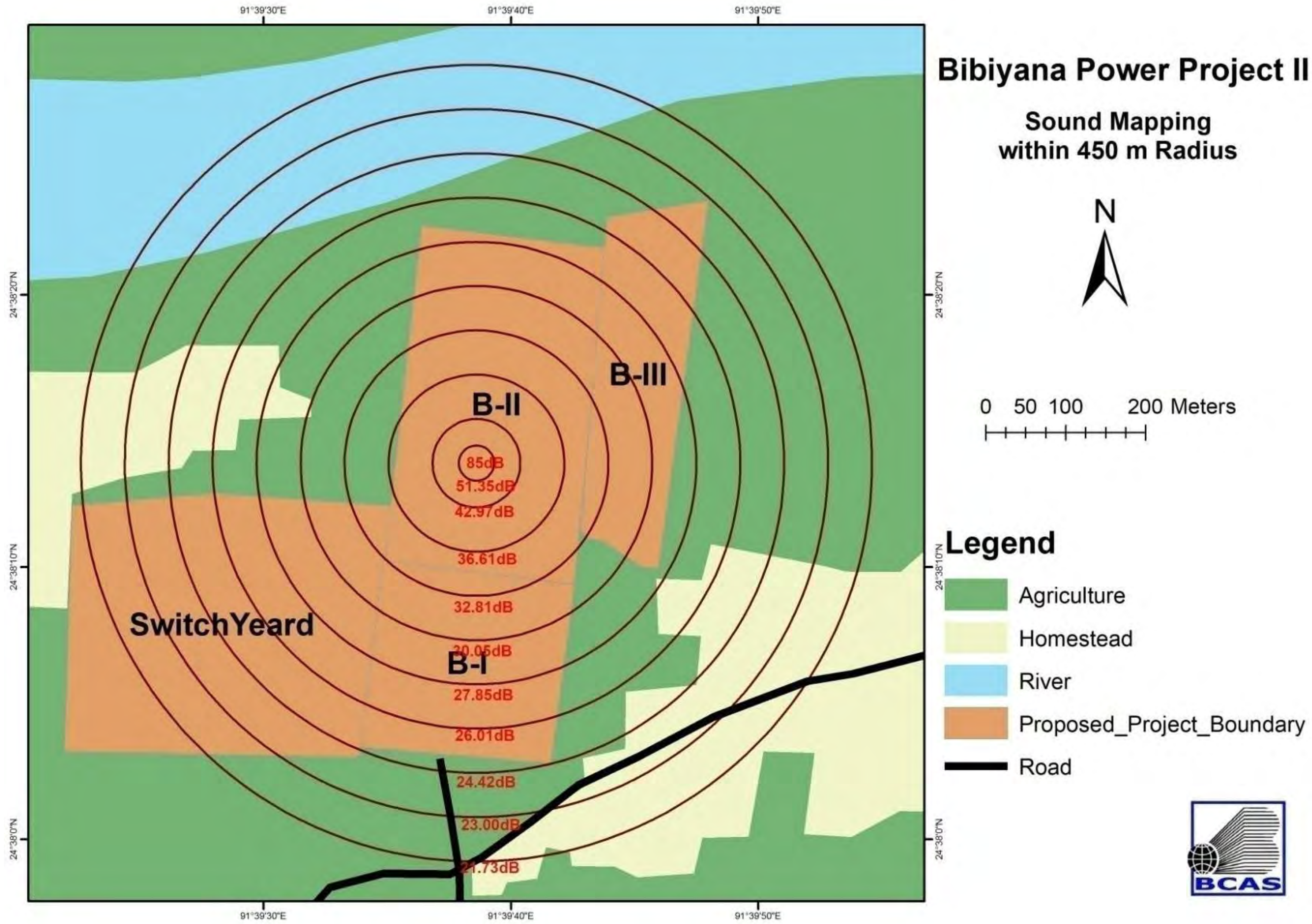


5.2.3.1 Noise Modelling Results

At 85 dB noise input the predicted noise output is as follows:

Radius (m)	1	5	10	20	30	50	100	150	200	250	300	350	400
Output Sound power level in dB	85	63	57	51	47	43	37	33	30	28	26	24	23

Figure 5.11 Contour plot showing noise power level (dB) from SBPCL II Power Plant for 450m radius



5.2.3.2 Cumulative Noise Modelling from Bibiyana I and III and SBPCL II power plant

According to information provided by the manufacturer, the source noise from the proposed gas turbines to be used in the SBPCL II Power Plant is 85 dBA at 1m. In the absence of specific details at this stage, the same specification for Bibiyana I and III Power Plants are assumed.

The noise modelling is based upon the same method set out in 5.2.4. To calculate the cumulative impact, the total noise from each turbine is logarithmically added according to the formulae given below:

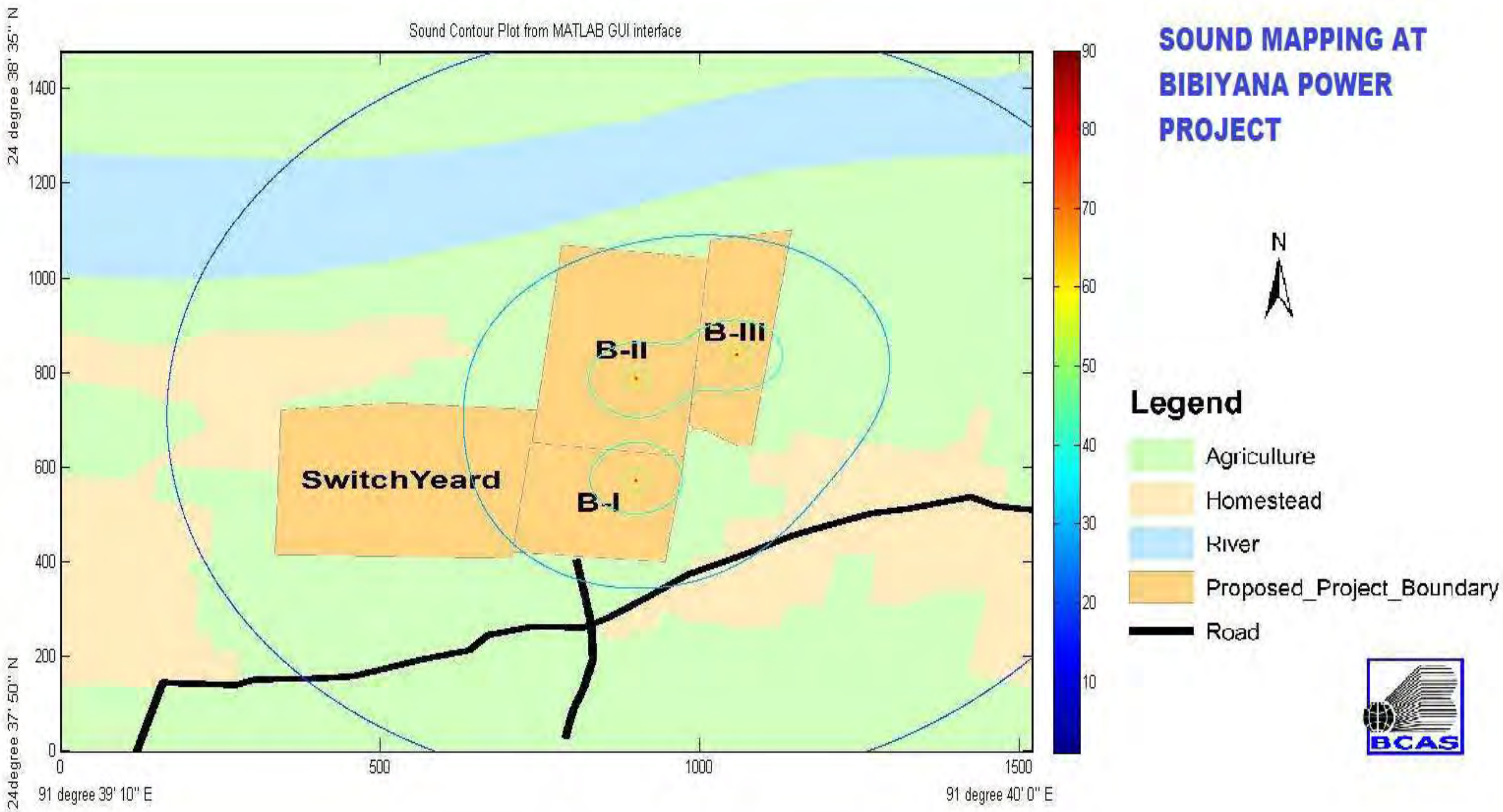
$$L_A, L_B, L_C = 10\log_{10}(10^{LA/10}+10^{LB/10}+10^{LC/10}) \text{ dBA}$$

Where:
L_A = Sound Source 1 (i.e. Bibiyana I turbine)
L_B = Sound Source 2 (i.e. SBPCL II turbine)
L_C = Sound Source 3 (i.e. Bibiyana III turbine)

Graphic User Interface (GUI) software was built based upon the model using MATLAB programming language for enhancement in calculation and analysis. First the surrounding area (1.5 km X 1.5 km) is considered for sound effect. The entire area was divided into 2,250,000 points to obtain values at every 1m distance using 'meshgrid' command in MATLAB. All the co-ordinates value is defined in the code. The reference point (0,0) is the point $24^0 37'50''$ N & $91^0 39'10''$ E. The x-axis is along east and y-axis is along north direction.

A contour plot was drawn in MATLAB interface showing the sound level in different colored contour. The background map was imported using 'imread'and plotted in the background using 'imagesc'. The corresponding axisare defined beforehand. The 'flipdim' command is also required to plot contour in right position.

Figure 5.12: Contour plot showing noise power level (dB) from SBPCL II and Bibiyana I and III for 450m radius



5.2.3.4 Cumulative Noise Levels at Locally Sensitive Receptors

The day and night time noise levels at the nearest sensitive receptors were calculated as follows:

Table 5.8 Cumulative Noise Levels

Location	Approximate distance from the Source (m)*	NIGHT dB(A)			DAY dB(A)		
		Validation Baseline 2013	Sound Effect from SBPCL II and Bibiyana I and III (estimated from simulation)	Combined effect	Validation Baseline 2013	Sound Effect from SBPCL II and Bibiyana I and III (estimated from simulation)	Combined effect
Residential properties to the South-East	380	53.18	30.84	53.21	53.60	30.84	53.62
Residential properties to the South	420	49.64	30.31	49.69	47.06	30.31	47.16
Residential properties to the West	590	44.92	22.38	44.94	43.76	22.38	43.79
Residential properties to the North-West	250	47.06	29.93	47.14	48.23	29.93	48.29
Clinic to the East	310	53.92	33.48	53.96	49.65	33.48	49.75
Western plant boundary	300	44.92	28.90	45.03	37.41	28.90	37.98
Town of Sherpur to the South-East**	1,900	69.01	7.37	69.01	56.06	7.37	56.06

*distance measured from the Project Site (SPBCL II power plant)
**The sound levels indicated for Sherpur is not attributable to the construction work but to the road traffic at this point.

Based on the results in Table 5.12 it is clear that the proposed power plants (Bibiyana I and III Power Plants, and the SBPCL II Power Plant) will fall below the World Health (WHO) Noise Level Guidelines of 55 dBA during the day, though will likely exceed noise levels (45 dBA) at night.

In all instances where the combined noise level exceeds the World Health (WHO) Noise Level Guidelines12 of 55 dBA during the day and 45 dBA at night, this is due to high baseline noise levels. The largest impact as a result of the proposed power plants will be adjacent to southern site boundary where the increase in noise during the day time will be a 0.31 dB(a) increase compared with the existing baseline. Such an increase is considered to be negligible and is significantly below the 3 dB increase which is referenced in the IFC Guidance. Furthermore,

[12] World Health Organisation (WHO), 1999, Guidelines for Community Noise.

the model presents a 'worst-case scenario' as it does not take into account factors (listed in the model description above) which would reduce noise propagation.
In light of the above, it is concluded that the proposed three power plants will have a negligible impact on the noise environment at the nearest sensitive receptors.

5.2.3.5 Construction Noise

Noise impacts during construction are typically due to:

1. Clearing of vegetation, removal and stockpiling of topsoil and bulk earthworks;
2. Piling and preparing concrete foundations for major plant and buildings; and
3. Construction plant, such as generators and compressors, and construction vehicles.

The noise level at different locations was recorded during the validation during October, 2013 (shown in Table 5.12).

Whilst the impacts are localised and temporary in nature, construction noise has the potential to cause sleep disturbance. Therefore, the following mitigation measures will be implemented during the construction phase.

1. Fit residential grade mufflers and silencers to machines
2. Use rubber tyred machinery rather than metal tracked dozers etc. where possible.
3. Limit operation of earthmoving machinery to between 9am and 4pm when residences are less sensitive to noise and ambient levels are greatest.
4. Keep neighbours informed when noisy equipment is introduced to the Project Site and the likely duration of its use.
5. Ensuresite contact details are circulated to neighbouring residences to allow a swift response to complaints
6. Introduce a management strategy to monitor noise emissions, assess and record noise complaints and track performance in limiting and managing noise.
7. Enclose or shield engines of concrete mixers where practical.

The combined cycle turbine and the waste heat boiler will be covered . The construction of the building will consist of 5mm thick Corrugated Iron (CI) sheet, with 50 mm of an insulating material inside. With these parameters the calculations shows that the noise levels at the nearest households will be below DoE and IFC standards. The calculation of the noise levels is shown in the Annex 5.

5.2.4 The Kushiyara River

5.2.4.1 Water Supply System

As stated in Section 3.5, the SBPCL II Power Plant will operate a closed-loop cooling system; however a total of approximately 10,000 m^{3}per day will be abstracted from the Kushiyara River for the following purposes:

a. Replenishment cooling water and demi polished water for high pressure boiler, ventilation, and air conditioning system;
b. Potable water for the staff for drinking and kitchen use purpose, for shower, basin and sink use including other use by staff; and
c. Service water for battery limit cleaning, washing filters for ventilation system and other equipment. This service water may be hot in nature.

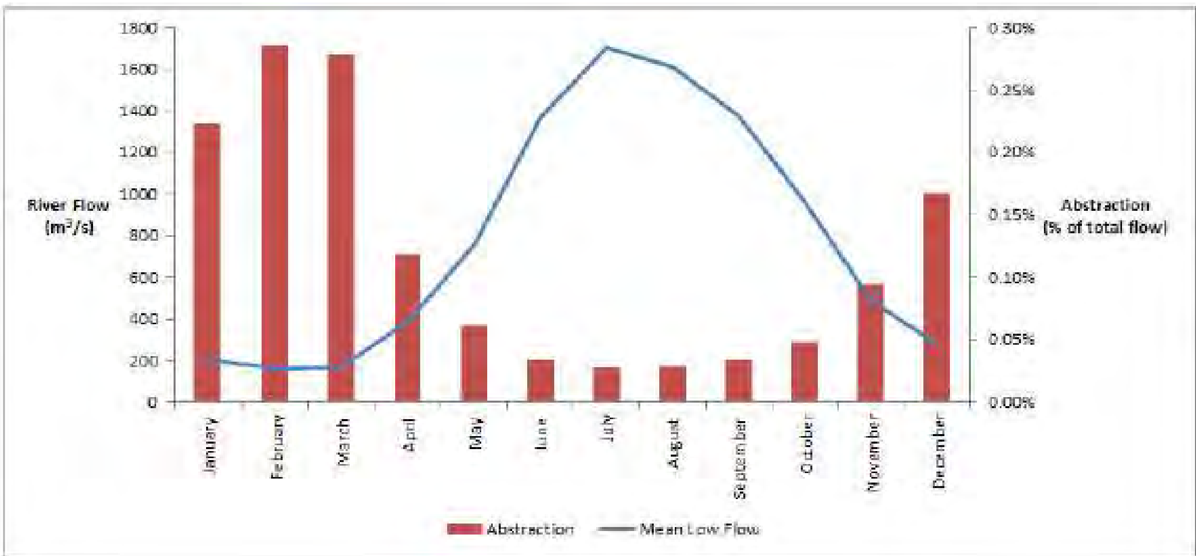
As stated in Section 4.3.2, based on river flow data recorded between 1995 and 2010 at the Sherpur monitoring station (refer to Figure 5.6), on average the low flow of the Kushiyara river varies between approximately1,700 m^3/s during the monsoon period and approximately 200 m^3/s during the dry season. During the period 1995-2010, a minimum flow of 57.8 m^3/s was recorded in March 1995.

5.2.4.2 Impact Assessment

According to the IFC EHS Industry Sector Guidelines for Thermal Power Plants (dated December 19, 2008), the intake flow should maintain resource use (i.e., irrigation and fisheries) as well as biodiversity during annual mean low flow conditions. As a guide, the IFC guidance states that stream flow requirements may be based on mean annual flow or mean low flow. Regulatory requirements may be 5% or higher for mean annual flows and 10% to 25% for mean low flows.

The source of all water will be the Kushiyara River, with water pumped through the cooling water intake system a rate that will not exceed 10,000 $m^3/24hr$ (i.e. 0.116 m^3/s). An abstraction rate of 0.116 m^3/s comprises approximately 0.006% of the average low flow during the monsoon season and approximately 0.058% of the mean low flow during the dry season (refer to Figure 5.6). Even during a repeat of the minimum recorded flow (i.e.58 m^3/s recorded in March 1995) the proposed abstraction would only comprise 0.2% of the total flow in the Kushiyara River.

Figure 5.13: Cooling Water Abstraction as a Percentage of Total Flow



Based on the above, the potential impact of the proposed water abstraction on the flow in the Kushiyara River is considered to be negligible.

5.2.4.3 Cumulative Impact

Whilst specific details of the proposed Bibiyana I and III Power Plants are unknown, according to the invitation to tender documents, both power plants will comprise a '*300-450 MW CCGT power plant*'. Therefore, given the absence of further information, for the purposes of this impact assessment, it has been assumed that the Bibyana I and III Power Plants will comprise the same specification as the SPBCL II Power Plant (i.e. a closed-loop system), with the same water requirements. Therefore the cumulative water requirements will not exceed 30,000 m_3/24hr (c.0.34 m_3/s). Therefore, as a worst case scenario during the dry season the water abstraction would only comprise 0.35% of the total river flow. Therefore, the potential impact of the cumulative water abstraction on the flow in the Kushiyara River is considered to be negligible.

5.2.4.4 Wastewater Discharge

Treated effluent (treatment processes described in Section 3.5.4) will be held in an effluent tank and then discharged in to the Kushiyara River. Prior to discharge, both the effluent in the tank and the river water temperature will be monitored for the following parameters: pH, temperature and conductivity. The effluent treatment system is designed to ensure compliance with the following IFC Guideline parameters:

Table 5.9: Effluent Quality Parameters

Parameter (all mg/L, except pH and Temperature)	**SBPCL II Effluent Quality**	**IFC Guidelines***
pH	6-9	6-9
TSS	50	50
Oil& grease	10	10
Total residual Chlorine	0.2	0.2
Chromium –total	0.5	0.5
Copper	0.5	0.5
Iron	1.0	1.0
Zinc	1.0	1.0
Lead	0.5	0.5
Cadmium	0.1	0.1
Mercury	0.005	0.005
Arsenic	0.5	0.5
Temperature (relative to river temperature)	±3°C	±3°C
Notes: Effluent guidelines to be applicable to relevant wastewater stream e.g. from boiler acid washing, regeneration of demineralises and condensate polishers, oil separated water, site drainages and cooling water; *IFC EHS Guidelines for Thermal Power Plants		

Providing that strict compliance with these effluent quality parameters is observed, the impact on the surface water quality of Kushiyara River from discharged effluent should be minimal. Blow down water from the cooling tower will be sent to a basin to cool down further before discharging into the River Kushiyara. The water would be sufficiently cooled to ensure the thermal impact will be negligible.

5.2.4.5 Accidental Contamination

There is also potential for sedimentation and siltation of the Kushiyara River as a result of earthworks and construction water run-off. However, an earth bund will be constructed to prevent the discharge of sediment and hazardous materials to neighboring water bodies. Furthermore, storm water will be discharged via a settlement tank and an oil separator to the Kushiyara River. To ensure the effectiveness of the proposed mitigation, water samples will be obtained quarterly from the Kushiyara River and analysed for pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, Arsenic and BOD.

There is also the potential for contamination due to spillage or accidental release of hazardous materials (i.e. fuels, lubricants, oils and solvents) onsite. However the following mitigation measures are proposed:

- Prohibition of dumping any contaminating material on the project site or elsewhere;
- Storage and routine handling of fuels, lubricants, oils, solvents and other potentially contaminating substances in a weather-protected area equipped with a secondary containment system for spills;
- Requisite steps should be taken toward spill prevention and, to this end, spill contingency plan should be undertaken. Necessary equipment and materials should be made available on-site to execute cleanup operations; and
- All materials recovered during clean-up operations should be stored in labelled and secured containers for subsequent disposal.

During the operational phase, surface water monitoring will be carried out downstream of the Project Site to ensure compliance with the Bangladesh water quality standards. Furthermore a facility-specific 'Spill Prevention, Control and Contingency Plan' will be developed outlining the power plant environmental design features, spill prevention and control procedures.

5.2.4.6 Flood Risk

As set out in Section 4.4.3, monsoon floods and flash floods occur in the lower parts of the Project Area. There is a small water body adjacent to the western side of the Project Area which floods the Project Site. In addition to this small water body, there are beels and canals around the Project Site that add to the floods during monsoon season. Flash floods occur during April to May in the area.

The BWDB has constructed a 9 m asl embankment on the banks of the Kushiyara River in the area to protect agriculture from flood damage. However, water levels in excess of 9 m asl cause inundation of the Project Site with potential impacts on livelihoods (i.e. agricultural crops) and damages to physical infrastructure.

The majority of the Project Site was originally situated at an elevation of 7.8 m above sea level (asl), with highest recorded flood recorded at an elevation of 10.15 m asl. During the validation survey carried in September/October 2013 it was found that land had already been completed at the Project Site in 2012, to protect the Project Site from floodwater. The final elevation of the Project Site is approximately 11.2 m asl (i.e. 1 m above the highest recorded flood, as per the RFP issued by BPDB). This land raising includes the construction/laydown area to the north of the proposed SBPCL II Power Plant.

Whilst the land raising will protect the SBPCL II power plant, from flash flooding, it will alter the drainage patter of the area and the surrounding land. However, the Kushiyara-Surma River catchment area occupies an area of c.1841 km^2 and the land raising of approximately 25 acres of land will have a minimal impact on this scale of floodplain.

Further assessment of flood mitigation and storm water attenuation will be undertaken by the EPC Contractor at the detailed design stage. However it is currently anticipated that on-site storage of storm water, to attenuate and regulate run-off rates, will be incorporated into the drainage design, with the effectiveness of storm water run-off attenuation measures subsequently monitored by EHS Manager.

Further consideration of flood risk as a result of climate change is included in Annex 14.

A requirement to undertake further assessment is included in the ESMMP (Section 8).

5.2.4.7 Greenhouse Gas Emission from SBPCL II Power Plant

In order to estimate GHG emission, the IFC recommended Carbon Emissions Estimation Tool (CEET model) has been used as set out below.

Greenhouse Gas Emission (GHG) Calculation:
To calculate GHG emission' the CEET model is used; this model is created by IFC to help users predict and understand the emissions profile of a potential GHG source. The model is user friendly, and very accurate. It gives the amount of GHG emission in Megatons CO_2 (equivalent) directly if heat duty or total gas is known.

Following Data was provided by SBPCL:
Net heat rate = 9,953 KJ/KWh
*Output power of the main engines = 228,692 KW
Annual Operating Days = 330 days
Daily Working hour = 24 hour

Calculated Data:
Total Annual Output from main engines = (228,692 KW X 330 X 24 hour)
= 1,811,240,640 KWh

Annual fuel consumption = $\frac{\text{Total Annual Output}}{\text{Net heat rate}}$

$= \frac{1811240640 \text{ KWh}}{9953 \text{ KJ/KWh}}$

$= 1.80273 \text{ X } 10^{+13}$ KJ

= 18,027.27809 TJ

The waste heat recovery boiler does not emit any GHG as it only utilizes the combustion product of the main engine hence it is not considered for GHG emission. The annual fuel consumption (TJ) is used as an input to CEET model and the annual CO_2 (equivalent) emission in tons is obtained.

Table 5.10: Results from CEET Model for Natural Gas

	Values	Unit
Annual Fuel Consumption	18,027.28	TJ
CO_2	56.100	Ton per TJ
CH_4	0.001	Ton per TJ
N_2O	0.0001	Ton per TJ
CO_2 (equivalent) emission per year	1,012,268	tons
CO_2 (equivalent) emission for entire project life (20 years)	20,245,360	tons

The entire project life is considered as 20 years. So, the emission calculated by means of CEET model is multiplied by 20 to obtain GHG emission data for the whole project life. The model shows that, the SBPCL II Power Plant will emit about 20,245,360 tons CO_2 (equivalent) during the years of operation.

Further consideration of potential impacts as a result of climate change is included in Annex 14.

5.2.5 Resettlement

The primary social impact associated with the Proposed Development (refer to Section 6) is the resettlement of Project Affected Persons (PAPs). This is assessed in a standalone Resettlement Action Plan (RAP) which accompanies this ESIA. However, the impacts and associated mitigation measures are summarised in the Impact Tables in Section 5.3.

5.2.6 Traffic

Due to the proximity of the Kushiyara River, the bulk of the construction material, heavy machinery and equipment required for the Proposed Development is being transported via the waterways. It is noted a substantial number of road movements (2,938) were recorded during a traffic survey at Sherpur Point during a 24 hour period. Accordingly, although then traffic (road) movements in the Project Area are likely to increase during the construction phase of the Proposed Development, this is considered unlikely to be significant.

There is potential however for the following impact as a result of the increase vehicular traffic in the local area:

- Traffic congestion of local roads and lanes;
- Increased wear and tear of local roads thus reducing lifespan of affected roads.
- Community disturbance and potential safety hazards, with pedestrians and cyclists using local roads will have to exercise more care with increase of vehicular traffic on the said roads; and
- Increase of exhaust emission from vehicles, which will pollute local atmospheric air.

During the pre-construction period, the road from Sherpur commercial centre to the Project Site was widened and strengthened to mitigate potential congestion and condition impacts by increasing its capacity.

Clear signposting would be provided to ensure both road users and pedestrians are made aware of traffic rules.

A traffic and transportation plan has been prepared for the construction phase and would be prepared for the operational phase, which includes/will include (but not limited to):

- avoid the transportation of materials or machinery during peak traffic periods;
- stick to agreed traffic routes, avoiding narrow roads and villages;
- enforce local road and river traffic rules;
- implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area;
- provide training on safe driving;
- prevent unauthorised access (i.e. public access) to the Project Site;
- load trucks in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and
- maintain and/or repair any private and public highways that have been damaged by vehicles from the construction site.

Furthermore, the EPC Contractor would:

- Implement the traffic and transportation plan.
- Record and investigate all accidents and near misses.
- Undertake visual inspection of roads used by construction vehicles.
- Review of complaints received via the formalised grievance mechanism.

A complete set of mitigation measure is set out in Table 5.7 and 5.8 below. Due to the scale of changes in road traffic, it is considered unlikely that significant increases in exhaust emissions from vehicles would occur.

In regard to river traffic, baseline surveys recorded approximately 179 river traffic movements travelling upstream and downstream on the Kushiyara River between 6 am and 6 pm. Non-motorized fishing boats were the most common vehicle type recorded in the survey, accounting for approximately 43 % of all river traffic movements. The Proposed Development would likely result in an increase in good transport along the River, the increase in river traffic movements has the potential to impact on the local community and the fishing by the local community. However, the EPC Contractor would monitor any complaints and liaise with other river users to resolve any navigational issues.

5.2.7 Biodiversity

The Project Site primarily comprises agricultural land and does not have any statutory designations or ecological protection status. However, the wider area (i.e. within the 10 km project AoI) is rich in faunal diversity. The possible impacts of the Proposed Development on biodiversity and wildlife could arise from any one or more of (impacts of the associated facilities are dealt with separately later in this ESIA):

- loss of habitats through development of the Project Site;
- impacts on the Kushiyara River through abstraction or discharges;
- hindrance to indigenous wildlife movement;
- other disturbances in construction or operation; and/or
- accidents impacting the environment.

In addition to the above, whilst the abstraction of cooling from the Kushiyara River will not affect the river flow, as identified in the IFC Guidelines, aquatic organisms drawn into cooling water intake structures may be impinged on components of the cooling water intake structure or entrained in the cooling water system itself. In the case of either impingement or entrainment, aquatic organisms may be killed or subjected to significant harm. There is also the potential for organisms to become entrapped in the intake canals.

In order to mitigate these potential impacts, barrier screens will be installed and the intake structure will be located towards the centre of the Kushiyara River to further reduce impingement and entrainment.

In regard to habitat loss, it is understood that the Project Site would not result in reclamation of any wetland areas or impacts on water flows and drainage. It would however, result in the loss or disturbance of agricultural land within the footprint of the Project Site.

To mitigate potential disturbance impacts on wildlife, boundary fencing of the Project Site will be implemented to ensure wildlife choose alternative routes. Furthermore, landscaped areas will be provided, where possible, around and within the Project Site using indigenous species to supply habitat for terrestrial and riparian species and improve aesthetics.

The Project Area is sparsely covered by vegetation and tree canopy. During the on-going construction works, all workers have been prohibited from felling trees, hunting wildlife and fishing in the vicinity of the Project Site. However, existing trees will be retained and uprooted trees (if any) will be replaced wherever feasible.

It is also understood that impacts on the Kushiyara River through abstraction would be negligible as the water required for the SBPCL II Power Plant would comprise a negligible volume compared to the flow rate of the River, even at its lowest flow. Furthermore, the potential for pollution of the Kushiyara River due to construction wastes would be mitigated through the provision of temporary waste disposal sites within the construction yard, as well provision of a suitable number of wash rooms. During operation, appropriate treatment plants for liquid and other wastes and/or facilities which allow the collection and storage of harmful and hazardous wastes in safe containers would be provided to minimize potential pollution impacts on the Kushiyara River.

Monitoring populations of terrestrial and aquatic organisms within the Project Site will take place every six months during the construction phase.

It is considered reasonable to assume all elements of the Proposed Development would adhere in construction and operation to international safety standards and contingency planning and mitigation. A complete set of mitigation measure is set out in Table 5.7 and 5.8 below. Following the implementation of such mitigation, the overall impact on biodiversity and wildlife is considered to be minor. The detailed fisheries survey undertaken indicates that the aquatic life in river Kushiyara will not be significantly impacted due to the SBPCL II Power Plant.

5.2.8 Soil

The possibility of the contamination of soil will be minimal as the power plant is natural gas based. The would be limited amount of liquid fuel stored for use in transport and operating of the emergency diesel generator in case of total shut down of the SPBCL II Power Plant.

The clearing of the land in the Project Site, and land raising works which have already been completed, will result in removal of the topsoil and land erosion which can in turn lead to sedimentation and pollution of the nearby water body and other water system. However, to mitigate these potential impacts construction work would be undertaken primarily in the dry season, with temporary silt-traps and/or other siltation prevention mechanisms provided.

During the operation of the Proposed Development, the following mitigation measures would be implemented to mitigate any potential impacts associated with hazardous materials management:

- Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies;
- Hazardous materials (i.e. oils, fuels, chemicals) will be stored in containers comprising appropriate secondary containment;
- Spill kits will be available to contain any accidental release of hazardous materials. A ‘Spill Prevention, Control and Contingency Plan’ will be developed, outlining the power plant design features and spill prevention and control measures;
- Drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil and waste oil storage tank areas will flow to a sump to be pumped to an oil-water separator; and
- No underground storage tanks (USTs), containing oils, fuels or chemicals, will be located at the Project Site.

A complete set of mitigation measure is set out in Table 5.7 and 5.8 below.

5.2.9 Waste

During the construction and operational phases of the Proposed Development, waste lubricants will be generated. The oily water generated because of this will be treated in the

ETP, with separated oil sold to the local contractors who will recycle to recover lubrication oil.
The solid waste generated including sludge from ETP will be disposed to GoB approved landfill. Other solid waste from the SBPCL II Power Plant will be transferred to reputable external contractors.

Solid waste generated by the people working at the Proposed Development includes paper, cartoons, bags, boxes, office wastes, pallets, empty drums etc. along with negligible quantities of domestic waste. All solid waste will be segregated properly; any with a secondary demand would be sold to the outside contractors whilst other solid wastes will be disposed of at a suitable licensed disposal facility.

To minimize the amount of waste generated and sent to landfill, employees of the Proposed Development would have training on waste management techniques. Regular collections would be scheduled to prevent the build-up of waste materials and audits of waste contractors would be instructed to ensure appropriate disposal methods are applied according to the waste stream.

In regard to human sanitary waste, there is potential for the labor influx associated with the Project Site to generate waste which would have the potential to impact the surface water quality of the nearby water resources and ultimately impact the health of the local community. However, implementation of management measures as mentioned in ADB SPS (2009); ADB Operations Manual (2010); IFC General EHS Guidelines; and the IFC EHS Guidelines for Thermal Power Plants would mitigate any potential impacts. Furthermore the Proposed Development would mitigate potential impacts associated with the generation of human sanitary waste by the:

- Provision of appropriate number of toilets and hand-washing points at the work-site;
- Provision of on-site treatment of sanitary wastes;
- Training construction employees on project sanitation practices.
- Regular checks by the EPC Contractor to ensure implementation of sanitary requirements;
- Periodic inspection of operational sewage treatment facilities by the EPC Contractor;
- Water quality sampling every 3 months, including BOD; and
- Regular checks of the sewage treatment system by the EHS Manager to ensure continuation of proper functioning.

A complete set of mitigation measure is set out in Table 5.7 and 5.8 below.

In light of the above, the impact of waste generated during both the construction and operational phases is considered to be insignificant.

5.2.10 Social Impact

The project envisages providing permanent employment of about 1000 skilled, semi-skilled and unskilled people during construction phase and a total of 40 skilled and unskilled personnel during its operational phase. This would help, although only partially, alleviate the unemployment burden of Bangladesh. Apart from this direct benefit, there would be other direct beneficial impacts on national economy through foreign investment.

The Proposed Development shall employ local people wherever possible and give preference to employment of the landless and jobless people.

A grievance mechanism through a Joint Committee for Community Relations (JCCR) has been proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SBPCL II management and elected local representatives. A complete set of mitigation measure is set out in Table 5.7 below.

As there might be hazards to the plant workers, employees and technical personnel, provisions need to be made by the Proposed Development for protecting occupational health, including protection of workers from hazards/fires/spillage etc. as well as protection of workers, health and assurance of safe drinking water supply and sanitation. The workers who work inside the proposed SBPCL II Power Plant face occupational health hazards due to different operational processes. Safe and good occupational health status of the employees and workers is important for not only the persons working in the SBPCL II Power Plant, but also for the better plant operation and maintenance.
Protective clothing and accessories would be provided to the workers who would be subjected to exposure to hazardous substances and situations. Regular medical check-ups are requiredto ensure the soundness of the health of the employees and workers.

EHS training and safety induction would be compulsory for all employees, with 6 monthly updates. An EHS Plan would be prepared, and would include:

- EHS Policy and Objectives;
- Appointment of qualified EHS specialist(s) who will be on-site throughout operations;
- Project EHS rules;
- Details of how rules and updates (if required) will be communicated to workers;
- Implementation of access restrictions (barriers and signage) will be used to prevent unauthorised access to the Project Site
- Identification and risk assessment of hazardous activities and high risk areas;
- Safe working methods for hazardous activities;
- Ensure all personnel are provided with all required PPE for the environment they are in and the tasks they are performing;
- Implementation of a Lock-out Tag-out program; and
- Reporting and investigation procedures for all severe and minor accidents, and near misses.

Training would be provided for all subcontractors to ensure site procedures are fully understood and complied with. Furthermore, pollution control measures are to be duly adopted as necessary, including noise and emissions control, so that there would not be any negative occupational health impact. A complete set of mitigation measure is set out in Table 5.7 and 5.8 below.

As set out above, the major social issues associated with the Proposed Development were land acquisition, resettlement and compensation. These issues are elaborated on in the RAP which is a separate report which accompanies the ESIA.

5.2.11 Trans Boundary Impacts

Air Quality modeling has demonstrated that air pollutants associated with operation of the SBPCL II Power Plant will reach acceptable ground level concentrations within the Project AoI. Furthermore, whilst SO_2 and NO_X are implicated in long-range and trans-boundary acid deposition (as stated in IFC EHS Guidelines for Thermal Power Plants), it has already been demonstrated that the SO_2 emissions will be negligible and, as stated in Section 3.3, the SBPCL II Power Plant will operate low NO_X burner emission control systems. Therefore, the potential for trans-boundary impacts is considered negligible. As such the Prior Informed Consent (PIC) requirements will not be triggered.

The power plant will use surface water from the Kushiyara River which is downstream of river Borak coming from India. The Kushiyara flows into the Bay of Bengal approximately 250 km downstream of the Project Site and therefore there is no potential for trans-boundary water pollution. Any upstream activities in India may result into lower flow rates in Kushiyara. However, there is a general water sharing contract between Bangladesh and India through which it is expected that the environmental aspects of Bangladesh have taken into consideration for any water diversion project in India related to the Borak River.

The border with India is located approximately 50 km to the south-east of the Project Site and as such noise generate from the SBPCL II Power Plant will not have any impact in the adjacent areas of India

5.3 Significant Environmental Impacts

The potential significant environmental impacts, prior to mitigation measures, associated with the Proposed Development are summarised in the following tables:

- Table 5.7 – Construction phase;
- Table 5.8 – Operational phase; and
- Table 5.9 – Decommissioning phase.

All pre-construction works have now been completed at the Project Site, therefore the assessment of impacts has not been presented in this ESIA. It is understood that all measures recommended in previous versions of the ESIA were implemented by the EPC Contractor and other sub-contractors during the works.

Impacts during the decommissioning phase will be similar to those for the construction phase and as such have not been assessed separately.

Impacts have been categorized into 'Minor', 'Medium' and 'Major' Impacts (assessed **prior to** consideration of potential mitigation measures). These are defined as follows:

Minor Impact: The impact, if any, is not considered significant and no mitigation will be necessary.

Medium Impact: The impact will be localised and/or temporary in nature and some migration will be necessary.

Major Impact: There is potential for a significant impact and mitigation, and monitoring of the effectiveness of the proposed mitigation, will be required. If appropriate and effective mitigation is not possible, an alternative course of action (i.e. alternative site, method or technology) will be required.

Negligible: No beneficial or adverse impact.

Table 5.11: Anticipated Impacts and Impact Management during the Construction Phase

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
1. Air Emissions			
Exhaust from heavy equipment and generator sets Fugitive dust in the immediate vicinity of the Project Site or haul route: Primary emissions of NO_X, SO_2, $PM_{2.5}$ and PM_{10}, CO, CO_2, VOCs, etc.	Major Major Major	Implementation of on-site good practices as mentioned in ADB SPS (2009) and Section F1/BP of ADB Operations Manual (2010); and Section 1.0 Environmental, Sub-section 1.1 Air Emissions and Ambient Air Quality of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants. Whilst emissions from vehicles and other combustion engines will be isolated and temporary in nature, the EPC Contractor will ensure: • Equipment and generators in good running condition through adequate maintenance; and • Switching off engines when not in use. In order to mitigate dust emissions, the EPC Contractor will carry out: • Periodic sprinkling of water throughout the area subject to the site preparation and land raising process to arrest dust emission; • Cover all stockpiles with canvas or plastic sheets during windy periods; • Clean road vehicles wheels before leaving the site; and • Prohibit rubbish burning within the construction site.	Regular checks by the EPC Contractor to ensure implementation of good management practices. Maintaining liaison with the public including systematic recording and investigation of any complaints.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
2. Noise			
Noise impact on nearby homesteads and/or sensitive receptors.	Major	Implementation of Noise Prevention and Mitigation measures as mentioned in ADB SPS (2009) and Section F1/BP of ADB Operations Manual (2010); and Section 1.0 Environmental, Sub-section 1.7 Noise of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants. The EPC Contractor will: • Select equipment and construction techniques that cause minimum noise. Maintain equipment in good working order; • Construction activities, such as piling, which generate significant noise, will be carried out during the daytime; • Install noise reduction equipment i.e. silencers and mufflers, on noisy plant and frequently check the efficiency of noise attenuation equipment; and • A grievance mechanism will be established as part of a stakeholder engagement plan. To mitigate potential noise from construction traffic, construction materials will be delivered using boats (via the Kushiyara River) wherever possible. Where road vehicles are required, these will be routed via the proposed access road in order to avoid the primary residential areas.	Daily check of noise management by the EPC Contractor. Maintaining liaison with the public including systematic recording and investigation of any complaints.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
3. Terrestrial and Aquatic Habitat			
Potential for impacts on wildlife (i.e. loss of habitat, hindrance to wildlife movement).	Minor	Boundary fencing of the Project Site area will ensure wildlife choose alternative routes. Provision of landscaped areas, where possible, around and within the Project Site using indigenous species to supply habitat for terrestrial and riparian species and improve aesthetics. Construction workers will be prohibited from felling trees, hunting wildlife and fishing in the vicinity of the project site.	Monitoring population of terrestrial and aquatic organisms of the area in every six months during the construction phase.
Potential for impacts on aquatic habitat and nearby fisheries.	Negligible	Provision of appropriate treatment plants for liquid and other wastes and/or facilities which allow the collection and storage of harmful and hazardous wastes in safe containers to minimize potential pollution impacts on the Kushiyara River.	Monitoring population of terrestrial and aquatic organisms of the area in every six months during the construction phase. Maintaining liaison with the public including systematic recording and investigation of any complaints.
4. Human Sanitary Wastes			
Potential for impairment of surface water quality, as well as health impacts.	Major	Implementation of management measure as mentioned in ADB SPS (2009) and Section F1/BP of ADB Operations Manual (2010); and Section 1.0 Environmental, Sub-section 1.6 Waste Management of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants and ensuring:	Regular check by EPC Contractor to ensure implementation of sanitary requirements. Periodic inspection of operational sewage treatment facilities by EPC Contractor. Water quality sampling every 3 months,

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		• Provision of appropriate number of toilets and hand-washing points at the work-site; • Provision of on-site treatment of sanitary wastes; and • Training construction employees on project sanitation practices.	including BOD.
5. Solid Wastes			
Solid waste generation and disposal (potential for land, surface water and groundwater contamination).	Major	Implementation of management measure as mentioned in ADB SPS (2009) and Section F1/BP of ADB Operations Manual (2010); and Section 1.0 Environmental, Sub-section 1.6 Waste Management of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants. • Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. • Segregate wastes by types and provide appropriate waste containers for the storage of all waste streams. • Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). • Prohibit the burning of wastes. • Arrange a waste removal contract and schedule at least weekly waste collections to prevent the build-up of waste materials. • Audit waste contractors to ensure appropriate disposal methods are applied according to the waste stream.	Regular inspection by EPC Contractor to ensure implementation of good waste management practices.
6. Surface Water Quality			
Sedimentation and run-off of hazardous materials (i.e.	Moderate	An earth bund will be constructed to prevent the discharge of sediment and hazardous materials to	Water samples will be obtained quarterly from the Kushiyara River and analysed for

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
oils and fuels) to neighbouring water bodies.		neighbouring water bodies. Storm water will be discharged via a settlement tank and an oil separator to the Kushiyara River.	pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, Arsenic and BOD.
7. Release of Contaminating Materials			
Environmental contamination due to spillage or accidental release of hazardous materials (i.e. fuels, lubricants, oils and solvents) onsite.	Minor	Measures should include: • Prohibition of dumping any contaminating material on the Project Site or elsewhere; • Storage and routine handling of fuels, lubricants, oils, solvents and other potentially contaminating substances in a weather-protected area equipped with a secondary containment system for spills; • Requisite steps should be taken toward spill prevention and, to this end, spill contingency plan should be undertaken. Necessary equipment and materials should be made available on-site to execute cleanup operations; and • All materials recovered during clean-up operations should be stored in labelled and secured containers for subsequent disposal.	EPC Contractor should: • Monitor refuelling and other material transfer process; and • Report all significant spills (i.e. volumes ≥ 5 litres) to concerned group for notifying appropriate GoB agency for proper action.
Environmental contamination due to spillage or accidental release of hazardous materials (i.e. fuels, lubricants, oils and solvents during off-site transportation.	Minor	Measures should include: • Safety program, including signage, speed restrictions, lights on trucks, truck load restrictions, equipment inspection (brake, horn, etc.); and • Establishing spill response procedure to allow quick response to clean up any offsite spills.	Inspection of vehicle safety equipment – periodically by EPC Contractor, daily by vehicle operators. EPC Contractor to report upon all spills associated with the project.
8. Traffic Safety			

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
Community disturbance and potential safety hazard.	Medium	Implementation of Section 3: Community Health and Safety and Sub-section 3.4: Traffic Safety of the IFC General EHS Guidelines and Section 1.0: Industry-Specific Impacts and Management and Sub-section 1.3: Traffic Safety of the IFC EHS Guidelines for Thermal Power Plants. Prepare a traffic and transportation plan for the construction phase, which includes (but not limited to): - avoid the transportation of materials or machinery during peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and river traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area; - provide training on safe driving; - prevent unauthorised access (i.e. public access) to the Project Site; - load trucks in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the construction site. Resolve potential river traffic navigation problems and construction of a jetty along the river bank. No	EPC Contractor to: - Implement the traffic and transportation plan. - Record and investigate all accidents and near misses. - Visual inspection of roads used by construction vehicles. - Review of complaints received via the formalised grievance mechanism.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		significant increase in river traffic volume is anticipated. A grievance mechanism established as part of a stakeholder engagement plan.	
Road Traffic Capacity of existing roads (weight/load limit and width of existing bridges, obstacles, e.g., power and telephone lines).	Medium	Survey of roadway for detecting weaknesses and obstacles that could be affected by project traffic.	EPC Contractor to investigate into all complaints.
River Traffic Community disturbance	Medium	Resolving potential navigational problems in respect of the project vis-à-vis river traffic and construction of jetty along the bank of the Kushiyara River.	EPC Contractor to investigate all potential related complaints.
9. Occupational Health and Safety			
Work-related injuries and health problems. Exposure of personnel to hazardous substances in the workplace.	Major Major	Implementation of Occupational Health and Safety Programme (OHSP) to address all aspects of worker health and safety in relation to the construction process of the project. Such a programme needs, inter alia, to taking into account all the necessary aspects detailed in ADB SPS (2009) and Section F1/BP of ADB Operations Manual (2010); and Section 2.0: Environment and Sub-section 2.2: Occupational Health and Safety of the IFC EHS Guidelines for Thermal Power Plants. Notify local clinics and hospitals before commencement of construction works. Job specific medicals for all employees.	EPC Contractor to monitor HS performance, including regular audits.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		EHS training and safety induction for all employees and 6 monthly updates. First aid kits and trained first aid practitioners on-site at all times. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the Project Site. Preparation of an EHS Plan for approval by SBPCL II, including: - EHS Policy and Objectives; - Appointment of qualified EHS specialist(s) who will be on-site throughout the construction project; - Project EHS rules; - Details of how rules and updates (if required) will be communicated to workers - Identification and risk assessment of hazardous activities and high risk areas; - Safe working methods for hazardous activities; - Ensure all personnel are provided with all required Personal Protective Equipment (PPE) for the environment they are in and the tasks they are performing; - Implementation of a Lock-out Tag-out program; and - Reporting and investigation procedure for all severe and minor accidents, and near misses.	

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		Ensuring all subcontractors (if any) sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure site procedures are fully understood and complied with.	
Vector-borne and Food contamination related diseases	Minor	EPC Contractor will be required to put in place a programme aimed at reducing the risk of occurrence of vector-borne diseases among construction personnel. This needs to include elimination of potential insect breeding sites and provision of preventive medication, where applicable.	Regular check of workplace personnel's health by designated medical team. Informing the workplace personnel of possible symptoms of diseases they might be exposed to and approaching on-site medical team as the necessity arises.
Concentration of Labor force	Major	Bangladesh has ratified key International Labour Organization (ILO) conventions[13], to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination. Bangladesh Standards (*Labour and Industrial Law of Bangladesh – First Edition, May, 1996*)and World Bank as well as ADB health and safety guidelines will be met. Key Chapters in Labour and Industrial Law of Bangladesh – First Edition, May, 1996 include: • Chapter 1: Workman's Compensation (Workman's Compensation Act, 1923); • Chapter 3: Health (Factories Rules, 1979); and • Chapter 4: Health and Safety (Factories Act, 1965).	SBPCL II to review recruitment policy and worker employment contracts.

[13] Bangladesh has ratified ILO conventions including: C11 Discrimination (Employment and Occupation) Convention, 1958; C105 Abolition of Forced Labour Convention, 1957; and C182 Worst Forms of Child Labour Convention, 1999.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
10. Emergency Response			
Emergency Response (i.e. Fire, Earthquake, Flood etc.)	Major	Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies, for approval by SBPCL II. The ERP will include: - what should be done and who should do it; - what equipment is required and where this will be located; and - staff training requirements and inductions for new workers and site visitors. In addition, the ERP will include: - a method for communication of the ERP to all workers and people arriving on-site; - an emergency contacts document which is maintained and up to date; - a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at the site and trained/equipped to respond; and - liaison with local emergency services to ensure they are familiar with the site layout and potentially hazardous locations.	Emergency drills, which are documented and critiqued. The drills should cover all emergencies and, where shift work is undertaken, include all shifts to ensure full staff participation. A schedule for inspections of Emergency equipment located around the site, to ensure it is in the correct location and in a suitable condition to be used.
11. Social Concerns			
Economic dislocation of	Major	A ‘standalone’ Resettlement Action Plan has been	

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
agricultural plot holders, shared croppers, day labourers, etc.		prepared and implemented. Resettlement will be undertaken prior to construction. SBPCL II will establish a community liaison office in a suitable location outside of the main plant. The Community Development Officer (CDO) will carry out his responsibility in interacting with the project affected people (PAPs) and advising the PAPs on compensation and livelihood restoration measures to be implemented by the Project. The CDO will maintain communication between SBPCL II and the PAPs. Where unforeseen situations or issues arise, the CDO will ensure SBPCL II takes an active role to help resolve the situation.	In the final Quarter of 2014 SBPCL II will engage an experienced entity to monitor and evaluate RAP implementation. In the short term, monitoring will track whether the actions proposed in the RAP are carried out according to the agreed timetable. In the long-term it will monitor the effectiveness of the RAP measures by assessing changes in income levels and standard of living of the PAPs.
Influx of Temporary Labourers	Major	The CDO will monitor social impacts on the local villages due to increased demand for goods, services and public health facilities arising out of an influx of workers in the project area. The on-site labor camp should meet the relevant standards. A grievance mechanism through a Joint Committee for Community Relations (JCCR) has been proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SBPCL II management and elected local representatives.	The project entrepreneur and the EPC contractor will monitor the social impacts on the local villages during the construction of the SBPCL II Power Plant and will work with CDO and local community leaders to mitigate any adverse impact.
12. Procurement of Local Labour, Goods and Services			
Economic benefits to the	Major	Review the suitability and capacity of local workers. The EPC Contractor will be encouraged to recruit local	The EPC Contractor will provide SBPCL II with details of the amount of local

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
people of Bibiyana area		labour, goods and services, wherever these are available at an acceptable quality and price. The EPC Contractor will be required to follow a local procurement policy. The EPC Contractor will develop a Recruitment Policy for approval by SBPCL II. The Recruitment Policy will include: i. ensure equal opportunities, fair treatment recruitment, compensation, remuneration, working conditions and terms of employment; ii. a means of expressing grievances; and iii. engaging subcontractors and suppliers who do not employ child labour or forced labour, and operate appropriate management systems consistent with requirements (i) and (ii).	labour, goods and services. SBPCL II to review recruitment policy and worker employment contracts.

5.3.1 The Operational Phase

Table 5.12: Anticipated Impacts and Impact Management during the Operational Phase

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
1. Air Emissions			
NO_X emissions below 50% plant load operating conditions.	Medium	Use of dry low NO_X burners for the gas turbines. Install Continuous Emission Monitoring Systems (CEMS) for continuous monitoring of emissions rates.	CEMS for stack emissions: - NO_X; - SO_2; - PM_{10}; - CO;

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		A gas metering System, contained in the regulating and metering station (RMS), will be installed to monitor the quality of the gas supplied by the Gas Supplier.	- O_2; and - Flow rate. The quantity and quality of the gas supplied (as per the gas supply agreements).
Ground-level NO_X concentration.	Medium	Use of 60 metre high stack to optimize dispersion of exhaust gases. Use of dry low NO_X burners for the gas turbines. Monitoring operating load conditions.	Monitoring ground-level NO_X concentrations (at a minimum of three locations) for 24-hour periods during the first three months of plant operation.
Green house Gases	Minor	Monitoring operating load conditions.	Annual GHG audit to be prepared.
2. Noise			
Noise levels at nearby receptors.	Medium	Gas turbines, generators and compressors will be installed in buildings equipped with acoustic walls and enclosures. Silencers and mufflers will be installed on all site vehicles. Post warning signs in areas where the noise level exceeds 80 dB(A) and ensure workers are provided with hearing protection when working in these areas. Establish a grievance mechanism as part of a stakeholder engagement plan.	Noise monitoring for Leq(24) and L90 at the nearest residential properties to the east and west (i.e. Paharpur and Parkul villages). Review of complaints received via the formalised grievance mechanism. Inspect all equipment and vehicles to ensure it is maintained in a good working order.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
3. Surface Water Quality			
Discharge of blow down water into the Kushiyara River Treated effluent will be discharged to the River.	Major	Blow down water from the cooling tower will be sent to a basin to cool down further before discharging into the River Kushiyara. The water would be sufficiently cooled to ensure the thermal impact will be negligible. Treated effluent shall be held in a tank and then discharged to the river. Prior to discharge, the effluent will be monitored to ensure it meets the effluent quality standards detailed in the IFC EHS Guidelines.	Monitoring of effluent quality will be undertaken prior to discharge for pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, Arsenic, Temperature.
Water Consumption	Negligible	Operation of a closed-loop cooling system within the SBPCL II power plant	Equipment will be monitored periodically to ensure there is no damage or accidental water loss.
Site operations, including the storage of hazardous materials (i.e. oils, fuels and chemicals), have the potential to impact the neighboring Kushiyara River.	Major	Surface water monitoring will be carried out downstream of the site to ensure compliance with the Bangladesh water quality standards. Hazardous materials will be stored with appropriate secondary containment to prevent accidental release to the river. The storm water drainage system will comprise oil/water interceptors and all drainage in the vicinity of designated hazardous materials	Water quality will be monitored once during the first 3 months following commissioning and subsequently once per year.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		storage areas will discharge to the effluent treatment system.	
4. Terrestrial and Aquatic Habitat			
Potential for impacts on wildlife (i.e. loss of habitat, hindrance to wildlife movement).	Minor	Boundary fencing of the Project Site will ensure wildlife choose alternative routes. Planting of indigenous trees, where possible, around the boundary of the Project Site. Provision of landscaped areas, where possible, around and within the Project Site using indigenous species to supply habitat for terrestrial and riparian species and improve aesthetics.	The planted trees will be inspected to ensure they become established. Any planted trees which do not successfully establish will be replaced.
Potential for impacts on aquatic habitat and nearby fisheries due to effluent discharges to the River..	Negligible	Provision of appropriate treatment plants for liquid and other wastes and/or facilities which allow the collection and storage of harmful and hazardous wastes in safe containers to minimize potential pollution impacts on the Kushiyara River. Use of barrier screens in the cooling water (make-up water) inlet to prevent entrainment of fish. Treated effluent will be monitored to ensure it meets the effluent quality	Monitoring population of terrestrial and aquatic organisms of the area in every six months during the construction phase. Maintaining liaison with the public including systematic recording and investigation of any complaints.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		standards detailed in the IFC EHS Guidelines.	
5. Human Sanitary Waste			
Potential for impairment of surface water quality, as well as health impacts.	Minor	Provision of an appropriate number of toilets and hand-washing points. Provision of on-site treatment of sanitary wastes. Training on sanitation practices.	Regular checks of the sewage treatment system by the EHS Manager to ensure continuation of proper functioning. Surface water quality sampling with analysis for COD/BOD
6. Solid Waste			
Solid waste generation and disposal (potential for land, surface water and groundwater contamination)	Medium	Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. Segregate wastes by types and provide appropriate waste containers for the storage of all waste streams. Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). Prohibit the burning of wastes. Arrange a waste removal contract and schedule at least weekly waste collections to prevent the build-up of waste materials. Audit waste contractors to ensure	Periodic checks by EHS Manager to ensure that waste management procedures are being followed.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		appropriate disposal methods are applied according to the waste stream.	
7. Hazardous Materials Management			
Soil, Groundwater and Surface water impacts as a result of poor hazardous materials management	Major	Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. Hazardous materials (i.e. oils, fuels, chemicals) will be stored in containers comprising appropriate secondary containment. Spill kits will be available to contain any accidental release of hazardous materials. A 'Spill Prevention, Control and Contingency Plan' will be developed, outlining the power plant design features and spill prevention and control measures. Drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil and waste oil storage tank areas will flow to a sump to be pumped to oil-water separator. No underground storage tanks (USTs), containing oils, fuels or chemicals, will be located on-site.	Periodic checks by EHS Manager to ensure mitigation measures are implemented and enforced.
8. Site Run-off			
Alteration in site drainage patterns	Major	Site design will be made in such a	Effectiveness of storm water run-off attenuation

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
and flows in vicinity of the SBPCL II Power Plant. Potential for flooding along the adjacent lands.		way as to diverting the Project Site drainage to minimize the impacts on the land and water system adjacent to the Project Site. Provision of storm water management drains to divert on-site surface flows. On-site storage of storm water, to attenuate and regulate run-off rates, will be incorporated into the drainage design.	measures will be monitored by EHS Manager. Maintaining liaison with the public including systematic recording of complaints relating to increased offsite flooding and follow-up.
9. Potentially Contaminating Wastes			
Release of sludge, waste oil, hydraulic fluids, paints, solvents and similar materials to the environment.	Major	Imposing strict prohibition of dumping or burial of any potentially contaminating waste. Potentially oil-contaminated drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil, waste oil storage tank areas and car parks will flow to a sump to be pumped to oil-water separator. All the other potentially contaminating wastes (used oil, drained hydraulic fluid, spent solvents, etc.,) will be recovered in separate, properly labelled containers and disposed of at off-site recycling facilities. Where viable options of incineration are	Site waste management will be continually monitored by the EHS Manager.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		available (e.g., refining of lubricating oil, solvent recovery, etc.), these will be pursued upon verification of environmental acceptability.	
10. Accidental Spills			
Spills of fuel or other contaminating wastes.	Medium	Tank storage areas will comprise impermeable surfacing and secondary containment of sufficient capacity to ensure containment of worst case spills. A facility-specific 'Spill Prevention, Control and Contingency Plan' will be developed outlining the power plant environmental design features, spill prevention and control procedures. Materials and equipment required to respond to the various types of potential spill incidents will be available on-site or nearby on a standby basis.	Hazardous materials storage facilities will be inspected by the EHS Manager. Periodic testing and checks of spill response readiness and emergency response equipment and material will be carried out on a continued basis.
11. Health, Safety and Emergency Response			
Poor health and safety practices may result in serious risk to workers.	Major	Notify local clinics and hospitals before commissioning of the SBPCL II Power Plant. Job specific medicals for all employees prior to start of work and updated annually.	Weekly site safety inspections shall be conducted and the results documented using a weekly inspection checklist. Analysis of minor accident and near miss statistics to identify 'hot spots' and take appropriate action.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		EHS training and safety induction for all employees and 6 monthly updates. First aid kits and trained first aid practitioners on-site at all times. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the Project Site. Preparation of an EHS Plan, including: - EHS Policy and Objectives; - Appointment of qualified EHS specialist(s) who will be on-site throughout operations; - Project EHS rules; - Details of how rules and updates (if required) will be communicated to workers - Identification and risk assessment of hazardous activities and high risk areas; - Safe working methods for hazardous activities; - Ensure all personnel are provided with all required PPE for the environment they are in and the tasks they are performing; - Implementation of a Lock-out Tag-out program; and - Reporting and investigation	

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		procedure for all severe and minor accidents, and near misses. Ensuring all subcontractors sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure site procedures are fully understood and complied with. Formation of an EHS Committee, chaired by the EHS Manager and comprising representative staff from a wide variety of levels and roles.	
Exploitation and discrimination of workers.	Major	Bangladesh has ratified key International Labour Organization (ILO) conventions, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination..	SBPCL II to write employment contracts and employ a Human Resources Manager responsible for enforcing ILO conventions.
Natural Hazards, including earthquakes, cyclones, tornados and floods, as well as fires and gas explosions, may severely impact upon power plant operations.	Major	Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies. The ERP will include: - what should be done and who should do it; - what equipment is required and where this will be located; and - staff training requirements and	At least quarterly emergency drills, which are documented and critiqued. The drills should cover all emergencies and, where shift work is undertaken, include all shifts to ensure full staff participation. A weekly schedule for inspections of Emergency equipment located around the site, to ensure it is in the correct location and in a suitable condition to be used.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		inductions for new workers and site visitors. In addition, the ERP will include: - a method for communication of the ERP to all workers and people arriving on-site; - an emergency contacts document which is maintained up to date; - a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at the Project Site and trained/equipped to respond; and - liaison with local emergency services to ensure they are familiar with the Project Site layout and potentially hazardous locations.	
14. Stakeholder Engagement			
Poor stakeholder engagement alienating local community	Major	A Stakeholder Engagement Plan will be prepared by SBPCL II, in order to: - establish clear stakeholder engagement channels. People in the neighbouring villages should have clear lines of communication to SBPCL II; and	Complaints and grievances will be recorded, investigated and addressed in a timely manner.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		- receive, investigate and address any complaints and/or concerns from all stakeholders. A grievance mechanism through a Joint Committee for Community Relations (JCCR) has been proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SBPCL II management and elected local representatives.	
15. Traffic and Transportation			
Increased congestion and safety implications on local roads, although traffic associated with the operational phase of the CCGT plant is considered to be minor.	Minor	Prepare a traffic and transportation plan for the operational phase, which includes (but not limited to): - avoid the delivery of materials or machinery during peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and river traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the	Implement the traffic and transportation plan. Record and investigate all accidents and near misses. Visual inspection of roads used by site vehicles. Review of complaints received via the formalised grievance mechanism.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		power plants area; - provide training on safe driving; - prevent unauthorised access (i.e. public access) to the Project Site; - load trucks (if used) in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the power plants site (if applicable). Resolve potential river traffic navigation problems and construction of a jetty along the river bank. No significant increase in river traffic volume is anticipated. A grievance mechanism established as part of a stakeholder engagement plan.	

5.3.2 The Decommissioning Phase

Table 5.13: Management Aspects during the Decommissioning Phase

Issue/Concerns	Anticipated Effect	Management Measures	Monitoring
Closure, Decommissioning and Rehabilitation	Major	Closure / Decommissioning may involve adverse impacts not perceived at this stage of the project. A detailed decommissioning and rehabilitation plan will be prepared prior to closure of the SBPCL II Power Plant. Such a plan might include: - strict adherence to all appropriate waste management techniques, including the reuse and recycling of materials wherever possible; - disposable of hazardous waste materials in a legal and responsible manner; - remediation of soil and/or groundwater contamination (if applicable); and - rehabilitation and enhancement of terrestrial habitats within the power plants footprints. - Mitigation measures to control dust and air emissions during the construction phase will be implemented.	Soil and groundwater monitoring to determine subsurface impacts (if any) of the power plant's operation. Restoration to baseline conditions, as detailed in Section 4 of this report.

6. Impact Assessment and Mitigation Measures: Off-site Infrastructure

6.1 Introduction

This chapter describes the potential social and environmental impacts associated with the offsite infrastructure connected to the SBPCL II Power Plant project. As detailed in Sections 3.6 to 3.9, the off-site infrastructure associated with the project comprises:

- Natural gas pipeline from the Bibiyana Gas Field to the Proposed Development;
- T-line from the switchyard to the national grid;
- Access road from the N2 highway to the Proposed Development ; and
- Sand Mining activities.

Whilst it is acknowledged that Sand Mining is not strictly an 'infrastructure' activity, it is assessed in this section of the report to differentiate it from the activities undertaken within the footprint of the proposed SBPCL II Power Plant. As noted previously, during the validation survey in September/October 2013, it was found that land raising work had already been completed at the Project Site in 2012. However, for completeness the assessment of potential impacts is provided in this ESIA. It is understood that all measures recommended in the earlier version of this ESIA were implemented by the EPC Contractor and other sub-contractors during the works.

Identification of such impacts has been followed by measures toward mitigating them. Enhancement measures of beneficial impacts and compensation to project affected persons have also been proposed. Specific attention and importance have been laid, *inter alia*, upon *(i) avoidance of adverse impacts due to the proposed project on the environment and the affected people of the project area, where possible; (ii) minimizing, mitigating and compensating for adverse project impacts on the environment and affected people, where avoidance is impossible;* and *(iii) suggesting measures toward strengthening the project proponents' capacity in enforcing safeguard systems and managing environmental and social risks*.

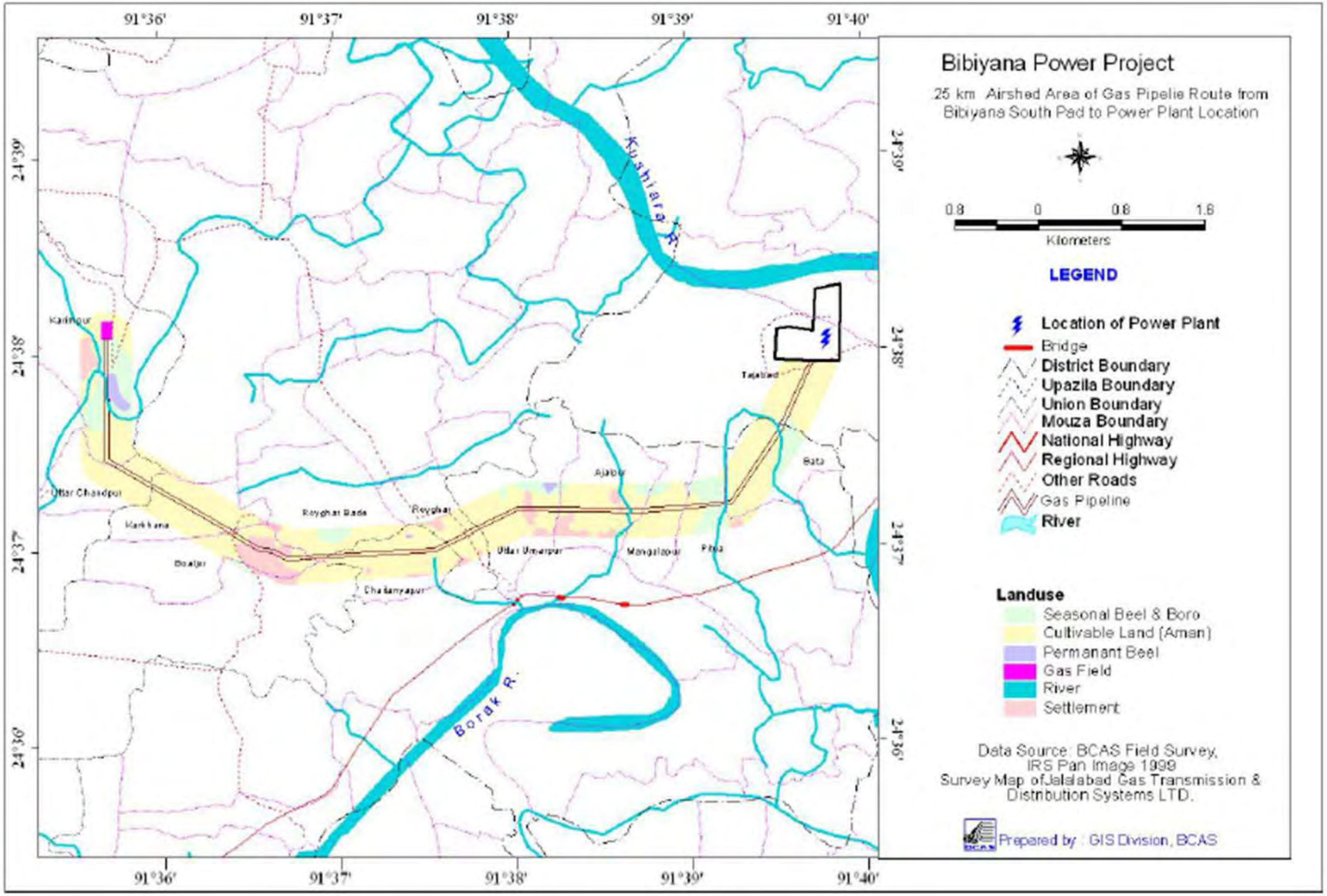
The following sections identify the potential impacts which may arise as a result of each associated facility considered to be part of the Proposed Development. An assessment of the Significant Environmental Impacts is provided in Table 6.2, in Section 6.5.

6.2 The Gas Pipeline

6.2.1 The Proposed Route

As set out in Section 2.6 the SBPCL II Power Plant will utilize natural gas as fuel for power generation, supplied via a 8.8 km gas pipelinefrom the nearby Bibiyana gas field at Karimgani, which is operated by Jalalabad Gas Transmission and Distribution System Ltd (JGTDSL).

Map 6.1: Route Alignment of Proposed Gas Pipeline



6.2.2 Gas Pipeline: Land Acquisition and Displacement

The gas distribution pipeline will cross a canal and pass-by Aushkandi Bazar, and Saidpur Bazar, and cross another canal before crossing the Hai river, agricultural land in Petua village before finally, reaching the connecting point at the Proposed Development. Acquisition of required land, as well as procurement of land, on a temporary requisition basis, has been in progress for the proposed pipeline laying. Project Affected Households (PAHs) due to the proposed pipeline laying process would, hence, need to be taken into consideration. Refer to the separate standalone RAP for further details.

6.2.3 Significance of Impact, Mitigation Measures and Resettlement Action Plan

Due to the nature of the pipeline, environmental impacts anticipated along the pipeline route will be temporary (during construction works) and non-severe in nature, limited to the immediate vicinity of the pipeline route. The only operational impact will be the physical presence of the pipeline. Conventional mitigation measures in respect of such environmental impacts will also be few (as in case of 113 trees along the proposed route alignment necessitating felling). The loss of trees needs to be compensated through biodiversity restoration by planting trees along the boundary of the Project Site and the access road.

Moreover, the adverse impact anticipated upon the majority of PAPs due to the proposed gas pipeline laying activities will be temporary and non-severe in nature. A Resettlement Action Plan (RAP) has been prepared (issued as a separate report which accompanies this ESIA).

There are no indigenous people (tribal or ethnic minority) within the PAPs to suffer any significant impact due to construction of the gas pipeline.

6.2.4 Potential Impacts during Construction

The potential construction impacts associated with the gas pipeline would be similar to those set out for the Proposed Development above and as such have not been discussed in detail. It is noted however there would be some temporary disruption to agricultural land during the construction works. Potential construction impacts and mitigation measures are discussed in Table 6.2. As set out above, the only operational impact will be the physical presence of the pipeline.

Following completion of the construction phase, in accordance with the gas supply agreements, ownership of the pipeline, including responsibility for operating and maintaining the pipeline, will be assigned to the Gas Supplier. Any reinstatement responsibilities will be taken by Jalalabaad Gas Company Ltd.

6.3 The Transmission Line

6.3.1 Potential Impacts

The potential construction impacts associated with the transmission line would be similar to those set out for the Proposed Development above and as such have not been discussed in detail. It is noted however that the transmission line infrastructure would not result in reclamation of any wetland areas or impacts on water flows and drainage, though some agricultural land would be disturbed. Potential construction impacts and mitigation measures are discussed in Table 6.2.

It is considered reasonable to assume all elements of the Proposed Development would adhere in construction and operation to international safety standards and contingency planning and mitigation.

During the operational phase the transmission line (power cables) would pose a collision risk to birds and wildlife. This potential significance of this impact is exacerbated by the presence of Baer's Pochard (*Aythyabaeri*) in Hail Haor and HakalukiHaor (refer to Section 4.8.2), which are located approximately 20 km south and 30 km east of the Project Site respectively. According to the IUCN Red List of Threatened Species, Baer's Poachard is classified as 'Endangered (EN)' owing to an apparent acceleration in the rate of its decline, as measured by numbers on the wintering grounds. It is now absent or occurs in greatly reduced numbers over much of its former wintering grounds and is common nowhere. It is thought that hunting and wetland destruction are the key reasons for its decline[14].

According to the Request for Proposal documents, dated 2nd September 2010 and signed by SBPCL II, PGCB is responsible for construction of T-line. The length of T-line anticipated from the national grid to the switchyard is approximately 70 m. Whilst the risk of bird collisions with the 70 m section of the transmission line is considered limited, mitigation measures are proposed in Section 6.3.3. to further reduce the risk of collisions.

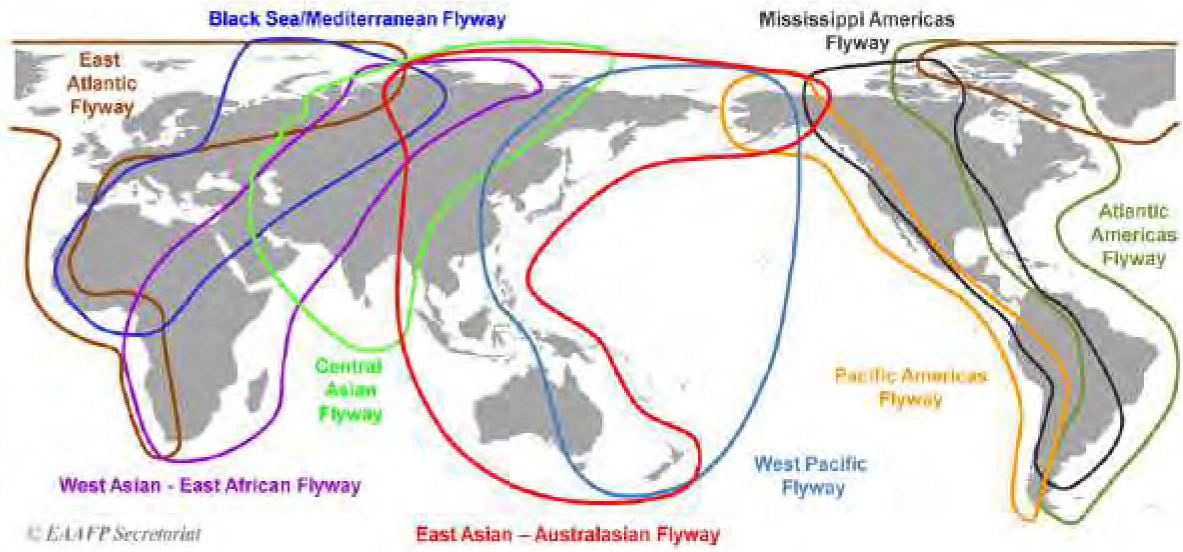
6.3.2 Migratory Birds

Migration studies of birds in Bangladesh are in their infancy, however in recent years it is notable that small numbers of waterbirds using Bangladesh have been fitted with satellite transmitters. Evidence so far indicates local movements within Bangladesh between wetlands plus some longer movements from the north-east to the lower Meghna and coast. In addition, waterfowl wintering in Orissa (India) pass through north-western Bangladesh, ducks wintering in Hakaluki Haor migrate through Assam and on to breeding grounds spread from the Tibetan plateau and western China, to western Mongolia, and even in one case a route through Manchuria to far eastern Siberia. Hence waterfowl wintering near the proposed site use (according to species and individual) both the Central Asian and East Asian-Australasian flyways[15], Bangladesh is located to the north of the intersection of these two flyways (refer to Map 6.2).

[14] Bird Life International, http://www.birdlife.org/datazone/speciesfactsheet.php?id=478, accessed November 2011.

[15] A flyway is a broad or generalised flight path used in bird migration by a number of species and populations of birds. Flyways generally span over continents and often oceans.

Map 6.2: Nine Global Migratory Flyways



In an important review Jenkins et al (2010)[16]24 found that for any given bird, vulnerability to collision and death from power cables depends on the likelihood of flying horizontally at power line height (exposure to collision risk) and the ability to see the power lines ahead in time to avoid an imminent collision (inherent susceptibility to collision). In general exposure is greatest in flocking species which regularly commute at low altitudes. Susceptibility to collision is largely a function of morphology and vision affecting a bird's ability to see the power line and capacity to take evasive action, so large, heavy, relatively small-winged birds with poor vision are most susceptible to collision. They further found from various studies that species widely affected are: waterbirds (which habitually congregate at wetlands and commute between them in flocks; particularly large and/or fast-flying species, such as large ducks, geese and swans, pelicans, flamingos, large herons and waders, have highest susceptibility), game birds and rails (which have limited exposure but are highly susceptible), and cranes and bustards (both of which, as large, heavy-bodied, flocking, low-level commuters are highly exposed and susceptible). To these can be added larger birds of prey, documented in several studies. However, some smaller species which are theoretically prone to collision – pigeons, various passerines, and solitary, high-speed predators such as falcons – may be under-represented in studies, perhaps simply because they are less likely to be found in surveys for corpses along power lines.

Given the known hazards elsewhere, and the high population of waterbirds using Hakaluki Haor, moving between wetland systems within Bangladesh over the winter (e.g. Sunamganj to Moulvi Bazar districts and Moulvi Bazar district to coast) and also migrating through this area, it is reasonable to expect that transmission cables mainly through collision of the birds with the T-line cables could have adverse impacts, particularly if they are located close to water bodies.

The nearest water bodies to SBPCL II Power Plant are Hakaluki Haor, Hail Haor, Baikka Beel and Kawa Dighi Haor. The largest wetland Hakaluki Haor is situated 30 km to the east

[16]Jenkins, A.R., Smallie, J.J. and Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International (2010) 1-16.

of the Project Site. However, the nearest wetland and breeding ground for the migratory birds is at the outside edge of the Project AoI. Figure 6.1 (an extract from Map 4.8) shows that the entrances of the route of migratory birds in Bangladesh and their breeding and staging grounds.

6.3.3 Mitigation Measures

As stated in Section 3.7, the route of the T-line from the switchyard to the National Grid is not available at this stage of the project. In order to fully assess potential impacts and determine appropriate mitigation measures more information is needed on the planned transmission lines (i.e. route and height) both for new and any upgraded or modified lines.

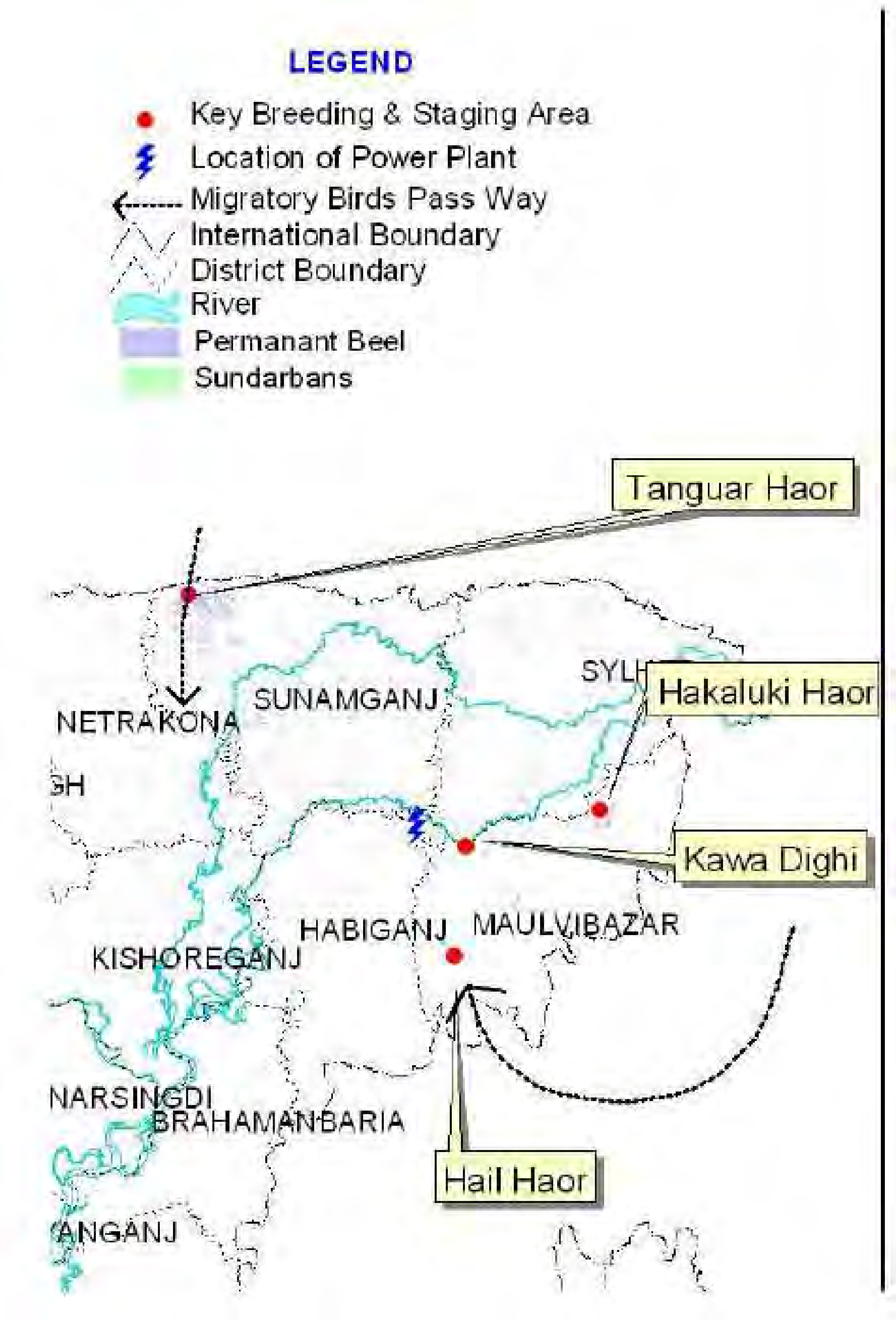
Depending on the route of the T-line there are several mitigation options available. Buried cables would of course eliminate the risk, but also widely used are various types of markers/bird deflectors on top of the top (earthing) cable which being the highest and thinnest cable is the main cause of collisions.

The following mitigation measures identified in Jenkins et al (2010) would be applied during the detailed design of the transmission line route:

- lines should not be over water bodies;
- lines should be kept as low as possible;
- span lengths should be kept as short as possible;
- cabling used should be as thick as possible;
- vertically separated arrays of lines should be avoided as much as possible;
- lines of similar height and structure with common sources and destinations should run in close parallel in effectively a common servitude; and
- lines with very different heights and configurations should be kept well apart.

In addition to the above, there is a wide range of possible options to mark lines to make them more visible. Only a fraction of these options have been properly field tested, but nearly all of the devices tested have yielded at least moderate reductions in collision frequency. In fact, on the evidence available, any sufficiently large form of marker (which thickens the appearance of the line at that point by at least 20 cm, over a length of at least 10–20 cm), placed with sufficient regularity (at least every 5–10 m) on either the earth wires (preferably) or the conductors, is likely to lower general collision rates by 50–80% (reference as per footnote 23).

Figure 6.1: Key Breeding Areas for Migratory Birds



6.4 Sand Mining

As stated in Section 3.9, during the validation survey carried in September/October 2013 it was found that the land raising has already been completed at the Project Site in 2012.
During the 2013 validation survey, it was found that sand mining had been undertaken at six of the nine sites originally identified, with a total excavation of approximately 300,000 m^3.

Figure 6.2: Proposed Sand Mining Locations (extract from Map 3.9)

Reference	River	Nearest Settlement
Site 1	Kushiyara	East of Monumukh
Site 2	Kushiyara	West of Monumukh
Site 3	Monu	South of Monumukh
Site 4	Kushiyara	Paharpur
Site 5	Kushiyara	Kamarkhada
Site 6	Kushiyara	Mathurapur
Site 7	Kushiyara	Galimpur
Site 8	Kushiyara	Hatidighi
Site 9	Kushiyara	Chatrafut

6.4.1 Potential Impacts

The Kushiyara and Monu rivers are rich in aquatic and fisheries resources, with 32 species recorded during a fish survey undertaken during the project (refer to Section 4.8.1). According to the fish survey, of the 32 species recorded, four were classified as Near Threatened in accordance with The International Union for Conservation of Nature (IUCN) Red List of Threatened Species, and these four species constitute approximately 15.5% of the total species recorded during the survey.

During the study, no species were identified, which are defined as Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU), according to The International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

Amongst the nine potential sand mining areas, a fish sanctuary (conservation site) is located approximately 1 km downstream of potential mining Site 2. As set out in Section 4.8.1.2, a River Dolphin habitat site (locally called 'Shusuk') was identified near the Hatidigi (Site 8). Through consultation with the local people and the fisheries study it was found that, although the site has not been declared a conservation site by the Fisheries Department, River Dolphin are visible in a large numbers at this site. Site 4 is located adjacent to the village of Paharpur, the most populated area of the nine sites, where the local residents heavily rely on fishing for their livelihood.

The two primary impacts associated with sand mining comprise river bank erosion and disturbance of fish habitats. In addition, there is potential for secondary social impact on the fishing community due to the disturbance of fish habitats and loss of agricultural land due to river bank erosion. The potential significance of these impacts for each of the six sites where sand mining occurred has been assessed in Table 6.1.

Table 6.1: Impacts of Sand Mining

Reference	Location	Adverse Impacts		
		Bank Erosion	Fish / Aquatic Habitats	Social Impacts
Site 1	East of Monumukh	M	M	M
Site 2	West of Monumukh	L	H	H
Site 3	South of Monumukh	M	L	L
Site 4	Paharpur	M	L	H
Site 5	Kamarkhada	M	L	L
Site 6	Mathurapur	M	L	L
Site 7	Galimpur	M	L	L
Site 8	Hatidighi	M	H	L
Site 9	Chatrafut	L	L	L
Notes H – High or Significant Impact M – Medium Impact L – Low or Negligible Impact				

Low Impact: The impact, if any, is not considered significant and no mitigation will be necessary.

Medium Impact: The impact will be localised and/or temporary in nature and some migration will be necessary.

High Impact: There is potential for a significant impact and mitigation, and monitoring of the effectiveness of the proposed mitigation, will be required. If appropriate and effective mitigation is not possible, an alternative course of action (i.e. alternative site, method or technology) will be required.

In addition to the potential adverse impacts associated with Sand Mining, there is a potential positive social impact. During the field visit local villagers reported support for the proposed dredging, as it was felt that sections of the wider river channel which run dry in dry season will retain water following dredging, increasing the fish catch and variety of fish available. However it is also noted that disturbance and/or loss of fish species and habitat have the potential to impact fishermen through loss their income.

The furthest distance of a sand mining site from the Project Site was 12 km. Sand will be transported to the plant site via 6 to 8 trawlers per day. As stated in section 4.10.2, a river traffic survey recorded 179 river traffic movements per day and therefore an addition 8 trawler movements will only result in a 4% increase in river traffic. Such an increase is considered to be negligible as the river is navigable throughout the year and the present river traffic is not significant.

Increased sediment loads, turbidity and sedimentation, with resultant changes in river channel morphology, is a potential major impact regardless of location and careful management will be required to mitigate this impact. Impacts associated with sand mining are described in more detail in Annex 10.

6.4.2 Mitigation Measures

Due to potential significant impacts on fisheries and aquatic habitats in the vicinity of sites 2 and 8, and social impacts in the vicinity of Site 4, sand mining will not be undertaken at these locations and will only be carried out in the remaining six locations. In addition, by spreading the mining across the six sites, this will reduce the impact at any one site, as over-extraction at a single location can destabilise the river bank[17].

As stated in Section 3.9.3, ‘grab dredgers’ and ‘plain suction dredging’ are the methods that will be employed for sand mining activities because these are the two methods currently available in Bangladesh. Of the two methods, plain suction dredging will be employed wherever possible because an agitating device is not necessary to draw material from the bottom surface and this creates fewer disturbances to the river bed. All dredging will be undertaken from a river barge and this will significantly reduce the potential for disturbance of the river bank.

[17] Basher, L.R. 2006.Monitoring of riverbed stability and morphology by regional councils in New Zealand. Landcare Research Contract Report LC0506/138.

6.5 Assessment of Significant Environmental Impacts

Table 6.2: Matrix of Significant Environmental Impacts (SEIs) associated with the construction of the Off-Site Infrastructure – Without Mitigation

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																							Comments
	Natural Environment																		Socio-economic Environment					
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employ-ment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
Construction Stage																											
Sand Mining																											
Impacts on Aquatic Ecology																		✓							✓		Grab dredging &Plain Suction Dredging has the potential to impact aquatic ecology **Mitigation measures:** Of the nine sites proposed, three sites will not be mined due to the proximity of a fish sanctuary (conservation site), a River Dolphin habitat site and the village of Paharpur. Sand mining will not be undertaken during the fish breeding season(April and May).

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employ-ment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
River Bank Erosion			✓																						✓		Grab dredging &Plain Suction Dredging has the potential to result in increased river bank erosion. **Mitigation measures:** • Dredging will be undertaken from a barge to prevent heavy plant causing river bank erosion; • If dredging of sandbars is undertaken, the upstream third of the sand bar will be retained; • Silt curtains will be used to minimize resuspension of sediments; • Sand mining will prioritise depositing/aggrading sections of the river, as these will recover faster; • No washing, crushing, screening, stockpiling or

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employ-ment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											plant operations will occur at locations within the rivers 'average high water elevation'; • Retain a vegetation buffer adjacent to the river bank; and • Devise a monitoring plan, including daily downstream turbidity measurements, to monitor the effectiveness of the mitigation measures.
Land Excavation for Gas Pipeline																											
Dust Emissions				✓															✓								Temporary and non-severe impact. **Mitigation measures:** Periodic sprinkling of water throughout the area subject to land excavation to arrest dust emissions.

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employ-ment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											Cover all stockpiles with canvas or plastic sheets during windy periods. Limit the speed of heavy good vehicles over unpaved surfaces.
Temporary displacement from agricultural land														✓											✓		Temporary loss ofagricultural land and trees. **Mitigation measures:** Adequate compensation to project affected people (PAPs) as detailed in the RAP.
Laying of pipeline across rivers, canals, beels																											
Impact on Boro Rice cultivation in seasonal beels.								✓																	✓		Temporary and non-severeimpactonagricultural practices. **Mitigation measures:** Adequate compensation to

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		**Socio-economic Environment**								
	Land/Agriculture			**Air**			**Hydrology & Drainage**			**Noise**			**Vegetation**			**Terrestrial/ Aquatic Fauna**			**Human Health**			**Homesteads**			**Employ-ment**		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											project affected people (PAPs) as detailed in the RAP.
Sedimentation of surface water bodies																	✓										Construction works adjacent to water bodies resulting in sedimentation. **Mitigation Measures:** Straw bales and sediment traps will be used to prevent sedimentation of water bodies.
Health and Safety																					✓						Hazardous working location. **Mitigation Measures:** Risk Assessments and Safe Working Methods will be prepared and implemented at the site. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																					Socio-economic Environment							
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											pipeline construction area.
Waste Management	✓						✓																				Poor waste management practices impact soil, groundwater and surface water bodies. **Mitigation measures:** Ensure good waste management practices, with appropriate provisions for the storage of hazardous wastes.
Hazardous Materials Storage	✓						✓												✓								Hazardous materials with the potential to impact soil, groundwater, surface water and human health. **Mitigation measures:** Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies.

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employ-ment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											Spill kits will be available to contain any accidental release of hazardous materials.
Operational Stage																											
The Transmission Line																											
Presence of the Transmission Line																		✓									Migratory birds colliding with the transmission line. **Mitigation measures:** Whilst the route has not been determined, the following mitigation measures will be implemented: - Buried cable (if possible) or use of markers; - Lines will not be constructed over Hakaluki and Hail Haors; and - Span lengths will be as short as possible and cabling will be as thick as

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land/Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employ-ment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											possible.

7. Risk Assessment and Emergency Response

7.1 Introduction

According to classical definition, hazard could be regarded as among the adverse consequences of an activity or a combination of several activities or involvement of the use of certain materials in an activity or in a combination of several activities that has the potential of initiating or propagating an unanticipated event/sequence of events that can be termed as an accident. Identification of hazard involves knowing how such a material is likely to behave in the process of related activities, such as its storage and transport.

Materials being used in power plant processes include fuels and chemicals, including natural gas and chlorine. Apart from the chemical and process characteristics of the material, the size and layout of the plant and equipment need specific consideration in order to assess the hazard potential. Similarly, natural hazards such as floods and earthquakes cannot be ignored, in the same way as domino or secondary effects of accidents occurring in the surroundings cannot be disregarded or ignored.

Identification of hazards in a power plant is of primary significance in the analysis, quantification and cost effective control of accidents involving the raw materials and/or chemicals utilized in the power generation process. The type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken. In the proposed project, hazard identification during storage and transport are particularly relevant.

It should be noted that this Chapter does not comprise a site-specific Hazard and Risk Assessment for the proposed SBPCLII Power Plant. Instead, this chapter provides guidelines to undertaking risk assessment and formulating an emergency response plan (ERP) for the development project. The potential exists for project-specific impacts and 'domino effects' that require further assessment in a detailed, site-specific, quantitative risk assessment (QRA) in order to arrive at an 'As-Low-As-Reasonably-Practicable' (ALARP)situation through site-specific mitigation and management measures.

An initial QRA for SBPCL II Power Plant has been prepared and included in Annex 12. The basic assumption is that natural handling through pipeline upstream the gas metering station and downstream to the turbine hall are the main risks. An initial QRA for the turbine hall has also been included. A detailed, site-specific QRA will be prepared in accordance with the International Electro technical Commission (IEC) International Standard 61822 *Hazard and Operability Studies (HAZOP) Application Guide* ('the IEC HAZOP Guide') and with reference to applicable guidance in the Institution of Chemical Engineers (IChemE) *HAZOP Guide to Best Practice, 2nd Edition, April 2008* ('the IChemE HAZOP Guide').

The IEC HAZOP Guide states, *"the best time to carry out a HAZOP study is just before the design is frozen [finalised]"* and this view is further supported by the IChemE HAZOP Guide, which states *"a study cannot be carried out on a partly developed design"*. In the case of the proposed SBPCL II Power Plant, the design is not finalised as further pertinent information will be provided by the EPC Contractor at the detailed design stage.

Hazards and risks in various forms, along with mitigation and management measures, are discussed further in this Chapter. The requirement and responsibility for undertaking the HAZOP study and preparing a detailed, site-specific QRA and ERP are included in the Environmental and Social Management and Monitoring Plan. These will be prepared for both the construction and the operational phases of the project.

7.2 Hazard Criteria

The criteria that will be employed for preliminary identification and evaluation of hazard potential include but are not limited to:

- Potential for uncontrolled exothermic reactions;
- Potential for loss from containment; and
- Potential for possible ignition sources.

7.2.1 Flammability, Instability and Toxicity

Hazardous substances will be classified into the following three main classes:

1. *Flammable substances*: Such substances require identification with air for their hazard to be realized. Under certain circumstances the vapours arising from flammable substances when mixed with air may be explosive, especially in confined spaces. However, if present in sufficient quantity such clouds may explode in open air also.

2. *Unstable substances*: Such substances are liquids or solids, which may decompose with such violence so as to give rise to blast waves.

3. *Toxic substances*: As the class refers to, such substances are toxic in nature causing danger and substantial damage to life when released into the atmosphere.

7.3 Risk Criteria

Natural gas, due to its highly flammable and explosive properties, could cause jet fire as well as explosion when released. Similarly, chlorine gas is highly toxic to exposure, and the scenario may develop due to leakage valve bodies, corroded pipelines, ruptured pipelines etc. In the event of partial failure of pressurized pipelines, natural gas will be released in the form of a jet and will lead to jet fire when in contact with naked flame or hot material. Explosion may also occur due to release of natural gas through leakage. Such a situation has the potential to cause significant harm to human health and damage to property.

7.3.1 Thermal Radiation

Thermal radiation due to jet flame may cause various degrees of burn on human bodies. Also its effect on objects like equipment, piping, building and other objects need to be evaluated. Physiological effects vis-à-vis degrees of burns caused due to thermal radiation are as under:

- 1st Degree Burn: Involve only epidermis, blister may occur; e.g., sunburn.
- 2nd Degree Burn: Involve whole of epidermis over the area of burn plus some portion of dermis.
- 3rd Degree Burn: Involve whole of epidermis and dermis; subcutaneous tissues may also be damaged.

7.3.2 Blast Overpressure

As mentioned above in the beginning of this sub-section, release of natural gas through leakage may also cause explosion leading to blast over-pressure.

7.3.3 Toxic Exposure

Damaging consequences may also be due to exposure to chlorine gas (approximately 25 tonnes of chlorine will be stored on-site). The physiological responses of human bodies to exposure to chlorine are[18]: slight symptom after several hours (concentration 1.0 ppm/3.0mg/m^3), coughing (concentration 30 ppm/87 mg/m^3), lethal for 50% of population after 30minutes exposure (concentration 500 ppm/1450 mg/m^3), fatal in 30 min or less (concentration1000 ppm/2900 mg/m^3) and fatal in 10 minutes (concentration 1800 ppm/5200 mg/m^3).

7.4 Hazard Risk Assessment

<u>*Objective*</u>: The objective of carrying out a Hazard Risk Assessment (HRA) for the SBPCL II Power Plant is to study the risks involving hazardous materials and their consequences. In this exercise, the study objectives are outlined hereunder.

The HRA process includes the following sequential steps:

1. Hazard and Risk Identification
2. Release Assessment
3. Exposure Assessment
4. Consequence Assessment
5. Risk Estimation

<u>Hazard Identification and Visualization of Maximum Credible Accident (MCA) Scenarios:</u> Identification of potential hazards due to construction and operation of power generation plants and visualization MCA scenarios are carried out toward the following purposes:

[18]Toxicity of Chlorine gas. E-medicine.medscape.com article 820779 Author: Eli Segal, MD, FRCP.

- To identify major hazards relating to fire, explosion and toxic release due to failure of pipeline/containment.
- To visualize the MCA scenarios.
- To assess the consequences of these accidents.
- To study past accident information in order to visualize worst accident situations.

Visualization of MCA Scenarios and Assessment of their Consequences: Such an aspect of HRA is undertaken toward analyzing and quantifying the primary and secondary effects as well as the damage potential of identified MCA scenarios with recourse to mathematical and analytical models.

Consequence Analysis: The scope of work for study of the consequences of MCA scenarios due to nature of exposures and characterization of risk levels on-site and off-site population and environment involves the following aspects:

- Detailed study of engineering information, diagrams, and lay out plans for the plants as well as chlorine storage facility.
- Identification of chemical and process hazards.
- Preliminary identification of hazardous section of the plant and storages with resources to Fire-Explosion and Toxicity Index (FETI).
- Past accident data analysis to identify possible worst accident scenarios.
- Visualization of Maximum Credible Accident (MCA) scenarios.
- Analysis of identified MCA scenarios and quantification of primary and secondary effects with recourse to mathematical models pertaining to cases of:
    - Toxic Dispersions
    - Heat Radiations
    - Vapour Cloud Explosion
- Determination of damage criteria for heat radiation, pressure wave and toxic concentration levels with respect to health criteria, dose-response relations and vulnerability models.
- Study of on-site and off-site population characteristics.
    - Characterization of risk analysis through study of nature of exposures, pathways and consequences of MCA scenarios and presentation of results in terms of damage distances.

7.4.1 Hazard Awareness

Awareness should be built up among the various strata of employees at the proposed power plant about the various types of hazards associated with power plants, their consequences and means to avoid them. All the sections of the power plant premises where hazardous activities are to be carried out or in which materials that could lead to various hazards are to be used should be labelled with stickers.

7.5 Hazardous Materials and Wastes

Hazardous materials related to power plants could be classified into the following four groups on the basis of their respective threshold quantities for safe use:

Group 1 – Toxic substances
Group 2 – Highly reactive substances
Group 3 – Explosive substance
Group 4 – Flammable substances

The following Table 7.1 shows the list of major chemicals which could be identified as hazardous chemicals in respect of their transportation, storage and use which are to be considered as major accidental hazard (MAH).

Table 7.1: Various Types of Hazardous Materials

Materials	Use	Nature of Material	Storage Quantity	Threshold Quantity for MAH
Fuel Oil	Supporting fuel	Highly flammable	3,750 kl#	2,500 tonnes
Transformer oil	Transformer	Highly flammable	15 kl	2,500 tonnes
Chlorine	Cooling tower	Toxic (Group1)	25 tonnes#	10 tonnes
Sulphuric Acid	Water treatment	Hazardous	24 tonnes	Not considered
Caustic Soda	Water treatment	Hazardous	24 tonnes	Not considered
Notes: # To be considered as MAH				

7.6 Hazard Identification and Control

Functional or operational aspects of a power generation process that are capable of initiating hazardous events could be considered along with the respective consequences in the exercise of identification of hazards and proposing control measures as depicted in Table 7.2 as under.

Table 7.2: Hazard Identification and Control

Operational Aspects	Possible Initiating Events	Possible Consequences	Preventive/Control Measures
Raw Materials			
Supply of Natural Gas through pipeline	• Pipeline leak (usually prolonged) • Pipeline rupture(usually instantaneous)	• Fire (flash or jet) • Uncontrolled Vapor Cloud Explosion	• Quality control in pipeline fabrication • Quality control in pipeline laying operation • Adequate depth of cover • Clearly marked pipeline route • Regular patrol to watch for excavation work in the vicinity of the pipeline • Protective coating to inhibit corrosion (also

Operational Aspects	Possible Initiating Events	Possible Consequences	Preventive/Control Measures
			cathodic protection) • Installation of protective devices (e.g., emergency isolation valves, cut-off valves and one-way valves) • Leak detection by automatic sensing devices • Evacuation of adjacent areas • Barricading of roads • Emergency Response Plan
Caustic Soda and Sulphuric Acid (demineralization plant)	• Traffic collisions • Spillage and leakage • Contact with reactive and/or corrosive materials	• Corrosive fumes • Chemical burns • Damage to Plant and equipment • Reactions – heat/corrosive fumes and vapor • Toxic gases/vapors (e.g., sulphur trioxide)	• Ensuring safe transportation of goods and materials • Safe packaging and handling of drums • Regular check of drums for weakening by corrosion • Spill control kit for acid and alkali • Emergency Response Plan including inert bunding to contain any spillage or leakage • Adequate personal protection equipment for corrosive spills and clean-ups • Neutralization of wastes/spillages and disposal by liquid waste contractor
Power Generation			
Natural Gas Fuel	• Turbine failure • Leak or rupture	• Flame out • Concentration of methane reaches lower flammability limit at ground-level • Potential flash-fire	• Stack dispersion of gas • Installation of quick response emergency isolation valves • Remotely activated shut-off system
Caustic Soda and Sulphuric Acid (demineralization plant)	• Spillage and leakage • Contact with oxidising materials	• Chemical burns • Damage to plant and equipment • Reactive (caustic +acid) • Contamination of soil and storm-water run-off	• Regular checks of drums for weakening due to corrosion • Bunding to contain spillage or leakage

7.7 Risk Assessment

The risk assessment determines whether the risks are tolerable or if risk mitigation measures are required to reduce the risk to a level which can be considered to be as low as reasonably practicable. Risk assessment depends on failure frequency of the system and probability of ignition and explosion. These could be assessed as under:

Failure frequency: The range of possible releases for a given component covers a wide spectrum – from a pinhole leak to a catastrophic rupture (of a vessel) or, even, to a full-bore rupture (e.g., that of a pipe). It is both time-consuming and unnecessary to consider every part of the range; instead, representative failure cases could be considered. For various types of component and for each of the representative hole sizes, failure frequencies during a given year need to be noted under three heads, viz., Failure Type (e.g., pipe damages, Liquid Storage Tank, Pressurized Vessel, etc.), Failure Cases (damage types, viz., leaks, holes, ruptures, significant leaks, etc.) and Failure per year, and summarized in a tabular form.

Ignition Probability: Ignition probability data is important in quantification of risks. Historical data on ignition of flammable releases could be used as a basis for determining suitable ignition probabilities. As probability of ignition depends upon availability of source of ignition, it also depends on the maintenance of safety level.

7.7.1 Fire Risk Mitigation

Since natural gas will be used as a major fuel in the electricity generation at the SBPCL II Power Plant, hazards may potentially result from leakage and ignition of natural gas. As a result, the impacts are caused by heat and pressure from the explosion. Practice fire drills, in accordance with the site's ERP, will be required so that, in case of fire, the appropriate course of action is taken. In the event of a major leak from the gas pipelines there will be a large number of pressure and temperature alarms on the compressors and generators which will warn of the event and shut down the compressor and gas turbine generators. The gas supply can be isolated either by a manual valve on site or by a remote operated valve at the central control building. Sensitive equipment such as electrical equipment will be protected by suitable fixed fire suppression equipment. There will also be portable fire extinguishers provided. In case of the proposed power plants, no modelling has been conducted. However, the secondary data analysis is considered which shows that the heat radiation in case of the leakage of flammable chemical substances, which is natural gas in this case, is ignited at the source will be recovered by the modern fire-fighting system and emergency fire security. In addition, the damage from the explosion will be minimized due to the modern fire proof structural design of the power station.

7.8 Emergency Plan

In recent years public awareness of hazards from industry have increased considerably. Local people and employees have now better legal safeguards against industrial disasters. The management today has more responsibilities in respect of any kind of disaster in its project. So a specific management plan to encounter a disaster situation is of utmost importance. As disaster types, sources, effects are different; it needs a multidisciplinary and multi-organizational approach to tackle such situations.

Types of Disaster: Disaster is an event which causes severe disruption to life of number of people or to the project activities resulting in suffering and loss of life and property. Disasters can be one or several of the types as under:

- Plant oriented - due to design errors, operational defects, chemical changes, failure of equipment human error etc. (in the plant area).
- Natural - flood, cyclone, fire, earthquakes, biological disaster.
- Manmade - war, riot, sabotage.

Degrees of Disaster: Disaster can be classified into 3 types depending on its effects:

a. Low – Such disasters are capable of causing injury, illness and equipment damage, but, are not, however, very serious and could be quickly manageable.
b. Medium – Disasters of this type can give rise to critical situations, can cause serious injuries to personnel, serious illness property and equipment damage.
c. High – Disasters of this extreme type lead to catastrophic situations, pose major danger to life and property. Such disasters cannot be immediately controlled. These can cause deaths, major widespread illness, injuries, loss of major property and equipment.

The contingency plan should provide for a Chief Coordinator. The Chief Coordinator will declare the contingencies arising out of the type of disaster that has taken place along with the mode of action in respect of the disaster type. The following could be prescribed as the mode of action during various degrees of disaster.

High Disaster – Catastrophic condition. All employees need to be evacuated. Local administration is to be properly informed and interacted with.

Medium Disaster – All project activities should be stopped. All employees are to be in safe place. To be ready for High disaster situation. Local administration should be properly informed and interacted with.

Low Disaster – Activities in the affected area stopped. To be ready for Medium type of disaster condition.

7.8.1 Objective of Emergency Plan

An on-site Emergency Plan is required to meet the emergency conditions during a disastrous event in the plant. Its objectives are to:

- Rescue and treat casualties
- Safeguard other people & Installations
- Minimize damage
- Control initially and restore ultimately to normal situation
- Arrange rehabilitation of the affective people

7.8.2 Implementation of Emergency Plan

Based on the nature of disasters anticipated during the three phases (pre-construction, construction and post-construction) of the project and the objectives of the emergency plan, necessary human resource and infrastructural facilities need to be made available to enable effective operation and execution of the plan. The plan could be revised and detailed after the commissioning of the plant when all the units are in final shape. Exact name and designations of all personnel could be then accommodated in the plan.

Actions during Emergency: At times of emergency due to any of the above types of disaster, the general employees of the proposed power plant should proceed to/contact the Emergency Assembly Point in their area. Designated persons will carry out the actions detailed in the Individual Plant Emergency Procedure. Their presence at the Emergency Assembly Point should be verified and ascertained through roll-calls. Personnel not at their normal work place must also move to the emergency assembly point and await necessary safety instructions.

Contractor's employees should also be instructed of the Emergency Procedures before commencing work on the Project Site. When required, they will report to the emergency assembly point at the Project Site.

Infrastructure for Execution of Emergency Plan:

a) Fire Fighting Facilities: The plant will have adequate firefighting aids including fire hydrants close to the various sections of the power generation area and Portable Fire Extinguishers of various types and sizes need to be installed at conveniently reachable locations.

b) Disaster signalling Siren: Siren to be used for raising the alarm and also for ALL CLEAR signal should be installed within the power plant premises.

c) First Aid Boxes should be provided at specific locations including at the Assembly point for administering preliminary treatment. A number of employees will be trained for first aid use.

d) Emergency Control Centre should be at a central as well as safe location in the plant premises wherefrom the Site Controller could direct the movements of Personnel and Equipment during an Emergency.

e) Contents of Emergency Control Centre should be as under:

i. External telephone line and a list of relevant telephone numbers to contact at times of emergency.
ii. Internal telephone and telephone list of Emergency Assembly Points.
iii. List of Emergency Control Team, who must be called showing addresses and telephone numbers.

iv. Emergency Controller's Red & White Helmet.
v. A list of all persons (by title) responsible for groups of employees.
vi. Logs and Emergency Controller's checklist.
vii. Emergency lighting.
viii. Copy of the emergency plan.
ix. List of persons trained in First Aid & Fire Fighting.
x. List of safety cabinets and their contents & locations.
xi. Battery operated torches.
xii. Detailed site plan.
xiii. First aid equipment including stretchers (in surgery).

Assembly Point is a place containing an internal telephone and paging system, where people can wait in a group during emergency to receive instructions from the Emergency Controller. External Communication will be done by Site Controller. The following persons and offices may be given updated information as necessary and asked for necessary help:

- Upazilla Nirbahi Officer (UNO)
- Police
- Fire Brigade
- Upazilla Health Complex/District Hospital
- Factory Inspector
- Local Media
- Upazilla Magistrate

8. Information disclosure, Consultation, and Participation

8.1 Consultation, Participation and Information Disclosure

In compliance with IFC Performance Standard 1 and EP Principle 5, Stakeholder Consultations were undertaken throughout the ESIA and RAP preparation process by BCAS to ensure accurate and timely information regarding the Proposed Development was shared with stakeholders including the Affected Communities and other interested parties. The following sections seek to:

- identify key stakeholders;
- provide details of the various consultation events, including attendance;
- summarise key issues identified during consultation; and
- outline the on-going consultation and disclosure during project implementation.
-

Further details are provided in the RAP, which accompanies the ESIA. Whilst much of the stakeholder engagement addressed resettlement issues, at the same time engagement included consideration of environmental and social issues.

8.2 Identification of key stakeholders

The following table shows the type of stakeholders consulted, as well as the key issues and concerns which were discussed.

Table 8.1: List of Stakeholders for information dissemination and disclosure

No.	Stakeholder	Issues and concerns discussed
1.	District Administration a) Deputy commissioner(DC) b) TNO C) Upazilla Chairman d) Union Parishad Chairman	The following were key issues in discussions with the district administration: • Follow up on the land acquisition process. • Process of compensation of land prices. • Resettlement of people from Khas land. • Permanent tenure for PAP on Khas land.
2.	Project Affected People (PAPs)	An informal meeting was held with all the PAPs in the AoI, with concerns recorded on a household level. One formal meeting took place to discuss all issues/impacts resulting from the Proposed Development. During the surveys the environmental issues were communicated to the stakeholders. The following was the key issue in discussions with the PAPs: • Compensation for land to be acquired/requisitioned.
3.	Bangladesh Power Grid Company	The following was the key issue in discussions with the Bangladesh Power Grid Company: • T-line is needed to transmit power from SBPCL II Power Plant and other plants/ projects in & around Sylhet zone.
4.	Jalalabad Gas Company Ltd.	The following was the key issue in discussions with the Jalalabad Gas Company Ltd: • Issue of exclusivity of the gas pipeline, i.e. that there will be no other pipelines built and that it will be used exclusively for the purposes of the Proposed

No.	Stakeholder	Issues and concerns discussed
		Development.
5.	Local 'Elite'- Community Leaders/high status individuals, Journalists, School Teachers	This group was present during the formal consultation meeting. The following was the key issue in discussions with the Local 'elite': • Ensuring fair compensation for land to all categories of people affected by the land acquisition/requisition; and • Meaningful community development for the people in the affected areas.

It should be noted that there are no particularly active non-governmental (NGOs) or community-based organisations (CBOs) in the Project Area and their presence is limited. However, there are a few micro-credit NGOs that did not provide any specific input in the consultation process related to the Proposed Development.

8.3 Consultation, Community participation and Disclosure prior to Project Implementation

8.3.1 Consultations and Information Dissemination

Public consultation has been carried out during different activities in the project cycle, using different techniques such as large consultation/public meeting, small group meeting, informal meeting as per environmental social and procedures of BCAS. These consultations were conducted in the pre-project situation in 2008, during the ESIA & RAP Study stage in 2011 and after completion of draft ESIA & RAP study, as well as disclosure of these reports in 2013 & 2014. A series of public discussion activities were undertaken by BCAS as part of designing a compensation package. These programmes included rapid appraisal and discussion with the PAPs and community leaders.

Due to their neutrality, and presence in the local area since 2008, BCAS were responsible for inviting all major stakeholder groups to attend the consultation meetings. The consultation approach was based on a combination of formal, informal meetings and focus group discussions. The formal meetings were held through prior notice and invitation including all the PAPs, district administration, local administration and other stakeholders in the affected area. The formal meetings also included focus group discussions comprising the individual groups that had been identified and informed prior to the meetings. Full meeting minutes of consultation with the stakeholders are shown in Annex-E of the RAP.

The informal meetings were held before the main activities of RAP preparation in order to update and validate the baseline study data collected by BCAS, and to identify the households to be surveyed for the 2014 RAP study. During the preparation of the ESIA & RAP study (2008-2014) a number of public consultations focus group discussions and other group discussion were conducted. The methodology used for the dissemination process is set out in the RAP, which accompanies the ESIA.

The aim of the meetings was to inform the public about the project in general and in particular about the following:

1. Finalization of the project plan;
2. Disclosure of Draft ESIA & RAP;
3. SBPCL II design standards in relation to the applicable international standards;
4. Health Impacts and their mitigation as part of the Environmental and Social Management and Monitoring Plan (ESMMP);
5. Measures taken to avoid public utilities and other social infrastructure such as school, hospital, roads, Kushiyara dyke, as well as to generate employment opportunities, and assist with the development of a small enterprise;
6. Other impacts associated with Right Way of Alignment (RoW), Access Road, Switch Yards, T-line approach to minimize and mitigate the effects;
7. Temporary lease (requisition) and acquisition details, proposed compensation packages and policies;
8. Compensation for land, affected structures, and trees; and
9. Any other compensation for any damages associated with the Project Development.

During consultations and engagement process with people in the Project locality, BCAS field staff explained potential impacts of the Proposed Development, details of compensation for the damage to crops, trees, residential structures, ponds etc., and measures taken to avoid impacts on public utilities and community infrastructure such as schools and roads.
As part of the negotiation process implemented by the DC responsible for the acquisition and requisition, the affected people have consented to the resettlement and compensation proposed by the Government as part of the land acquisition and requisition.

The attendees were then invited to discuss the advantages or disadvantages of the Proposed Development. The views and expectations of the Stakeholders expressed at each meeting were communicated to the SBPCL II management. To ensure an iterative process, the progress of the expectations were discussed in the subsequent meeting.

In total there were five informal group meetings, 17 focus group discussions (2008 and 2011) and four stakeholders' and Public consultation meetings held up to September 2011. The consultation process conducted in 2011 has been aimed at the provision of necessary information to the affected people as well as receiving feedback specifically from the PAPs.
A further five consultation meetings were held throughout September in 2013 (between the 3rd – 17th of September), with 77 attendees, as summarised below:

- Meeting with resettled group was held in the Khas land site where the landless people were resettled (to the west of the proposed switchyard) on 3rd September 2013;
- Meeting with the vulnerable female group of the landless area was held on 5th September 2013;

- Meeting with the Project Affected Persons who are directly affected by the lost of land (PAPs) was held on 12th September 2013;
- Meeting with the local elite whose are directly and indirectly affected was held on 13th September 2013; and
- Meeting in Parkul village near to the Project Site on 17th September 2013.

A further consultation meeting was held on 5 March 2014, at the Auskandi union Parisad in Habigonj. The key purpose of this meeting was to obtain feedback/ information from all Stakeholders including PAPs. Approximately 65 participants including local UP members, elite class of all villages of the Union and the representatives from SBPCL II and BCAS attended the meeting.

8.3.2 Key issues identified during consultation

The results of the focus group discussions/consultation with affected persons are detailed in Annex E of the RAP. The consultation focused on key issues relating to the environmental and social impact of the Proposed Development, as well as resettlement and compensation. The latter allowed all proposed measures to be developed with sufficient input from the affected stakeholders, using the mechanism of participatory, inclusive and informed consultation.

The following table summarises the specific outcomes of the consultations with the PAPs, including actions that have been taken by the Proposed Development in response to concerns expressed by the affected people.

Table 8.2: Outcomes of the consultations with PAPs

Purpose	Outcome	Action/ Mitigation
Determine an extent of local support for SBPCL II Power Plant project	PAPs and local people are in favour of the planned work since they believe that this power plant will create employment opportunities and will improve socioeconomic conditions in the locality.	SBPCL II made a commitment in formal meeting with PAPs to provide employment priority and local community development to ensure economic benefits.
Identify key impacts	The main impacts associated with Proposed Development will be land acquisition, displacement of some homesteads and dwellings, and disruption of income sources/livelihoods and other aspects as a result of the resettlement.	These issues have been identified and examined in the RAP.
Identify expectations of PAPs	PAPs expect obtaining employment at the power plant and receiving fair compensation and cash assistance for the loss of their lands, homesteads and other assets. It is also expected that educational and health care facilities will be established by the Project.	These aspects have been covered in the RAP which accompanies the ESIA, as well as through consultations with all the stakeholders.
Identify landowners who	55 landowners (Category-2) will have	The Land acquisition has been

Purpose	Outcome	Action/ Mitigation
will only lose their croplands	their farm land subject to acquisition	completed for the Project Site, price negotiation has been completed and compensation process has been initiated.
Identify share croppers who may be affected by land acquisition. This includes both Share croppers who do not own land in the project area (Category- F) and those who share crops as well as own farm land in the Project Area.	There are 52 share croppers in the acquisition land who do not own any land in the project area (Category-4).They expect compensation for their lost crop during the project implementation.	SBPCL II agreed to provide monetary compensation to this group through the safety net programme, as described in the RAP.
Identify households that require resettlement	29 households will be relocated: 20 households require full resettlement and 9 households will be under partial resettlement.	Fully resettled and partially affected households will receive compensation based on the RAP.
Assess the significance of the socio- economic impacts	Loss of agricultural lands will disrupt production of rice for subsistence and market sale.	Informal settlers on Khas land, sharecroppers and daily labourers whose livelihoods depend on land will be compensated and will be able to avail of employment opportunities generated by the Project. These provisions have been included in the RAP.
Determine PAP preferences for compensation and mitigation	In addition to fair compensation for their land and dwellings, PAPs expect availability of jobs at the plant. Some people expressed their preference to receive compensation directly from SBPCL II, being concerned about possible delays of the Government compensation payment system.	DC will provide compensation as per the Government regulations. There is no provision for SBPCL II to compensate directly for the Government acquired land;
Identification of PAPs who do not own land in the area to be acquired but reside on Khas land and cultivate their trees in the Project Area subject to acquisition.	20 PAPs have been identified in this category (Category-1), whose housing structures and trees will be lost as a result of the land acquisition.	Compensation for this group has been addressed in the RAP.
Determination of resettlers' preferences for relocation	Most of the resettlers would like to relocate close to their current settlements but they are concerned about potential disturbances and disruptions that might take place in vicinity of the plant during its operation.	The Government has identified alternative land for resettlers close to their present location.

8.4 Consultation, Community participation and Disclosure during Project Implementation

8.4.1 Consultation and Disclosure of the RAP

The RAP, once approved by the lending agencies will be placed in a number of locations for public review and comment. The locations will include the library at BCAS (Bangladesh Centre for Advanced Studies), Department of Environment, and the DC office, Habigonj District.
The process of stakeholder engagement will also continue throughout implementation of the Project as set out below.

8.4.2 Consultation during Construction and Operation

Consultation and disclose will be on-going throughout the construction and operation of the Proposed Development. The Community Development Officer (CDO) will be responsible for the Project's interaction with the affected communities and for facilitating the participation of the local community in implementing the Community Development Programme.

In addition, SBPCL II will set up a community development committee (CDC) where the CDC will be available at scheduled times. Additionally, the local community will also be represented in the Joint Committee for Community Relations to maintain dialogue between the community and SBPCL II and to assist in resolving grievances. The proposed plan for future public consultations is as follows:

Table 8.3: Plan for Future Public Consultation

Activity	Consultation Technique	Schedule
Detailed/ Check survey	Public Meeting and individual affected household survey. The survey will be focused on compensation, rehabilitation and community development programme related to the different Project components, including the SBPCL II Power Plant, Gas pipeline, Switch yard, T-Line, Access road.	Every 6 months, public meetings between July – December
Construction Phase	Localised group meetings, distribution of information leaflets and brochures, Public display	Throughout construction period
Operational Phase	Information brochures, operation field offices in the affected localities, monitoring and providing response to public enquiries and press releases.	Continuous during Project operations

9. Grievance Redress Mechanism

9.1 Grievance Mechanism

For the purpose of this ESIA a grievance is defined as a, "*Concern or complaint (which may be real or perceived) raised by an individual or group of stakeholders whose livelihood; health, safety and security; amenity; and cultural norms and heritage have been, or may have been, adversely affected by a project activity which, if not addressed effectively, can pose a risk to SBPCL II operations and/or the interest of the complainant(s)"*. Concerns or complaints can arise from a range of project activities such as breaches of community health, safety and security commitments causing death of a domestic animal or an accidental oil spill as examples. A grievance mechanism aimed at managing all grievances ***except*** those relating to implementation of the accompanying Resettlement Action Plan and to labour terms and conditions is presented below. Separate and distinct grievance resolution procedures will be devised and implemented for these other types of grievances.

An effective grievance mechanism is an important aspect of stakeholder engagement, particularly with affected communities, as it can demonstrate to these stakeholders that grievances will be addressed in good faith and through a transparent and impartial process which is culturally acceptable. It also provides a means for stakeholders to continue to engage with a company and is an important component of company risk management.

The SBPCL II grievance mechanism is based on the following principles/characteristics:

- Culturally appropriate (in terms of applying the following key principles in an effective manner, but in line with cultural norms of behavior);
- Accessibility to all local stakeholder especially affected communities;
- Transparency (but with provision for confidentiality as appropriate);
- Prompt decision-making;
- Fairness;
- No cost to complainant; and
- No retribution to complainant.

Based on these principles the grievance mechanism will involve these stages:

- Grievance submission and issue of receipt to complainant;
- Investigation and decision (solution proposed or grievance rejected);
- Communication of decision to complainant. If decisions rejected then internal escalation to a) senior management and if a second decision is rejected then further escalation to b) adjudication involving a third party (a specially constituted committee of locally respected high status individuals, for example, those involved in dispute resolution under local political or customary procedures with SBPCL II representation, but not a majority); and
- Periodic, but regular checks on implementation of actions following agreed decisions.

The existence of the grievance mechanism will not in any way impede the ability of a complainant to pursue redress through judicial and/or administrate processes.

Figure **9.3: Grievance Mechanism Procedure**

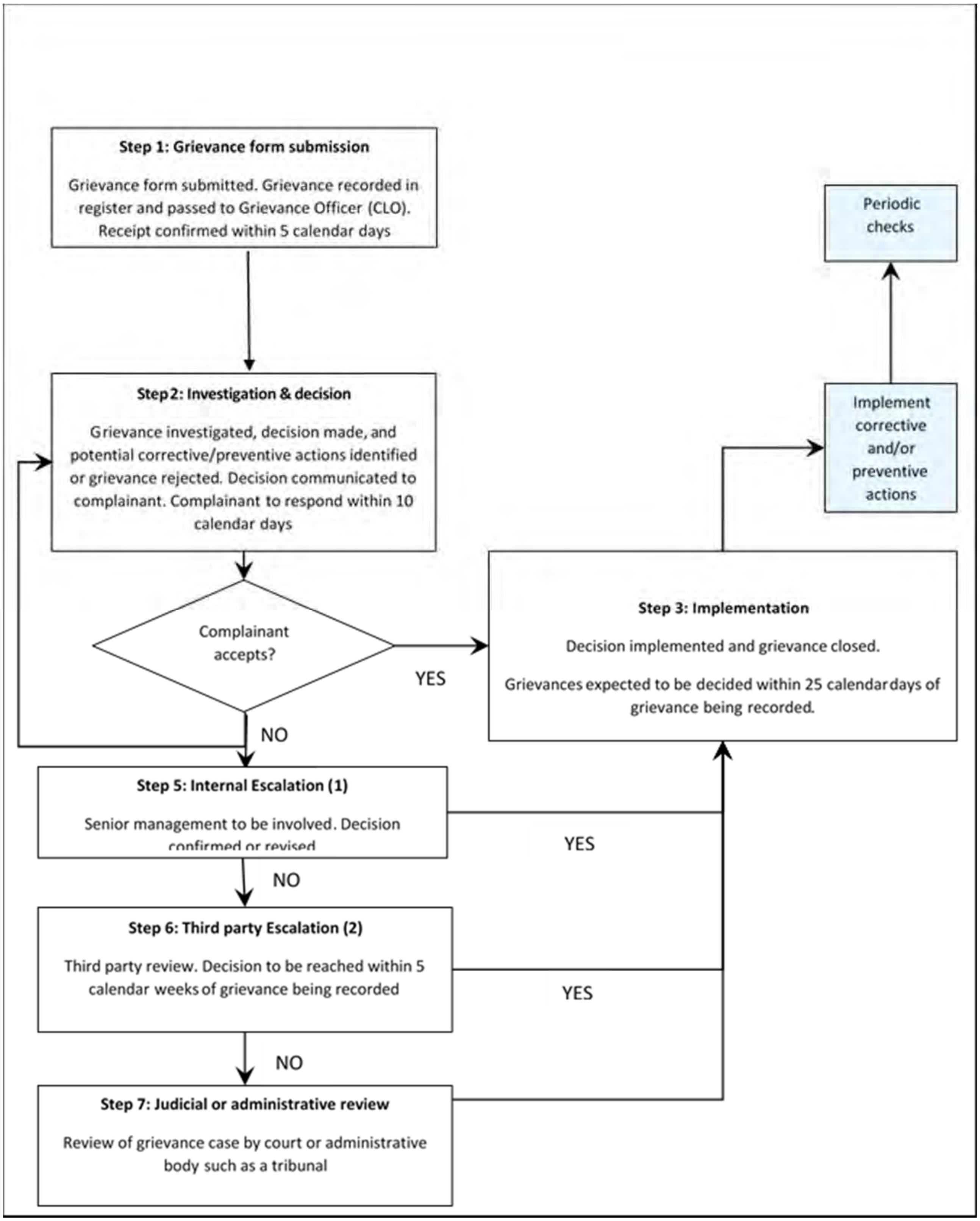


Figure 9.4: Grievance form below shows the procedure to be applied when implementing the grievance mechanism. This procedure will be disclosed and disseminated externally to all stakeholders. Also, SBPCL II will prepare an internal, administrative procedure for managing

the grievance mechanism, or adapt an existing procedure, so that it is aligned with this grievance procedure. This internal, administrative procedure will show the various stages and actions, also in a flow diagram format, with allocation of personnel responsibilities and timelines for undertaking actions/reaching decisions. In addition, SBPCL II will prepare/adapt a specific electronic grievance 'register' for recording the status of individual grievances as they move through the procedure. It will also initiate hard copy files for keeping written documents, such as grievance forms (see Figure 9.2 below) and any other hard copy materials needed to support the electronic register and, overall, implementation of the procedure.

SBPCL II is committed to ensuring that sufficient staff resources will be allocated to managing the grievance mechanism(s) and, also, sufficient time will be made available to enable staff to manage the grievance mechanism(s) effectively.

Information on the grievance mechanism (essentially the procedure) will be disseminated in such a way that all local stakeholders, especially affected communities are informed that the mechanism exists and how they can 'use' it. This will require, primarily, a coordinated and coherent publicity campaign, especially, in the affected communities in/near the Project Site (that is within a 10 km radius of the Project Site). SBPCL II will ensure that community members know where grievance forms (Figure 9.2) can be obtained and to whom they can be submitted (CLO or any SBPCL II official). In addition, care will be taken to ensure that local stakeholders know that grievance boxes will be located in public buildings (with easy public access) in each community. These will be emptied on a regular basis (at least once every 3 days by the CLO) and grievances collected for recording in the office.

As many community members are illiterate, special provision will be made to meet their needs. Affected communities will be informed that a grievance can be presented verbally to a CLO or other SBPCL II official. The CLO and/or official will record the details on a grievance form (those noted by staff other than the CLO will be passed to the CLO). Subsequently, the CLO will return to the complainant and provide a copy of the completed grievance form and receipt. The complainant will be allowed to have a literate relative or friend in attendance so that the complainant is reassured that the grievance is a true reflection of the grievance as submitted verbally. Similar provision for a literate relative or friend to be in attendance will occur for all transactions involving hard copies of written forms/documents. Thumb-print signature will be accepted as legally binding.

The grievance mechanism and procedure as presented may be implemented by the EPC Contractor during the construction phase. If SBCPL II decides that this is the favoured option then it must include provisions governing the grievance mechanism/procedures in the contract between itself and the selected EPC Contractor. In addition, it must audit the EPC Contractor's performance every quarter for the duration of the construction phase and ensure that corrective action is taken promptly and effectively if problems are detected by the audits.

Figure 9.3: Grievance Mechanism Procedure

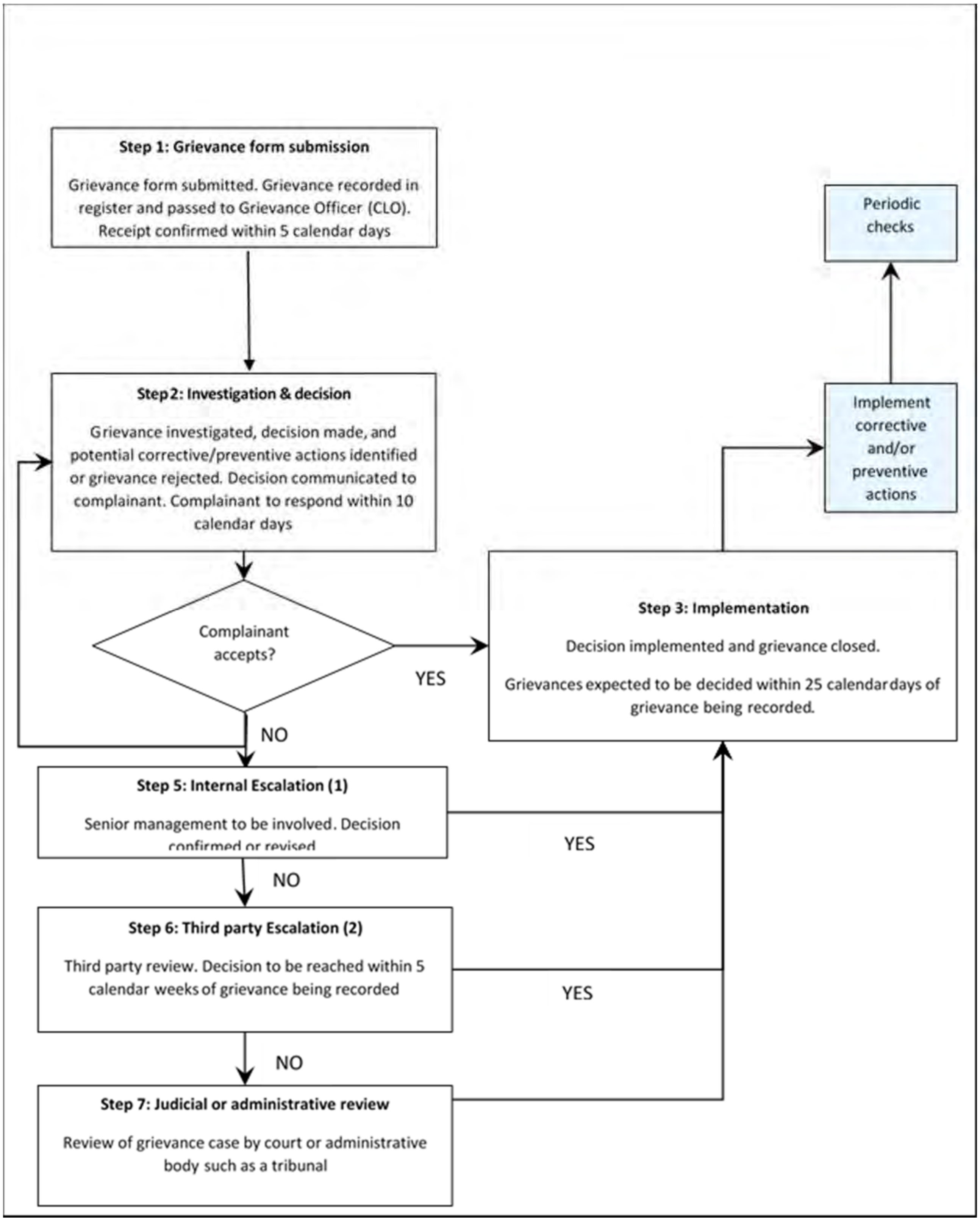


Figure 9.4: Grievance form

Reference Number (for SBPCL II use only):

Full Name of individual or organization (an individual's name required in either case)	____ ____
Contact Information: **Please indicate by marking the box how you wish to be contacted (by post, telephone, e-mail or in person) and then provide the appropriate contact information**	☐ **By Post: Please provide full address:** ____ ____ ☐ **By Telephone:** ____ ☐ **By E-mail** ______________________________________ ☐ **In person: Please provide full address** ____ ____
Preferred language for communication	☐ **[Bengali]** ☐ **[English]** ☐ **[Other]**
Description of your grievance:	**What happened? Where did it happen? Who did it happen to? What has been the consequence for you?**
Frequency of cause/s of your grievance	
	☐ **Single incident (date ________________)** ☐ **Happened more than once (how many times? _____)** ☐ **On-going (currently experiencing problem)**
What would you like to see happen to resolve your grievance?	
Decision:	**Signature of Complainant:** **Date:** **Signature of SBPCL II CLO:** **Date:**

10. Environmental and Social Management and Monitoring Plan (ESMMP)

10.1 Introduction

This chapter deals at length with the measures that SBPCL II, will take in response to the need for sound environmental management throughout the various phases of the proposed project. The chapter also outlines measures that will be taken in relation to the management of social impacts and the need to address grievances that the various project stakeholders might have, in respect of various stages of project implementation, throughout the life of the proposed project.

The mitigation measures proposed in Chapters 5 and 6 of this ESIA Report, which are designed to avoid or minimize impacts during pre-construction, construction, operational and decommissioning phases of the project form the basis of this Chapter. This Chapter presents the specific plan for implementing the mitigation and monitoring requirements and addressing community grievances within the framework of an Environmental and Social Management and Monitoring Plan (ESMMP). The following principles were used to guide the preparation of the ESMMP:

- focus on occupational health, safety, and environment risk prevention;
- affordable, safe technologies are used wherever failure of equipment would have a significant effect on safety, health, or the environment;
- conformance with relevant standards, codes, and practices will be considered in the application of the safe technologies;
- all activities will be performed in a safe and effective manner and all equipment will be maintained in good operating conditions for the protection of health and safety of all persons and the conservation of the environment and property;
- all necessary precautions are carried out to control, remove, or otherwise correct any hazardous materials leaks and/or spills, or other health and safety hazards;
- all activities and components related to construction of the power station will meet relevant international standards which ensure sufficient technical levels of safety; and
- necessary measures will be ensured to redress grievances that the communities within and in the proximity of the Project Site might experience.

This Chapter describes the ESMMP of the SBPCL II Power Plant project and addresses the following key components:

- management activities and systems;
- plans, procedures, and programs;
- monitoring activities;
- implementation schedule; and
- plans for integrating the ESMMP within the overall development plan for the SBPCL II Power Plant project.

10.2 Environmental Management

SBPCL II is committed to constructing and operating the power plant in an environmentally responsible manner and in compliance with relevant environmental laws, regulations, and guidelines in force in the country and also those prescribed by donor agencies, including the IFC and the ADB. SBPCL II will implement an Environmental Management System (EMS), including an environmental policy that states the principles and intentions of the enterprise in relation to its overall environmental performance. Such principles and intentions will be communicated to each employee as well as the nature of their individual environmental responsibilities. Where appropriate, staff training will be undertaken to ensure their continued environmental performance. In addition, SBPCL II will aim to obtain International Organization for Standardization (ISO) 14001 accreditation for the EMS within the first three years of operation.

SBPCL II is also committed to the creation and implementation of programs to reduce the probability of occurrence of adverse impacts upon the environment. As required, contingency plans will be developed for mitigating potential adverse incidents. SBPCL II will expect the same level of environmental performance from its agents, suppliers, and contractors and will stipulate this in any legally binding agreements it enters with these parties.

SBPCL II will also ensure that appropriate corporate resources, personnel and reporting and accountability systems, are in place for the successful implementation of the ESMMP. They will, on a continuing basis, review the objectives of the ESMMP as well as the company's success in achieving them.

Where objectives are not being achieved, corrective action will be taken. The ESMMP objectives will also be modified over the life of the SBPCL II Power Plant, as appropriate, to reflect changing environmental laws, regulations, standards, and technologies.

10.3 Plans, Procedures and Programs

As part of the ESMMP objectives, several plans, procedures, and programs has been developed to guide every stage of project construction, operation, and decommissioning so that the environmental performance of the power plant is optimized. While formulating a detailed ESMMP for the proposed SBPCL II Power Plant project, the pertinent impacts during the four phases, (i.e. pre-construction, construction, operation and decommissioning) have been taken into consideration. The pertinent impact aspects during the three project stages, as applicable, have been as under the following major headings:

1. Air Quality (dust and other particulate matter generation, stack emissions);
2. Noise and Vibration;
3. Hydrology and Surface Water Quality;
4. Drainage and Flood Control;
5. Terrestrial Ecology;
6. Aquatic Ecology;
7. Land Use;

8. Water Use;
9. Traffic and Transportation;
10. Solid Wastes;
11. Occupational Health and Safety;
12. Emergency Response;
13. Resettlement;
14. Socio-Economics; and
15. Public Relations.

The following sections present an overview of the plans, procedures, and programs that will be developed for the SBPCL II Power Plant.

Resettlement Action Plan: SBPCL II will implement a RAP which was prepared following relevant public consultations and the RAP comprises a standalone document; however, key mitigation measures and resettlement issues are identified in the ESMMP.

10.4 Environmental and Social Management and Monitoring Plan (EMP)

The ESMMP is sub-divided into the following phases of development:

- Table 8.1: Pre-Construction Phase;
- Table 8.2: Construction Phase;
- Table 8.3: Operational Phase; and
- Table 8.4: Decommissioning Phase.

10.4.1 The Pre-Construction Phase

Table 10.1: ESMMP for the Pre-Construction Phase

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
SBPCL II Power Plant, Access Road and Gas Pipeline	Site Preparation and Land Raising	Dust Emissions	Periodic sprinkling of water throughout the area subject to the site preparation and land raising process to arrest dust emission. Cover all stockpiles with canvas or plastic sheets during windy periods. Limit the speed of heavy good vehicles over unpaved surfaces. Cover materials during transport to site. Clean road vehicles wheels before leaving the site. Prohibit rubbish burning within the construction site.	Visual Observations. SPM, PM10 and PM2.5 Monitoring	Continuous. Quarterly	EPC Contractor
		Land owners: loss of land, structures, trees, crops, livelihood and income opportunities. Informal settlers and squatters: loss of land, structures, trees, crops, livelihood and income opportunities.	Compensation to project affected persons (PAPs) as detailed in the RAP. SBPCL II will establish a community liaison office in a suitable location outside of the main plant. The Community Development Officer (CDO) will carry out his responsibility in interacting with the PAPs and advising the PAPs on livelihood restoration measures implemented by the project.	CDO is to maintain open channels of communication between the resettled families and SBPCL II. Where unforeseen situations or issues arise, SBPCL II will take an active role to help resolve the situation or the issues with those directly involved. In the fourth quarter of 2014 SBPCL II will engage an experienced entity to	Compensation must be paid or deposited within a period of one year from the date of decision of land acquisition and/or requisition.	SBPCL II

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
		Social Dislocation and vulnerability.		monitor and evaluate RAP implementation. In the short term monitoring will track whether the actions proposed in the RAP were carried out according to the agreed timetable. In the long-term it will focus on the effectiveness of the mitigation measures by assessing income levels and standards of living of the PAPs.		
		Land Raising increasing off-site flood risk	A storm water drainage plan, comprising suitable run-off attenuation, will be developed for the site to ensure downstream flooding is not increased as a result of land raising. A flood risk assessment will be carried out to determine the impact of land raising on the local drainage pattern.	Visual observations.	Continuous	EPC Contractor
		Health and Safety	Risk Assessments and Safe Working Methods will be prepared and implemented at the site. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the project site.	All incidents and near misses	Continuous	EPC Contractor
		Labour Conditions	Bangladesh has ratified key International Labour o (ILO) conventions[19]27, to ensure the work conditions are reasonable and	Employment records.	At the start of employment	EPC Contractor

[19]Bangladesh has ratified ILO conventions including: C11 Discrimination (Employment and Occupation) Convention, 1958; C105 Abolition of Forced Labour Convention, 1957; and C182 Worst Forms of Child Labour Convention, 1999.

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			safe, and employees are free from any form of discrimination.			
		Hazardous Materials Management	Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. Spill kits will be available to contain any accidental release of hazardous materials.	Visual Observations	Continuous	EPC Contractor
		Traffic and Transport	A traffic and transportation plan will be prepared, including both river and road traffic.	Adherence to the rules in the plan.	Continuous	EPC Contractor
Sand Mining	Grab dredging & Plain Suction Dredging	Environmental Management	Prior to commencement of dredging activities a Dredging Management Plan (DMP) will prepared by the contractor, comprising measures to avoid, minimize or control potential impacts, and a monitoring program during the works.	Adherence to the methods and mitigation measures proposed in the DMP	Continuous	Appointed Contractor
		Aquatic Ecology	Of the nine sites proposed, three sites will not be mined due to the proximity of a fish sanctuary (conservation site), a River Dolphin habitat site and Paharpur village. Sand mining will not be undertaken during the fish breeding season (April and May). The plain suction dredging method will be used wherever possible because this creates fewer disturbances to the river bed. Silt curtains will be used to minimize the resuspension of sediments. No washing, crushing, screening, stockpiling or plant operations will occur at locations within the rivers 'average high	Turbidity of the River	Daily	EPC Contractor

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			water elevation', as these activities have increased potential to release fine sediments.			
		River Bank Erosion	Sand Mining will be spread across 6 sites to reduce the impact at any one site, as over-extraction at a single location can destabilize the river bank. Dredging will be undertaken from a barge to prevent heavy plant causing river bank erosion. If dredging of sand bars is undertaken, the upstream third of the sand bar will be retained. A vegetation buffer will be retained adjacent to the river bank. Prioritise depositing/aggrading sections of the river over eroding/degrading sections, as these will recover faster	Visual Observations	Continuous	EPC Contractor

10.4.2 The Construction Phase

Table 10.2: ESMMP for the Construction Phase

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
Natural Gas Pipeline	Land Excavation	Dust Emission	Periodic sprinkling of water throughout the area subject to land excavation to arrest dust emissions. Cover all stockpiles with canvas or plastic sheets during windy periods. Limit the speed of heavy good vehicles over unpaved surfaces.	Visual Observations.	Continuous.	EPC Contractor
	Laying of Pipeline Across Rivers, Canals, Beels, etc.	Sedimentation of surface water bodies	Straw bales and sediment traps will be used to prevent sedimentation of water bodies.	Visual Observations	Continuous	EPC Contractor
		Health and Safety	Risk Assessments and Safe Working Methods will be prepared and implemented at the site. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the Project Site.	All incidents and near misses. Safety audits	Continuous Weekly	EPC Contractor
		Waste Management	Ensure good waste management practices, with appropriate provisions for the storage of hazardous wastes.	Visual Observations	Continuous	EPC Contractor
		Hazardous Materials Management	Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies.	Visual Observations	Continuous	EPC Contractor

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			Spill kits will be available to contain any accidental release of hazardous materials. All hazardous materials will be provided with secondary containment.			
SBPCL II Power Plant, Access Road & Transmission Line	Construction	Dust Emissions	Periodic sprinkling of water throughout the area subject to the site preparation and land raising process to arrest dust emissions. Cover all stockpiles with canvas or plastic sheets during windy periods. Limit the speed of heavy good vehicles over unpaved surfaces. Cover materials during transport to site. Clean road vehicles wheels before leaving the site. Prohibit rubbish burning within the construction site.	Visual Observations. Maintaining liaison with the public including systematic recording and investigation of any complaints. PM_{10} and $PM_{2.5}$Monitoring	Continuous Quarterly	EPC Contractor
		Air Emissions	Vehicle and construction plant combustion engine emissions will be isolated and temporary in nature. However, in the event that vehicles are left standing for significant periods, their engines will be switched off. In addition, the EPC Contractor will ensure that all plant is maintained in a satisfactory manner so as to minimize emissions.	Ensure all vehicles and plant are maintained in good working order.	During routine maintenance and during start-up and shut-down. Schedule a monthly inspection of equipment.	EPC Contractor
		Noise	Select equipment and construction techniques that cause minimum noise. Maintain equipment in good working order. Construction activities, such as piling, which generate significant noise, will be carried out	Contractor observations. Review of complaints received via the formalised grievance mechanism.	Daily checks of equipment and whenever complaints are received.	EPC Contractor

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			during the daytime. Install noise reduction equipment i.e. silencers and mufflers, on noisy plant and frequently check the efficiency of noise attenuation equipment. A grievance mechanism will be established as part of a stakeholder engagement plan.		Schedule a monthly inspection of equipment.	
		Surface Water Quality and Hydrology	An earth bund will be constructed to prevent the discharge of sediment and hazardous materials to neighbouring water bodies. Storm water will be discharged via an oil separator and settlement tank to the Kushiyara River.	Visual inspections. Water sampling and analysis for: - pH; - TSS; - Oil & Grease; - Total residual Chlorine; - Total Chromium; - Copper; - Iron; - Zinc; - Lead; - Cadmium; - Mercury; - Arsenic; and - BOD.	Daily visual inspections. Water sampling every three months and three locations: 50 m upstream; adjacent to the Project Site; and 50 m downstream.	EPC Contractor
		Hydrology – Erosion of the Kushiyara River	Monitor the banks of the Kushiyara River and address any significant increased erosion of the bank adjacent to or opposite to the Project Site by stablisation methods.	Visual inspection of the river banks adjacent to and opposite to the Project Site (including taking photographs for comparative assessment).	Every month	EPC Contractor
		Groundwater Quality	All hazardous materials will be provided with secondary containment to limit the potential for subsurface impacts.	Groundwater sampling and analysis for: pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, Arsenic and BOD.	Quarterly from on-site deep and shallow tubes wells.	EPC Contractor

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
		Terrestrial and Aquatic Ecology	Construction workers will be prohibited from felling trees, hunting wildlife and fishing in the vicinity of the Project Site. Trees will be planted around the boundary of the Project Site during the construction phase.	-	-	EPC Contractor
		Migratory Birds	Once the proposed route of the transmission line(s) has been determined, a bird survey and management plan will be prepared. This will be reviewed and assessed to ensure there will be no impact on migratory birds.	Proposed T-Line route(s) relative to Hakaluki and Hail Haors.	Prior to construction of the T-Lines	SBPCL II
		Traffic and Transportation	Prepare a traffic and transportation plan for the construction phase, which includes (but not limited to): - avoid the transportation of materials or machinery during peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and river traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area; - provide training on safe driving; - prevent unauthorised access (i.e. public access) to the construction site; - load trucks in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the construction site. Resolve potential river traffic navigation	Implement the traffic and transportation plan. Record and investigate all accidents and near misses. Visual inspection of roads used by construction vehicles. Review of complaints received via the formalised grievance mechanism.	At the start of the project. When necessary. Monthly When necessary.	EPC Contractor

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			problems and construction of a jetty along the river bank. No significant increase in river traffic volume is anticipated. A grievance mechanism established as part of a stakeholder engagement plan.			
		Solid Wastes	Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. Segregate wastes by types and provide appropriate waste containers for the storage of all waste streams. Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). Prohibit the burning of wastes. Arrange a waste removal contract and schedule at least weekly waste collections to prevent the build-up of waste materials. Audit waste contractors to ensure appropriate disposal methods are applied according to the waste stream.	Visual inspections of all waste storage areas to ensure the mitigation measures applied	Weekly	EPC Contractor
		Human and Sanitary Wastes	Provision of an appropriate number of toilets and hand-washing points. Provision of on-site treatment of sanitary wastes. Training on sanitation practices.	Visual inspection and water quality sampling with analysis for BOD.	Continuous observations. Water quality sampling every 3 months.	EPC Contractor
		Hazardous Materials	Refuelling, washing and maintenance of plant and vehicles will be prohibited in the	Visual Observations	Continuous	EPC Contractor

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
		Management	vicinity of water bodies. Spill kits will be available to contain any accidental release of hazardous materials. All hazardous materials will be provided with secondary containment.			
		Occupational Health and Safety	Notify local clinics and hospitals before commencement of construction works. Job specific medicals for all employees. EHS training and safety induction for all employees and 6 monthly updates. First aid kits and trained first aid practitioners on-site at all times. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the Project Site. Preparation of an EHS Plan for approval by SBPCL II, including: - EHS Policy and Objectives; - Appointment of qualified EHS specialist(s) who will be onsite throughout the construction project; - Project EHS rules; - Details of how rules and updates (if required) will be communicated to workers - Identification and risk assessment of hazardous activities and high risk areas; - Safe working methods for hazardous activities, including confined space	Weekly EHS inspections, including: - Scaffolding; - Excavations; - Mobile and lifting equipment; - Confined spaces. Weekly site safety inspections shall be conducted and the results documented using a weekly inspection checklist. Analysis of minor accident and near miss statistics to identify 'hot spots' and take appropriate action.	Weekly	EPC Contractor EHS Plan to be approved by SBPCL II.

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			working and working at heights; - Ensure all personnel are provided with all required PPE for the environment they are in and the tasks they are performing; - Implementation of a Lock-out Tag-out program; and - Reporting and investigation procedure for all severe and minor accidents, and near misses. Ensuring all subcontractors (if any) sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure site procedures are fully understood and complied with.			
		Labour Conditions	Bangladesh has ratified key International Labour Organization (ILO) conventions, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination.	Employment records.	At the start of employment	EPC Contractor
		Emergency Response (i.e. Fire, Earthquake, Flood etc.)	Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies, for approval by SBPCL II. The ERP will include: - what should be done and who should do it; - what equipment is required and where this will be located; and - staff training requirements and inductions for new workers and site visitors. In addition, the ERP will include: - a method for communication of the ERP to all workers and people arriving on-site; - an emergency contacts document which is maintained up to date;	Emergency drills, which are documented and critiqued. The drills should cover all emergencies and, where shift work is undertaken, include all shifts to ensure full staff participation. A schedule for inspections of Emergency equipment located around the site, to ensure it is in the correct location and in a suitable condition to be used.	At least every three months. Weekly	Emergency Coordinator (appointed by EPC Contractor)

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			- a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at the site and trained/equipped to respond; and - liaison with local emergency services to ensure they are familiar with the Project Site layout and potentially hazardous locations.			
		Socio-Economics	The CDO will monitor social impacts on the local villages due to increased demand for goods, services and public health facilities arising out of an influx of workers in the project area. A grievance mechanism through a Joint Committee for Community Relations (JCCR) has been proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SBPCL II management and elected local representatives. Review the suitability and capacity of local workers. The EPC Contractor will be encouraged to recruit local labour, goods and services, wherever these are available at an acceptable quality and price. The EPC Contractor will be required to follow a local procurement policy. The EPC Contractor will develop a Recruitment Policy for approval by SBPCL II. The Recruitment Policy will include:	JCCR meetings. The EPC Contractor will provide SBPCL II with details of the amount of local labour, goods and services. SBPCL II to review recruitment policy and worker employment contracts.	To be confirmed by JCCR. Quaterly At the outset of the project.	EPC Contractor CDO and JCCR SBPCL II

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			iv. ensure equal opportunities, fair treatment and nondiscrimination in relation to recruitment, compensation, remuneration, working conditions and terms of employment; v. a means of expressing grievances; and vi. engaging subcontractors and suppliers who do not employ child labour or forced labour, and operate appropriate management systems consistent with requirements (i) and (ii).			
		Public Relations & Stakeholder Engagement	Conduct proactive public relations (PR) exercises consisting of news/information dissemination to increase understanding of the project. The PR will be carried out using local media, leaflets and meetings/seminars on the progress of the project and environmental and social enhancement measures associated with the project. A Public Relations Plan will be prepared by SBPCL II, in order to: - establish clear stakeholder engagement channels. People in the neighbouring villages should have clear lines of communication to SBPCL II; - communicate how environmental mitigation measures will be implemented throughout the project; - receive, investigate and address any complaints and/or concerns from all stakeholders.	-	-	SBPCL II

10.4.3 The Operational Phase

Table 10.3: ESMMP for the Operational Phase

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
Access Road	Operation and Maintenance	-	As detailed in the Land Lease Agreements, following construction, SBPCL II shall hand over the completed Access Road to Bangladesh Power Development Board (BPDB). Risk and responsibility for the Access Road shall pass to BPDB.	-	-	BPDB
Gas Pipeline	Operation and Maintenance	-	As detailed in the Gas Supply Agreements, following construction, Jalalabad Gas Transmission and Distribution System Limited ('the Gas Supplier') shall be responsible for operation and maintenance of the Gas Pipeline.	-	-	The Gas Supplier
Transmission Line	Operation and Maintenance	-	As detailed in the Request for Proposal (RFP) document, SBPCL II will only be responsible for the first 70 m of the T-line. The Power Grid Company of Bangladesh (PGCB) will be responsible for the construction, operation and maintenance of the majority of the T-line.	-	-	PGCB
SBPCL II Power Plant & Transmission Line	Operational Phase	Environmental Management System (EMS)	SBPCL II will implement an EMS, including an environmental policy, and aim to obtain ISO 14001 accreditation within the first three years of operation. SBPCL II will appoint a suitably qualified Environmental Health & Safety (EHS) Coordinator, who will be responsible for implementation of the EMS. The EHS Coordinator will report directly to the Plant Manager who will have overall responsibility for EHS Management.	ISO 14001 accreditation	Three years	SBPCL II and the EHS Coordinator
		Health & Safety Management	SBPCL II will implement a Health and Safety Management System, and aim to obtain	OHSAS 18001 accreditation	Three years	SBPCL II and the EHS Coordinator

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
		System	OHSAS 18001 accreditation within the first three years of operation.			
		Air Quality	Use of dry low NOX burners for the gas turbines to control NOX emissions. Use of 60m high stacks to optimize dispersion of exhaust gases. Install Continuous Emission Monitoring Systems (CEMS) for continuous monitoring of emissions rates. Monitoring ground-level NOX concentrations at three locations in neighbouring villages. A gas metering System, contained in the regulating and metering station (RMS), will be installed to monitor the quality of the gas supplied by the Gas Supplier.	CEMS for stack emissions: - NOX; - PM10; - CO; - O2; and - Flow rate. Ground-level NOX concentrations in the neighbouring villages of Parkul, Bongaon and Paharpur. The quantity and quality of the gas supplied (as per the gas supply agreements)	CEMS operated continuous during operation and calibrated annually Monitoring ground-level NO_X concentrations (at a minimum of three locations) for a 24-hour period during the first three months of plant operation and subsequently annually. Continuous during operation.	SBPCL II
		Noise	Gas turbines, generators and compressors will be installed in buildings equipped with acoustic walls and enclosures. Silencers and mufflers will be installed on all site vehicles. Post warning signs in areas where the noise level exceeds 80 dB(A) and ensure workers are provided with hearing protection when working in these areas.	Noise monitoring for Leq(24), Ldn and L90 at the nearest residential properties to the east and west (i.e. Paharpur and Parkul villages). Review of complaints received via the formalised grievance mechanism. Inspect all equipment and	During the first 3 months following commissioning and subsequently at least once per year. If/when received. During routine	EHS Coordinator EHS Coordinator EHS Coordinator

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			Establish a grievance mechanism as part of a stakeholder engagement plan.	vehicles to ensure it is maintained in a good working order.	maintenance.	
		Effluent Discharge	Treated effluent shall be held in a tank and then discharged to the river. Prior to discharge, the will be monitored and the effluent treatment plant (ETP) is designed to ensure it meets the effluent quality standards detailed in the DoE Guidelines.	pH, temperature and conductivity. pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, Arsenic, Temperature.	Prior to discharge. Quarterly during the first year of operation to monitoring the effectiveness of the ETP. Subsequently annually.	SBPCL II
		Surface Water Quality	Surface water monitoring will be carried out downstream of the site to ensure compliance with the DoE water quality standards. Hazardous materials will be stored with appropriate secondary containment to prevent accidental release to the river. The storm water drainage system will comprise oil/water interceptors and all drainage in the vicinity of designated hazardous materials storage areas will discharge to the effluent treatment system. Water abstraction rates will be monitored daily and compared with anticipated abstraction rate (10,000 m3/24hr). Further assessment will be undertaken if anticipated abstraction rates are exceeded.	All parameters detailed in the DoE water quality standards (refer to Section 4.4.4). Visual inspections and review of the site drainage plan/infrastructure. Abstraction rates	Once during the first 3 months following commissioning and subsequently at least once per year. Daily	EHS Coordinator
		Terrestrial and Aquatic Habitats	Boundary fencing will make terrestrial wildlife choose alternative routes.	Fish habitat survey in accordance with details in Section 4.8.1.	Following the first year of operation.	SBPCL II

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			Planting of indigenous trees, where possible, around the boundary of the Project Site. Use of barrier screens in the cooling water (make-up water) inlet to prevent entrainment of fish.			
		Traffic and Transportation	Prepare a traffic and transportation plan for the operational phase, which includes (but not limited to): - avoid the delivery of materials or machinery during peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and river traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the SBPCL II Power Plant; - provide training on safe driving; - prevent unauthorised access (i.e. public access) to the ProjectSite; - load trucks (if used) in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the power plants site (if applicable). A grievance mechanism established as part of a stakeholder engagement plan.	Implement the traffic and transportation plan. Record and investigate all accidents and near misses. Visual inspection of roads used by site vehicles. Review of complaints received via the formalised grievance mechanism.	At the start of the project. When necessary. Annually When necessary.	SBPCL II
		Waste Management	Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. Segregate wastes by types and provide	Visual Observations	Monthly	EHS Coordinator

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			appropriate waste containers for the storage of all waste streams. Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). Prohibit the burning of wastes. Arrange a waste removal contract and schedule at least weekly waste collections to prevent the build-up of waste materials. Audit waste contractors to ensure appropriate disposal methods are applied according to the waste stream.			
		Human and Sanitary Wastes	Provision of an appropriate number of toilets and hand-washing points. Provision of on-site treatment of sanitary wastes. Training on sanitation practices.	Visual inspection. Surface water quality sampling with analysis for COD/BOD.	Continuous observations. Quarterly water quality sampling.	EHS Coordinator
		Hazardous Materials Management	Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. Hazardous materials (i.e. oils, fuels, chemicals) will be stored in containers comprising appropriate secondary containment. Material Safety Data Sheets (MSDS) will be retained for all hazardous materials used on-site. Copies will be available in the areas where they are used. Spill kits will be available to contain any accidental release of hazardous materials. A	Visual Observations	Continuous	EHS Coordinator

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			'Spill Prevention, Control and Contingency Plan' will be developed, outlining the power plant design features and spill prevention and control measures. Drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil and waste oil storage tank areas will flow to a sump to be pumped to oil-water separator. No underground storage tanks (USTs), containing oils, fuels or chemicals, will be located on-site.			
		Occupational Health and Safety	Notify local clinics and hospitals before commissioning of the SBPCL II Power Plant. Job specific medicals for all employees prior to start of work and updated annually. EHS training and safety induction for all employees and 6 monthly updates. First aid kits and trained first aid practitioners on-site at all times. Access restrictions (barriers and signage) will be used to prevent unauthorised access to the Project Site. Preparation of an EHS Plan, including: - EHS Policy and Objectives; - Project EHS rules; - Details of how rules and updates (if required) will be communicated to workers - Identification and risk assessment of hazardous activities and high risk areas; - Safe working methods for hazardous	Monthly site safety inspections shall be conducted and the results documented using an inspection checklist. Analysis of minor accident and near miss statistics to identify 'hot spots' and take appropriate action. An independent audit by a suitably qualified consultant.	Monthly \ Quarterly Annually	EHS Manager EHS Coordinator Independent Safety Consultant

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			activities, including confined space working and working at heights; - Ensure all personnel are provided with all required PPE for the environment they are in and the tasks they are performing; - Implementation of a Lock-out Tag-out program; and - Reporting and investigation procedure for all severe and minor accidents, and near misses. Ensuring all subcontractors sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure site procedures are fully understood and complied with. Formation of an EHS Committee, chaired by the EHS Manager and comprising representative staff from a wide variety of levels and roles.			
		Climate Change Adaptation	Develop a climate change adaptation policy including monitoring, measurement and corrective actions for the following: • Flood mitigation (safe access / egress during flood events / use of evacuation shelters); • Surface water quality monitoring to include ambient river temperature, where ambient water temperature is consistently (i.e. over 6 months) within 1.5°C of the temperature design limit of the SBPCL II Power Plant then adaptation measures should be actioned, including use of areas already allocated for potential adaptation plant (refer to Annex 14 for further details); and • Monitor the banks of the Kushiyara	To be defined in full within the climate change adaptation policy, however would include the following: • Monitoring of ambient temperature of the River Kushiyara; and • Visual inspection of the river banks adjacent to and opposite to the Project Site (including taking photographs for comparative assessment).	Policy to be completed within 6 months from start of operation and to be integrated into the EMS. Monitoring of the temperature of the Kushiyara River every 3 months. Visual inspection of the banks of the Kushiyara River every month	SBPCL II

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			River and address any significant increased erosion of the banks adjacent to or opposite to the Project Site by stablisation methods			
		Greenhouse Gas Emissions	Undertake an annual greenhouse gas emission audit to quantify greenhouse gases associated both with the Project Site and off-site linked activities. The finding of the audit should include identification of feasible measures to reduce or off-set emissions.	GHG emissions using a recognised methodology.	Annually	SBPCL II to appoint a suitably competent auditing party.
		Labour Conditions	Bangladesh has ratified key International Labour Organisation (ILO) conventions, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination.	Employment records.	At the start of employment	SBPCL II to appoint a Human Resources (HR) Department
		Emergency Response	Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies, including gas-leaks and a fire risk assessment. The ERP will include: - what should be done and who should do it; - what equipment is required and where this will be located; and - staff training requirements and inductions for new workers and site visitors. In addition, the ERP will include: - a method for communication of the ERP to all workers and people arriving on-site; - an emergency contacts document which is maintained up to date; - a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at	Emergency drills, which are documented and critiqued. The drills should cover all emergencies and, where shift work is undertaken, include all shifts to ensure full staff participation. A schedule for inspections of Emergency equipment located around the site, to ensure it is in the correct location and in a suitable condition to be used.	At least every three months. Weekly	Emergency Coordinator (appointed by SBPCL II)

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			the site and trained/equipped to respond; and - liaison with local emergency services to ensure they are familiar with the site layout and potentially hazardouslocations.			
		Socio-Economics	The CDO will monitor social impacts on the local villages due to increased demand for goods, services and public health facilities arising out of additional workers (operating the SBPCL II Power Plant). A grievance mechanism through a Joint Committee for Community Relations (JCCR) will be proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SBPCL II management and elected local representatives. SBPCL II will look to procure local goods and services, wherever these are available at an acceptable quality and price. SBPCL II will adopt a Recruitment Policy including: i. Implementation of training programmes to facilitate skill development and enhancement of locally recruited workers; ii. ensure equal opportunities, fair treatment and nondiscrimination in relation to recruitment, compensation, remuneration, working conditions and terms of employment; iii. a means of expressing grievances; and iv. engaging subcontractors and suppliers who do not employ child labour or forced labour, and operate appropriate	CDO and JCCR to meet and discuss any adverse impacts. Annual report on workforce composition vis-à-vis local versus non-local personnel will be made by the HR Manager.	To be confirmed	SBPCL II, the CDO and local community leaders.

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
			management systems consistent with requirements (ii) and (iii).			
		Stakeholder Engagement	A Stakeholder Engagement Plan will be prepared by SBPCL II, in order to: - establish clear stakeholder engagement channels. People in the neighbouring villages should have clear lines of communication to SBPCL II; and - receive, investigation and address any complaints and/or concerns from all stakeholders.	Complaints and Grievances	If/when received	SBPCL II

10.4.4 The Decommissioning Phase

Table 10.4: ESMMP for the Decommissioning Phase

Project Component	Activity / Events	Adverse Impacts	Mitigation Measures / Compensation	Monitoring Parameters	Frequency	Responsibility
SBPCL II Power Plant	Closure, Decommissioning and Rehabilitation (the anticipated lifespan of the SBPL II Power Plant is 20 years)	-	Closure / Decommissioning may involve adverse impacts not perceived at this stage of the project. A detailed decommissioning and rehabilitation plan will be prepared prior to closure of the power plants. Such a plan might include: - strict adherence to all appropriate waste management techniques, including the reuse and recycling of materials wherever possible; - disposable of hazardous waste materials in a legal and responsible manner; - remediation of soil and/or groundwater contamination (if applicable); and - rehabilitation and enhancement of terrestrial habitats within the power plants footprints.	Soil and groundwater monitoring to determine subsurface impacts (if any) of the power plants operation. Restoration to baseline conditions, as detailed in Section 4 of this report.	-	SBPCL II

10.5 EMP Implementation and Cost Schedule

The entrepreneurs of the project, SBPCL II, will prepare a schedule of implementation of the ESMMP, redress grievances and make a cost estimate for the purpose. The list of events of ESMMP to be implemented should also include the mitigation and monitoring programs included in the RAP along with their approximate implementation costs, as present in Table 8.5.

Table 10.5: ESMMP Cost Schedule

Events	Mitigation	Implementation Procedure	Responsibility	Capital Cost (Tk)	Recurrent Cost (Tk per year)
Environmental and Social Management System (EMSS)	ISO 14001 EHS Coordinator	Implement an EMS and aim to obtain ISO 14001 accreditation within the first three years of operation. Appoint a suitably qualified Environmental Health & Safety (EHS) Coordinator, who will be responsible for implementation of the Environmental and Health & Safety (HS) Management System (see below)	SBPCL II	2,400,000	650,000
Health & Safety (HS) Management System	OHSAS 18001	Implement an HS Management System and aim to obtain OHSAS 18001 accreditation within the first three years of operation.	SBPCL II	2,000,000	400,000
Stack Emission	NOx Emissions	Dry, low NOx burners Installation during construction	EPC Contractor	-	-
		NOx emissions monitoring Developing operations monitoring program	SBPCL II	-	200,000
	CEMS for stack emissions	Installed during construction	EPC Contractor	-	-

Events	Mitigation	Implementation Procedure	Responsibility	Capital Cost (Tk)	Recurrent Cost (Tk per year)
Ambient Air Quality	Monitoring ground-level NOX, SPM, PM10 and PM2.5concentrations at three locations in neighbouring villages.	Monitoring in Parkul, Bongaon and Paharpur for a 24-hour period once during the first 3 months and subsequently annually	SBPCL II	-	250,000
Noise	Noise monitoring at the nearest residential properties to the east and west.	Developing operations monitoring program.	SBPCL II	100,000 (Two Noise Meters)	25,000
Surface Water Quality	Establishing an appropriate monitoring program	All parameters detailed in the DoE water quality standards (refer to Section 4.4.4.1).	SBPCL II	-	100,000
Groundwater Quality	Establishing an appropriate monitoring program	All parameters detailed in the DoE water quality standards (refer to Section 4.4.4.2).	SBPCL II	-	100,000
Land Raising	Flood Risk Assessment	A flood risk assessment will be carried out to determine the impact of land raising on the local drainage pattern.	EPC Contractor	-	-
T-Line Construction	Breeding Bird Survey	Once the proposed route of the transmission line has been determined, a breeding bird survey and management plan will be prepared. This will be reviewed and assessed to ensure there will be no impact on migratory birds.	PCGB	-	-
Aquatic Habitats	Fish Habitat Survey	Undertake a fish habitat survey following the first year of operation.	SBPCL II	500,000	200,000
	Barrier Screens	Install barrier screens in the cooling water inlet to prevent entrainment of fish.	EPC Contractor	-	-

Events	Mitigation	Implementation Procedure	Responsibility	Capital Cost (Tk)	Recurrent Cost (Tk per year)
Landscaping	Plantation of trees and vegetation lost during land development	Designing afforestation program	SBPCL II	500,000	100,000
Socio-Economics	Nominating a Community Development Officer (CDO)	CDO to follow up the social and development issues	Project Entrepreneur	228,405,714 (Further details in RAP, Table 8.1)	600,000 (Annual salary of CDO)
		Legal Advisor to follow up the land disputes	BPDB, PGCB, Jalalabad Gas SBPCL II		
	Resettlement Action Plan (RAP)	Contained in RAP in the ESIA Report	SBPCL II		
Project Plans	Developing an Emergency Response Plan	Staff training and awareness	SBPCL II	100,000	Management Time Only
	Developing an operation and maintenance plan	Staff training and awareness	SBPCL II	Management Time Only	
	Developing a Traffic & Transportation plan	Staff and/or subcontractor training and awareness	SBPCL II	100,000	Management Time Only
Employee Training	Training on ESIA issues and commitments	Policy and procedures, environmental management and analytical techniques	SBPCL II	Management Time Only	1,000,000
			Total	**235,005,714**	**3,625,000**

10.6 Integration of ESMMP with Overall Project

Implementation of ESMMP is to take effect simultaneously with the planning and development of the proposed SBPCL II Power Plant. Specific responsibilities to carry out the various programs and plans of ESMMP will be assigned to project personnel and an established as well as accountable management system. Management will also provide the essential resources for the purpose.

Contractors will be responsible and accountable for the actions of their company and employees. These responsibilities will be incorporated into the contract documents consistent with the recommendations of ESMMP.

10.7 Institutional Aspects of ESMMP Implementation

Implementation of ESMMP along with redress of grievances will depend largely upon the project entrepreneurs – SBPCL II – in as much as it will ensure environmentally sound efficient working conditions of the project during the construction phase and the operational phase. The entrepreneur, to this end, needs to set up an efficient institutional mechanism through deploying its own groups of personnel – the electro-mechanical group, the group consisting of personnel trained in environmental monitoring and compliance procedures, the social safeguard group and a group of security personnel – along with the EPC Contractor (to be engaged in construction and initial phases of operation of the project). Personnel to be deployed by the entrepreneur and those of the EPC Contractor have to collaborate among themselves through a set of guidelines to be developed in line with the Environmental Management and Monitoring Programs as detailed in the ESMMP.

11. Conclusions and Recommendations

11.1 Conclusions

The ESIA report finds that though there is potential for adverse environmental and social impacts associated with the SBPCL II Power Plant which is under consideration, these are manageable provided recommendations in the ESMMP are appropriately followed.

The project is indispensable in view of the current energy shortage scenario in Bangladesh. The consequences of an undersupply would harm the sustainability of the existing industrial production in the country as well as impact upon the quality of life of those affected by the power outages. Furthermore, should the SPBCL II Power Plant not be implemented, the considerable advantages associated with Proposed Development and its associated power generation and creation of employment would be lost.

A number of alternative energy generation technologies have been considered, and discounted for various reasons. Therefore, CCGT is considered to be the most appropriate power generating technology for the SBPCL II Power Plant.

Some of the impact on the social environment is positive given the job opportunities created for local residents from the project. This would help, although only partially, alleviate the unemployment burden of Bangladesh. Apart from this direct benefit, there would be other direct beneficial impacts on national economy through foreign investment.

One of the most critical issues for the project is safety. Environmental, Health and Safety (EHS) training and safety induction would be compulsory for all employees, with 6 monthly updates, and an EHS Plan would be prepared, which would also address community safety.

The project has been designed to comply, where possible, 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 IFC's, ADB's and IDB's environmental standards. SBPCL II will implement an EMS, including an environmental policy that states the principles and intentions of the enterprise in relation to its overall environmental performance. Such principles and intentions will be communicated to each employee as well as the nature of their individual environmental responsibilities.
Given the management measures and monitoring commitments by SPBCL II for the project, environmental impact of the project will be manageable and the Proposed Development can be considered as a nationally important and environmentally sustainable industrial venture.

11.2 Recommendations

In order to manage the potential adverse environmental impacts, especially in the operational phase of the plant, the recommendations provided in the ESMMP should be followed with due diligence. As part of the ESMMP objectives, several management and monitoring plans, procedures, and programs have been developed to guide every stage of project construction, operation, and decommissioning so that the environmental performance of the SPBCL II Power Plant is optimised.

Some of important actions required are:

1. Appoint a suitably qualified Environmental Health & Safety (EHS) Coordinator and develop an EHS Plan for the SBPCL II Power Plant.
2. Development of an Environment Management System (EMS) for the SBPCL II Power Plant.
3. Training of staff on ESMMP related issues.
4. Activation of a Joint Committee for Community Relations (JCCR) as a grievance mechanism and prompt response to public complaints.
5. Establishment of a community liaison office and appointment of a Community Development Officer (CDO).
6. Development of a Public Relations Plan.
7. Develop an Emergency Response Plan (ERP).
8. Develop formalised Grievance Procedures.
9. Conduct a bird survey and develop a management plan
10. Development of a Transportation Plan.
11. Development of a Climate Change Adaptation Policy.
12. Conduct an annual greenhouse gas emission audit.
13. Undertake regular monitoring of the Kushiyara River.
14. Allocation of adequate resources in the yearly budget for implementation of the ESMMP.

The ESMMP objectives will also be modified over the life of the SBPCL II Power Plant, as appropriate, to reflect changing environmental laws, regulations, standards, and technologies.

ANNEXURES

ANNEX- 1: Terms of Reference (TOR)

Environment and Social Impact Assessment (ESIA) for Bibiyana II Power Project

TOR (Terms Of Reference)
Environment and Social Impact Assessment (ESIA) for Bibiyana II Power Project

Submitted by

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For

Summit Bibiyana II Power Company Limited

Context:

The Government of Bangladesh (GOB) decided to implement 642MW Combined Cycle Gas Turbine power plant in Bibiyana named as Bibiyana I and Bibiyana II each having an installed capacity of 341 MW. Open tenders were floated inviting Independent Power Producers to bid for the projects. The projects were awarded to an Independent Power Producer (IPP) consortium consisting of Summit Industrial & Mercantile Corporation (Pvt.) Ltd. and General Electric (GE) of USA.

Accordingly, an Environmental and Social Impact Assessment (ESIA) was undertaken for Bibiyana I and Bibiyan II in April 2010-2011. The scopes of this assessment were:

- Prepare a detailed ESIA for Bibiyana I & II projects.
- Prepare a Resettlement Action Plan (RAP) for the main plant area, the gas pipeline, the approach road and the power evacuation facilities.

The project sponsors have now decided to implement the Bibiyana II project only, having a generation capacity of 341MW. The configuration of the project has also been changed. The project sponsors will not now take the responsibilities or invest in the gas pipeline, the approach road and the power evacuation facilities, which were in the scope of Bibiyana I project. Under the new arrangement, these will be the responsibility of the GOB and therefore will not remain under the purview of the proposed Bibiyana II project. However, the study will take into account the associated facilities and their Environmental & Social impacts will be covered as a part the ESIA.

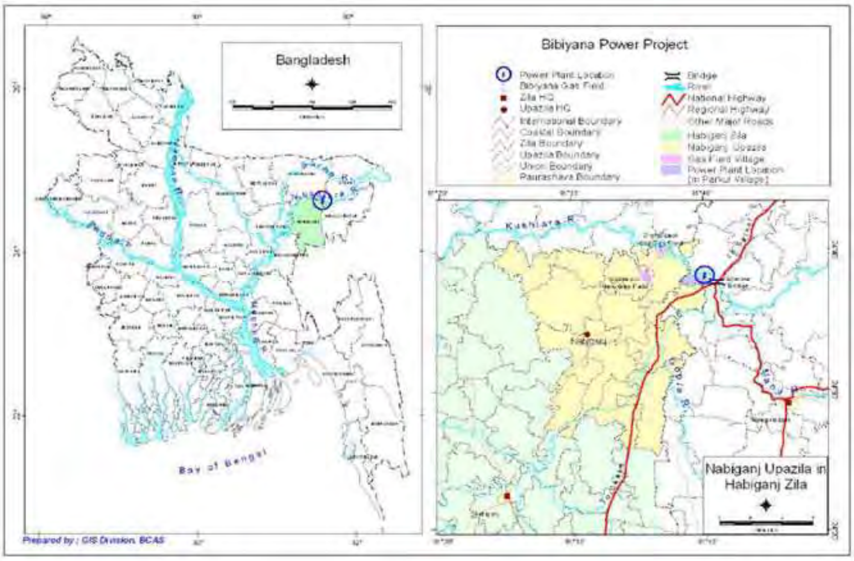
The environmental legislation in Bangladesh, particularly, The Bangladesh Environment Conservation Act, 1995 (Amended in 2002) and the Environmental Conservation Rules 1997 states that any development project shall require environmental clearance from the Department of Environment (DOE), Ministry of Environment and Forest, Government of the People's Republic of Bangladesh.

The Bibiyana II 341MW Combined Cycle Gas Turbine power plant falls under the "Red Category" as per The Environment Conservation Rules, 1997, which required submitting Initial Environmental Examination (IEE) report to the DOE in 2011. On examining the IEE, the DOE has already issued a site clearance certificate along with a TOR relating to the ESIA as per their requirements. A copy of which is in the exhibited in the appendix. The ESIA will be prepared following the TOR from the DOE and complying with the IFC Performance Standards (2012) including WBG EHS Guidelines especially WBG EHS Guidelines for Thermal Power 2008 and safeguard policies of the ADB (2009) will be used.

Project Area

The geographic location of the Bibiyana II site is at 91° 39′ 37″ E. longitude and 24° 38′ 18″ N. latitude. The site location is on the south bank of the Bibiyana (Kushiyara) river. The site is about 2 km west of the N2 road (Dhaka - Sylhet National Highway) or from the Sherpur Bridge point. The site location is about 180 km north-east of Dhaka and about 45 km south-west of Sylhet district headquarter. Administratively, it is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of Habiganj district.

Map-: Location Map of Bibiyana II Independent Power project



Objectives of the assessments:

The environmental and social components of the project area may be impacted by the proposed Bibiyana II 341 MW power plant. The objective of the study will be to assess the environmental and social impacts of the proposed project in order to prepare an environmental and social management plan suggesting mitigation measures for minimizing the effect of the negative impacts, enhancement plan for increasing the benefits of the positive impacts and an environmental and social monitoring plan which will include health and safety issues.

***Proposed Activities*:**

Bangladesh Centre for Advanced Studies (BCAS) with contribution from ENVIRON, U.K. has agreed to carry out the following tasks:

- To carry out the ESIA for the Bibiyana II power project based on the TOR provided by the DOE along with the site clearance and complying with IFC Performance Standards 2012 including WBG EHS guidelines especially WBG EHS Guidelines for Thermal Power 2008 and ADB’s SPS (2009).

Methodology:

One of the requirements of initiating the implementation of the project is to obtain an Environmental Clearance Certificate from the Department of Environment under the Ministry of Environment and Forest of the Government of Bangladesh. According to the Environmental Conservation Act 1995 and the Environmental Conservation Rules of 1997 of the Government of Bangladesh, all power generation projects fall under the red category and as such will require a detailed Environment and Social Impact Assessment (ESIA) for the projects after obtaining the site clearance on submission of the Initial Environment Examination (IEE).

The site clearance has already been issued for the project. In order to obtain the final Environmental Clearance Certificate the project sponsors must submit an ESIA report which will provide a more comprehensive analysis of environment and social impacts as per the TOR provided by DOE with the site clearance.

For the preparation of the ESIA and the Resettlement Action Plan (RAP) the Performance Standards set by IFC in 2012 including WBG EHS Guidelines especially WBG EHS Guidelines for Thermal Power 2008 and ADB's SPS (2009) will be followed.

The IFC's 2012 Sustainability Framework articulates the Corporation's strategic commitment to sustainable development, and is an integral part of IFC's approach to risk management. The Sustainability Framework comprises IFC's Policy and Performance Standards on Environmental and Social Sustainability, and IFC's Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. IFC's Access to Information Policy reflects IFC's commitment to transparency and good governance on its operations, and outlines the Corporation's institutional disclosure obligations regarding its investment and advisory services. The Performance Standards are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation in order to achieve its overall development objectives. The Performance Standards may also be applied by other financial institutions.

Together, the eight Performance Standards establish standards that the client is to meet throughout the life of an investment by IFC.

Performance Standards of IFC includes the following:

Performance Standard 1: Assessment and Management of Social and Environmental Risks and Impacts
Performance Standard 2: Labor and Working Conditions
Performance Standard 3: Resource Efficiency and Pollution Prevention
Performance Standard 4: Community Health, Safety and Security
Performance Standard 5: Land Acquisition and Involuntary Resettlement
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 7: Indigenous Peoples
Performance Standard 8: Cultural Heritage

The proposed activities for Bibiyana 2 ESIA

A. Environment

BCAS had carried out a baseline survey and analysis on 1) conducting a quantitative and qualitative baseline environmental assessment of ambient air quality, groundwater quality, noise measurements, local biodiversity including flora and fauna, river and road traffic assessment in 2010-2011. It is proposed that these baseline data will be used for the Bibiyana II project. However, a detailed review of the ESIA report would be undertaken with a view to identify information and data gaps. A survey and data collection exercise will be carried out in order to ascertain if any significant changes have taken place which may have an influence on the baseline study carried out in 2010 and 2011 and to collect data to address identified information gaps.

a. Undertake an Environmental and Social Impact Assessment study for the power project based on three season data. The baseline data should be based on information collected for the area within 10 km radius of the project site and 50 m on both sides of the proposed gas pipeline and power evacuation lines to assess the dimensions of the study area and describe relevant physical, biological, socioeconomic, health and labor conditions, including any changes anticipated as part of the project. Specifically, the ESIA baseline study should be based on the following key parameters. If the earlier ESIA did not cover the following information, then the same should be collected as part of the fresh ESIA:

   i. Meteorological data: Continuous micrometeorological information of the area at one location should have been collected through a micro-meteorological station. Further secondary data should also be collected and analysed.

   ii. Air Environment: Air quality data should be generated **for standard parameters (SPM, PM10, PM2.5, NO_x, SO_2, CO and HC)** from 10 locations on continuous basis for one week. AERMOD will be used for air quality modeling. Attempts will be made to include secondary data for other seasons. The data collected during March/April 2011 and the data collected during 2008-2009 and any other recent secondary data during 2012 and 2103 will be included.
   iii. Noise Environment: Noise sampling to be carried out on continuous basis for 24 hours once during the study period. Present the equivalent noise levels and compare it with the Funds and National Standards.
   iv. Traffic volume: Monitor traffic volume at five locations in and around the project site;
   v. Water Environment: Assess water availability and demand by users including the proposed project and labor camp. Determine the impact on the users downstream of the river. Assess the surface and ground water quality at 8 locations around the project site including local community settlements. Surface water will be sampled at 5 locations in the River Kushiara and two in the nearest settlements and one deep groundwater sample in the plant location.
   vi. Soil Environment: Analysis of soil type, chemistry and soil geography will be carried out.
   vii. Landuse: Develop landuse information of the project site and surrounding areas through GIS based satellite imageries to depict landuse, drainage pattern, physical features, habitation etc.
   viii. Biodiversity: Biodiversity baseline to cover both terrestrial/avian and aquatic environment.

b. Further an ecological assessment shall be undertaken on wildlife management in the area. Data should be relevant to decisions about project location, design, operation, and mitigation measures.

c. Undertake an assessment of labor influx during construction and operations and an assessment of occupational and community health and safety related aspects during construction and operations.
d. Predict and assess the project's likely positive and negative impacts, in quantitative terms to the extent possible on the air, water, noise, soil, landuse, flora and fauna. Use appropriate prediction software and models; identify mitigation measures and any residual negative impacts that cannot be mitigated. Explore opportunities for enhancement. Identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specify topics that do not require further attention.
e. Biodiversity impact assessment to cover both terrestrial/avian and aquatic environment.
f. Evaluate impacts and risks from associated facilities including gas pipeline, access road, evacuation lines, and any other third party activities such as any industrial and agricultural activities in the area.
g. Also take into account current and proposed development activities along with the sensitive receptors within the project area. Examine cumulative impacts as appropriate.
h. Review the alternatives considered for the project (including the 'no project' alternative) with a focus on location, technology, design and operation in terms of their potential social and environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. State the basis for selecting the particular technology and justify the approaches to pollution prevention and abatement;
i. Climate Risk Assessment and GHG predictions using CEET model
j. Delineate an environmental mitigation and management program/plan consisting of the set of mitigation and management measures to be taken during construction, implementation, operation and decommissioning of the project to avoid, reduce, mitigate, or compensate for adverse social and environmental impacts, in the order of priority, and their timelines. May include multiple policies, procedures, practices, and management plans and actions. Describe residual impacts. Describe the desired outcomes as measurable events to the extent possible, such as performance indicators, targets or acceptance criteria that can be tracked over defined time periods, and indicate the resources, including budget, and responsibilities required for implementation. Where the project identifies measures and actions necessary for the project to meet the Performance Standards, the management program may include an Action Plan.
k. Hazardous Waste Management during construction and particularly operation;
l. Develop a monitoring and reporting program of the environmental aspect for the construction and operational phases;
m. The Consultant should also refer to applicable IFC Environmental, Health and Safety Guidelines (WBG EHS Guidelines for Thermal Power 2008), IFC's General EHS Guidelines to identify Good International Industry Practice referred to in the Performance Standards and ADB's SPS (2009).

B. Social

- A socio-economic study was conducted for Bibiyana I & II projects in 2010-2011. The study covered a 5 kilometers radius area of the plant through questionnaire sample survey. It is proposed that the socio-economic study carried out for Bibiyana I & II ESIA will be used for the Bibiyana II project. The justification being that the demography and the general socio-economic scenario has not changed significantly in the area. However, for the Bibiyana II ESIA additional survey will be carried out in order to validate the baseline conditions and to address information gaps, if any. A total of 204 households will be surveyed as sample for the validation purpose.

- A 100% survey of the Project Affected People (PAPs) was carried out in 2010-2011 for the Bibiyana I & II project. The Resettlement Action Plan (RAP) prepared included the plant area, the power evacuation facilities, gas pipeline and the approach road. Under the Bibiyana II project it is proposed that the RAP will take into consideration the new configuration of the project in terms of the associated facilities and define the boundaries and project components of the PAPs in consultation with the lenders and the GOB. The RAP should cover all PAPs impacted by the project including all associated facilities such as gas pipeline, access road, evacuation lines, etc

The ESIA will review the existing socio-economic data and social impact assessment with a view to identify gaps, requirements for future assessments in accordance with the national legislation, IFC Performance Standards and ADB safeguard requirements 2 and 3 of ADB's SPS (2009). The social impact assessment should specifically cover, among other things:

1. social baseline and assessing socio-economic conditions;
2. an assessment of the impacts of land acquisition for the project, as well as the adequacy of compensation to affected households
3. evaluation of all social impacts of the project, both positive and negative (loss of land, loss of livelihood, loss of access to land/natural resources, etc.);
4. assessment of the degree to which the communities within the area of influence of the project support the project;
5. Social impact assessment including various social management plans (resettlement Action Plan, Stakeholder Engagement Plan, Grievance Redress Mechanism, Livelihood Restoration Plan, Community Development, Plan, etc.)

Based on the above, the consultant will:

i. Review the existing ESIA and socio-economic data

ii. Undertake Social Impact Assessment covering all stakeholders including informal settlers, landless laborers, etc.

iii. Document land acquisition process for government, private and forest / agriculture land and assess the impact of land acquisition. Include various government notifications and announcements as annexes.

iv. Conduct an additional socioeconomic survey covering all the project affected households including non-titleholders to establish baseline socio-economic data including those impacted by the associated facilities such as gas pipeline, access road, evacuation lines, substation etc.

v. Utilize qualitative and quantitative methods to collect information on local perspectives, concerns and aspirations of impacts on the women, youth, indigenous people, employment, income streams, household survival strategies, vulnerable groups, division of labour, resource dependency, basic developmental indicators.

i. Document stakeholder engagement, information disclosure and consultation and participation process till date and proposed. Include minutes of meetings conducted with various stakeholders with attendance sheets / details of people attended, venue, date, photos and copy of materials presented as attachment. Consultation with relevant Civil Society Organizations (CSOs)/Non-Government organizations should also form part of the consultation activities.

ii. Socio-economic baseline data to be included in the ESIA should include:

   a. Household characteristics, such as number of members, gender, age, education level, employment status/primary occupation, illness/disease, any specific vulnerabilities on account of age, women headed families, disabilities, social status, dependence on natural resources (grazing, fishing, forest/agriculture based produce, nomadic nature of communities), informal settlers/squatters;

b. Livelihood/occupation (title holder, landless laborers, sharecropper, groups with traditional/customary rights), grazing, fishing, non timber forest produce dependent, nomadic/migrant communities with seasonal dependence on certain natural resources within project area of influence etc. Expenditure profile should also be covered.
c. type of housing (joint family dwelling, single family dwelling or other), other assets such as consumer durables, access to and amount of land in possession, boats, etc;
d. Income streams, salary, skills, access to skills development and training, self employed/employ others, market produce/livestock, seasonal/part time labor, in-kind bartering, money sent from elsewhere/remittances;
e. Entrepreneurship, access to credit; and
f. Common property resources, public infrastructure and cultural property.
g. Skill mapping of PAPs for development of entitlements

iii. Develop mitigation measures for identified impacts, develop an entitlement framework and prepare detailed PAP-wise entitlement matrix as part of Resettlement Action Plan. The RAP should include measures for livelihood restoration and other identified impacts
iv. Ascertain replacement value of assets lost, including land. Compare compensation determined / paid for the assets under various categories such as land, structures, establishments, etc vis-à-vis replacement cost for such assets and determine the gap.
v. Assess if PS 7 & PS8, and SR3 of ADB's SPS (2009) get triggered and develop plans such as Indigenous Peoples Development Plan accordingly and determine impacts on indigenous people and propose measures in line with IFC Performance Standard 7 and safeguard requirement 3 of ADB's SPS (2009).
vi. Identify vulnerable PAPs and determine impacts on vulnerable groups. Recommend specific measures for vulnerable PAPs.
vii. Undertake Information Consultation and Participation (ICP) and BCS for the project in line with IFC Performance Standards.
viii. Draw implementable plans consistent with PS 5 and PS 7 requirements to address and mitigate impacts emerging from land acquisition resultant physical and economic displacement and measures to address compensation gap, if any

- Review of the adequacy and efficiency of proposed mitigation measures for the plant.

- Development of an Environmental and Social Management Plans (E&SMPs) which will also include a robust monitoring plan.

Output

1. Environmental and Social Impact Assessment (ESIA) for Bibiyana II
2. Environmental Management and Monitoring Plans, Resettlement Action Plan including Livelihood Restoration Plan, Stakeholder Engagement Plan, Grievance Redress Mechanism, (refer table of contents below)

Table of Contents:

The proposed table of contents of the ESIA report is as follows:

5.1 Air Environment Climate and Meteorology
- 5.1.1 Impact During Construction Phase
- 5.1.2 Impact During Operation Phase
- 5.1.3 Impact During Decommissioning Phase
- 5.1.4 Mitigation Measures

5.2 Noise/Vibration
- 5.2.1 Impact During Construction Phase
- 5.2.2 Impact During Operation Phase
- 5.2.3 Impact During Decommissioning Phase
- 5.2.4 Mitigation Measures

5.3 Water Environment
- 5.3.1 Surface Water
- 5.3.1.1 Impact During Construction Phase
- 5.3.1.2 Impact During Operation Phase
- 5.3.1.3 Impact During Decommissioning Phase
- 5.3.1.4 Mitigation Measures
- 5.3.2 Ground Water
- 5.3.2.1 Impact During Construction Phase
- 5.3.2.2 Impact During Operation Phase
- 5.3.2.3Impact During Decommissioning Phase
- 5.3.2.4 Mitigation Measures

5.4 Land Environment
- 5.4.1 Impact During Construction Phase
- 5.4.2 Impact During Operation Phase
- 5.4.3 Mitigation Measures

5.5 Biological Environment
- 5.5.1 Impact During Construction Phase
- 5.5.2 Impact During Operation Phase
- 5.5.3Impact During Decommissioning Phase
- 5.5.4 Mitigation Measures

5.6 Socio-Economic Environment
- 5.6.1 Impact During Construction Phase (such as loss of land, loss of livelihood, loss of access to common property resources, impact of labor influx, etc)
- 5.6.2 Impact During Operation Phase
- 5.7.3Impact During Decommissioning Phase
- 5.6.4 Mitigation Measures (among other measures this should include an Entitlement Framework for mitigation of impacts on PAPs)

6 ENVIRONMENTAL AND SOCIAL MONITORING AND REPORTING PROGRAMME

6.1 Monitoring during Dredging and Reclamation
- 6.1.1 Water Quality

6.2 Monitoring of Shoreline Changes /Other Climate Related Changes

6.3 Comprehensive Monitoring
- 6.4.1 Terrestrial Environment
- 6.4.2 Air Quality Monitoring
- 6.4.3 Noise Monitoring
- 6.4.4 Water Quality Monitoring
- 6.4.5 Soil Quality Monitoring

6.4.6 Biodiversity Monitoring
6.4.7 Flora and Fauna Monitoring
6.4.8 Socio-economic (include indicators to be monitored. Third party monitoring requirements, frequency of monitoring, etc)

7 PROJECT BENEFITS

7.1 Improvement in Infrastructural Facilities
7.2 Improvement in Social Infrastructure
7.3 Employment Potential

8 SOCIAL AND ENVIRONMENT MANAGEMENT PLAN (EMP)

8.1 Environment Management Cell/Organization during construction and operation
8.2 Both for construction and operation phases following plans, as applicable, to be developed
SOPs for Safe Operations and Compliances
Occupational and Community Health and Safety Management Plan
Contractor Management Plan
Additional Studies (if any)
Contract Labor and Labor Camp management plan
Emergency Preparedness and Response Plan
Pollution Prevention Plan
Hazardous Materials Management Plan
Resettlement Action Plan
Community Development Plan
Stakeholder Engagement Plan Information Disclosure, Consultation, and Participation
Community Grievance Redress Plan
Livelihood Restoration Plan

8.3 Routine Monitoring
8.4 Training Schedule for Operational Staff and Implementation
8.5 Monitoring Schedules and Implementation
8.6 Inspection Schedules and Implementation
8.7 Follow-Up of Recommendations of Monitoring / Inspection
8.8 Post Resettlement Audit by third party

9 IMPLEMENTATION SCHEDULE AND RESOURCES

9.1 Implementation schedule for mitigation measures and plans with clear timelines and responsibility
9.2 Resources and Budgetary Allocation

10 SUMMARY AND CONCLUSIONS/RECOMMENDATIONS

10.1 Summary
10.2 Conclusion/Recommendations

List of figures
List of tables
List of required approvals and clearances
References
Annexures

Annex 1

DOE Initial Environmental Examination (IEE) checklist
Initial Environmental Examination (IEE) checklist

IEE Check list for Red category projects

Give information in the open space / put tick mark (✔) enclose necessary paper wherever necessary

1.0 General Information

1.1 Name of the Company t ______________________

a. Entrepreneurs Name t ______________________

b. Contact Address t ______________________

____

1.2 Name of the project t ______________________

____

a. Location of the Industry t ______________________

____

b. Present address t ______________________

____

c. Telephone/ Fax t ______________________

d. E-mail t ______________________

Include detail map of the project showing road, canal, beel ,river and key point Installations . Show General Map as annexure -1

2.0 Description of the proposed project

2.1 Total Amount invested t ______________________

2.2 Detail of Land used

Total Amount invested t __________

Detail of Land used __________

a. Total amount of Land under project __________ Square meter

b. Amount of land developed

2.3 **Use of land in the prposed project**

2.3.1 Present use of

land

2.3.2 Use of land within radius of 1 km :

2.3.3 Width of nearest main road from the project **Meter**

2.3.4 Items situated within one kilometer distance of the project

- Wetland
- Natural Stream
- Flood control project
- Forest
- Park/playground
- Hill/Hillock
- Others
- Residential Area

2.3.5 Items situated within 500 meter distance

- Historical Place
- Military installations
- Special area
- Environmentally critical Area
- Key Point Installation
- Hospital/Clinic
- Educational Institutions
- Restricted Area
- Air Polluting Industry
- Residential Area
- Food Silo
- Others

2.3.6 Project site

North

South

East

West

2.4 Description of Project Phases

2.4.1 Construction Phase

2.4.1.1 Building for the project

☐ **To be constructed** ☐ Rented

	Use of different floors of building	Number of Floor	Area of Floor (square Meter)
☐	Administrative/ Office	________	________
☐	Factory/Production program	________	________
☐	Raw Materials warehouse	________	________
☐	Resthouse/Day care	________	________
☐	Canteen	________	________
☐	Toilet Facility	________	________
☐	Effluent Treatment Plant	________	________
☐	Water Treatment Plant	________	________
☐	Generator	________	________
☐	Toxic waste store	________	________

☐ Solid waste store	____________	________________
☐ Others	____________	________________

2.4.1.2 Services for Building Construction

a) Water

Source ____________________ Daily consumption t ____________ Cubic meter

b**) Power**

Sourcet ____________________ Daily Consumption ____________ KWH

2.4.2 Operation Phase

2.4.2.1 Factory production Program/Process Description (Use extra page and enclose Flow diagram as Annexure :2D

____

____

____

____

____

____

____

____

2.4.2.2 Time of factory operation t

Average	Hour/Day	Day/Week
Maximum	Hour/Day	Day/Week

2.4.2.3 Raw material and Final product (List of all the raw materials and chemicals use for production process and extra page may be used, if required)

Raw material	Source of raw material	Quantity (Yearly)

2.4.2.4 Production capacity (List of all the products and extra page may be used, if required)

Final product	Quantity (Yearly)

2.4.2.5 Description of manpowert

Administrative : ______________________

Production process : ______________________

Environmental management : ______________________

Total : ______________________

2.4.2.6 Description of machinery and equipment t (Provide list of all the machinery and equipment and extra page may be used, if required)

machinery and equipment	**Quantity**

2.4.2.7 Power supply

	Supplier	**Production capacity (kVA)**	**Demand (kW)**
o	National power grid line		
o	Own generator		
o	Others		

2.4.2.8 Water supply

Source	Description	Water consumption	
		Residence	Industry
o Supply water	______	______	______
o Surface water	______	______	______
o Won Deep tube well	______	______	______
o Recycled water	______	______	______
o Others	______	______	______

2.4.2.8 Fuel Supply (gas/coal/furnace oil etc)

Source t ______________ Daily consumption t ______________ m^3/ton/lit

3.0 List of industrial waste (Identification waste during production process)

- ☐ Acidic waste (Example t Hydrochloric acid, Sulfuric acid, Nitric acid etc)
- ☐ Alkaline waste (NaOH, KOH, alkaline cleaner etc)
- ☐ Asbestos waste
- ☐ Ceramic/mineral waste
- ☐ Polluted container (Previously used for chemicals and paints)
- ☐ Chemical fertilizer/ pesticide waste
- ☐ Raw waste
- ☐ Fixed waste (Solidified, Chemically fixed and encapsulated waste¨)
- ☐ Inorganic chemical waste (Example: Arsenic, copper, cadmium etc)
- ☐ Waste from leather
- ☐ Metallic waste
- ☐ Oil (Example: waste oil, oil/mixed with water)
- ☐ Organic sludge
- ☐ Organic solution (Example: Helogenated, aliphatic, aromatic compound)
- ☐ Dye/Ink/Paint waste
- ☐ Paper waste
- ☐ Pathogenic / infectious waste
- ☐ Pharmaceutical waste
- ☐ Plastic waste
- ☐ Electroplating waste
- ☐ Rotten waste (Example: Grease trap, animal waste)
- ☐ Reactive chemical waste (Example: Explosive, Reducing and oxidizing agent)
- ☐ Resin/ Lattice / Adhesive
- ☐ Rubber waste
- ☐ Styrofoam waste

- ☐ Tannery waste
- ☐ Textile waste
- ☐ Others

4.0 Liquid effluent t (source of liquid effluent, nature of pollution and approximate quantity and use extra page if necessary)

source of liquid effluent	approximate quantity	nature of pollution	
		Poisonous	**nonpoisonous**
☐ Production process	______	☐	☐
☐ washing/cleaning	______	☐	☐
☐ cooling	______	☐	☐
☐ Residential swages	______	☐	☐
☐ Retreating water	______	☐	☐
☐ others ______	______	☐	☐

4.1 Treatment Process of Effluentt

Source of Effluent	EffluentTreatment Process		
	Own ETP	**Joint ETP**	**Direct Discharge**
☐ Production Process	☐	☐	☐
☐ Washing/Cleaning	☐	☐	☐
☐ Cooling Process	☐	☐	☐
☐ Sewerage	☐	☐	☐
☐ Recycled Water	☐	☐	☐
☐ Others ______	☐	☐	☐

Total Quantity

Final destination of Effluent ______________________

4.1.1 Proposed Effluent treatment Plant (ETP layout enclose Annexure -4A**)**

Treatment Capacity of ETP ______________ Mete rcube/day

Units of ETPt

Infrastructure	☐ Screening ☐ Oil-Water Separator	☐ Equalization ☐ Sedimentation	☐ Grit Removal ☐ ______
Chemical	☐ Absorption	☐ Disinfection	☐ pH Correction

	☐ Flocculation/ Coagulation ☐ Chemical Oxidation		☐ ________
Biological	☐ Sequenching batch reactor ☐ Biological Contactor ☐ Stabilization Pond	☐ Activated Sludge ☐ Trickling Filter ☐.....Digestion	☐ Aerated Lagoon ☐ , ________
Sludge Treatment	☐ Thickening ☐ Digestion	☐ Heat Drying ☐ Dewatering	☐ Burning in Brick field ☐
Others	☐ Ion exchange ☐ Activated Carbon adsorption	☐Membrane Filtration ☐ Septic tank &Soak well	☐ Reverse Osmosis

4.1.2 Sewerage disposal / Treatm,ent process(Sewerage treatment layout should be enclosed: Annexure 4B

Capacity ____________________

☐ Existing Sewerage line

☐ Self Sewerage treatment Plant

☐ Self Septic Tank & Soak well

☐ Others

4.1.3 Water purification system

o Chlorination o De Ionization

o Reverse Osmosis o Others

5.0 Drainage system(Enclose drainage lay out plan)

Type ☐ Open drain ☐ Covered /Underground design.

Where the drain will be connected ?

☐ Public drainage ☐ Canal/river ☐ others ________

6.0 Particulate matter and gaseous discharge

	Source	Types of particulate matter & Gaseous discharge				
		Particle		Particle		Particle

☐ Power Plant
☐ Own Generator
☐ Furnace
☐ Woven
☐ Varnish kettle
☐ Paint booth
☐ boiler

☐ incinerator
☐ Rotary kiln
☐ others

6.1 Gaseous discharge Management (Put tick mark on item which will be implemented.)

☐ Chimney ☐ Dust Collector ☐ Scrubber ☐ Exhaust Fan
☐ Toxic Gas Filtration ☐ Gas Absorption ☐ Cyclone (Duct, id fan and Stack)
☐ **Electrostatic Precipitator** ☐ Houses/Fabric Filtration ☐ Others, _____

7 Sound Pollution Control system(put tick mark on item which will be installed)

☐ Insulator
☐ Muffler
☐ Silencer
☐ Thick Wall
☐ Glasswool
☐ Canopy
☐ Others

8 Action to be taken againstOccupational Health Hazard (Put tick mark)

☐ Mask
☐ Safety Spectacle
☐ Gloves
☐ Gumboot
☐ Helmet
☐ Ear Plug
☐ Others

9.0 Impact assessment &Mitigation

Legend D – Direct impact In – Indirect impact
L – Long term impact S – Short term impact
R – Changeable I – Not changeable

9.1 Construction Phase

Possible Influence	Importance of Influence			Mitigation
	D/I n	L/S	R/I	

☐ Dust created due to land cleaning , civil work and earth work.				○ Regular spray of water on earthen road or open field/ land ○ Cleaning of Truck and other equipment from soil/mud nbefore leaving the project area ○ Transportation of goods covered by tripol on the truck ○ Temporary Fence around the construction area ○ Others
☐ Removal of soil due to construction of Road and other earth work				○ Storing top soil in a safe place and placing the same as top soil in the land fill area. ○ Planting trees in the construction area as soon as possible .
☐ Erosion of land due to soil removal and digging work .				○ Start construction work in dry season ○ Providing barrier net
☐ Siltation due to soil removal and open earth work				○ Building temporary silt trap/ digging pond ○ Piling up spoil soil at a distance place from drain ○ Use spoil soil for filling land
☐ **Pollution in nearest wet land due to removal construction waste .**				○ Making Temporary arrangement within construction area for disposal of waste and disposal of solid waste properly ○ Arranging adequate wash room ○ Proper disposal system & sanitation system to be followed by Contractor and workers
☐ **Employment**				○ Priority of Local peoples for employment
☐ **Increased number of accidents**				○ Following safety rules by the contractor and workers during construction period

9.2 Operation and Maintenance Phase

Probable impact	Significance of Impact			Mitigating / Enhancement Measures
	D/In	L/S	R/I	
☐ **Creation of problem for adjacent people and their wealth**				○ Keeping adequate buffer area ○ Planting trees in buffer area ○ Building side wall around the project ○ Others ______________
☐ **Air Pollution due to dust and smoke**				○ Taking measure to to avoid air pollution ○ Others______________
☐ **Surface / underground Water pollution due to household waste**				○ Workable septic tank and soak pit making ○ Installation of Right type of swerage treatment plant ○ Others ______________
☐ Surface /underground water pollution from factory's effluent				○ Appropriate effluent treatment Plant for industrial effluent ○ Others ______________
☐ **Environmental Pollution /workplace pollution due to toxic waste**				○ Dangerous /Toxic waste would be treated ○ Will be burnt in the incinerator ○ Will be preserved. ○ Others______________
☐ **Sound Pollution**				○ Necessary measures to be taken for controlling sound pollution (e.g Insulator, Muffler, Silencer) ○ Others______________
☐ Bad smell				○ Arranging perfect shield container, Masking agent etc ○ Others ______________
☐ **Vibration due to operation of machinery**				○ Arrangement for controlling vibration (e.g Shock Absorber, damper/isolator, Spring isolator) ○ Others______________

☐ Problem due to solid waste				○ Adequate measure to separate solid waste/ preserve solid waste ○ Arranging training for the worker on waste management. ○ Regular collection of waste as per environmental rule for disposal ○ Used Lead Acid battery to be returned to the specific dealer ○ Solid waste disposal in the particular dumpsite or sanitary landfill ○ Others ______________

10 Environmental management and monitoring plan (EMP)

Project program	Monitoring site	Monitoring parameter	Monitoring frequency	Responsible person for monitoring/ monitoring unit
Construction Example t Solid waste collection	Construction area	Wastage material	Weekly/Daily	
Operation Example t Solid waste produce Industrial effluent discharge Air pollution discharge Hazardous waste produce Working	Production/packaging/storage area Effluent treatment plant Air pollution discharge place/specify the place Production area Hazardous waste storage area Production area	Packaging material /Scraped weight pH, BOD, COD, Temp, TSS, TDS,SS etc SMP/ PM, NO_x, SO_x Quantity, Storage, Labeling Quantity, Storage, Labeling Light, air,	Daily Quarterly Quarterly Daily Daily Quarterly	

environment		humidity, sound, temperature		

11.0 Emergency Management

11.1 Probable Risk Situation

- ☐ Fire
- ☐ Explosive
- ☐ Death or seriously injury of workers for any harmful work
- ☐ Poisonous material or gas flow/discharge
- ☐ Harmful material discharge for environment
- ☐ Others

11.2 Protection of hazardus situation and steps taken for encountering the same

Risk situation	Steps taken for protection	Encountering/controling steps
Fire hazard	o Fire exite o Water store in the water tank or pond o Fire hydrent o Emergency light/pw-La o Regularly fire drill o Others, __________	o Quickly close the factory o Safe transfer of the worker o Contacting hospital/ civil defense authority o Others, _______
Risk situation	**Steps taken for protection**	**Encountering/controling steps**
Explosion	o Regular testing of machinary and equipments o Instalation of signaling instrument o Preparation of operation manual and providing traing on it o Arrenging safe place for transfer in case of emergance o First aid o Others, __________	o Quickly close the factory o Safe transfer of the worker o Providing required health service in a safe place o Contacting hospital/ civil defense authority o Others, _______
Discharge of Poisonous material or gas flow	o Regular testing of machinary and equipments o Instolation of automatic equipment and signal provide equipment when discharge of poisonous material or gas exeedes particular standards o Preparation of manual precotionary measures and providing training on it o Storing required medicine incase of discharge of poisonus material or gas o Others, __________	o Quick shut down of the plant o Safe transfer of the worker o Providing required health service in a safe place o Contacting hospital/ civil defense authority o Others, ____________

Discharge of liquid/ volatile mater endangering environment	o Regular chacking of discharge line o Regular monitoring and maintanance of ETP o Regular monitoring of air pollution instruments o keeping reagents and spare parts and alternative power suply o Others, ____________	o Quick shut down of the plant o To inform the DoE o To inform local authority o To provide compensation o Steps taken in consultation with DoE to reduce polution o Others, ____________
Death or injury of employees	o Implementation of automation system where possibility of death or injury exists o Preparation of training manual and providing training to reduce professional risk Others, ____________	o Primary health service o Quick transfer to hospital o Compensation as per low o Others, ____________
Others	o	o

12. Public Consultation

12.1 Have any public consultation for project program?

☐ Yes ☐ No

12.2 Public opinion after consultation (Name of the participants, address and minutes given in an annexure)

☐ Positive ☐ Negative ☐ Others, ____________

I hereby declare that information submitted in IEE form is true to my knowledge and no information has been hidden or distorted.

13.0 Annexe t

		Documents	**Yes**	**No**
1	Annexe-1	General map of project area	o	o
2	Annexe-2K	Lay out plan of Project	o	o
3	Annexe-2L	Map of beside the project area with distance	o	o
4	Annexe-2M	Photo of project area	o	o
5	Annexe-2N	Process flow diagram	o	o
6	Annexe-4K	Lay out of ETP	o	o
7	Annexe-4L	Sewage treatment plant/lay out of safety tank and soakwell	o	o
8	Annexe-5	Lay out plan of dranage system	o	o
9	Fill up IEE check list		o	o

Annex- 2: Initial Environmental Examination (IEE) checklist

Initial Environmental Examination (IEE) checklist

IEE Check list for Orange –B and Red category projects

Give information in the open space / put tick mark (✔) enclose necessary paper wherever necessary

1.0 General Information

1.1 Name of the Company t ______________________

a. Entrepreneurs Name t ______________________

b. Contact Address t ______________________

____

1.2 Name of the project t ______________________

____

. Location of the Industry t ______________________

____

b. Present address t ______________________

____

c. Telephone/ Fax t ______________________

d. E-mail t ______________________

Include detail map of the project showing road, canal, beel, river and key point Installations. Show General Map as annexure -1

2.0 Description of the proposed project

2.1 Total Amount invested t ______________________

2.2 Detail of Land used

Total Amount invested t ______________________

Detail of Land used ______________________

a. Total amount of Land under project ______________________ Square meter

b. Amount of land developed

1. 2. 3 2. **Use of land in the prposed project**

2.3.1 Present use of land

2.3.2 Use of land within radius of 1 km :

2.3.3 Width of nearest main road from the **Meter**

project

2.3.4 Items situated within one kilometer distance of the project

o Wetland	o Natural Stream	o Flood control project	o Forest
o Park/playground	o Hill/Hillock	o Others	o Residential Area

2.3.5 Items situated within 500 meter distance

o Historical Place	o Military installations	o Special area	o Environmentally critical Area
o Key Point Installation	o Hospital/Clinic	o Educational Institutions	o Restricted Area
o Air Polluting Industry	o Residential Area	o Food Silo	o Others

2.3.6 Project site

North

South

East

West

3. **2.4** Description of Project Phases

2.4.1 Construction Phase

2.4.1.1 Building for the project

☐ **To be constructed** ☐ Rented

4.	Use of different floors of building	Number of Floor	Area of Floor (square Meter)
☐	Administrative/ Office	5.	
☐	Factory/Production program		
☐	Raw Materials warehouse		
☐	Resthouse /Day care		
☐	Canteen		
☐	Toilet Facility		
☐	6. Effluent Treatment Plant		
☐	Water Treatment Plant		
☐	Generator		
☐	Toxic waste store		
☐	Solid waste store		
☐	Others		

2.4.1.2 Services for Building Construction

a) Water

Source ______________________ Daily consumption t ____________ Cubic meter

b) **Power**

Sourcet ______________________ Daily Consumption ____________ KWH

2.4.2 Operation Phase

2.4.2.1 Factory production Program/Process Description (Use extra page and enclose Flow diagram as Annexure :2D

____

2.4.2.2 Time of factory operation t

Average ____________ Hour/Day ____________ Day/Week

Maximum ____________ Hour/Day ____________ Day/Week

2.4.2.3 Raw material and Final product (List of all the raw materials and chemicals use for production process and extra page may be used, if required)

Raw material	Source of raw material	Quantity (Yearly)

2.4.2.4 Production capacity (List of all the products and extra page may be used, if required)

Final product	Quantity (Yearly)

2.4.2.5 Description of manpowert

Administrative : ______________________

Production process : ______________________

Environmental management : ______________________

Total : ______________________

2.4.2.6 Description of machinery and equipment t (Provide list of all the machinery and equipment and extra page may be used, if required)

machinery and equipment	Quantity
7.	

2.4.2.7 Power supply

	Supplier	Production capacity (kVA)	Demand (kW)
o	National power grid line		
o	Own generator		
o	Others	8.	

2.4.2.8 Water supply

Source		Description	Water consumption	
			Residence	Industry
o	Supply water	___	___	___
o	Surface water	___	___	___
o	Won Deep tube well	___	___	___
o	Recycled water	___	___	___
o	Others	___	___	___

2.4.2.8 Fuel Supply (gas/coal/furnace oil etc)

Source t ____________________ Daily consumption t ____________ m^3/ton/lit

3.0 List of industrial waste (Identification waste during production process)

- ☐ Acidic waste (Example t Hydrochloric acid, Sulfuric acid, Nitric acid etc)
- ☐ 9. Alkaline waste (NaOH, KOH, alkaline cleaner etc)
- ☐ Asbestos waste
- ☐ Ceramic/mineral waste
- ☐ Polluted container (Previously used for chemicals and paints)
- ☐ Chemical fertilizer/ pesticide waste
- ☐ Raw waste
- ☐ Fixed waste (Solidified, Chemically fixed and encapsulated waste¨)
- ☐ Inorganic chemical waste (Example: Arsenic, copper, cadmium etc)
- ☐ Waste from leather
- ☐ Metallic waste
- ☐ Oil (Example: waste oil, oil/mixed with water)
- ☐ Organic sludge
- ☐ Organic solution (Example: Helogenated, aliphatic, aromatic compound)
- ☐ Dye/Ink/Paint waste
- ☐ Paper waste
- ☐ Pathogenic / infectious waste
- ☐ Pharmaceutical waste
- ☐ Plastic waste
- ☐ Electroplating waste
- ☐ Rotten waste (Example: Grease trap, animal waste)

- ☐ Reactive chemical waste (Example: Explosive, Reducing and oxidizing agent)
- ☐ Resin/ Lattice / Adhesive
- ☐ Rubber waste
- ☐ Styrofoam waste
- ☐ Tannery waste
- ☐ Textile waste
- ☐ Others

10. **4.0** **Liquid effluent t** (source of liquid effluent, nature of pollution and approximate quantity and use extra page if necessary)

11. source of liquid effluent	12. approximate quantity	13. nature of pollution **Poisonous**	**nonpoisonous**
☐ 14. Production process	______	☐	☐
☐ 15. washing/cleaning	______	☐	☐
☐ cooling	______	☐	☐
☐ Residential swages	______	☐	☐
☐ Retreating water	______	☐	☐
☐ others ______	______	☐	☐

4.1 Treatment Process of Effluentt

16. **Source of Effluent**	17. **EffluentTreatment Process** **Own ETP** 1!	19. **Joint ETP** 2(	21. **Direct Discharge**
☐ 22. Production Process	☐	☐	☐
☐ 23. Washing/Cleaning	☐	☐	☐
☐ Cooling Process	☐	☐	☐
☐ Sewerage	☐	☐	☐
☐ Recycled Water	☐	☐	☐
☐ Others ______	☐	☐	☐

Total Quantity

24. Final destination of Effluent 25. ______

4.1.1 Proposed Effluent treatment Plant (ETP layout enclose Annexure -4A**)**

Treatment Capacity of ETP ______ Meter cube/day

Units of ETPt

Infrastructure	☐ Screening ☐ Oil-Water Separator	☐ Equalization ☐ Sedimentation	☐ Grit Removal ☐ ______
Chemical	☐ Absorption ☐ Flocculation/ Coagulation	☐ Disinfection ☐ Chemical Oxidation	☐ pH Correction ☐ ______

Biological	☐ Sequenching batch reactor ☐ Biological Contactor ☐ Stabilization Pond	☐ Activated Sludge ☐ Trickling Filter ☐.....Digestion	☐ Aerated Lagoon ☐ , ________
Sludge Treatment	☐ Thickening ☐ Digestion	☐ Heat Drying ☐ Dewatering	☐ Burning in Brick field ☐ ________
Others	☐ Ion exchange ☐ Activated Carbon adsorption	☐Membrane Filtration ☐ Septic tank &Soak well	☐ Reverse Osmosis

4.1.2 Sewerage disposal / Treatm,ent process(Sewerage treatment layout should be enclosed: Annexure 4B

Capacity ________________________________

☐ Existing Sewerage line

☐ Self Sewerage treatment Plant

☐ Self Septic Tank & Soak well

☐ Others

4.1.3 Water purification system

26. o Chlorination 27. o 28. De Ionization

o Reverse Osmosis o Others

5.0 Drainage system(Enclose drainage lay out plan)

Type ☐ Open drain ☐ Covered /Underground design.

Where the drain will be connected ?

☐ Public drainage ☐ Canal/river ☐ others ________

29. **6.0 Particulate matter and gaseous discharge**

	Source	Types of particulate matter & Gaseous discharge					
		Particle		Particle		Particle	
	☐ 30. Power Plant	31.	32.	33.	34.	35.	36.

☐ Own Generator

☐ Furnace

☐ Woven

☐ Varnish kettle

☐ Paint booth

☐ boiler

☐ incinerator

☐ Rotary kiln

☐ others

37.

6.1 Gaseous discharge Management (Put tick mark on item which will be implemented.)

38.

☐ Chimney ☐ Dust Collector ☐ Scrubber ☐ Exhaust Fan
☐ Toxic Gas Filtration ☐ Gas Absorption ☐ Cyclone (Duct, id fan and Stack)
☐ **Electrostatic Precipitator** ☐ Houses/Fabric Filtration ☐ Others, ____

39.

7 Sound Pollution Control system(put tick mark on item which will be installed)

40.

- ☐ 41. Insulator
- ☐ Muffler
- ☐ Silencer
- ☐ Thick Wall
- ☐ Glasswool
- ☐ Canopy
- ☐ Others

42.

8 Action to be taken against Occupational Health Hazard (Put tick mark)

43.

- ☐ 44. Mask
- ☐ Safety Spectacle
- ☐ Gloves
- ☐ Gumboot
- ☐ Helmet
- ☐ Ear Plug
- ☐ Others

45.

9.0 Impact assessment &Mitigation

Legend D – Direct impact 46. In – Indirect impact
L – Long term impact S – Short term impact
R – Changeable I – Not changeable

9.1 Construction Phase

Possible Influence	**Importance of Influence**			**Mitigation**
	D/In	L/S	R/I	
☐ Dust created due to land cleaning , civil work and earth work.				○ Regular spray of water on earthen road or open field/ land ○ Cleaning of Truck and other equipment from soil/mud nbefore leaving the project area ○ Transportation of goods covered by tripol on the truck ○ Temporary Fence around the construction area ○ Others
☐ Removal of soil due to construction of Road and other earth work				○ Storing top soil in a safe place and placing the same as top soil in the land fill area. ○ Planting trees in the construction area as soon as possible .

☐ Erosion of land due to soil removal and digging work .				○ Start construction work in dry season ○ Providing barrier net
☐ Siltation due to soil removal and open earth work				○ Building temporary silt trap/ digging pond ○ Piling up spoil soil at a distance place from drain ○ Use spoil soil for filling land
☐ **Pollution in nearest wet land due to removal construction waste .**				○ Making Temporary arrangement within construction area for disposal of waste and disposal of solid waste properly ○ Arranging adequate wash room ○ Proper disposal system & sanitation system to be followed by Contractor and workers
☐ **Employment**				○ Priority of Local peoples for employment
☐ **Increased number of accidents**				○ Following safety rules by the contractor and workers during construction period

9.2 Operation and Maintenance Phase

Probable impact	**Significance of Impact**			**Mitigating / Enhancement Measures**
	D/In	L/S	R/I	
☐ **Creation of problem for adjacent people and their wealth**				○ Keeping adequate buffer area ○ Planting trees in buffer area ○ Building side wall around the project ○ Others _____________
☐ **Air Pollution due to dust and smoke**				○ Taking measure to to avoid air pollution ○ Others_____________
☐ **Surface / underground Water pollution due to household waste**				○ Workable septic tank and soak pit making ○ Installation of Right type of swerage treatment plant ○ Others _____________
☐ Surface /underground water pollution from factory's effluent				○ Appropriate effluent treatment Plant for industrial effluent ○ Others _____________
☐ **Environmental Pollution /workplace pollution due to toxic waste**				○ Dangerous /Toxic waste would be treated ○ Will be burnt in the incinerator ○ Will be preserved. ○ Others_____________
☐ **Sound Pollution**				○ Necessary measures to be taken for controlling sound pollution (e.g Insulator, Muffler, Silencer) ○ Others_____________
☐ Bad smell				○ Arranging perfect shield container, Masking agent etc Others

☐ **Vibration due to operation of machinery**				○ Arrangement for controlling vibration (e.g Shock Absorber, damper/isolator, Spring isolator) ○ Others____________
☐ Problem due to solid waste				○ Adequate measure to separate solid waste/ preserve solid waste ○ Arranging training for the worker on waste management. ○ Regular collection of waste as per environmental rule for disposal ○ Used Lead Acid battery to be returned to the specific dealer ○ Solid waste disposal in the particular dumpsite or sanitary landfill ○ Others ____________

10 Environmental management and monitoring plan (EMP)

Project program	Monitoring site	Monitoring parameter	Monitoring frequency	Responsible person for monitoring/ monitoring unit
Construction Example t Solid waste collection	Construction area	Wastage material	Weekly/Daily	
Operation 47. Example t Solid waste produce Industrial effluent discharge Air pollution discharge Hazardous waste produce Working environment	 Production/packaging/storage area Effluent treatment plant Air pollution discharge place/specify the place Production area Hazardous waste storage area Production area	 Packaging material /Scraped weight pH, BOD, COD, Temp, TSS, TDS,SS etc SMP/PM, NO_x, SO_x Quantity, Storage, Labeling Quantity, Storage, Labeling Light, air, humidity, sound, temperature	 Daily Quarterly Quarterly Daily Daily Quarterly	

11.0 Emergency Management

11.1 Probable Risk Situation

- ☐ 48. Fire
- ☐ Explosive
- ☐ Death or seriously injury of workers for any harmful work
- ☐ Poisonous material or gas flow/discharge
- ☐ Harmful material discharge for environment
- ☐ Others

11.2 Protection of hazardus situation and steps taken for encountering the same

Risk situation	Steps taken for protection	Encountering/controling steps

Fire hazard	o Fire exite o Water store in the water tank or pond o Fire hydrent o Emergency light/pw-La o Regularly fire drill o Others, _________	o Quickly close the factory o Safe transfer of the worker o Contacting hospital/ civil defense authority o Others, _______
Risk situation	**Steps taken for protection**	**Encountering/controling steps**
Explosion	o Regular testing of machinary and equipments o Instalation of signaling instrument o Preparation of operation manual and providing traing on it o Arrenging safe place for transfer in case of emergance o First aid o Others, _________	o Quickly close the factory o Safe transfer of the worker o Providing required health service in a safe place o Contacting hospital/ civil defense authority o Others, _______
Discharge of Poisonous material or gas flow	o Regular testing of machinary and equipments o Instolation of automatic equipment and signal provide equipment when discharge of poisonous material or gas exeedes particular standards o Preparation of manual precotionary measures and providing training on it o Storing required medicine incase of discharge of poisonus material or gas o Others, _________	o Quick shut down of the plant o Safe transfer of the worker o Providing required health service in a safe place o Contacting hospital/ civil defense authority o Others, ____________
Discharge of liquid/ volatile mater endangering environment	o Regular chacking of discharge line o Regular monitoring and maintanance of ETP o Regular monitoring of air pollution instruments o keeping reagents and spare parts and alternative power suply o Others, ____________	o Quick shut down of the plant o To inform the DoE o To inform local authority o To provide compensation o Steps taken in consultation with DoE to reduce polution o Others, ____________
Death or injury of employees	o Implementation of automation system where possibility of death or injury exists o Preparation of training manual and providing training to reduce professional risk Others, ____________	o Primary health service o Quick transfer to hospital o Compensation as per low o Others, ____________
Others	o	o

12. Public Consultation

12.1 Have any public consultation for project program?

☐ Yes ☐ No

12.2 Public opinion after consultation (Name of the participants, address and minutes given in an annexure)

☐ Positive ☐ Negative ☐ Others, ____________

I hereby declare that information submitted in IEE form is true to my knowledge and no information has been hidden or distorted.

13.0 Annexe t

		Documents	Yes	No
1	Annexe- 1	General map of project area	o	o
2	Annexe-2K	Lay out plan of Project	o	o
3	Annexe-2L	Map of beside the project area with distance	o	o
4	Annexe-2M	Photo of project area	o	o
5	Annexe-2N	Process flow diagram	o	o
6	Annexe-4K	Lay out of ETP	o	o
7	Annexe-4L	Sewage treatment plant/lay out of safety tank and soakwell	o	o
8	Annexe-5	Lay out plan of dranage system	o	o
9	Fill up IEE check list		o	o

Annex 3: IEE Report

SUMMIT BIBIYANA POWER CO. LTD. 1 & 2
(SBPCL 1 & 2)

Initial Environmental Examination (IEE) Report

for

Bibiyana Power Project 1 & 2

Prepared by

Bangladesh Centre for Advanced Studies

Submitted : 15 March, 2011

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TABLE OF CONTENTS

List of Acronyms

APSCL	:	Ashuganj Power Station Company Ltd.
AQM	:	Air Quality Monitoring
BBS	:	Bangladesh Bureau of Statistics.
BOT	:	Build, Operate and Transfer
BOI	:	Board of Investment
BCAS	:	Bangladesh Centre for Advanced Studies
BERC	:	Bangladesh Energy Regulatory Commission
BPDB	:	Bangladesh Power Development Board
CCGT	:	Combined Cycle Gas Turbine
CCPP	:	Combined Cycle Power Plant
DESA	:	Dhaka Electric Supply Association.
DESCO	:	Dhaka Electric Supply Company
DOE	:	Department of Environment
GOB	:	Government of Bangladesh
GNI	:	Gross National Income.
GDP	:	Gross Domestic Products
IFC	:	International Finance Corporation
MPEMR	:	Ministry of Power Energy & Mineral Resources.
MW	:	Mega Watt
MOF	:	Ministry of Finance
NEP	:	National Energy Policy
NGO	:	Non Government Organization.
N2	:	National Hyghway-2
PPA	:	Power Purchase Agreement
PDB	:	Power Development Board
RE	:	Renewable Energy
REB	:	Rural Electrification Board.
SBC	:	Sadharan Bima Corporation
SBPCL 1 & 2	:	Summit Bibiyana Power Co. Ltd. 1 & 2
SBU	:	Strategic Business Units
WZPDCL	:	West Zone Power Distribution Company.

1. Introduction

This Initial Environmental Examination (IEE) report has been prepared in respect of the proposed development of the Bibiyana I and SPBCL II Power Plants; it is noted that only the SBPCL II Power Plant is the focus of the ESIA to which this IEE accompanies.

This IEE has been based on the findings of a reconnaissance study on the baseline environmental and socio-economic conditions pertaining to the project area proposed to accommodate two combined cycle gas turbine power plants (Bibiyana-1 and Bibiyana-2) proposed by Summit Bibiyana Power Co. Ltd. 1 & 2 (SBPCL 1 & 2) at Bibiyana in the village Parkul, union Aushkandi, upazilla Nabiganj of the district of Habiganj. Each power plant will have an individual generation capacity of 351MW and the whole project comprising the two plants will have a combined generation capacity of 682 MW (341MW × 2). The proposed project site is situated in an area to the south of the river Kushiyara at Bibiyana of the district of Habiganj.

1.1 Background of the Project

The Summit Bibiyana Power Co. Ltd. 1 & 2 (SBPCL 1 & 2) originally proposed to set up two Combined Cycle Turbine power plants at Bibiyana as per decision of the Government toward awarding the task in favour of the proponent. SBPCL II now, seeks to construct and operate one combined cycle gas-turbine power plant (SBPCL II Power Plant) at Bibiyana in the district of Habiganj about 180 kms north-east of the capital city Dhaka. The information provided in this IEE is considered to remain valid to provide baseline context and an initial environmental examination of the effects pertaining to the SPBCL II Power Plant.

1.2 Existing Power Scenario in Bangladesh

There has been quite an enormous demand of power in Bangladesh, specifically, in the sectors of industry, agriculture, utility service, households, etc. The demand, over the years, has attained an insurmountable dimension as the supply positions continue to fail gradually and ever-increasingly to meet all the more ever-increasing demand. Coming-in of various industrial activities in a previously not-so-much industrialized country like Bangladesh, cropping up high-rise industrial as well as residential complexes, manifold diversification of power consumption, etc., compared to the limited and insufficient growth of the power sector till date, have been the reason behind the present-day power crisis in the country. Government sponsored conventional power generation and distribution system alone is incapable of overcoming the prevailing trend of power crisis within a short period, while the demand position warrants immediate action. A public-private partnership is, hence, adopted toward meeting the power crisis and, hence, keeping the pace of economic development unhindered. The Bangladesh Power Development Board (BPDB) has been the only agency in the government sector for production of power and its sale and distribution to household, office, agriculture, industrial and various other purposes. The situation pertaining to the power sector under BPDB is as under.

Table-1.1: Situation of the Power Sector under BPDB

Power production	
Installed capacity	MW
01. BPDB	3,945
02. IPP and Mixed	1,290

Total	*5,275*
Highest power supply	
01. BPDB	2,591
02. IPP and Mixed	1,221
Total	*3,812*
Power Transmission	KM
01. 230 KV	1,466
02. 132 KV	5,502
Total	*6,968*
Power Distribution	
Distribution Line (33 KV, 11 KV, 0.4 KV)	45,644 KM
Total Customer	2.503 Million
Electrified Villages	46,523
Per capita power production	170 KWH

Source: *Bangladesh Economic Research, 2007*
Finance Division, Ministry of Finance and Planning
Government of the People's Republic of Bangladesh.

Production of power in the country during various periods has been as under.

Table-1.2: Production of power during various periods

Period	Installed Capacity	Highest production (MW)	Dependable capacity (MW)
1995-96	2,908	2,087	2,105
1996-96	2,908	2,114	2,148
1997-98	3,091	2,136	2,320
1998-99	3,611	2,449	2,850
1999-00	3,711	2,665	2,665
2000-01	4,005	3,033	3,033
2001-02	4,230	3,218	3,300
2002-03	4,710	3,458	3,600
2003-04	4,710	3,622	3,700
2004-05	5,025	3,751	3,900
2005-06	5,275	3,812	4,150
2006-07 (December 2006)	5,275	3,587	4,150

Source: Bangladesh Economic Research, 2007 Finance Division, Ministry of Finance and Planning Government of the People's Republic of Bangladesh.

The implementation scenario of power projects are as under.

Table-1.3: Installation of Power Plants

Sl No.	Name of the power project	Capacity (MW)	Proposed operation time
	Government Sector		
01.	210 MW Siddhirganj Thermal Power Plant	210	2009-10
02.	Sirajganj 150MW Gas Turbine	150	2009-10
03.	Sikolbaha 225MW Combined Cycle	225	2009-10
04.	Khulna 150 Peaking Plant	150	2009-10
05.	Bhola 150 MW Combined Cycle	150	2009-10
06.	Sylhet 150 MW Combined Cycle	150	2009-10

Sl No.	Name of the power project	Capacity (MW)	Proposed operation time
07.	Siddhirganj 2x120 MW Peaking Power Plant	240	2008-09
08.	Siddhirganj 2x150 MW Gas Turbine Power Plant	300	2009-10
09.	Chandpur 150 MW Combined Cycle Power Plant	150	2008-09
10.	Sikolbaha 150 MW Gas Turbine	150	2008-09
	Private Sector		
11.	Baghabari (Westmont) 40 MW Combined Cycle Power Plant	40	2007
12.	Baghabari (Westmont) 130 MW Combined Cycle Power Plant	130	2008-09
13.	Sirajganj 450 MW Combined Cycle Power Plant	450	2009-10
14.	Meghnaghat 450 MW Combined Cycle Power Plant (2nd)	450	2008-09
15.	Meghnaghat 450MW Combined Cycle Power Plant (3rd)	450	2009-10
16.	SPP	90	2008

Source: *Bangladesh Economic Research, 2007, Finance Division, Ministry of Finance and Planning, Government of the People's Republic of Bangladesh.*

As has been said earlier elsewhere, the demand-supply gap in the power sector of the country is significantly high and has been widening over time due to all the more ever-increasing demands are put on. Besides the existing agricultural and still coming up household sector, the demand being put on by the industrial sector is virtually unlimited. Such a situation compels coming up new projects to have their own power system. The existing power scenario of the country, thus, presents the above demand situation as tremendous compounded by the fact that more than 95% of the rural population is still beyond the reach of the power grid. The government, however, envisages an ambitious plan to reach the power facilities to 100% of the population by 2025.

The peak power demand in Bangladesh is varied between 2400 MW and 2600 MW. At present PDB can meet about 2000-2200 MW of power. That is whey there is always a shortage of about 400 to 600 MW of power during peak demand. Generally REB and subsequently PBS suffers due to this shortage of load. The electricity distributed through the PBS's is about 15 percent of combined country-wide sales of power by the Bangladesh Power Development Board (BPDB) and Dhaka Electric Supply Authority (DESA). The Government considers this to be insufficient and wishes to extend the share of the PBS's. There are at present 54 PBS's under REB in the country and their daily demand are 400 MW of power, which PDB is constrained to meet during peak time.

It is observed from the daily load curve that the load management has not been very effective and there is predominant peak during the evening hours. Bangladesh is gradually shifting to industrialization and this growth is certain, if security of supplies and load shedding can be avoided. In this context, the proposed installation of 22 MW natural gas-fired power plant at Narsingdi becomes a necessity. Such a power plant would improve the existing power scenario both locally in particular and nationally, in general.

Proper location/siting, the process ionvolved and waste abatement as well as control are among the very important aspects for a project to be environmentally sound. In tackling environmental issues arising out of any project or activity or anticipated of any proposed project or activity are being taken care of by the concerned various sectoral agencies through their respective legislations, rules and regulations. Policies, strategies being adopted on the general and overall environment conservation and also on sectoral issues – have given paramount importance by the government toward imparting sustainability to various undertakings for the welfare of the country, economy and the people at large. Sustainable development is therefore the corner stone of the policies and procedures regarding Industrial or any other development activities in Bangladesh. As such the proposed combined cycle power generation projects – Bibiyana-1 and Bibiyana-2 – need to comply with all the relevant national legislation, in general and, in particular, to the Environment Conservation Act, 1995 (ECA, ’95) and Environment Conservation Rules, 1997 (ECR, ’97). The environmental legislation encompasses laws relating to the protection of environmental health, the control of pollution, and conservation of wildlife and natural resources.

1.3 Nature and Objective of the Study

The study has been based on the environmental and socio-economic perspectives of the project site and that of the area with 10km airshed and command area and the significant impacts of the SBPCL 1 & 2 proposed power plant project anticipated upon the existing environmental and socio-economic system pertaining to the project command area. Broad objective of this study has been to provide a basis for detailed assessment of the identified environmental and socio-economic impacts of the proposed power plant project toward undertaking mitigation measures to minimize adverse impacts and enhancement measures of beneficial impacts, formulate environmental management and monitoring plans and plans for addressing health and safety issues.

The specific objectives of this IEE are to:

- Present a general description of the project and the process;
- Present a description of the pre-project environment;
- Delineate the anticipated 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 Terms of Reference for detailed Environmental Impact Assessmen in the project area with Environmental Management and Monitoring Plan.

1.4 Consistency with Bangladesh Environment Conservation Act, Rules and Guidelines

Environment Conservation Act 1995 (ECA’95) is currently the main legislative document relating to environmental protection in Bangladesh. Under this act, ‘No industrial unit or project shall be established or adopted without obtaining environmental clearance, in the manner prescribed by the rules, from Director General’. Compliance with the provision of this Act is the responsibility of Department of Environment (DOE). A set of the relevant rules to implement the ECA, 95 has been made available through the Environment Conservation Rules, 1997 (ECR, ‘97). The rules under ECR, ‘97 mainly consist of :

- Categorized list (green, orange and red) of the projects;
- Application format to take environmental clearance;
- Ambient standards in relation to water pollution, air pollution and noise, as well as permitted discharge/emission levels of water and air pollutants and noise by industries.

In the light of categorization made under the above ECR, ’97, the SBPCL 1 & 2 proposed Combined Cycle Gas Turbine Power Plant project at Bibiyana falls under the ‘Red’ category. The rules also incorporate “inclusion lists” of projects requiring varying degrees of environmental investigation e.g. all the new projects under red category generally will require two-steps assessment procedure, firstly an Initial Environmental Examination (IEE) for site clearance, and secondly, if warranted, a full Environmental Impact Assessment (EIA) for technical clearance. This has been carried out as part of fulfilling the requirements of ECR, ’97 toward obtaining ‘Site Clearance’ in favor of the proposed project from DOE.

1.5 Scope of Work

Scope of work included : (i) conducting a baseline environmental study for the proposed plant site, (ii) performing an initial environmental impact assessment for the two gas-fired, combined cycle plants at the proposed site to provide a basis of assessing socio-economic impacts of constructing these power plant at the proposed site.

Details of the scope of work pertaining to the study had been as under:

i. Establishment of the environmental and social baseline conditions of the Project.
ii. Carrying out of the Initial Environmental Examination (IEE) for Bibiyana1 and Bibiyana 2 power projects as per IEE format prescribed by the Department of Environment (DOE).

1.6 Methodology

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

- Confirmation of survey/monitoring data in the baseline study carried out by BCAS in 2009. A rapid field survey was carried out to update the baseline study.
- Understanding the technical aspects of the proposed power plants;
- Identification of potential environmental impacts, residual impacts (if any) and evaluating the consequences. Identification of impacts was done using Checklists method.

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.

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 Standard 1 besides following the guidelines set forth by DOE.

1.7 IEE Team

The IEE Team comprised the following:

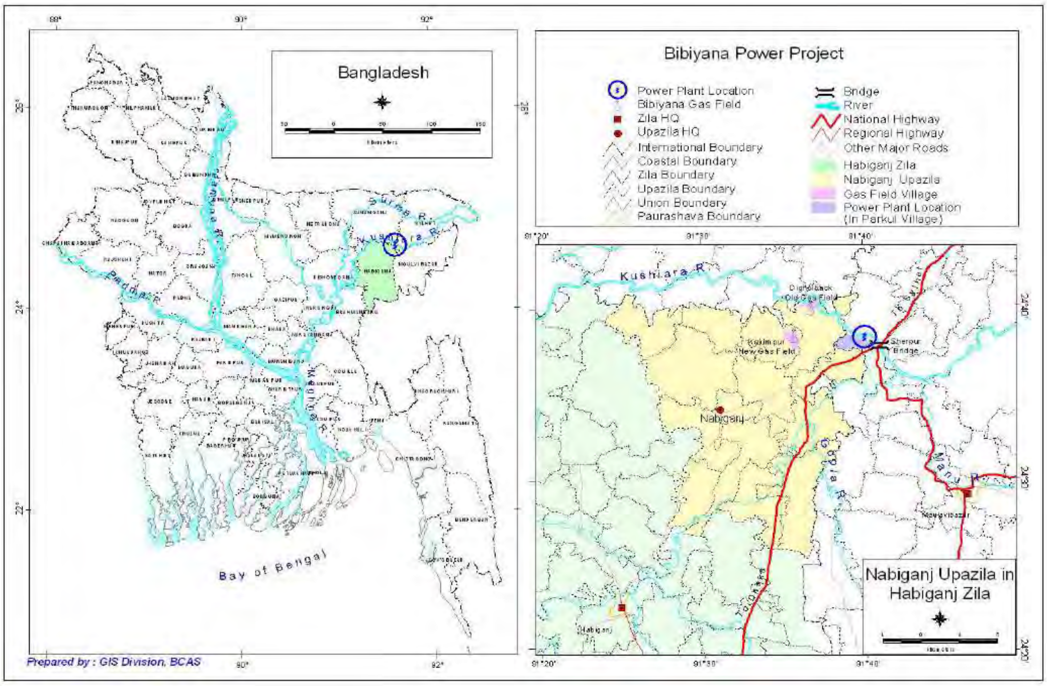
i.	Dr. M. Eusuf, Air Dispersion Modeling Expert	Team Leader
ii.	Syed Md. Iqbal Ali, EIA and Resettlement Expert	Member
iii.	Dr. Moinul Islam Sharif, Energy Expert	Member
iv.	Mr. Ahmed Al Farouq, IEE/EIA Expert	Member
v.	Mr. Khandaker Mainuddin, Socio-economic Expert	Member
vi.	Ms. Olena Reza, Gender Expert	Member
vii.	Dr. J. C. Shaha, Air Quality Monitoring Expert	Member
viii.	Mr. M. A. Mahmood, Mechanical Engineer	Member
ix.	Mr. Ikbal Hossain, Water Modelling Expert	Member
x.	Mr. Md. Osman Goni Shawkat, Field Coordinator	Member
xi.	Mr. Md. Belayet Hossain, Public Consultation Expert	Member
xii.	Ms. Mirza Arifah Ahmed, Landuse and GIS Expert	Member
xiii.	Mr. Ikbal Hossain, Hydrology and survey expert	Member
xiv.	Ms. Ismot Ara, GIS Analyst	Member
xv.	Mr. Md. Mizanur Rahman, Field Surveyor	Member
xvi.	Ms.Syeda Meherunnesa Afsana, Data entry operator	Member
xvii.	Mr. Md. Shahid Hossain, Local Assistant	Member

xviii. Mr. Rohel Ahmed, Local Assistant Member

2. Description of Project Site

2.1 Geographic Location

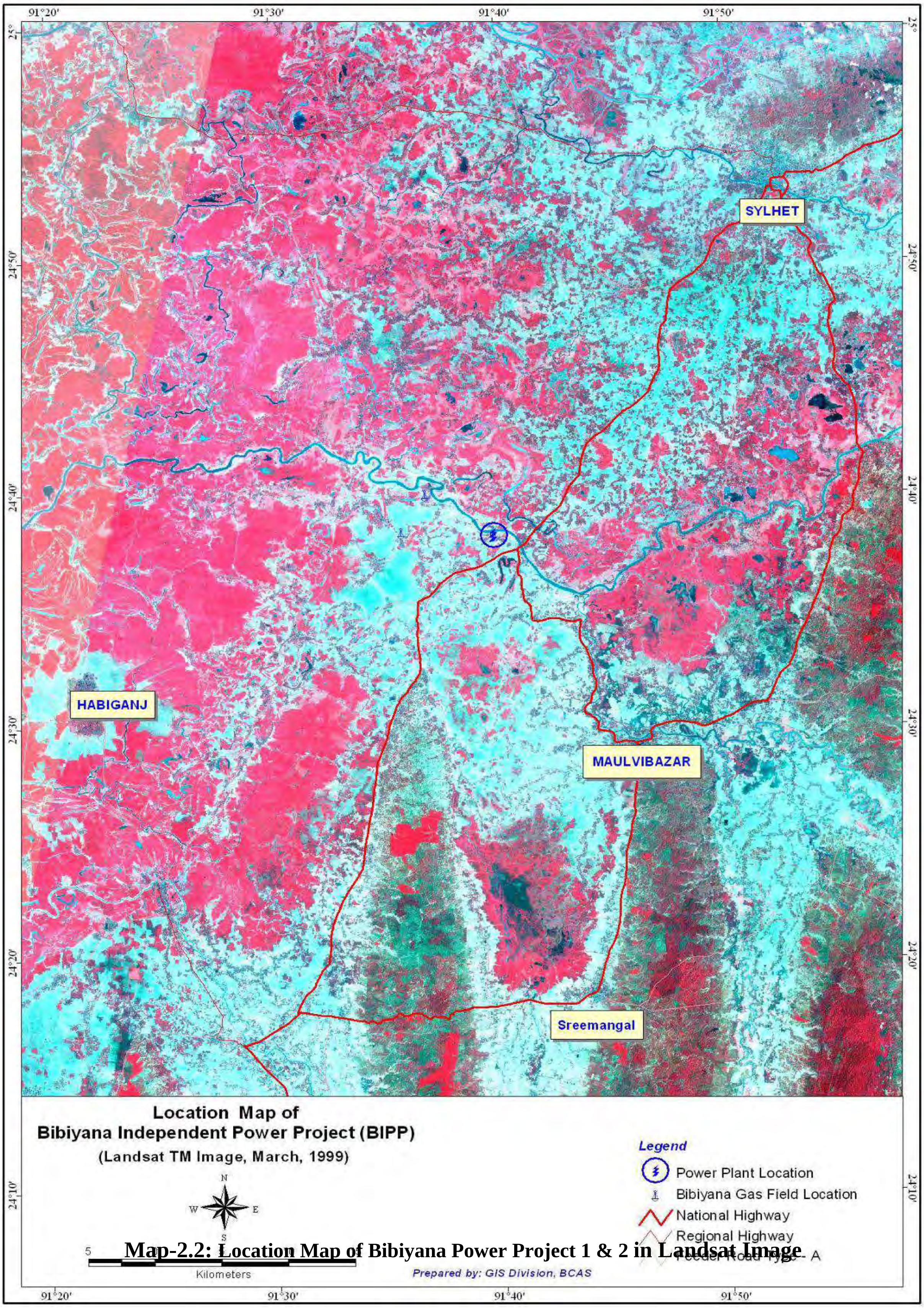
The site proposed for Bibiyana Power Project 1 & 2 by SBPCL 1 & 2 for accommodating two 450MW combined cycle gas-turbine power plants is located at 91° 39′ 37″ E. longitude and 24° 38′ 18″ N. latitude on the south bank of the river Kushiyara. The site is about 2 kms from the Sherpur Bridge point to the west of the Dhaka - Sylhet National Highway N2, about 180 kms north-east of Dhaka and about 45 kms south-west of Sylhet district headquarters. Administratively, it is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of Habiganj district (Project location Map shown in Map – 2.1 & Map – 2.2). Buffer area within 2km and 10km of the airshed and command area radii of the project location is shown in Map – 2.3.



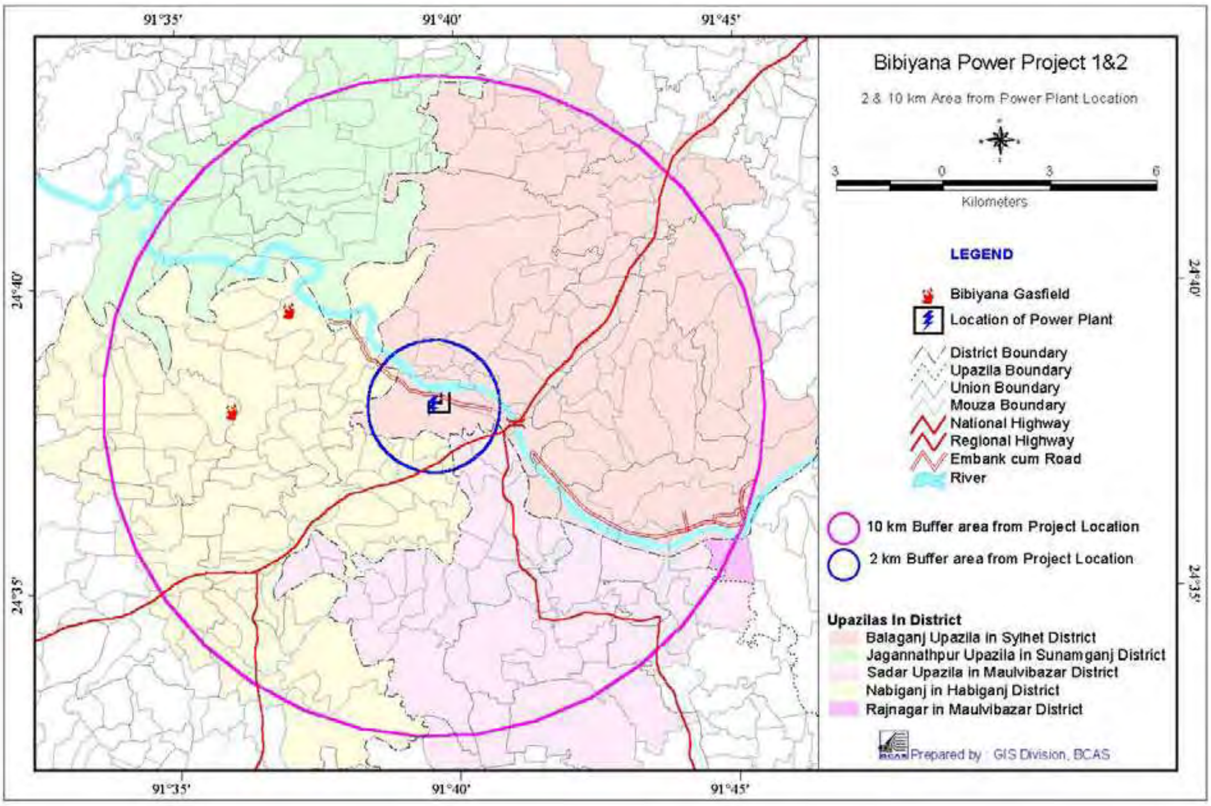
Map-2.1: Location Map of Bibiyana Power Project 1 & 2

2.2 Means of Access

The proposed site of the Bibiyana Power Project 1 & 2 is at about 2km mud road distance from the Sherpur Bridge point of the Dhaka-Sylhet highway N2. Therefore, the power project site can be reached by road from Dhaka or from Sylhet. Sylhet is also linked with Dhaka by air and railway services. Significant volumes of heavy goods can also transported by the river, which passes by northern side of the project location.



Map-2.2: Location Map of Bibiyana Power Project 1 & 2 in Landsat Image



Map – 2.3: Buffer area within 2km and 10km Airshed and Command Area radii of Project Location

Photograph of the project area appears at Annex-1.

3. Description of the Proposed Project

3.1 General Information

General information pertaining to Bibiyana-1 and Bibiyana-2 Combined Cycle Gas Turbine Power Plant Project is as under:

1)	Name of the Entrepreneur	Summit Bibiyana Power Co. Ltd
2)	Address of Correspondence	Summit Centre, 18 Karwan Bazar C/A, Dhaka 1215
3)	Name of the Project	Bibiyana Power Project 1 & 2
4)	Locational Address of the Project	Bibiyana (on the south bank of river Kushiyara; 2km west of Dhaka-Sylhet National Highway, N2 from Sherpur Bridge point), Vill. – Parkul, Union – Aushkandi, Upazilla – Nabiganj, Diistrict – Habiganj
5)	Geographic Location	91°39′37″ E Longitude and 24°38′18″ N Latitude
6)	Current Office Address	Summit Centre, 18 Karwan Bazar C/A, Dhaka 1215
7)	Telephone/Fax	Tel: (880 2)9130845 (8 Lines); Fax: (880 2) 9130853-54.
8)	Email	sumgrp@summit-centre.com

3.2 Project Description

Total invested amount toward the proposed Bibiyana Power Project 1 & 2 has been US$ 270m on a land acquired for the purpose measuring 63 acres at the project site. The entire 63 acres of the acquired land will be developed as per the drawn out Layout Plan (Annex-). Number of manpower at the height of the project (during construction phase) will be 1000; while during operation phase, it will be 40. Land use type within 1km radius of the proposed project area has been a mix of agricultural, homesteads and fallow.

Details of areas surrounding the proposed project site are as under:

- North: Homesteads, agricultural land, river Kushiyara
- East Dhaka-Sylhet National Highway N2, homesteads, agricultural land
- South Agricultural land, Dhaka-Sylhet National Highway N2
- West Agricultural land, homesteads.

3.3 Technological Specification

The proposed Bibiyana Power Project 1 & 2 will consist of two combined-cycle gas-turbine power generation plants each with a combined gross capacity of 682MW. The plants will run on natural gas from Bibiyana gas field situated at about 7 kms from the site. Specifications mentioned below are indicative. However, these figures will be updated and corresponding accurate figures in respect of stack height and other parameters will be provided during the full-scale EIA process. Such calculations will be based on design values of the combined cycle power plant in terms of exit gas velocity, quantity of flue gas generated, etc.

Stack Height :	50 meters
Effective Stack Height:	50 meters
Stack diameter	3 meters
Exit gas velocity:	not less than 15 m/sec.
Fuel consumption per unit power production	8042 BTU/kWh
Mass of pollutant emission per unit power production:	0.697 g/kWh
Mass of pollutant emission per unit time:	87 g/sec NOx
Emission control system used if any:	Low NOx burners (<25 ppm)

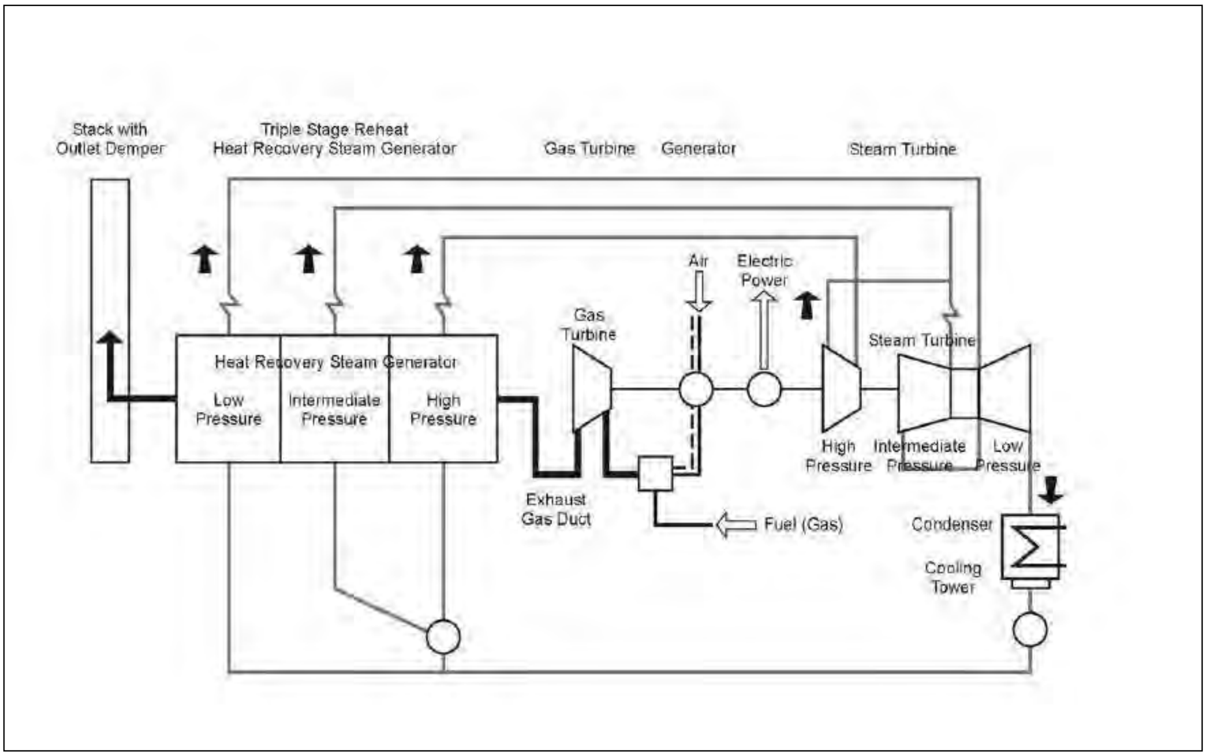
The plant will be built on the southern Bank of river Kushiyara and, as such, the availability of fresh water to the proposed site could be ascertained. Water for all cooling purposes will be drawn from and waste water will be discharged (after being brought to river-water temperature) to the Kushiyara river at a point downstream of the intake point. List of machineries to be imported from abroad appears at Annex-2.

3.4 Power Generation Process

Power generation process of proposed Bibiyana Power Project 1 & 2 will involve Combined Cycle Gas Turbine system. The system comprises a river water pumping system, water treatment and demineralization plant condensing equipment, feed water system, chemical dosing system, compressed air system, air conditioning system, ventilation system, effluent treatment system, and chemical laboratory. Typical process flow diagram of such a system is as under (Figure-3.1).

The proposed plant will play a significant role in addressing the present shortfalls in electricity requirements in Bangladesh. The extent of load shedding has reached such a stage that build up of additional capacity has became a matter of urgent necessity.

Figure-3.1: Typical Process Flow Diagram for proposed Bibiyana Power Project 1 & 2



3.5 Quality Specification of Natural Gas to be Delivered to the Proposed Facility

3.5.1 Chemical Composition

The natural gas to be delivered to the proposed SBPCL 1 & 2 facility contains a minimum of 85.0%(v/v) and a maximum of 100.00%(v/v). Ethane, propane, butane, pentane and higher hydrocarbons, H_2S, CO_2, N_2, O_2, inert compounds (total combined nitrogen, oxygen, carbon dioxide and any other inert compound) have respective presence to respective 6.00%, 5.00%, 3.00%, 2,00%, 0%, 2.00%, 3.00%, 1.0% and 5.00% with practically 0% at the minimum level. The gas will have a Btu content of not less than 900 Btu (HHV) per SCF. Temperature range of the gas will be within 59 degrees Fahrenheit (15°C) – 140 degrees Fahrenheit (60°C). The gas will be commercially free from objectionable odor and dust or other solid matter, liquid matter, gum and gum-forming constituents, toxic or hazardous substances in concentration which might present health or safety hazard to company's employees and/or the general public. Liquefiable hydrocarbons will not be more than 2.0 American gallons per 1,000,000 SCF of the gas. The pressure at which gas will be delivered at the point of delivery will not be less than 150 psig and will not be more than 550 psig as long as the pressure persists.

4. Environmental Baselibe

4.1 Physical Environment

4.1.1 Climate

The project area has a pronounced tropical monsoon climate. There are three main seasons: the monsoon (or rain) season from May to October during which about 90% of the total annual rainfall is received; the dry season (or winter) from November to February which has the lowest temperature and humidity of the year and the pre-monsoon (or hot) season from March to April.

Temperature: Mean monthly temperatures vary from about 6.5°C. in January to 35.8°C. in April. The mean annual temperature is about 25°C (Appendix 3).

Rainfall: About 92% of the annual rainfall occurs in the seven months from April to October in the project area. Within the surrounding areas of the project site in the Kushiyara valley and neighboring hills, the rainfall is very high. At Srimangal (37 kilometers south-east of BIPP), the average annual rainfall is 242 cm. and at Sylhet (35 kilometers north-east of the BIPP site) the rainfall average is 418 cm. and near the foot at the abrupt Meghalaya plateau at Sunamganj it is 533 cm. (Cherapunji, barely 16 kilometers across the border in straight line to the north of Chhatak, records an astonishing average of 1082 cm. annually) (Appendix 3).

Humidity: Mean monthly relative humidity ranges from 77% in the dry season (November to February) to about 84% in the rainy season (June to October). In the area, fog is very common in winter and also it is the cloudiest part of Bangladesh (Appendix 3).

4.1.2 Hydrology and Drainage System

The Barak river divides itself into two branches (Surma and Kushiyara) within Cachar district of Asam (India). The second branches of the Barak is known as the Kushiyara, which flows in a westerly direction for some distance then towards the south and south-west to Fenchuganj where it is joined by Juri river originating from the Tripura hills having a catchment area of 1841 sq. kilometers with a rainfall between 229 cm-305 cm. Continuing a south-westerly course, it passes Balaganj, once the largest trading mart in the Sylhet district. Originating in the Tripura hills, the river Manu has a catchment area of 1000 sq. kilometers. It bifurcates into two branches, the southern branch is called the Bibiyana which meets the Surma at Markuli and the combined flow as the Kali river falls into the Meghna. The southern stream resumes the original name of Barak and flows westward to Nabiganj and then south-west to Habiganj, where it is joined by the Khoawi from the mountainous country beyond the southern frontier which has a catchment area of 450 sq. miles and meets the Kalni river. The combined course takes the name of Dhaleswari which forms the western boundary of the Habiganj district for a short distance and ultimately falls into the Meghna river. The Kushiyara passes through the northern side of the BIPP site. The flood period is generally from the last week of May to the middle of October.

The principal tributaries of this locality are the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang, all originating from Tripura hills. The river is navigable almost throughout the year although sand bars often create difficulties for smooth navigation.

4.1.2.1 Kushiyara River

Kushiyara river located on the northern side flows from the east to the west and occupies 9% of total area. Water flow is high during the rainy season and brings a lot of silt. In other seasons, there is low water flow and water is more or less clear. Motor launches and all kinds of boats ply in all the seasons. Because of the erosion of the north bank by Kushiyara river, the channel shifted towards north of the Lama Tajpur village and silt deposited on the south bank, and thus village Dakhin Tajpur was formed. Lama Tajpur suffers most where during the last few decades the Kushiyara river eroded most part of the village and divided the village in two major parts. However, the river in the vicinity of the site area of Bibiyana in the village of Parkul has not caused significant erosion over the recent decade. Erosion along the river bank in the site area will be established during full-scale EIA.

4.1.2.2 Canals

Water body including canals, ponds and beels occupied only 2% of the total surveyed area. Most of the canals get dried up during winter season and show water flows during monsoon season. There is a big water body on the eastern side of the village Majlispur. Originally, this water body known as Buro river used to flow into the Kushiyara river. At present, both sides are closed. On one side Dhaka sylhet highway (N_2) and on the other side sherpur-Moulavibazar road. This water body is 10-12 meters deep. DC office leases out this water body to the local fishermen.

4.1.2.3 Beels

A beel is a comparatively large cultivable land without any settlement. There are three degraded beels namely Bagber beel, Ari beel and Dakriar beel in the surveyed area. Most of the area in winter becomes dry.

4.1.2.4 Ponds

There are ponds within the settlement areas. Most of the families have one or two ponds used for aquaculture and household purposes. The area of a pond varies from 10 decimal to 1 acre.

4.1.2.5 Ground Water

As other parts of the country, this area also receives sufficient amount of rainfall and there is a good availability of ground water that is being used by hand pumps for drinking and domestic purposes. Some industries are using deep rube wells within their premises to meet the requirement of good quality water for various purposes. Industries within the BSCIC area fulfill their requirements of water from there own set up. The scattered homesteads are using hand tube well (HTW) to meet their domestic demand. During site visit it was observed that sufficient quantity of water coming out from the HTW. However, there is no specific complaint about non-availability of ground water. As other parts of the country, this area also receives sufficient amount of rainfall and there is a good availability of ground water that is being used by hand pumps for drinking and domestic purposes.

4.1.3 Air Quality

Air quality at the project-site is typical of a rural environment. Ambient concentrations of air pollutants are seemingly very low to practically non-existent. SPM increases intermittently in some areas when winds pick up dust over unpaved roads and exposed surfaces. Sources of emissions come from vehicles plying along the Dhaka-Sylhet National Highway, N2 running along the south and western direction from the project site .

4.1.4 Soils

In most of the Surma flood plain, there is no annual deposition of new sediment; however, the soils are older and more developed, and in rainy season, flood water is clear. The landscape is very gentle undulating or nearly level. The main soils on the high flood areas and flood plain rides have grey silty to loamy top soils and grey silty to clayey sub-soils with black structure. The basin soils are very similar, but more clayey. Most soils overlie stratified material at 2 – 5 feet depth. Almost all of the soils are seasonally flooded, and dry out by the middle of the dry season.

4.1.5 Earthquakes

Bangladesh has been divided into four seismic zones. The north-eastern part of Bangladesh is in the most active seismic zone and has experienced earthquakes of moderate/high intensity. The great earthquake of 1897, which had its epicenter in Shilong Plateu in India, caused widespread damages. Two major earthquakes – the Bengal earthquake of 1885 and Srimangal earthquake of 1918 – caused severe damages on limited areas surrounding their epicenters. Earthquakes with magnitudes between 7.0 and 8.7 on the Richter scale have been experienced, but they are rare events (Brammer and Khan 1990 cited in A Atiq Rahman et. al (1994) v.1, p. (166).

4.1.6 Topography

The land within the 10km project command area radius is part of the Surma floodplain with almost no annual deposition of new sediment and is composed of older and more developed soil. The landscape is very gentle undulating or nearly level. The main soils cosist of grey silty to loamy top soils along with black structured greyey silty to clayey subsoils. The project command area comprises agricultural land, homestead land, dykes, mudroads, the river Kushiyara, principal tributaries to the river – the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang – all originating in the Tripura hills.

4.1.7 Land Use Pattern

Total area is located in the river basin, which is in the foot hills of Tripura. Most of the land is under crop cultivation. People are engaged mainly in rice cultivation during Boro and Aman seasons. In Rabi season, people mainly cultivate different vegetables only in some portions of their crop fields. Homesteads, perennial water bodies like river, beels and haors, roads & embankment and markets are other categories of land use in the airshed.

Various categories of land use in the project area are presented in the following Table (Table 4.1)

Table-4.1: Current Landuse Pattern of Surveyed Areas

Sl. No.	Landuse Pattern	Number	% of Total
01	Agricultural lands	-	73%
02	Settlement area	-	12%
03	Power plant site (Acquired land)	-	2.5%
04	Proposed approach road	-	.5%
05	School	3	-
06	Clinic	2	-
07	Road (earthen/Semi pacca)	-	1%
08	Shops	15	-
09	Mosque	9	-
10	Moqtab	4	-
11	Eidga	2	-

Sl. No.	Landuse Pattern	Number	% of Total
12	Graveyard	4	-
13	Mazar (Spiritual graves)	4	-
14	Rice mill	5	-
15	Rivers (Kushiyara)	-	9%
16	Water body (Canals, Ponds, Beel)	-	2%
	Total		**100%**

4.1.8 Settlement Area

Settlement in the project area includes the homestead, vegetation with local, indigenous fruits bearing trees. Besides, some exotic species and medicinal plants were also observed during the survey. Different occupation groups like farmers, sharecroppers, day laboures, businesses men, service holders, rickshaw/van pullers, transport workers are living in the area.

4.2 Biological Environment

4.2.1 Natural Vegetation

Natural vegetation is represented by open water aquatic vegetation. Freshwater swam forest and terrestrial forest types are different in their physiognomy, species composition and ecological characteristics.

There are some 75 species of fishes in the locality. Local status and distribution according to IUCN Red Book are also shown in the same table. Out of these 43 species are not threatened, 23 critically endangered, 9 of lower risk and vulnerable.

4.2.2 Animal Resources

The area is extremely rich in their faunal diversity. This area still remains to be the internationally important wintering area for migratory waterfowl, principally ducks and shore birds. There are 18 kinds of reptiles, 7 kinds of domestic animals and 77 kinds of birds. Out of 18 species of reptiles, 6 are vulnerable. Number of vulnerable domestic animals is one and those of birds are 21.

List of flora and fauna of the proposed project area appears at Annex-3.

4.3 Socio-economic Environment

4.3.1 Population and Family Size

The airshed of the proposed Bibniyana Power Project 1 & 2 has a population 174, 779 and of which 88, 034 are males and 86, 746 are females. There are 29,025 households in the same air shed area and the average family size estimated 6.02 persons.

In 2 kms. radius of the power project location, total population was 18195 of which 9,293 are males and 8,903 are females. There are 3051 families in the high impact zone and the average family size found 5.96 persons.

4.3.2 Religious and Dwelling Houses

Religion-wise people are grouped as Muslims, Hindus, Buddhists, Christians and Tribals. The Muslims dominate in the airshed, followed by Hindus. Most of the village houses are kutcha construction, and materials used for roofs and walls are corrugated iron-sheets. Houses with brick walls are also common in this airshed.

4.3.3 Educational Status

About 28% of the population in the study area are illiterate. Another 8.2% of the population are able to sign although they can neither read nor write. The population having primary level education (upto 5 years of schooling) and secondary level education (up to 10 years of schooling) are 44.4% and 16.3% respectively. Only 2.8% of the population have SSC and higher academic attainment. Bachelor and higher degree have been achieved by only 0.7% of the population under the survey (Table-4.2).

Table-4.2: Educational Status of Household Members by Study Area (%)

Educational Status	Study/Impact Area				
	High Impact	Medium Impact	Low Impact	Fishermen Village	All
Illiterate	26.1	19.8	38.9	31.4	27.7
Can sign only	8.2	7.3	6.2	10.7	8.2
Primary	45.2	52.0	37.6	42.2	44.4
Secondary	17.2	17.2	13.7	11.6	16.2
S.S.C and equivalent	1.9	1.5	2.2	3.0	2.0
H.S.C and equivalent	0.7	1.5	1.2	0.3	0.8
Degree and above	0.7	0.7	0.2	0.8	0.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire

Literacy, in general, is higher among the males than the females. Illiteracy among the males and the females are 25% and 31% respectively. SSC and higher degree have been received by 4.5% of the males and 2.5% of the females under the survey. Educational status of the study population under different impact zones reflect some variations (Table-4.3).

Table-4.3: Educational Status of Household Members by Sex

(%)

Educational Status	Study/Impact Area									
	High Impact		Medium Impact		Low Impact		Fishermen Village		All	
	male	female	male	female	male	female	male	female	male	female
Illiterate	23.2	29.3	16.1	23.5	39.2	38.5	28.0	35.0	25.1	30.5
Can sign only	9.3	7.1	8.0	6.6	5.7	6.8	10.8	10.7	8.9	7.4
Primary	46.9	43.0	56.2	47.9	37.8	37.0	45.6	38.4	46.4	42.3
Secondary	16.5	18.1	13.1	21.3	12.0	15.6	11.8	11.3	15.1	17.3
S.S.C and equivalent	2.0	1.9	2.2	0.7	2.4	2.1	2.2	4.0	2.1	2.0
H.S.C and equivalent	1.0	0.3	2.9	-	2.4	-	0.5	-	1.3	0.2
Degree and above	1.1	0.3	1.5	-	0.5	-	1.1	0.6	1.1	0.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire

4.3.4 Main Activities of the Population Over the Last 10 years and Above

According to the 2001 census, the main activities of the population 10 years and over in the air shed area are household works, agriculture, business, service, transport, construction and others.

People in the study villages are engaged in different types of primary and secondary occupations such as farming, wage labour, business, services (govt. & non-govt.), fishing, household work, overseas employment, carpenter/black smith, rickshaw/ van driving etc. The survey reveals that the highest percentage (32.6%) of the workforce are engaged in household work followed by other occupations including agriculture/farming (13.2%), wage labour (7.1%), business (5.4%), overseas employment (2.5%), services (2.2%) and fishermen (1.4%). Other occupations such as carpenter, blacksmith, handicrafts constitute a smaller section of the working population. Students comprise 31.2% of the population. Other than students, farming, household works, wage labour etc. are the main occupations in all the impact zones excepting the fisherman village. Fishing activities happen to be an important occupation in the fishing village (Table-4.4).

Aside from primary occupation, a significant proportion of the population also adopt a secondary occupation to enhance the household income. Agriculture, wage labour and business are found to be the dominant secondary occupation in the study area.

Table-4.4: Primary Occupation of Household Members by Study Area

(%)

Primary Occupation	Study/Impact Area				
	High Impact	Medium Impact	Low Impact	Fishermen Village	All
Agriculture/Farming	15.4	18.0	8.2	1.2	13.2
Wage labour	7.1	1.9	12.9	4.8	7.1
Household work	32.2	37.2	34.8	29.5	32.6
Work in abroad	2.7	3.4	1.6	1.5	2.5
Fishing	0.3	-	-	10.5	1.4
Van/Rickshaw puller	0.4	-	0.3	0.6	0.4
Service	1.8	2.7	2.5	3.6	2.2
Business	4.2	2.7	7.9	13.0	5.4
Student	31.9	29.9	27.9	31.6	31.2
Unemployed	1.8	0.8	1.9	1.8	1.7
Handicrafts	0.3	0.4	-	0.3	0.3
Carpenter/black smith	0.6	1.5	0.5	-	0.6
Others	1.3	1.5	1.5	1.6	1.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire

4.3.5 Sources of Household Income

According to the 2001 census, the main sources of income of the airshed area are agriculture/forestry and livestock, agriculture labour, non-agriculture labour, handloom, industry, business, hawker, transport, construction, religious, service, rent, remittance, and others.

Agriculture labour is the main sources of income for majority (27%) dwelling units in the airshed. Agriculture labour is followed by agriculture/forestry & livestock (18%), business (10%), non-agric labour (7%), fishery (6%) and remittance (6).

The survey reveals that households derive their income from multiple sources including agricultural crops (rice and wheat), wage, salary, business, livestock, remittance, etc.

Agro crops especially rice/wheat is the largest source accounting for 32.4% of household income in the study area. The next important sources is remittance which contributes 19.7% to household income. Other sources are business, wage labour, livestock and services contributing 14.6%, 12%, 5.1% and 4.2% respectively to household income.

The contributions of different sources to household income are marked by noteworthy variations among the impact zones. Fisheries, for example, contributes 25.7% to household income in the fishermen village; whereas its contribution is less than one percent in medium impact area. Livestock contributes 6.3% to household income in low impact area compared to only 0.6% in fishermen village. The contribution of business/trade to household income varies from 9.2% in medium impact area to 36% in fishermen village (Table-4.5).

Table-4.5: Percentage of Annual Household Income from Different Sources

Source	Study/Impact Area				
	High Impact	**Medium Impact**	**Low Impact**	**Fisherman Village**	**All**
Rice/Wheat production	35.0	36.9	29.3	7.4	32.4
Vegetables	1.3	0.02	-	0.2	0.9
Daily wages	12.5	4.9	18.6	6.6	12.0
Service	3.9	5.4	3.0	6.1	4.2
Business	13.9	9.2	10.7	35.9	14.6
Fruits	0.2	-	0.4	0.1	0.2
Timber and timber products	0.5	0.6	0.3	-	0.5
Fuel wood	0.5	0.6	1.2	0.2	0.6
Fish	0.8	0.7	4.0	25.7	3.1
Livestock	5.5	4.5	6.3	0.6	5.1
Poultry	0.9	0.9	0.5	0.5	0.8
Handicrafts	0.5	-	-	0.5	0.4
Remittance	18.5	30.0	22.6	10.8	19.7
Milk	0.5	0.6	0.3	0.04	0.5
Relatives	1.6	2.0	1.1	0.3	1.5
Pension	0.6	0.2	-	-	0.4
Jute	0.1	-	-	-	0.1
Others	3.2	3.5	1.7	5.1	3.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire

4.3.6 Energy Use in the Locality

This locality is connected with grid electricity for use in domestic and business purposes. Land base biomass fuels obtained from trees, field crops and livestock play an important role in meeting cooking energy demand. At present, in the localities, people are using only biomass fuel for cooking food. None of the areas is connected with natural gas supply for domestic use or for use in industries in the locality.

4.3.7 Industries

Types of industries that are at present in operation in the airshed are shown in the 2nd column of Table 4.6. Against each type industry, types of fuel used and probable nature of pollution caused are also given.

Table-4.6: Industries Available in the Airshed

Sl. No.	Type of industry	Biomass fuel		Conventional Fuel		Probable nature of pollution caused
		Wood	Non-woody biomass	Diesel/ coal	Electrical	
1	Rice husking	-	Rice husk	Diesel	-	NO_x, SO_2, P.M. Noise
2	Flour Mill	-	-	Diesel	-	NO_x, SO_2, P.M. Noise
3	Bakery	√	-	-	-	Smoke from wood firing
4	Manufacture of wood products	-	-	-	√	P.M.
5	Tobacco	√	√	-	-	PM
6	Tea	√	√	-	-	PM
7	Bricks	√	-	Coal	-	NO_x, SO_2, P.M.
8	Pottery	√	-		-	P.M.

4.3.8 Power Plant Site

The proposed power plant site has acquired 63 acres of land. **Previously, where no homestead had been located in the proposed power plant site, new homesteads were found to have cropped-up during the recent reconnaiaance survey.** Most of the part of the selected site is relatively high land compared to the surrounding areas. On the northern side of the site is the Kushiyara river.

4.3.9 Approach Road

The approach road passes through Majlispur, Pitua, Bata mouza and Parkul village. It is about 2 kms from the highway (N_2). No settlement was found to be in the approach road.

4.3.10 Roads and Communication

Through the plant site there is road – only 2 km brick soling and the rest mud built. There are Kushiyara dykes along the Kushiyara river starting from Sherpur bridge passing through Parkul and Paharpur villages. It is the main road in and around the project area. Besides this, there are some earthen roads passing through the villages (adjacent to the project site) to connect the Sherpur commercial centre. Vehicle movement during the rainy season becomes difficult and prone to accident. Earthen roads are used only in dry season and most of the time villagers use boat for their movement. Plantation programme has been initiated along the roadside with local and exotic species by different organizations.

4.3.11 Educational and Religious Institutes

There are 3 schools located in the surveyed area. Beside these, 9 mosques, 4 Moqtabs (religions school), 2 Eidgahs, 4 graveyards and 4 spiritual graves were found during the survey.

4.3.12 Infrastructures

Dhaka - Sylhet national highway and several paved roads have been constructed in the air shed for travel and communication. Regular bus and other transport services (including rental cars, auto rickshaws, rickshaw/rickshaw vans) are being used for peoples' movement from one place to another. People also use regular service launch and engine boat and country boats for their movement and transporting their products.

Bangladesh Water Development Board has constructed embankment on the banks of the river in the area to protect agriculture from flood damage. This embankment is also used as village roads for movement.

Bibiyana gas field, Union Parishad Offices, Markets & Hats, educational institutes, religious centres (Mosques, Temples and Churches) are located in this airshed. The area is connected with grid electricity, but no telephone for the village people. There is no pipeline for gas supply to local community, although the Bibiyana gas field located in the airshed supplies gas to the national gas pipe line.

4.3.13 Urbanization

No urban centre has yet developed within this airshed.

Sherpur, the village business centre, is about 2 kms to the east of the project site. Dhaka-Sylhet highway (N2) passes through this centre. Buses and trucks pass through this highway and the honking of buses and trucks reach the plant site also.

5. Kind of Emissons and Effluents

Emission from the proposed project operation will mostly consist of particulates (PM_{10}) and oxides of nitrogen.

Effluent will consist principally of waste water from various stages of project operation and domestic uses.

6. The Project Airshed

About 10km radius airshed has been assumed based on similar size (450 MW) Meghnaghat Power Plant in Bangladesh. Administratively, the airshed spreads over four Upazilas of four districts (shown in the project site location map). Name of districts, Upazilas, unions and number of villages under projecy airshed are shown in the Table -6.1.

Table-6.1: Name of Districts, Upazilas and Unions, and Number of Villages in the Project Airshed.

District	Upazila	Union	Number of Villages
Sylhet	Balaganj	Sadipur	34
		Gouala	4
		Pachim Pailanpur	23
		Purbo Pailanpur	4
Sunamganj	Jaganatpur	Ashrkandi	10
		Paligaon	2
Habiganj	Nabiganj	Digholbak	41
		Auskandi	38
		Einathganj	8
		Devpara	1
Maulvibazar	Maulvibazar Sarder	Khalilpur	28
		Manumkh	11
Estimated total number of villages are within the project airshed			204

7. Consideration of Alternatives

i) The country is flat having relatively limited potential for hydroelectricity.

ii) No active geothermal site has been found.
iii) The country has about 1700 million tones of bituminous coal, most of which lie buried at depth of over 900 meters thus making extraction relatively expensive. However, coal from low-lying structure (Barapukuria) is being dug out for power generation. Coal is environmentally less friendly as it gives high emission of carbondioxide and leads to acid rain because of high sulphur content.
iv) No oil field worth the name has yet been discovered.
v) But the country has a sizable deposit of natural gas. The composition of Bibiyana gas is given in Appendix 11. This gas will generate very low quantities of particutes, sulphur dioxide and with a suitable burner producing minmal quantities of oxides of nitrogen.
vi) Site selection is ideal as it involves resettlement issues to a minimal extent.
vii) The proximity of the Bibiyana gas field (about 7 kms) offers a big advantage in that the cost of pipe-laying will not be significant.
viii) As shown in subsequent sections, environmental pollution during the period of construction and also during the period of operation will be mostly insignificant.
ix) The proposed site is less than a kilometer from the river Kushiyara. The project activity during the construction phase will involve safe transportation of heavy equipment, e.g., cooling towers, steam generators, etc., through river routes to the proposed site. As such, the proposed site is the only feasible way for such transportation. In addition, river transportation will be cheaper.
x) Availability of large volumes of cooling water required to be withdrawn from the river Kushiyara will be yet another advantage of the proposed site in view of the proximity of the source (i.e., the river Kushiyara) at less than 1km and cost effectiveness.

In consideration of these facts, the proposed plant option with the site looks ideal.

8. Identification of Significant Environmental Impacts (SEIs)

8.1 Scoping of Impacts

The potential impacts due to implementation of the proposed natural gas-fired two 450 MW Bibiyana-1 and Bibiyana-2 combined cycle power plants were identified by using a Simple checklist.

The following Table (Table-8.1) represents the checklist developed for the proposed natural gas-based power plants. 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 checklist, major environmental components, which will be adversely affected by activities of the project are: air quality, noise hazard and socio-economic environment. All these impacts will arise in operation phase of the project. ***It should be noted that identification indicated in the Checklists relates to the significant level of impact without mitigation of negative impacts.***

8.2 Prediction of SEIs

8.2.1 General Considerations

A scoping exercise has been undertaken in section 8.1 to identify the impacts, which are likely to occur during the various phases of the project. In the Checklist (Table-8.1) referred to section 8.1 evaluation of the all impacts are done using criteria words ‘none’, ‘minor’, ‘moderate’ and ‘major’ with nature of impacts indicating ‘adverse’ and ‘beneficial’ and short comments are also provided to justify the criteria given to. In the following sections, greater detail prediction and evaluation are done for those impacts, which are considered to have major SEIs. These potential impacts are discussed in relation to relevant regulations and standards of the country. To maintain logical sequence of the EIA process, the possible mitigation/ enhancing measures for SEIs are also discussed concurrently. At the end of each such section, status of residual impact is also mentioned. At the plant location, with practically no activity taking place, the basic environmental conditions remain as usual with the inadequacy of buffer zone. Hence mitigation/enhancement measures are beyond the scope of discussion at this stage.

Table-8.1: Checklist of Significant Environmental Impacts (SEAs) due to the proposed Natural Gas-based Combined Cycle Bibiyana-1 and Bibiyana-2 Power Plants,

Project Phase	Significant Environmental Impacts (SEAs)	SEIs without mitigation measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
	Land value depreciation	x						No land value changes anticipated; no impact.
	Loss of and displacement from homestead land			x		x		Minimal loss of and displacement from homesteads land; medium impact
Plant Location	Loss of and displacement from agricultural land				x	x		Significant loss of and displacement from agricultural land; major impact
	Damage to nearby operation	x						No impact is anticipated
	Disruption to drainage pattern			x		x		Disruption of natural drainage system is anticipated; medium impact.
	Inadequacy of buffer zone			x		x		Buffer strip is absent.
	Encroachment into Precious ecology	x						No precious ecological issues; no impact.
	Run off erosion		x			x		Land cutting and filling would create runoff erosion during rainy season.
	Worker accident		x			x		High probability of occurrence in all construction work.
Construction Stage	Sanitation diseases hazard				x	x		Concentration of labor force create un-hygienic condition
	Noise/vibration hazard			x		x		Piling/Equipment installations create noise.
	Traffic congestion			x		x		Carrying of construction materials to the site will create traffic congestion.
	Blockage of wildlife passage		x			x		Minor hindrance to wildlife mobility during construction; temporary adverse impact.
	Employment				x		x	Major employment opportunity during construction.
	Encroachment into Precious ecology	x						No precious ecological issues; no impact.
	Depreciation of environmental aesthetics	x						Transmission line would be laid by the side of road; no impact.
	Erosion/silt runoff during construction			x		x		Minor damage to roadside land; minor impact.
	Continued erosion/silt runoff from uncovered exposed areas			x		x		No uncovered area would be left after construction; no impact.
Post-construction and Operation Stage	Pollution from liquid discharge	x						No process liquid waste will be generated; no impact.
	Pollution from solid waste		x			x		No significant solid waste; no significant impact.
	Air quality		x			x		Emission will be minimal because of natural gas utilization; minor impact.
	Occupational health hazard			x		x		Inherently likely to occur.
	Odor hazard		x			x		No obnoxious odor will be generated; no significant impact.
	Traffic congestion			x		x		No carrying of product to and raw materials from outside.
	Noise hazard				x	x		Major noise generation is expected; major impact.
	Employment				x		x	Medium employment opportunity during operation
	Destruction of homesteads and Resettlement issues				x	x		*Homesteads are located within and around the project site. Land development, Construction and Operational stages of the project will involve destruction, eviction or damage of such homesteads or private property necessitating compensation to and resettlement of PAPs. Major adverse impact.*

8.2.2 Impact Assessment and Mitigation

Besides the above scoping exercise, general assessment of the anticipated impacts due to the project in the project area during various stages have also be made following the DOE checklist for IEE of industries and development projects toward obtaining ‘Site Clearance’. Assessment of impacts made for construction and operation as well as maintenance phases of the proposed Bibiyana-1 and Bibiyana-2 Combined Cycle Power Plant Project reveal the following.

8.2.2.1 Impact on Physical and Biological Environment

A. Construction Phase

Impacts anticipated on the physical and biological environment of the project area could be a mix direct (mostly), indirect, long-term (mostly), short-term, reversible and irreversible ones. Dust will be the main pollutant during land development and approach road and power plant premises construction and also during laying of natural gas pipeline. Clearing of the land in the project site, associated earth work, excavation, construction of access road and power plant premises, etc., will generate dust and also result in removal of the top-soil, land erosion, sedimentation and pollution of the nearby water body and other water system. The project area is sparsely covered by vegetation and tree canopy. However, existing trees will be retained and uprooted trees (if any) will be replaced wherever feasible. Earthmoving equipment will generate noise likely, at times, to be maximum up to the level of 85 dB(A) and will be unlikely to affect areas beyond 500m away from the project site. There will be a temporary hindrance to biodiversity habitat and movement along and through the project area and will be over after completion of the construction period. The construction phase will also result in escalation of extent and degrees of accidents. There will, however be a beneficial impact of employment of 1000 skilled and semi-skilled manpower during the construction phase.

Mitigation and enhancement measures: Measures to be taken would comprise regular sprinkling of water on unpaved roads/uncovered spaces, removal of soil/mud from trucks and other appliances, transportation of materials in tarpaulin-covered trucks, surrounding the construction yard by temporary fencing. Temporary silt-trap or digging of pond toward siltation prevention, stockpiling of spoil soil at a safe distance from the drainage system, utilizing spoil soil in land-fill, etc., could comprise measures toward prevention/minimization of anticipated sedimentation and siltation of the nearby water body and other water system. Strict adherence to safety rules by the contractors and workers needs to be ensured toward minimizing occurrence, extent and degrees of accidents during construction period. Employing local people during the construction process will enhance beneficial impact in the area.

The above could be summarized in the following Table-8.2.

Legend: D – Direct Impact
L – Long-term Impact
R – Reversible Impact
In – Indirect Impact
S – Short-term Impact
I – Irreversible Impact

Table-8.2: Impact on Physical and Biological Environment during Construction Phase

Anticipated Impacts	Impact category			Mitigation/Enhancement Measures
	D/In	L/S	R/I	
• Clearing of site-land, earth work and dust generation due to earth work	D	L	R	o Regular sprinkling of water on unpaved roads/uncovered spaces; o Removal of soil/mud from trucks and other appliances prior to leaving the project area; o Transport of materials in tarpaulin-covered trucks; o Surrounding the construction yard by temporary fencing
• Removal of top-soil due to earth work, construction of access road	D	L	I	o Storage of top-soil in a safe space and creation of top-soil on filled land utilizing this preserved soil o Plantation of trees in the construction yard as quickly as possible
• Land erosion along the uncovered space due to soil removal and excavation.	D	L	I	o Undertaking construction work during dry seasons; o Laying barrier net
• Siltation of water system or drainage from uncovered piles of soil	D	L	I	o Temporary silt-trap or digging of pond toward siltation prevention; o Stockpiling of spoil soil at a safe distance from the drainage system o Utilizing spoil soil in land-fill
• Pollution of the nearby water system due to construction wates	In	S	I	o Making provision for temporary disposal of wastes inside construction yard and disposal of solid wastes in an appropriate manner; o Providing for sufficient number of wash rooms; o Making provision for contractors and workers to obey appropriate means of waste removal and sanitation measures.
• Employment	D	L	R	o Preference to employment of local people.
• Escalation of the degrees of accidents	D	L	R	o Ensuring strict adherence to safety rules by th econsultants and workers during construction period

B. Operation and Maintenance Phase

High noise from turbines and air compressors, vibration, stack emission, discharge of cooling water, spillage of lube oil, grease, solid wastes and various other forms of wastes (harmful, hazardous) could pollute the environment of the project area and adjacesnt areas. Adverse impact are anticipated on neighboring dwellers and their properties, the ambient air quality (due, particularly to stack emission of PM_{10}, NO_x), pollution of surface water and and aquifer levels, etc.

Mitigation measures: Mitigation measures to above anticipated adverse impacts could comprise provision of insulators, mufflers (for noise pollution control); shock absorbers, isolators, spring isolators (for vibration control); sufficient buffer zones with tree plantation, erection of boundary wall around the project area, erection of stacks with optimum heights to ensure efficient dispersion of emission (for control of air pollution), construction of appropriate treatment plants for liquid and other wastes, treatment, if possible or collection and sorage of harmful and hazardous wastes in safe containers in safe places for eventual environment-friendly disposal.

The above could be summarized in the following Table-8.3.

Legend: D – Direct Impact
L – Long-term Impact
R – Reversible Impact
In – Indirect Impact
S – Short-term Impact
I – Irreversible Impact

Table-8.3: Impact on Physical and Biological Environment during Operation and Maintenace Phase

Anticipated Impacts	Impact category			Mitigation/Enhancement Measures
	D/In	L/S	R/I	
• Adverse impact on neighboring dwellers and their properties	D	L	I	o Provision of sufficient buffer zones; o Tree plantation in buffer zones; o Erection of boundary wall around the project area;
• Air pollution due to emission of dust, smoke, etc.	D	L	I	o Measures toward controlling air pollution;
• Pollution of surface water or aquifer due to domestic wastes	In	S	I	o Provision of effective septic tank and soak-pits; o Construction of appropriate treatment plant for wastes
• Pollution of surface water or aquifer due to liquid wastes generated by the power plants	In	S	I	o Construction of appropriate treatment plant for liquid wastes
• Pollution of the environment or that of the work area by harmful or hazardous wastes	D	L	I	o Treatment of hazardous or harmful wastes; o Incineration; o Preserving in safe containers in safe places for eventual safe disposal.
• Noise pollution	D	L	I	o Necessary measures toward control of noise pollution (e.g., insulators, mufflers, silencers).
• Vibration	D	L	I	o Necessary measures toward vibration control (e.g., shock absorber, demper/isolator, spring isolator)
• Issues arising out due to solid wastes	D	L	I	o Sufficient measures toward separation/preservation of solid wastes; o Training of employees on waste management techniques o Regular collection of wastes for environment-friendly disposal o Disposal of used lead-acid batteries to identified dealers only o Disposal of solid wastes to identified dump-sites or sanitary landfills.

8.2.2.2 Impact on Socio-economic Environment

A. Impact on employment and family finance

The project envisages providing permanent employment of about 1000 skilled, semi-skilled and unskilled manpower during construction phase and a total of 40 skilled and unskilled personnel during its operation phase. This would, although insignificantly partially, help alleviate the unemployment burden of the country. Apart from this direct benefit, there would other direct beneficial impacts on national economy through foreign investment.

Benefit Enhancement Measure: Although labor recruitment is a matter of company having the absolute right to determine whom it shall and shall not employ, but still, the project proponent shall employ local people wherever possible and to give preference to employment of the land less and jobless people. This will ensure the real benefit for the poor.

B. Compensation and Resettlement Issues

Land development, pre-construction, construction, post construction and operational stages might involve destruction of homesteads or damage to private property which necessitate resettlement. It is evident from the location map, land use map and foregoing discussion that although the site of proposed power plant does not involve any homestead land or private property within it, those could be located in the surrounding and adjoining areas. Moreover, land development activities could impact upon a couple or so of homesteads and homestead land, quite a significant volune of agricultural land necessitating compensation to and resettlement of PAPs.

C. Impact on health and safety

Impact Origin: As there might be hazards to the plant workers, employees and technical personnel, provisions need to be made by the project for protecting occupational health, including protection of workers from hazards/fires/spillage etc. as well as protection of workers, health and assurance of safe drinking water supply and sanitation. The workers who work inside the factory face occupational health hazard due to different operation processes.

Mitigation Measures: Safe and good occupational health status of the employees and workers is important for not only the persons working in the plant, but also for the better plant operation and maintenance. Protective clothing and accessories should be provided to the workers, who would be subjected to exposure to hazardous substances and situation. Regular medical check-up is to be done to ensure the soundness of health of the employees and workers. Pollution control measures are to be duly adopted as necessary, including noise and emission control, so that there would not be any negative occupational health impact. Insurance for all employees should be taken out. A senior Medical Officer with sufficient background and experience in occupational health problems should coordinate this issue and would be responsible for dr5awing up and implementing a detailed and regular program for ensuring health safety for all the workers in the industrial unit.

D. Other safety provisions

Beyond the above measures, the project would also have full provision for the fighting and first aid medical services. The proponent also will construct an underground water reservoir for fire fighting. The project has provision in its recurring annual expenditure for purchasing safety items such as aprons, hand gloves, ear protector etc.

9. Conclusion

The IEE exercise undertaken on the Bibiyana-1 and Bibiyana-2 natural gas-fired comnined cycle power plant project reveals both adverse and beneficial impacts anticipated on the environment and socio-economic conditions of the project area. Both kinds of anticipated impacts are of significant dimensions. Besides the measures toward mitigation of adverse impacts and enhancement of beneficial impacts outlined in Section-8 of this report, the fact that the proposed project project falls under the 'Red' category as per categorization made by ECR, '97, a full-scale Environmental Impact Assessment (EIA) is necessary and, hence, suggested toward obtaining Environmental Clearance Certificate in favor of the proposed project from the Department of Environment. Terms of Reference for EIA are annexed for approval of the Department of Environment (Annex-5).

Photograph of the Bibiyana Power Project 1 & 2 Site

Sl. No.	Name of Machinery	
1	Gas Turbine & Accessories	
2	Steam Turbine & Accessories	
3	HRSG and Accessories	
4	Power Transformers & Accessories	
5	Auxiliary and station Transformers	
6	400 kV Switchyard and accessories	
7	230 kV Switchyard and accessories	
8	DCS control system and accessories	
9	Pumps	
10	Motors	
11	DM Plant	
12	Effluent Treatment Equipment	
13	SCADA and data highways	
14	RTU	
15	Power and Auxilary Cables	
16	MCC Panels	
17	Gas Compressor and accessories	
18	RMS and accessories	
19	Gas Pipe, valves and accessories	
20	Crane and hoist	
21	Jetty equipment	
22	Cooling Tower	
23	Compressed Air System	
24	Feed Water and Condensate	
25	Condenser cooling water circulating system	
26	Fire protection and detection	
27	Fire pumps and jocky pumps	
28	Hose pipe and others	
29	Fire Extinguisher	
30	Ventilation and air conditioning system	
31	SC System	
32	Switch and Socket	
33	Lighting and grounding system	
34	UPS and DC Power System	
35	Diesel Generator	
36	BBT, MV and System	
37	400/230 Kv Substation and accessories	
38	Cable Trays	
39	Lube oil	
40	Transformer oil	
41	Laboratory equipment	
42	Workshop equipment	
43	Initial Spares	
44	Circuit Breakers and Earth Breakers	
45	Earth Switch, LA and others	
46	Hydrogen Generation plant	

Data Collected by: BCAS

List of Faunal Resources of Bibiyana

Status code* : NT : Not Threatened,
CR : Critically endangered,
LR : Lower risk,
VU :Vulnerable

Distribution code*: W: Wide, N : North, E : East, S : South, SE : South East, NE : North East
B: Beel , H: Haor, R: River, P: Pond, SW: South West, SB: Sundarban, Hilly Area

Sl. No.	Name of Fishes (Local Name)	Scientific Name	Local Status	Distribution
1	Magur	Clarius batrachus	NT	W
2	Koi	Anabas testudineus	NT	W
3	Shing	Heteropnwustes fossilis	NT	W
4	Taki	Channa punctatus	NT	W
5	Shar Punti	Puntius sarana	NT	W
6	Tit Punti	Puntius ticto	NT	W
7	Zat Punti	Puntius sophore	NT	W
8	Bujuri Tengra	Mystus tengara	NT	W
9	Bara Tengra	Mystus cavasius	NT	W
10	Choto Tengra	Mystus vittatus	NT	W
11	Catla	Catla catla	NT	W
12	Lal kholisha	Colisa lalius	NT	W
13	Shoul	Channa striata	NT	W
14	Gazar	Channa marulius	NT	W
15	Minar Cup	Cyprinus carpio	NT	W
16	Gras Cup	Ctenopharyngodon idellus	NT	W
17	Mrigale	Cirrhinus mrigala	NT	W
18	Kargu	Cyprinus carpio	NT	W
19	Ruie	Labeo rohita	NT	W
20	Boal	Wallago attu	NT	W
21	Tara Bhain	Macrognathus aculeatus	NT	W
22	Choto Bhaine	Mastacembelus psncalus	NT	W
23	Buthum	Lepiodocephalus guntea	NT	W
24	Mola	Amblypharyngodon mola	NT	W
25	Pholi	Notopterus notopoterus	NT	W
26	Chanda	Chanda nama	NT	W
27	Khailsha	Colisa lalius	NT	W
28	Lamba chanda	Chanda baculis	CR	B
29	Pabdha	Ompok pabda	CR	H
30	Batashi	Clupisoma (Pseudentropious atherrinoides)	CR	B
31	Belichoto		CR	B
32	Aire	Mystus aor	CR	R
33	Chitol	Notopterus chitala	LR	R,B
34	Telapia	Oreochromis (Telapia) mossambicus	LR	P

Sl. No.	Name of Fishes (Local Name)	Scientific Name	Local Status	Distribution
35	Kalobouse	Labeo rohita	LR	P
36	Khakila	Xenentodon cancila	LR	B,P
37	Chang Taki	Channa punctatus	LR	B,P
38	Prawn	Macrobrachium	LR	B,R
39	Boiragi echa		CR	B
40	Nanid		CR	B
41	Paria		CR	B
42	Hilsha	Tenualosa ilisha	CR	R
43	Lobster		NT	R
44	Small Prown		NT	B,R
45	Kecki	Corica soborna	NT	B
46	Bashpata	Danio devario	NT	B,H
47	Tengra	Mystus vittatus	NT	B,R
48	Choto Tengra	Mystus tengara	NT	B,R
49	Kaliboush	Labeo calbasu	NT	B,P
50	Bag Gutum	LepiodocephalusGuntea	NT	B,P
51	Mrigel	Cirrhinus mrigala	NT	B,P
52	Bhata		NT	R
53	Kazli Anu		CR	B
54	Pangash	Pangasius pangasius	NT	B,P
55	Lachu		LR	B,R
56	Rani	Botia Dario	LR	B
57	Chanda	Chanda baculis	NT	B,P
58	Cela Patha	Oxygaster pholo	CR	B
59	Bagoire	Mystus aor	VU	R,B
60	Rita		CR	B,P
61	Bele	Glossogobius giurius	NT	R,B
62	Poa	Pama pama	CR	R
63	Kakinna		CR	B,H
64	Along		CR	B
65	Pewa		CR	B
66	Mati Bangi		CR	B
67	Kedhar		CR	B
68	Nanid	Labeo nandina	CR	B
69	Paria		CR	B
70	Gongi		CR	B
71	Brighet	Aristechthys nobilis	CR	B
72	Minar cup	Cyprinus carpio	NT	B,P
73	Grascup	Ctenophalmichthys molitrix	NT	B,P
74	African Magur	Clarias gariepinus	NT	P
75	Thai Koi	Tetraodon culcutia	NT	P

* Codes according to IUCN Red Book

There are 23 species of fishes are critically endanger. These species once was available in the river, beel and other wetlands. Last 2/3 years it is found in very small scale. We (BCAS team) conduct a FGD with the fisherman and than we discussed about these species, they told us these species hardly we see and in future it will be extinct.

Name of Wild Animals

Sl. No.	Wild Animal (Local Name)	Local Status	Distribution
1	Jackal /Fox	LR	W
2	Beji	NT	W
3	Khatas	LR	W
4	Sojaru	VU	E
5	Rokta Khauri	LR	S
6	Ghuisaph	LR	W
7	Bon Biral	CR	NE
8	Kathbiral	VU	NE

Name of Water Animals

Sl. No.	Other water Animals (Local Name)	Local Status	Distribution
1	Snail	NT	W
2	Jhinuk	VU	W
3	Crab	NT	W
4	Panipoka	NT	W
5	Jouk	NT	W
6	Kacchab	VU	W
7	Kuchia	VU	W
8	Udd	VU	W

Name of Reptiles

Sl. No.	Name of Reptiles (Local Name)	Local Status	Distribution
1	Kalgokhra Saph	NT	Hilly area
2	Khaiya	LR	W
3	Pora	NT	Hilly area
4	Hald	VU	Hilly area
5	Dharash	LR	W
6	Patalat	LR	Hilly area
7	Sutanali	LR	W
8	Ginibura	VU	Hilly area
9	Mete Shap	LR	W
10	Darash Shap	LR	W
11	Jatshap	LR	W
12	Aujoghar	VU	Hilly area
13	Dhora	NT	W
14	Kalkewte shap	VU	Hilly area
15	Dumukhosaph	VU	W
16	Hakanishap	VU	Hilly area
17	Dudraj Saph	LR	W
18	Matiya Saph	NT	SB

Name of Domestic Animals

Sl. No.	Name of Domestic Animals	Local Status	Distribution
1	Cow	NT	W
2	Goat	NT	W
3	Duck	NT	W
4	Hen	NT	W
5	Dove	LR	W
6	Cat	VU	W
7	Dog	LR	W

Name of Terrestrial Birds

Sl. No.	Name of Terrestrial Birds (Local Name)	Local Status	Distribution
1	Pati Kak	NT	W
2	Dhan Shalik	NT	W
3	Babui	NT	W
4	Chowrui	NT	W
5	Ghugu	NT	W
6	Kabutor	NT	W
7	Kanakua	NT	Hilly area
8	Chil	NT	W
9	Bulbuli	NT	W
10	Duburi	NT	W
11	Kokil	NT	W
12	Kanakuka	VU	W
13	Hottiti	VU	S
14	Shuichora	VU	S
15	Dailacha	VU	S
16	Boigola	VU	S
17	Holdey Pakhy	VU	Hilly area
18	Madhuchakkha	VU	S
19	Fepe	VU	Hilly area
20	Nemaru	VU	Hilly area
21	Benga	VU	Hilly area
22	Vatoi	VU	Hilly area
23	Tirshul	VU	Hilly area
24	Panikapur	VU	Hilly area
25	Kechkechi	VU	Hilly area
26	Ailvarai	VU	Hilly area
27	Satvaria	VU	Hilly area
28	Darkak	NT	W
29	Dhahuk	NT	W
30	Doel	NT	W
31	Tuntuni	NT	W
32	Parrot	NT	W

Sl. No.	Name of Terrestrial Birds (Local Name)	Local Status	Distribution
33	Koak	NT	W
34	Shama	NT	W
35	Tarwa	NT	W
36	Kaththokra	NT	W
37	Gangchil	NT	S
38	Kora	NT	S
39	Laxhmi Pacha	LR	Hilly area
40	Hutum Pecha	LR	W
41	Shokun	LR	S
42	Kalophakhi	VU	Hilly area
43	Catock/Sorgom	VU	Hilly area
44	Nolkhak	VU	SB
45	Sarosh	LR	W
46	Ratchora	VU	SB
47	Moyna	VU	Hilly area
48	Kutum Pakhi	LR	W
49	Kana Khokhra	LR	Hilly area
50	Feshka	LR	Hilly area
51	Doial	LR	Hilly area
52	Bajpakhi	LR	W
53	Chockha	LR	SB
54	Chakla	LR	SB

Name of Migratory/Acquatic Birds

Sl. No.	Migratory/Acquatic Birds (Local Name)	Local Status	Distribution
1	Kanibock	NT	W
2	Nolbock	NT	W
3	Choto bock	LR	SB
4	Lelvhodro Bok	VU	SB
5	Machranga	NT	W
6	Pankaouri	NT	W
7	Pantihas	NT	W
8	Dholabok	LR	NE, SB
9	Bale Has	LR	SB
10	Kaem	LR	SB
11	Cherchiri/Cegha	VU	SB
12	Choipokhshi	VU	SB
13	Paikor	VU	SB
14	Gobok	VU	SB
15	Kajla Bock	LR	SB
16	Manikjor	LR	SB
17	Lairal	LR	SB
18	Fepi	VU	SB

List of Floral Resources of Bibiyana (Medicinal Plants)

Sl. No.	Name of the trees (Local Name)	Local Status	Distribution
1	Nim	VU	W
2	Aurjun	VU	S
3	Lazzabati	NT	W
4	Hatir Shoor	LR	W
5	Bon Jamir	LR	NE
6	Ojaru Jarman Lata	NT	W
7	Dumaru	NT	NE
8	Durba Gas	NT	W
9	Palui Shak	NT	W
10	Amloky	VU	W
11	Bohera	VU	NE
12	Hartaki	VU	NE
13	Roktachita	VU	W
14	Harjora	VU	W
15	Kumari Lata	NT	W
16	Cini cham	NT	W
17	Mohalom	VU	S
18	Dhutra	NT	W
19	Nishinda	VU	W
20	Shatamukhi	VU	W
21	Patharkuchi	VU	W
22	Tunithankuni (Thankhuni)	NT	W
23	Bhatipata	NT	S
24	Hiyalmati	NT	E
25	Helencha	NT	W
26	Chaku	NT	E
27	Sharnalata	VU	W
28	Kalomeg	VU	S
29	Isharmul	VU	S
30	Harengashak	NT	S
31	Kheraiya	NT	S
32	Dhal Kolosh	VU	E
33	Akond	VU	S
34	Tulshi	LR	W
35	Kheyaghas	LR	W
36	Bon Begun	NT	S
37	Mankochu	NT	W

Name of the Trees

Sl. No.	Name of the Trees (Local Name)	Local Status	Distribution
1	Raintee	NT	W
2	Kadam	NT	W

Sl. No.	Name of the Trees (Local Name)	Local Status	Distribution
3	Shilkorai	NT	W
4	Akashi	LR	NE
5	Mehagini	LR	W
6	Chandan	CR	S
7	Kalahozra	NT	NE
8	Shewla	NT	W
9	Karul	CR	W
10	Hizal	NT	NE
11	Patkhara	LLR	S
12	Banyan Tree	CR	W
13	Pahari Neem	CR	N
14	Shimul	NT	W
15	Eucalictus	NT	NE
16	Latim	NT	N
17	Merua	NT	E
18	Jiga	NT	E
19	Bhatipata	NT	E
20	Beljam	LR	E
21	Chambol	LR	NE
22	Belgium	LR	NE
23	Doubgach	LR	E
24	Jalmondhir	LR	S
25	Murta	LR	S
26	Shegun	NT	W
27	Taragach	NT	N
28	Chini bot	NT	N
29	Chatni	NT	N
30	Barun	NT	N
31	Jagdumur	NT	N
32	Ratin	VU	Hilly area

Name of the Fruit Trees

Sl. No.	Name of the Fruit Trees (Local Name)	Local Status	Distribution
1	Mango	NT	W
2	Jackfruit	NT	W
3	Coconut	NT	W
4	Payara	NT	W
5	Jam	NT	W
6	Lichee	VU	W
7	Amra	LR	S
8	Nut	NT	W
9	Boroi	NT	W
10	Jambura	NT	W
11	Lemon	NT	W

Sl. No.	Name of the Fruit Trees (Local Name)	Local Status	Distribution
12	Papwa	NT	W
13	Banana	NT	W
14	Dalim	VU	W
15	Kamranga	VU	W
16	Pineapple	VU	W
17	Gab	NT	W
18	Dewa	NT	W
19	Bel	NT	W
20	Mangstan	LR	W
21	Tal	NT	W
22	Caw	CR	W
23	Kalojam	LR	E
24	Chalte	VU	E
25	Jalpai	LR	W
26	Koichura	NT	S
27	Atafal	VU	W

Name of Flower Trees

Sl. No.	Name of Flower Trees	Local Status	Distribution
1	Ghandaraj	LR	W
2	Rose	LR	W
3	Night Queen	VU	W
4	Raktajaba	NT	W
5	Urpul	NT	S
6	Dumur Flower	NT	NE
7	Pata Bahar	NT	S
8	Dalia	VU	W
9	Kamini	VU	W
10	Bakul	VU	W
11	Gasful	NT	W
12	Krishna Chura	VU	W
13	Murta	NT	W
14	Beliful	VU	W
15	Moragful	VU	N
16	Sunflower	LR	W
17	Polash	VU	W

Name of Floral Resources

Sl. No.	Floral Resources (Local Name)	Local Status	Distribution
1	Water Hyacinth	NT	W
2	Shapla	NT	W
3	Waterlily	NT	W
4	Shingrai	VU	S

5	Chisrai	VU	S
6	Parua	VU	S
7	Tendara	VU	S
8	Aerail	VU	N
9	Nolkhagra	VU	S
10	Kolmi	NT	W
11	Helencha	NT	W
12	Malancha	NT	W
13	Halenga	NT	W
14	Keisir	NT	S
15	Kutipana	NT	S

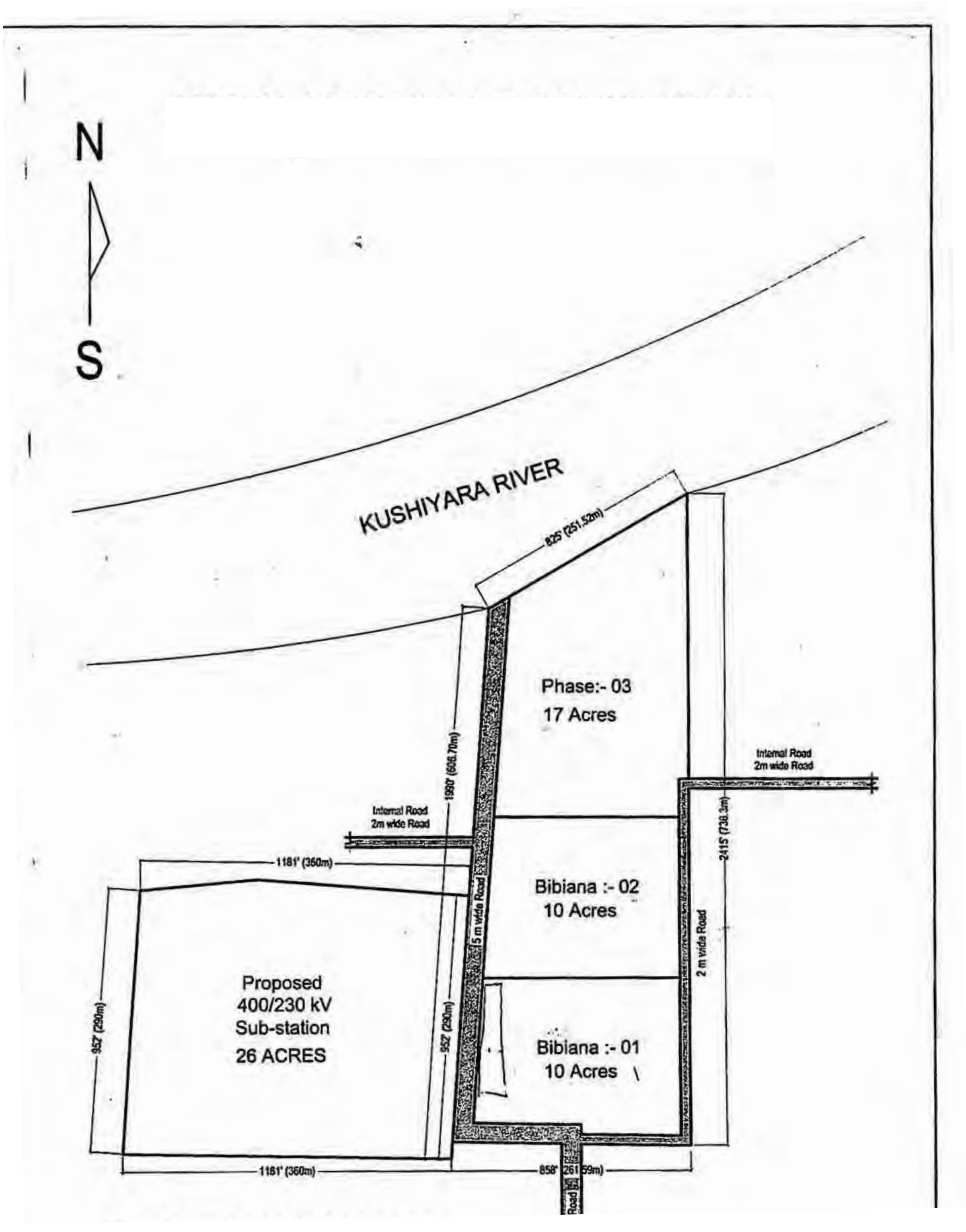
Name of Cultivated Crops and Vegetables in the Project Area

Sl. No.	Aous Paddy(Local Name)	Planting Season	Harvesting Season
1	Aus paddy	April	July
2	Chini paddy	June (Ashar)	August
3	Biplob		
4	BR-28		
5	BR-29		
6	Paijam		
7	Botta Balam		
8	Nazirshail		
9	Lal Balam		
10	Chinigura		
11	Latial		
12	Chirashail		

Sl. No.	Amon Rice(Local Name)	Planting Season	Harvesting Season
1	Lucky Paddy	March (Chaitra)	November (Agrahayan)
2	Bagdar		
3	Goyal Bitpa		
4	Jalo Beda Biron		
5	Boro Rice	November-December (Augrahayan-Poush)	April (Boishakh)
6	BR 29		
7	BR 28		
8	BR 26		
9	BR 14		
10	Hybrid		
11	Khaiya		
12	Dhali Boro		
Sl. No.	**Jute**	**March(Chaitra)**	**August(Bhandra)**
1	Mustard	October-November (Katric – Agrahayan)	February(Falgun)

Sl. No.	Winter Vegetable	Planting Season	Harvesting Season
1	Cavage, Cauliflower, Radis, Poteto, Data, Chilee, Begun, Dhania, Puishak, Vandi, Olkopy, Tometo, Salgom, Sweet Palmkin, Sweet Poteto, Khira, Watermillon, Chal Palmkin, Lau, Seem, Ginga, Anaj (Cirinta)	October-November (Katric-Agrahayan)	December, January, February, March (Poush, Mag, Falgunand Chaitra)
2	Mukhi	December(Poush)	June, July,August (Srabon, Badra and Asshin)
	Vegetables(Local Name)		
1	Data, Papwa, Puishak, Lady Finger, Karala	Throughout the year	

Layout plan for Bibiyana Power project 1 & 2



Annexure -4: Air Quality / Noise Monitoring Report

1 Methodology

The monitoring of environmental parameters were performed based on the primary data generation during the measurement of Air quality and Noise quality (Ambient Noise in dBa at the boundary of the Project Site to nearby receptor at day and night time) parameters.

Sampling Plans and Procedures
Initially a routine monitoring network has established. A short training on sampling and monitoring provided to those field officers who involved with the tasks.

The responsible personnel have established, implemented, and maintained a documented sampling plans and procedures for environmental monitoring. The Consultant maintained a high standard of sampling plan and procedures, which included the following issues:

a) Tests to define the variability and/or repeatability of the environmental monitoring results,
b) Measures to assure the accuracy of the method, which includes the calibrations.
c) Measures to evaluate method capability, such as measurement uncertainty, detection limits, and quantification limits.
d) Strictly maintain the technical holding time of all samples and samples were tested within technical holding time
e) Selection and use of reagents and standards of appropriate quality, and use of consumables before their expiry dates

The consultant/persons responsible and established, implemented, and maintained procedures for recording relevant data and operations relating to sample collection and maintained record through chain of custody.

Sample Handling

The responsible personnel maintained predefined documented procedures for sample handling, which protected the integrity and identity of the samples.

Sample Acceptance Procedure

The persons responsible maintained a documented sample acceptance procedure that outline the circumstances and criteria under which samples were accepted or rejected.

2. Time period (dry season):

Ambient air quality monitoring has been started on 28th of February 2011 and ended on 27th of May. The monitoring program comprise of 24 days over three month period. Monitoring was done for continuous 24hrs a day. Electricity shutdown time made commensurate with extra time monitoring.

March -April as considered dry season and May as monsoon season.

No. of samples were measured: 24 Samples

Deduction of results: Nil

3. Assembly, description and the photos of the air quality monitoring instruments Parameters (SO_2, NOx, PM_{10}, SPM, CO)

Photograph -1 : Respirable Dust Sampler for SPM, PM_{10}, SO_2, NOx measurement

Photograph -2 : Carbon Monoxide meter for CO measurement

4. Presentation of Results

After monitoring of various parameters like total suspended particulates (TSP), PM_{10}, Oxides of Nitrogen (NO_X), Sulfur dioxide (SO_2) and Carbon Monoxide (CO) in the field collected samples are tested in the Enviro Quality Laboratory

5. Discussion of the Results – Existing Air Quality (PM_{10}, SPM, SO_2, NO_X and CO) of the Project Area

The result for ambient air quality monitoring shows the PM_{10}, SPM, SO_2, NO_X and CO Concentrations of the ambient air. From the analysis it is observed that the concentration of all these parameters is far below from the allowable limit except one PM_{10}. CO found is nil. The weather was Sunny during dry season and in May rain started. In the dry season the values found more than monsoon season.

The results also indicate that the value of SPM values is comparatively less than $PM_{10.}$ This fine particle matter may be generated from the surrounding area including wind flow and bio-mass burning of the project area.

6. National Ambient Air Quality Standard for Bangladesh/DoE

For carrying out the production, the standard for air and noise quality of the environment shall be determined in accordance with the standard specified in Schedule 2 and Schedule 4 in the Environment Conservation Rules 1997, compiled by DoE, Ministry of Environment and Forest, GoB. Schedule 2 and 4 are presented in the Table 2 and Table 3.National Ambient Air Quality Standards Published in the Bangladesh Gazette (19 July 2005) and is shown in Table 3.

Table 2: Bangladesh Standards for Ambient Air

Location	Unit	SPM (Suspended particulate matters)	SO_2 (Sulphur di-oxide)	NO_X (Oxide of Nitrogen)
Industrial and mix area	mg/m^3	500	120	100
Commercial and mix area	mg/m^3	400	100	100
Residential and Rural area	mg/m^3	200	80	80
Sensitive area	mg/m^3	100	30	30

*Source: *(Schedule -2, Rule 12, Environment Conservation Rules 1997*

Notes:

- Sensitive area includes national monuments, health resorts, hospital, archaeological sites, educational institutions and other government designated area (If any).
- Any industrial unit located not in a designated industrial area will not discharge such pollutants, which may contribute exceed the ambient air quality above in the surrounding areas of residential and sensitive areas.
- Suspended particulate matters mean airborne particles of diameters of 10 micron or less.

Table 3: Bangladesh Standards for Ambient Air (Revised 19th July in 2005)

Pollutant	Objective	Averaging Time
$PM_{2.5}$	15 µg /m3	Annual (f)
	65 µg /m3	24-hour (h)
PM_{10}	50 µg /m3	Annual (b)

	150 µg /m3	24-hours(g)
SPM	200 µg /m3	8-hours
SO_2	80 µg /m3; (0.03 ppm)	Annual
	365 µg / m3; (0.14 ppm)	24-hour (a)
NO_x	100 µg /m3; (0.053 ppm)	Annual
CO	10mg/m3; (9 ppm) (a)	8-hours (a)
	40mg/m3; (35 ppm) (a)	1-hour (a)
Lead	0.5 µg/m3	Annual (i)
Ozone	157 µg /m3; (0.08 ppm)	8-hour (e)
	235 µg /m3; (0.12 ppm)	1-hour(d)

Notes:

a) Not to be exceeded more than once per year
b) The objective is attained when the annul arithmetic mean is less then or equal to 50µg/m3.
c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150µg/m3 is equal to or than 1.
d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 0.12 ppm is equal to or less then 1.
e) 3-year average of annual 4^{th} highest concentration
f) Spatially averaged over designated monitors
g) The from the 99^{th} percentile.
h) The from is the 98^{th} percentile
i) Annual arithmetic average based on lead analysis of TSP samples operated on an every 6^{th} day schedule.

7. National Ambient Noise Standard for Bangladesh/DoE

The guidelines for acceptable noise level, especially outside plant boundary have been considered as levels recommended by internationally acclaimed standards. Bangladesh has categorized the noise by the following levels.

Table 3: Bangladesh Standards for Noise

Location Category	Standards determined at dBa unit	
	Day	Night
Silent Zone	45	35
Residential Area	50	40
Mixed Area (basically residential and together used for commercial and Industrial purposes)	60	50
Commercial area	70	60
Industrial area	75	70

*Source: ECR *Schedule 4, A Compilation of Environmental Laws, DoE*

Notes:

- Limits presented are one-hour energy equivalent sound exposure limits;
- 'Daytime' is 06.00 to 21.00 hours, 'nighttime' is 21.00 to 06.00 hour; and
- Sound exposure at a receptor resulting solely from the facility, irrespective of ambient sound levels, should not exceed the presented limits.

7. IFC/ World Bank/ADB Standard

"World Bank Pollution Preservation and Abatement Handbook" prescribed maximum noise level for power station which is:

"Noise abatement measures should achieve either the following levels or a minimum increase in background levels of 3 dBa. Measurements are to be taken at noise receptors located outside the project property." The maximum noise allowable limit is presented in Table 4 in the unit of dBa.

Table 5: Maximum Noise Allowable Limit

Receptor Type	Daytime (07.00 -22.00 hr)	Nighttime (22.00-07.00 hr)
Residential; Institutional; Educational	55	45
Industrial; Commercial	70	70

*Source: *Thermal Power-Guidelines for NPW plants, World Bank, 1998*

8. Asian Development Bank Guidelines

"Environment Guidelines for selected industrial and power development projects" published by the Asian Development Bank suggests that:

"In the range of 55 dBa to 75 dBa, impacts are of the "annoyance" type resulting in interference with speech communication, general well being and sleep. Response to such problems varies with the receptor, for example, schools, offices and similar receptors where ease of speech is of primary concern, will not have the same response to an increase from 55 dBa to 60 dBa as a busy commercial district. Above 75 dBa, the possibility of severe health effects occurs such as loss of hearing." Protected noise levels that are presented in these guidelines are presented in Table 5.

Table 6: Protective Noise Levels

Effect	Level	Area
Hearing	79 dBa	All areas at the year
Outdoor activity interference and annoyance	55 dBa	Outdoors in residential areas and forms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use. Outdoor areas where people spend limited amounts of time, such as school yards, playground, etc.
Indoor activity interference and annoyance		Indoor residential areas Other indoor areas with human activities such as schools etc.

**Source: US EPA 500/9-79-100, November 1978*

9. Interpretation of Guideline

All the above-mentioned guidelines present desirable objectives based on generally accepted studies on human response to noise and particulate matter. However, in certain urban environments, higher noise levels are tolerated to a greater extant due to acclimatization to existing sources. In these environments the change in sound levels, and the corresponding perception of those changes, is a more relevant measure of expected community response. Residential and institutional areas are of primary importance in assessing noise impacts (i.e., they are considered "sensitive"). Commercial and industrial areas can tolerate much higher sound environments, which is illustrated by the much higher guideline limits for these areas in both the World Bank and Bangladesh guidelines.

The Asian Development Bank Guidelines are focused on annoyance and health issues related to overall noise levels sustained in a certain type of receptor. They do not address specific limits on the relative or absolute contribution of a particular source (e.g., a power plant) at a receptor. Conversely, Bangladesh guidelines are interpreted as limiting the sound levels produced by a facility at a receptor and do not account for ambient sound levels.

10. Conclusions

Environmental monitoring of ambient air and noise quality parameters has been performed for the period of March-May, 2011. Air quality parameters were determined in the site with the help of the High Volume Sampler attached with NL411gases monitoring unit, digital carbon monoxide meter used for CO measurement and noise quality was by Noise Level Meter.

Ambient air quality were monitored and analyzed of samples in the enviro quality laboratory. From the analysis it is found that the ambient air quality is satisfactory and within the allowable limit specified by Department of Environment. SO_2, NOx and CO at all not a problem of the operation of the industry. There is a revised standard for $PM_{2.5,}$ Pm_{10}, SO_2, NOx and CO for air for industrial unit. However, these values are also found below the World Bank standard. It is found from other scientific study that PM_{10} values are increasing day by day against revised standard published in 2005 for ambient air quality. However, it will be a major concern in future.

Noise level quality of project has also been measured. According to the measurement, the noise level around the plant area found no higher (night time) than the allowable limit of mixed zone, but below the limit of commercial and industrial zone, which is normally observed everywhere

Finally it can be concluded that the proposed project have carrying capacity to accumulate SPM and other gaseous pollution and will not show detrimental impact on the environment in terms of air and noise pollution and also the proposed project will provide a good working environment for the workers due to the project is in the country side.

Annex -5: NOISE MEASUREMENT DATA

Noise Level

Introduction:
The noise pollution is not a widely mentioned problem in the proposed Summit Bibiyana Power Project 1&2 (SBPCL) area; some respondents have attributed noise pollution to different types of vehicles that ply over the roads in the study area.

Average noise levels (dB) in the daytime at the plant site have been measured 60 dB (approximate). The average noise level at night is approximately 52 dB in the same place. After setting up the plant, the area will be considered as an industrial zone. They meet the National Ambient Air Quality Standards (NAAQS) level except some stray cases because of the honking of the buses and trucks and motor vehicles passing through Sherpur, Bongaon and Pharpur commercial centre about 2.5 km (minimum) to the each side of the Project Site and at the Project Site (Parkul point). NAAQS levels for industrial zone are 70 dB (night) and 75 dB (day).

Measurements and Results:

Existing noise level of the project area was measured over periods of 24 hours. The state of noise level obtaining throughout the project area and in areas in immediate vicinity and beyond is well within acceptable limits. Noise levels (dB) in the daytime and midnight on March –April 2011 are presented in Figure 1 to 8.

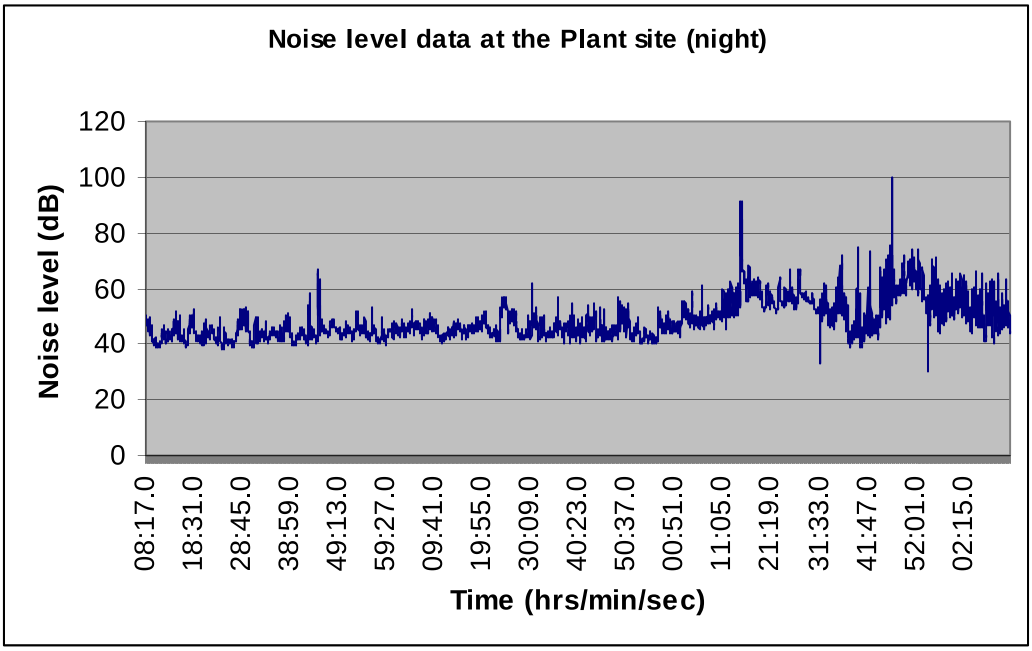


Figure-1: The result of Noise level at Plant site (night) on 15th April 2011

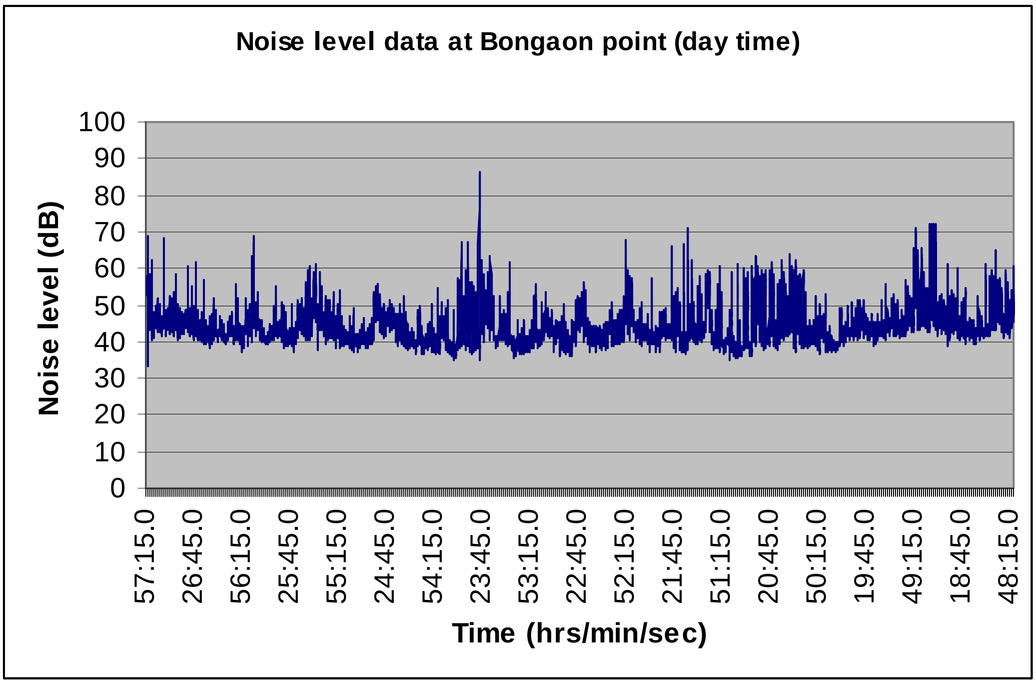


Figure-2: The result of Noise level at Bongaon Point (nearest to the plant site) on 18th April 2011

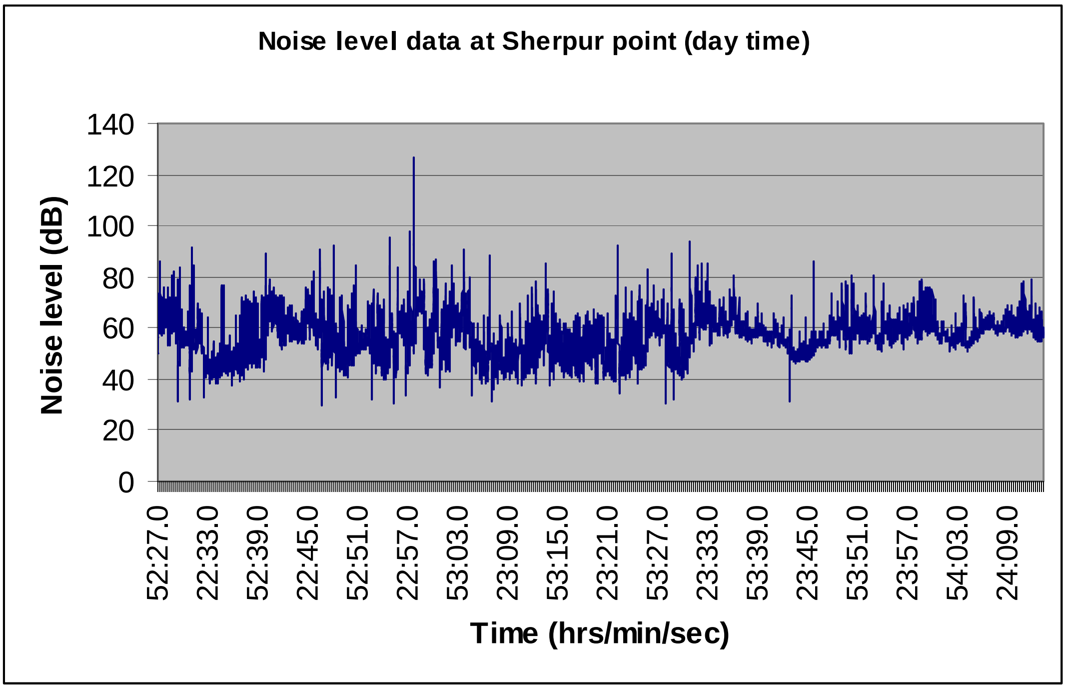


Figure-3: The result of Noise level at Sherpur Point (nearest to population centre) on 19th April 2011

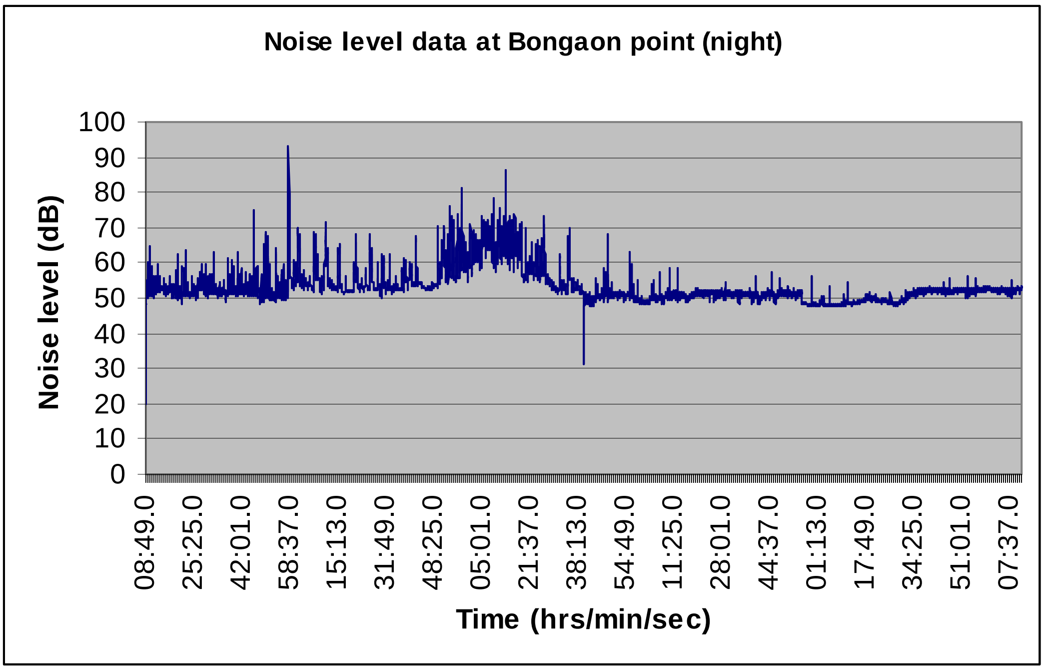


Figure-4: The result of Noise level at Bongaon Point (nearest to plant site) on the 19th April 2011

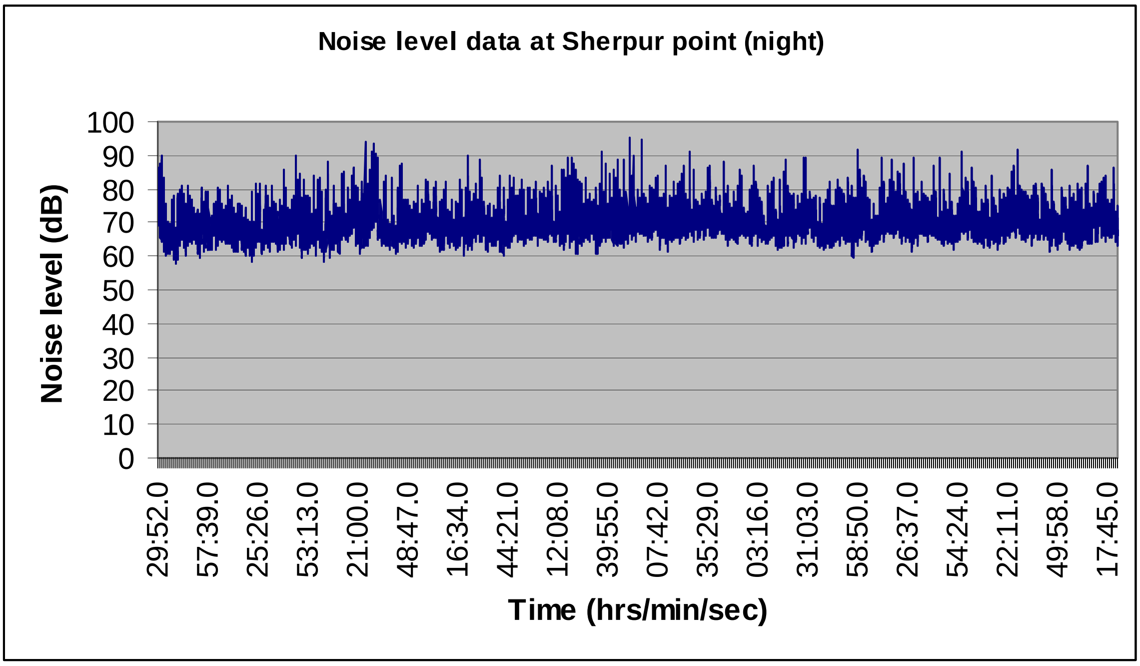


Figure-5: The result of Noise level at Sherpur Point (nearest to population centre) on the 20th April 2011

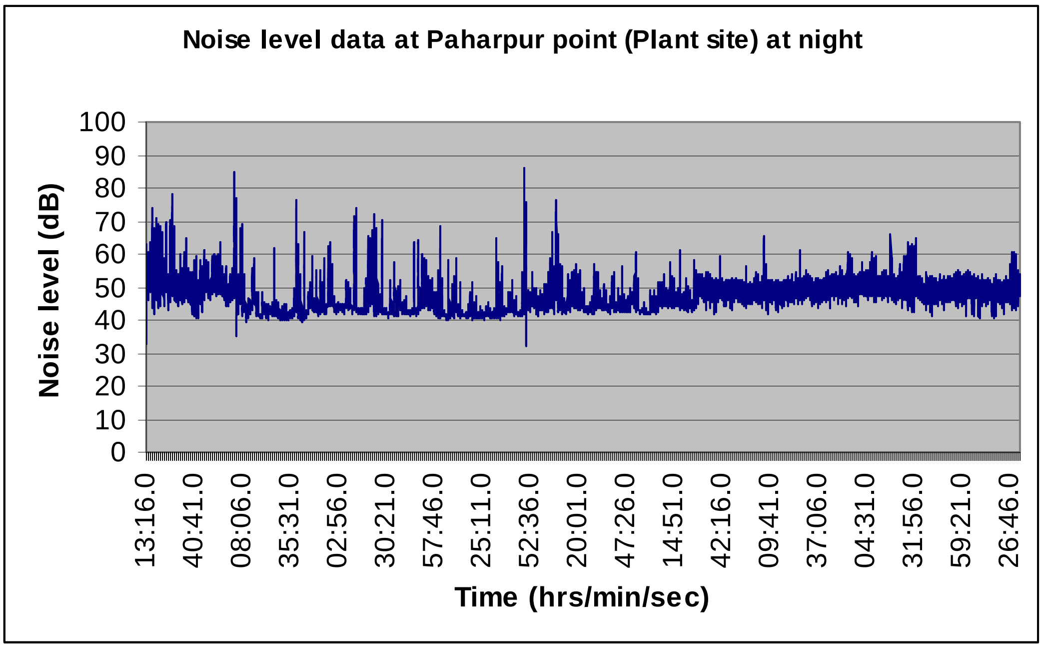


Figure-6: The result of Noise level at Paharpur Point (northern side of the plant and very closed to a passing road) on the 20th April 2011

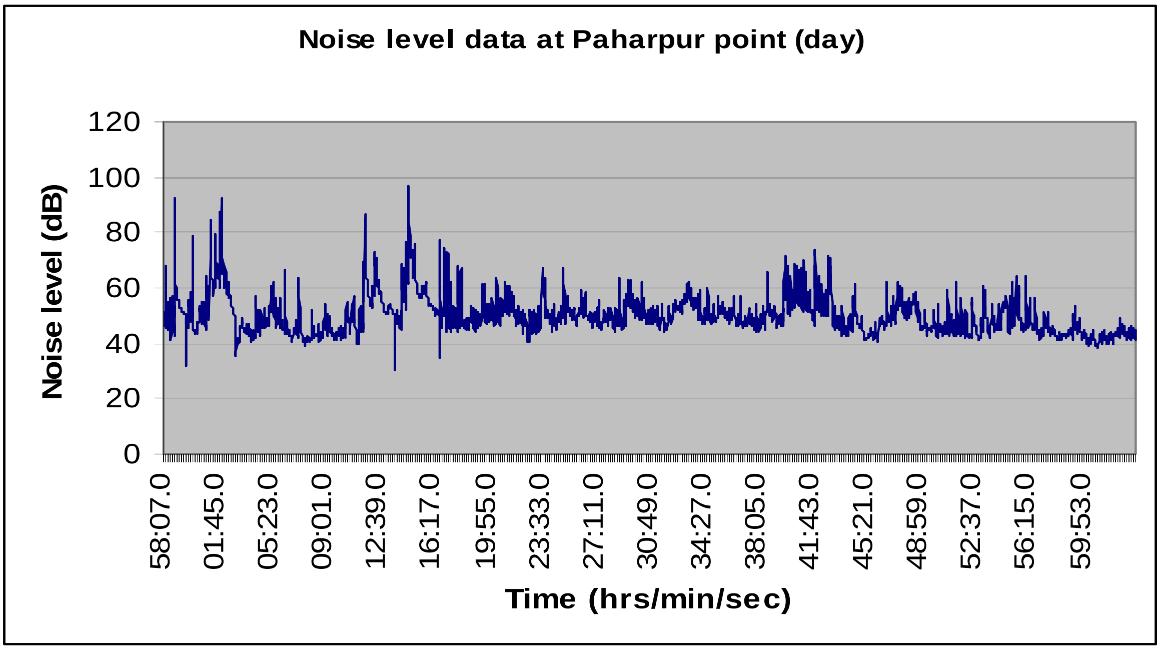


Figure-7: The result of Noise level at Pharpur Point on the 21st April 2011

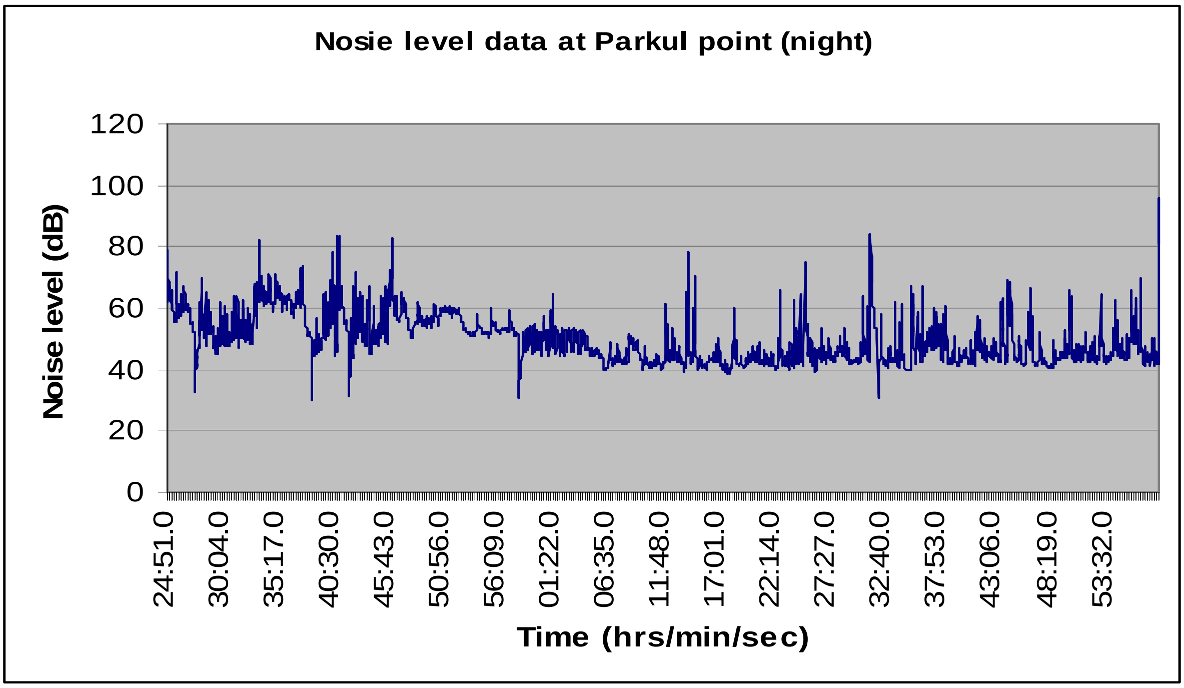


Figure-8: The result of Noise level at Southern side of the Plant (Beside a passing road) on the 21st April

Results:

The above figures show that, noise level varies place to place along with the time. The noise level has been measured during mid April, 2011 to May 2011. Three points have been taken for the noise level measurements at the Summit Bibiyana Power Project 1 & 2 (SBPP) site. Sherpur point is the most vulnerable one where the average noise level has been measured 60 dB at day time and 70 dB at night (Figures- 1, 3 and 5). The average noise level of Bongaon point has been measured 50 dB. At day time, the average level of noise at Bongaon point is 45 dB whereas it is 55 dB (approximately) at night (Figures-2 and 4). The average noise level of Pharpur has been measured 45 dB both during day and night time. The result of Noise level at Southern side of the plant has averaged 42 dB at night.

Annex- 6: Water Quality of Project Site

BCSIR LABORATORIES, DHAKA
Dr. Qudrat-i-Khuda Road, Dhanmondi, Dhaka-1205

Water ANALYSIS REPORT

Referred by : BANGLADESH CENTRE FOR ADVANCED STUDIES
House #10, Road # 16A, Guslhan-1, Dhaka-1212.
Site and date of
Sample Collection : Parkul village, Kushiyara River. 01 August, 2011
Subject of the letter : Cooling Water Chemical Analysis
No. of Sample : 1 (One)

Sl No.	Sample	Parameter	Unit	Concentration	Bangladesh standard
	Cooling River water	COD	mg/L	14.0	200
		Dissolved Oxygen	mg/L	4.0	4.5-8
		Ammonia Nitrogen	mg/L	Less than 0.05	50
		Nitrites	mg/L	Less than0.07	
		Nitrate	mg/L	3.0	10
		Mercury	mg/L	Less than 0.01	.01
		Manganese	mg/L	Less than 0.05	5
		Phosphate	mg/L	0.52	
		Phosphorus	mg/L	0.55	1
		Iron	mg/L	0.80	2
		Chlorine	mg/L	Not detected	0.2 for drinking water
		Ca	mg/L	11.6	75
		Arsenic	mg/L	Less than 0.01	.05
		Total acidity as $CaCO^3$	mg/L	47	
		Alkalinity as $CaCO^3$	mg/L	70	200-500
		Total Hardness as $CaCO^3$	mg/L	65	
		Lead	mg/L	Less than 0.01	0.05
		Potassium	mg/L	2.4	12
		Sodium	mg/L	11.01	200
		pH at $24.5^{O}C$	-	7.66	6-9
		TSS	mg/L	13.8	10
		TDS	mg/L	150	1000
		Total Solid	mg/L	148	
		Sulfate	mg/L	7.0	400
		Turbidity	NTU	17.0	10
		Conductivity	μS/cm	160	

BCSIR LABORATORIES, DHAKA
Dr. Qudrat-i-Khuda Road, Dhanmondi, Dhaka-1205

ANALYSIS REPORT

Referred by : BANGLADESH CENTRE FOR ADVANCED STUDIES
House #10, Road # 16A, Guslhan-1, Dhaka-1212.
Site and date of
Sample Collection : Parkul village, Kushiyara river. 01 August, 2011
Subject of the letter : Cooling Water Chemical Analysis
No. of Sample : 1 (One)

Sl. No.	Sample	Parameters	Concentration
1	River Water	Ammonia nitrogen, N	2.84 mg/L
		Dissolved oxygen, O_2	3.85 mg/L
		Lead, Pb	Less than 0.1 mg/L
		Potassium, K	2.63 mg/L
		Sodium, Na	2.37 mg/l
		pH at 23.3 ^{0}C	5.95
		TSS	1200 mg/L
		TDS	155 mg/L
		Total solids	1386 mg/L
		Sulfate	3.08 mg/L
		Turbidity	320 NTU
		Conductivity (of filtered sample)	160 us/cm
		Total hardness as $CaCO_3$	16 mg/L
		Alkalinity as $CaCo_3$	35.3 mg/L
		Total acidity as $CaCo_3$	170 mg/L
		Arsenic, As	Less than 0.01 mg/L
		Calcium, Ca	4.94 mg/L
		Chlorine, CI	Not detectable
		COD	28mg/L
		Iron, Fe	0.92 mg/L
		Phosphorus, P	4.65 mg/L
		Phosphates, PO_4	10.2 mg/L
		Manganese, Mn	0.28 mg/L
		Mercury, Hg	Less than 0.0 mg/L
		Nitrate, No_3	Not detectable
		Nitrate, No_2	Not detectable

Source: BCAS study

Annex -7: National Ambient Air Quality Standards

Table: National Ambient Air Quality Standards (NAAQS) for Bangladesh

Pollutant	Objectives	Average
CO	10 mg/m^3 (9 ppm)	8 hours(a)
	40 mg/m^3 (35 ppm)	1 hour(a)
Pb	0.5 μg/m^3	Annual
NO_2	100 μg/m^3 (0.053 ppm)	Annual
Pm10	50 μg/m^3	Annual (b)
	150 μg/m^3	24 hours (c)
PM2.5	15 μg/m^3	Annual
	65 μg/m^3	24 hours
O_3	235 μg/m^3 (0.12 ppm)	1 hour (d)
	157 μg/m^3 (0.08 ppm)	8 hours
SO_2	80 μg/m^3 (0.03 ppm)	Annual
	365 μg/m^3 (0.14 ppm)	24 hours (a)

Notes:

(a) Not to be exceeded more than once per year

(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 μg/m^3

(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 μg/m^3 is equal to or less than 1

(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 0.12 ppm is equal to or less than 1 (Source: AQMP, DOE).

Table: Noise Quality Standards of Bangladesh, by Zone and Time of Day

Zone Class	Limits in dBa	
	Daytime (6 a.m. – 9 p.m.)	**Nighttime (9 p.m. – 6 a.m.)**
Silent zone	45	35
Residential zone	50	40
Mixed (residential/commercial/industrial) zone	60	50
Commercial zone	70	60
Industrial zone	75	70

Source : AQMP, DOE

Annex -8: Composition of Bibiyana Gas

Bibiyana Field Gas Composition

(Test Methods: ASTM D-1945-96, GPA Standard 2286-95) Test Date: 20 May, 2011

COMPONENTS (MOLE %)	Mole %	Vol %
Oxygen (O_2)	0.00000	0.000
Nitrogen (N_2)	0.20370	0.204
Methane (CH_4)	95.45877	95.458
Carbon Dioxide (CO_2)	0.14891	0.149
Ethane (C_2H_6)	2.39689	2.397
Propane (C_3H_8)	1.07558	1.076
Isobutane (iC_4H_{10})	0.21602	0.216
n-Butane (nC_4H_{10})	0.18561	0.186
Isopentane (iC_5H_{12})	0.09623	0.196
n-Pentane (nC_5H_{12})	0.05051	0.051
Hexanes (C_6H_{14})	0.05195	0.052
Heptanes (C_7H_{16})	0.06816	0.068
Octanes (C_8H_{16})	0.04284	0.043
Nonanes (C_9H_{20})	0.00483	0.005
Nonanes + (C_9H_{20})+	0.00000	0.000
Total	100.00	100.00

Figure 2.1 b

Bibiyana Field Gas Physical Properties:

(Methods: ASTM 3599-98, GPA 2172-96)

Parameter	Value
Real Relative Density/Specific Gravity	0.592903
Gross (Higher) Heating Value	1061.8052 Btu/scft
Liquefiable Hydrocarbon Content	0.131 GPM (gallons per throusand cubic feet)
Viscosity	0.025cp
Temperature	81° F
Pressure	977 psi

Annex 9: Notice, Certificates and Clearances

চেয়ারম্যানের কার্যালয়

৫নং আউশকান্দি ইউনিয়ন পরিষদ

ডাক- বাজার সঙ্গীদপুর, উপজেলা- নবীগঞ্জ, জেলা- হবিগঞ্জ।

সূত্র ঃ- তারিখঃ..............................

স্মারক নং

অবস্থানগত/পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের ছক

১। আবেদনকারীর নাম ঃ সামিট পাওয়ার কোম্পানী লিঃ

২। পিতা/স্বামী/স্ত্রীর নাম ঃ

৩। আবেদন কারীর ঠিকানা ঃ সামিট সেন্টার,১৮কাওরান বাজার কমার্শিয়াল এরিয়া ঢাকা-১২১৫।

৪। কারখানা/প্রকল্পের অবস্থানগত ঠিকানা ঃ গ্রামঃ পারকুল, উপজেলা ঃ নবীগঞ্জ, জেলা ঃ হবিগঞ্জ।

৫। কারখানা/প্রকল্পের তফসিল ঃ

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দাগ নং	জমির ধরন	মোট জমির পরিমাণ
হবিগঞ্জ	নবীগঞ্জ	তাজাবাদ	৩৩১৩,১৫৫, ২১৫,১৫১, ১৫৮,১৭১, ১৮৩,৩৪৫, ৩৯২,৪৭৪, ৪৭৫,৬৪৯, ৮৫১,৮৫৭, ৮১০,৭৯৬, ১১০৫,১২৫৮	৩১০৭-৩১১৪,৩১৪২-৩১৬৭,৩১৬৯-৩১৮৬,৩১৯০-৩২০০,৩২০৭,৩২২০,৩২২৫,৩২২৬,৩২২৯-২৬৮,৩২৭২,৩২৭৯,৩২৮৩-৩২৯০,৩২৯৮,৩৩০৩,৩৩০৭-৩৩১০,৩৩২৩-৩২৬,৩১৩৪,৩১৩৯,৩১৫৩,৩১৮৭,৩৩০১,৩৩১৭,৩৩২৬,৩৩৬৪,৩৩৭২-৩৭৬,৩৪১৫,৩৪৪৫,৩৪৪৯,৩৪৬২,৩৪৬২,১২৪৯,১২৫০-১২৭৭,১২৯৮-১৩০৬, ১৩১৭-১৩২৬, ১৩৩৩-১৩৪২, ১৩৪৮-১৩৫১,১৩৬৭-১৩৭৫,১৩৮৬,১৪২৫	এক ফসলী ও দু'ফসলী জমি	৬৩ একর

৬। কারখানা/প্রকল্পের উৎপাদিত/উৎপাদিতব্য পণ্যের নাম ঃ বিদ্যুৎ

উপরোক্ত তথ্যাদির আলোকে,সামিট বিবিয়ানা ১ এবং ২ পাওয়ার কোম্পানী লিঃ প্রকল্পকে নিম্নবর্ণিত শর্তসাপেক্ষে অনাপত্তিপত্র প্রদান করা হলো।

(চলমান পাতা)

(জের-২)

শর্তাবলী

১. প্রকল্প/কারখানা স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরন করতে হবে

২. পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত পদ্ধতিতে ছাড়পত্র গ্রহন করতে হবে।

৩. কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তা নিশ্চিত করতে হবে।

৪. উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে এবং অগ্নিকান্ড কিংবা অন্য কোন দূর্ঘটনার সময় জরুরি নির্গমন ব্যবস্থা থাকতে হবে।

৫. বায়ু ও শব্দদূষণ করা যাবে না।

৬. কারখানা/ প্রকল্প সৃষ্ট তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উল্লিখিত যে কোন শর্ত লঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক কারখানা/প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া হবে।

২০/৪/২১

তারিখ ঃ

স্থানীয় কর্তৃপক্ষের স্বাক্ষর ও সীল ঃ
(মোঃ দিলাওর হোসেন)
চেয়ারম্যান
৫নং আউশকান্দি ইউ, পি
নবীগঞ্জ, হবিগঞ্জ।

1st Notice for land Acquisition(Gas Pipeline) from the Deputy Commissioner (DC), Nabigonj, Habigonj, Bangladesh

হুকুম দখল মামলা নং- ০২/২০২০-২০২১

ফরম ক

(৪ নং ধারা দেখুন)

স্থাবর সম্পত্তি হুকুম দখল আদেশ নামা

যেহেতু 'ক' তফসিলে বর্ণিত সম্পত্তি সরকারের প্রয়োজনে এবং জনস্বার্থে গ্যাস পাইপ লাইনের উদ্দেশ্যে হুকুম দখল করা প্রয়োজন।

অতএব, এখন ১৯৮২ সনের ২ নং অধ্যাদেশের ১৮ ধারা অর্ন্তগত (১) উপধারার ক্ষমতাবলে আমি উক্ত সম্পত্তি হুকুম দখল করিলাম এবং এই মর্মে নির্দেশ দিতেছি যে, জনাব- [illegible] পিং নছির উল্লা

ঠিকানা ঃ-

উক্ত সম্পত্তির মালিক/দখলদার

(ক) আমার পক্ষে ক্ষমতাপ্রাপ্ত অফিসারের নিকট তারিখে সম্পত্তির দখল হস্তান্তর করিবেন।

(খ) নিম্নে খ, তফসিলে বর্ণিত সমুদয় অস্থাবর অথবা আমার ক্ষমতা প্রাপ্ত কোন অফিসার কর্তৃক উল্লেখিত অন্য কোন অস্থাবর সম্পত্তি সরাইয়া ফেলিবেন।

(গ) সম্পত্তিটি কোন রকম ভাবে নিষ্পত্তি করিবেন না যেন এই আদেশনামা বলবৎ থাকা পর্যন্ত সম্পাত্তিটি আমার ইচ্ছামত ব্যবহারের কোন রকম গোলমাল অথবা হস্তক্ষেপ করা না হয়।

তফসিল - ক উপজেলা- নবীগঞ্জ- মৌজা- দেবপাড়া জেঃ এলঃ নং- ৪১

তফসিল - খ

দাগ নং-	খতিয়ান নং-	পরিমাণ
২৭৬৬	৬১	.১৬০৪
২৭৬৮	"	.০৬০০
২৭৬৭	৬৫২	.০৬৭৫

তারিখ

জেলা প্রশাসক
হবিগঞ্জ।

মোঃ হাফুজ শহীদ
সার্ভেয়ার
ভূমি অধিগ্রহণ শাখা
হবিগঞ্জ।

৫.১.২১
(মোঃ ইউনুস আলী)
ভূমি অধিগ্রহণ কর্মকর্তা
হবিগঞ্জ।

1st Notice for land Acquisition (Main Plant) from the Deputy Commissioner (DC), Nabigonj, Habigonj, Bangladesh

বাং (ইং) .... জেলা হুকুম দখল কেস সংখ্যা ০১/২০০৭-২০০৮

নোটিশ জারীর তারিখ ঃ

ফরম- 'ক'

(৪ নং বিধির (১) উপ-বিধি দ্রষ্টব্য)

[illegible]

নোটিশ

(৩ ধারার অধীনে)

যেহেতু নিম্নোক্ত তফশীলে বর্ণিত সম্পত্তি [illegible] জনকল্যান মূলক উদ্দেশ্যে এবং গণস্বার্থে প্রয়োজন অথবা প্রয়োজন হইতে পারে, সেহেতু এক্ষনে ১৯৮২ সনের সম্পত্তি হুকুম দখল ও রিকুইজিশন অধ্যাদেশ (১৯৮২ সনের ২ নং অধ্যাদেশ) এর ৩ ধারায় বর্ণিত সিদ্ধান্ত এতদ্বারা সংশ্লিষ্ট সকলকে অবগতির জন্য নোটিশ জারী করা হইল যে, উক্ত সম্পত্তি সরকার কর্তৃক হুকুম দখলের [illegible] হইয়াছে।

উক্ত সম্পত্তিতে স্বার্থবান যে কোন ব্যক্তি এই নোটিশ জারী হওয়ার ১৫(পনের) দিনের মধ্যে প্রস্তাবিত সম্পত্তি হুকুম দখলের বিরুদ্ধে নিম্ন স্বাক্ষরকারীর নিকট আপত্তি দায়ের করিতে পারেন।

তফশীল

দাগ নং ঃ ৬২৩১, ৬২৬৬, ৬২৬৭

খতিয়ান নং ঃ ৬০১

মৌজা ঃ [illegible]

উপজেলা ঃ নবীগঞ্জ

সেই জমির পরিমান ঃ ০.২৫, ০.০৬, ০.১০

সার্ভেয়ার
ভূমি হুকুম দখল শাখা
হবিগঞ্জ।

তারিখ ঃ..................

[illegible] দখল শাখা
হবিগঞ্জ।

জেলা প্রশাসকের পক্ষে
ভূমি হুকুম দখল কর্মকর্তা
হবিগঞ্জ জেলা

2nd Notice for land Acquisition (Main Plant) from the Deputy Commissioner (DC), Nabigonj, Habigonj, Bangladesh

গণ প্রজাতন্ত্রী বাংলাদেশ সরকার
জেলা প্রশাসকের কার্য্যালয়
ভূমি হুকুম দখল শাখা
হবিগঞ্জ।

(৩২)

২০০৯ ইং সনের হুকুম দখল কেস নং ০৬/২০১০-২০১১ ইং।

ফরম - 'খ'
(৪ নং বিধির (১) উপ-বিধি দ্রষ্টব্য)
নোটিশ
(৬ ধারার অধীন)

প্রাপক [illegible] সম্পত্তির মালিক / দখলকার / স্বার্থবান ব্যক্তি।

এতদ্বারা ১৯৮২ ইং সনের হুকুম দখল ও রিকুইজিশন অধ্যাদেশ (১৯৮২ সনের ২ নং অধ্যাদেশ) এর ৬ ধারা মোতাবেক নোটিশ প্রদান করা হইল যে, সরকার নিম্ন বর্ণিত তফশীলভুক্ত সম্পত্তি হুকুম দখল করার সিদ্ধান্ত করিয়াছেন এবং তাহার দখল গ্রহন করিতে মনস্থ করিয়াছেন।

অতএব, উক্ত সম্পত্তির মালিক / দখলদার / স্বার্থবান ব্যক্তিগণকে এতদ্বারা অনুরোধ করা হইল যে, তাহারা যেন ব্যক্তিগতভাবে অথবা তাহাদের অনুমোদিত প্রতিনিধির মাধ্যমে নিম্ন স্বাক্ষরকারীর নিকট ভূমি অধিগ্রহন শাখার অফিসে ২৭/০১/২০১১ তারিখে [illegible] হইতে [illegible] সময়ের মধ্যে উপস্থিত হইয়া -

১) উক্ত সম্পত্তিতে তাহার / তাহাদের স্বার্থের প্রকৃত এবং উক্ত স্বার্থের পরিমান ও উহাতে তাহাদের স্বার্থ বাবদ দাবী পূর্ন বিবরণ প্রদান করেন এবং

২) উক্ত সম্পত্তির অথবা উহার কোন অংশের সব অংশীদার বা বন্ধক গ্রহীতা থাকিলে অথবা অন্য কোন প্রকার কেহ উহাতে স্বার্থবান হইলে এবং উক্ত সম্পত্তি বাবদ তাহারা কেহ স্বার্থ লভ্যাংশ করিয়া থাকিলে উহার সম্পর্কে যতদূর সম্ভব বিবৃতি প্রদান করিবেন অথবা লিখিত বিবৃতি পেশ করিবেন।

-ঃ তপশীল ঃ-

দাগ নং ১৩২০,

খতিয়ান নং ২১৯,

মৌজা [illegible] জে. এল. নং ৪১,

উপজেলা নবীগঞ্জ জেলা - হবিগঞ্জ।

মোট জমির পরিমান ০.১৬, একর।

3rd Notice for land Acquisition from the Deputy Commissioner (DC), Nabigonj, Habigonj, Bangladesh

১০৪

ফরম নং-১৪০

বাংলা (১৯৯ .... সনের হুকুম দখল কেস নং- এল. এ. কেইস নং- ০৬/২০০৭-২০০৮

ফরম "গ"

(৬ বিধি ৩ এর (১) উপ-বিধি দ্রষ্টব্য)

-: নোটিশ :-

(৭ ধারার অধীনে)

প্রাপক/বরাবর [illegible]

[illegible]

এতদ্বারা ১৯৮২ ইং সনের স্থাবর সম্পত্তি হুকুম দখল এবং রিকুজিশন অধ্যাদেশ (১৯৮২ সনের ২ নং অধ্যাদেশ) এর ধারার (৩) উপ-ধারা মোতাবেক নোটিশ প্রদান করা যাইতেছে যে, আপনি/আপনারা উপরোক্ত সম্পত্তি হুকুম দখল কেসে স্বার্থবান/ব্যক্তিবর্গ বলিয়া গণ্য হইয়াছেন এবং আমার মতানুসারে আপনাকে/আপনাদিগকে নিম্ন বর্ণিত হারে ক্ষতিপুরন প্রদান করা হইবে।

প্রতি একর জমির ক্ষতিপুরন 2,56,750/- টাকা হারে মোট 89,928/-

ঘর বাড়ীর জন্য ক্ষতিপুরন .... টাকা হারে মোট /

অন্যান্য সম্পত্তি বাবদ ক্ষতিপুরন .... টাকা হারে মোট 89,928/-

মোট টাকা-

আপনার প্রাপ্তব্য টাকার পরিমান টাকা = 89,928/-

উপরোক্ত ক্ষতিপুরনের টাকা গ্রহনে নিযুক্ত আপনি স্বয়ং না আপনার যথাযথ অনুমোদিত প্রতিনিধি ১৮/০৭/০৮ ইং তারিখ অথবা তৎপুর্বে আমার নিকটে হাজির হইবেন।

মৌজা:- [illegible]

দাগ নং	খতিয়ান	শ্রেনী	এরিয়া	টাকা
৩৪৫৬	৮২০	[illegible]	-	89,928/-
৩৩৬২	১			
৩৩৬৬	৮২০			

তারিখ:-

জেলা প্রশাসক,
হবিগঞ্জ।

ভূমি হুকুম দখল শাখা

Approval Notice from the Bangladesh Inland Water Transport Authority (BIWTA) for Sand mining

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
নৌ-পরিবহন মন্ত্রণালয়
টিএ অধিশাখা
বাংলাদেশ সচিবালয়, ঢাকা।

০৭ ভাদ্র, ১৪১৭
তারিখ : -----------------
২২ আগস্ট, ২০১০

নং-১৮.০১৪.০১৮.৮০.০০.০০৭.২০১০- ৭২৫

বিষয় : হবিগঞ্জ জেলার তাজাবাদ, মৌজাপুর ও শালিকপুর মৌজাস্থ কুশিয়ারা নদী হতে বালি উত্তোলনের অনাপত্তি প্রসংগে।

সূত্র : (১) বিআইডব্লিউটিএ'র পত্র নং-পিটিডি/অপস/মাটি খনন/নাঃগঞ্জ/১৩২/১১০৮/১১৫৬, তাং-২৭.০৭.২০১০
(২) হবিগঞ্জ জেলা প্রশাসকের স্মারক নং-জেপ্রহ/রাজস্ব/সভা/ড্রেজিং/১৪/১৪-৭/২০০৯-৬৪৫(৬)
তাং ২০.০৫.২০০৯

উপর্যুক্ত বিষয়ে বিআইডব্লিউটিএ থেকে প্রাপ্ত (সংযুক্তিসহ) কাগজপত্র এতদসংগে প্রেরণ করা হলো। হাইড্রোগ্রাফিক জরিপ চার্ট নং-NED866/2009(A&B) এ প্রদর্শিত স্থান হতে (কপি সংযুক্ত) কতিপয় শর্ত সাপেক্ষে ৪৫,০০,০০০ (পয়তাল্লিশ লক্ষ) ঘনফুট বালি মেসার্স ন্যাশন ট্রেড ইন্টারন্যাশনাল এর অনুকূলে বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষ অনাপত্তি জ্ঞাপন করেছে। উক্ত অনাপত্তির প্রেক্ষিতে বিধি মোতাবেক প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য নির্দেশক্রমে অনুরোধ করা হলো।

সংযুক্তি : বর্ণনামতে

(মোঃ শহিদুল ইসলাম)
উপ-সচিব
ফোন-৭১৬৪৫০৯
ds.ta@mos.gov.bd

জেলা প্রশাসক
হবিগঞ্জ

অনুলিপি :

১। এ্যাডভোকেট মোঃ আবু জাহির, মাননীয় সংসদ সদস্য, ২৪১, হবিগঞ্জ-৩।
২। সচিব, ভূমি মন্ত্রণালয়, বাংলাদেশ সচিবালয়, ঢাকা।
৩। চেয়ারম্যান, বিআইডব্লিউটিএ, ১৪১-৪৩ মতিঝিল বা/এ, ঢাকা।
৪। মেসার্স ন্যাশন ট্রেড ইন্টারন্যাশনাল, শেরপুর, নবীগঞ্জ, হবিগঞ্জ।

M/C

Letter-2010 - 539 -

Approval Notice from the Bangladesh Inland Water Transport Authority (BIWTA) for Sand mining

Fax No. [illegible]
Grams AUTHORITY
Phone [illegible] 9552039 [illegible]

বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষ

BANGLADESH INLAND WATER TRANSPORT AUTHORITY

বিআইডব্লিউটিএ ভবন
১৪১-১৪৩, মতিঝিল বাণিজ্যিক এলাকা
পোস্ট বক্স ৭৬, ঢাকা-১০০০
বাংলাদেশ

পাতা-২

BIWTA BHABAN
141-143, MOTIJHEEL C.A.
POST BOX 76, DHAKA-1000
BANGLADESH

(১৭) মাটি/বালি-উত্তোলনের সময় সরকারী, আধা-সরকারী, স্বায়ত্তশাসিত ও ব্যক্তি মালিকানাধীন কোন প্রতিষ্ঠানের স্থাপনার কোন ক্ষতি করা যাবে না। কোন ক্ষতিপূরণের দাবি আসলে আবেদনকারী বহন করবে;

(১৮) মাটি অপসারনকালে কোন প্রকার দুর্ঘটনার জন্য এ কর্তৃপক্ষ দায়ী থাকবে না। যে কোন প্রকার অনাকাঙ্ক্ষিত ঘটনার জন্য আবেদনকারী দায়ী থাকবে এবং কোন প্রকার ক্ষতি পূরণের দাবি আসলে আবেদনকারীকে তা বহন করতে হবে;

(১৯) মাটি অপসারনকালে নদীর তীর সংলগ্ন ফসলি জমি/স্থাপনা ও পরিবেশের এবং ব্রীজের কোনরূপ ক্ষতিসাধন করা যাবে না;

(২০) নদীর তীর ভূমির ঢাল (Slope) যথাযথভাবে সংরক্ষণ করে মাটি অপসারন করতে হবে;

(২১) জীব-বৈচিত্র সংরক্ষণ ও পরিবেশ দূষণমুক্ত রাখতে হবে;

(২২) মাটি অপসারনের বিষয়ে সরকার কর্তৃক জারীকৃত সকল প্রজ্ঞাপন/বিধি-বিধান ও আইনসমূহ মেনে চলতে হবে;

(২৩) আবেদনপত্রের সাথে সংযুক্ত হাইড্রোগ্রাফিক সার্ভে চার্টে চিহ্নিত স্থানের বাহিরে মাটি অপসারন করা যাবে না;

(২৪) ব্রীজের ১ কিলোমিটার আপ ও ডাউনে মাটি অপসারন করা যাবে না। শর্ত থাকে যে, সড়ক ও জনপথ, এলজিইডি বা অন্য কোন সংস্থার ব্রীজের নিকট হতে মাটি অপসারন করতে হলে সংশ্লিষ্ট ব্রীজ কর্তৃপক্ষের নিকট হতে লিখিত অনুমতি নিতে হবে;

(২৫) মেসার্স নাশন ট্রেড ইন্টারন্যাশনাল কর্তৃক কুশিয়ারা নদী হতে মাটি অপসারনের জন্য সংশ্লিষ্ট বন্দর নিয়ন্ত্রণ কর্মকর্তার সার্বিক তত্ত্বাবধানে সংশ্লিষ্ট প্রকৌশল বিভাগের সহায়তায় অনুমোদিত নক্সায় চিহ্নিত স্থান হতে নির্ধারিত পরিমাণ মাটি নির্দিষ্ট সময়ের মধ্যে অপসারনের প্রয়োজনীয় ব্যবস্থা গ্রহণ করবে;

(২৬) মাটি অপসারনের জন্য প্রস্তাবিত এলাকায় হাইকোর্টের রীট বা কোন আইনগত জটিলতা থাকলে তা আবেদনকারী নিজ উদ্যোগে সমাধা করবে;

(২৭) কর্তৃপক্ষের কোন কারণ দর্শানো ব্যতীত মাটি খনন [illegible] করতে পারবে;

(২৮) ড্রেজিং কাজ শেষের সাথে সাথে আবেদনকারীকে তার নিজ খরচে ও নিজ দায়িত্বে ড্রেজারের সকল পাইপ লাইন ও অন্যান্য মালামাল অপসারন করতে হবে;

(২৯) বালি/মাটি উত্তোলনের সময়কাল সর্বোচ্চ ৬(ছয়) মাস, কার্যদিবসের মধ্যে সংশ্লিষ্ট প্রতিষ্ঠান নিজ খরচে বিআইডব্লিউটিএ'র হাইড্রোগ্রাফি বিভাগ কর্তৃক সমাপ্তোত্তর জরিপ সম্পাদন করাবেন। অতঃপর হাইড্রোগ্রাফি বিভাগ উত্তোলনকৃত বালি/মাটির পরিমাণ নির্ণয় পূর্বক বিআইডব্লিউটিএ'র বন্দর ও পরিবহন বিভাগ বরাবর প্রতিবেদন পেশ করবে;

(৩০) বর্ণিত কোন শর্ত ভংগ করা হলে মাটি/বালি উত্তোলন তাৎক্ষণিকভাবে বন্ধ করে দেওয়া হবে এবং অনুমোদন বাতিল বলে গণ্য হবে।

২। আলোচ্য স্থানটি নারায়ণগঞ্জ নদী বন্দরের আওতাভুক্ত বিধায় বালি/মাটি উত্তোলনের নিমিত্ত [illegible] ৭(সাত) দিন পূর্বে নির্বাহী প্রকৌশলী, [illegible], নারায়ণগঞ্জ-কে অবহিত করতে হবে এবং সংশ্লিষ্ট বন্দর কর্মকর্তার তত্ত্বাবধানে নির্বাহী প্রকৌশলী, [illegible], নারায়ণগঞ্জ ড্রেজিং, নারায়ণগঞ্জ এর প্রতিনিধি দ্বারা সার্ভে করে বালি/মাটি খনন স্থান ও খনন এলাকার পরিমাণ নির্ধারণ, খননকার্য নিবিড়ভাবে মনিটরিং এবং খননকৃত/উত্তোলিত মাটি/বালির হিসাব সংরক্ষণ করবেন।

৩। নদী থেকে মাটি অপসারনের বিষয়ে জ্বালানী ও খনিজ সম্পদ, পরিবেশ ও বন, ভূমি, স্বরাষ্ট্র ও নৌপরিবহন এবং পানি সম্পদ মন্ত্রণালয় হতে মতামত গ্রহনের শর্ত আরোপ করা যেতে পারে।

৪। উক্ত বিষয়ে মন্ত্রণালয়ের সদয় সম্মতির জন্য নির্দেশক্রমে প্রেরণ করা হলো।

সংযুক্তঃ বর্ণনামতে।

স্বাক্ষরিত/=
(সৈয়দ মনোয়ার হোসেন)
সচিব

অনুলিপিঃ-

১। জেলা প্রশাসক, হবিগঞ্জ।

Minutes of the meeting was held between the Project Affected Peoples (PAPs) and Upazila Chairman, Deputy Commissioner (DC), TNO, LAO, Local Chairman and Members at DC Office, Habigonj

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
জেলা প্রশাসকের কার্যালয়
(ভূমি অধিগ্রহণ শাখা)
হবিগঞ্জ।
ওয়েবসাইটঃ www.dchabiganj.gov.bd ই-মেইলঃ dchabiganj@ moestab.gov.bd

হবিগঞ্জ জেলার নবীগঞ্জ উপজেলাধীন তাজাবাদ বাটা ও মজলিশপুর মৌজার ৪১.২৪৩৫ একর ভূমিতে ৩৩০-৪৫০ মেগাওয়াট কম্বাইন্ড বিদ্যুৎ কেন্দ্র নির্মাণ প্রকল্পের জন্য অধিগ্রহণকৃত ভূমির ক্ষতিগ্রস্থ ব্যক্তিদের প্রদেয় অতিরিক্ত ক্ষতিপূরণ নির্ধারণের নিমিত্ত ক্ষতিগ্রস্থ ভূমির মালিক ও সংশ্লিষ্ট এলাকার জনপ্রতিনিধিগণের সমন্বয়ে অনুষ্ঠিত সভার কার্যবিবরণী।

সভাপতিঃ জনাব মোঃ আবুল কাসেম তালুকদার
জেলা প্রশাসক, হবিগঞ্জ

তারিখ [illegible]

স্থান ঃ জেলা প্রশাসক, হবিগঞ্জ এর "সভাকক্ষ"।

উপস্থিত সদস্যবৃন্দের নামের তালিকা ঃ- পরিশিষ্ট "ক"।

সভায় উপস্থিত সকলকে স্বাগত জানিয়ে সভাপতি সভার কার্যক্রম শুরু করেন। এরপর সভাপতির অনুমতিক্রমে ভূমি অধিগ্রহণ কর্মকর্তা, হবিগঞ্জ অধিগ্রহণকৃত ভূমির বিস্তারিত তথ্য উপস্থাপন করেন। তিনি জানান হবিগঞ্জ জেলার নবীগঞ্জ উপজেলাধীন তাজাবাদ, বাটা ও মজলিশপুর মৌজার ৪১.২৪৩৫ একর ভূমি বাংলাদেশ বিদ্যুৎ উন্নয়ন বোর্ড, ঢাকা কর্তৃক ৩৩০-৪৫০ মেগাওয়াট কম্বাইন্ড বিদ্যুৎ কেন্দ্র নির্মাণ প্রকল্পের জন্য অধিগ্রহণকৃত ভূমির ক্ষতিগ্রস্থ ব্যক্তিদের ক্ষতিপূরণ প্রদানের নিমিত্ত ০৩ (তিন) ধারা নোটিশ জারির পূর্ববর্তী এক বছরের ক্রয়-বিক্রয় দলিলের তথ্য সংগ্রহ করে সংগৃহীত তথ্যের ভিত্তিতে নীতিমালা মোতাবেক একর প্রতি ভূমির মূল্য নির্ধারণ করা হয়। এরপর ক্ষতিগ্রস্থ ভূমির মালিকগণকে ক্ষতিপূরণের অর্থ প্রদানের নিমিত্ত ০৭ (সাত) ধারার নোটিশ জারী করা হয়। ধার্যকৃত ক্ষতিপূরণ যুক্তিসঙ্গত ও প্রকৃত বাজারমূল্যের সাথে সঙ্গতিপূর্ণ হয়নি মর্মে উল্লেখ করে ক্ষতিগ্রস্থ ব্যক্তিগণ ক্ষতিপূরণ গ্রহণে অস্বীকৃতিসহ অধিগ্রহণকৃত ভূমিতে উন্নয়ন কাজে বাধা প্রদান করতে থাকেন। পরবর্তীতে জটিলতা নিরসনের লক্ষ্যে জেলা প্রশাসক, হবিগঞ্জ মহোদয়ের নির্দেশনা মোতাবেক অতিরিক্ত জেলা প্রশাসক (রাজস্ব), হবিগঞ্জ মহোদয়ের নেতৃত্বে উপজেলা নির্বাহী অফিসার, নবীগঞ্জ, [illegible], সহকারী কমিশনার (ভূমি), নবীগঞ্জ ও প্রত্যাশী সংস্থার প্রতিনিধিগণ [illegible] স্থান সরেজমিন পরিদর্শন করেন। পরিদর্শনকালে এ বিষয়ে এলাকার জনগণের সাথে বিস্তারিত আলাপ-আলোচনা হয়। [illegible]

সভায় আলোচনাকালে-

ক. ক্ষতিগ্রস্থ ব্যক্তিদের প্রতিনিধি জনাব [illegible] বক্তব্য প্রদান করেন। তিনি জানান অধিগ্রহণের জন্য প্রস্তাবিত জায়গাই তাদের একমাত্র সম্বল। বর্তমানে বাজারে এ জায়গা [illegible] হিসেবে বিক্রি হয়। কিন্তু সরকার কর্তৃক নির্ধারিত ক্ষতিপূরণ বাজারমূল্যের চেয়ে অনেক কম। ক্ষতিপূরণের এ টাকা দিয়ে [illegible]। সেক্ষেত্রে তাদের পথে বসা ছাড়া কোন উপায় থাকবেনা। তাই তারা ক্ষতিপূরণের [illegible] প্রত্যাশী সংস্থা কর্তৃক উপযুক্ত মূল্য নিশ্চিত করা হলে তারা [illegible]। তাই বাস্তবতার নিরিখে যুক্তিসংগত ক্ষতিপূরণ নির্ধারণ আবশ্যক।

চলমান পাতা-০২-

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খ. ক্ষতিগ্রস্থ ব্যক্তি জনাব সমুজ আলী জানান পার্শ্ববর্তী মৌজায় (মৌলভীবাজার জেলার শেরপুরে) ৪/৫ লক্ষ টাকা শতক দরে বিক্রি হয় এবং তাদের মৌজায় ৭০/৮০ হাজার টাকা শতক জমি বিক্রি হয়। তাই তারা উপযুক্ত ক্ষতিপূরণ দাবী করছেন।

গ. সাবেক ইউ/পি চেয়ারম্যান, ৫নং আউশকান্দি ইউনিয়ন, নবীগঞ্জ, হবিগঞ্জ সভায় জানান বর্তমানে দেশে অনেক বিদ্যুতের চাহিদা রয়েছে। সেলক্ষ্যে সরকার বিদ্যুৎ উৎপাদনের জন্য জমি অধিগ্রহণ করেছে। কিন্তু অধিগ্রহণকৃত ভূমির উপযুক্ত মূল্য প্রদান না করা না হলে ক্ষতিগ্রস্থ ব্যক্তিগণ মারাত্মকভাবে লোকসানের সন্মুখীন হবে। তাই তিনি অধিগ্রহণকৃত ভূমির প্রতি শতকের জন্য প্রস্তাবিত মূল্যের অতিরিক্ত হিসেবে কমপক্ষে ৩০ হাজার টাকা করে পুনর্বাসন ক্ষতিপূরণ প্রদান করার জন্য সভায় প্রস্তাব রাখেন।

ঘ. বর্তমান ইউ/পি চেয়ারম্যান, ৫নং আউশকান্দি ইউনিয়ন, নবীগঞ্জ, হবিগঞ্জ জনাব দিলোওয়ার হোসেন সভায় ৫০ হাজার টাকা শতক পুনর্বাসন ক্ষতিপূরণ প্রদানের প্রস্তাব করেন। পরে তিনি সাবেক চেয়ারম্যান এর সাথে একমত পোষণ করে ৩০ হাজার টাকা পুনর্বাসন ক্ষতিপূরণের সুপারিশ করেন।

ঙ. প্রকল্প পরিচালক মোঃ এ. বি. সিদ্দিক সভায় জানান জাতীয় গ্রীডে বিদ্যুৎ সরবরাহ বৃদ্ধি করা অতীব জরুরী এবং বিদ্যুৎ প্ল্যান্ট নির্মাণ জাতীয় জনগুরুত্বপূর্ণ বিষয় হিসেবে বিবেচিত। তাই অতি দ্রুত বিদ্যুৎ প্ল্যান্ট নির্মাণের তাগিদ থাকলেও জনগণের স্বার্থ পরিপন্থী কোন সিদ্ধান্ত কোনক্রমেই কাম্য নয়। বরং সকলের সহযোগিতায় জাতীয় স্বার্থ বাস্তবায়নই তাদের কাম্য। তাই ক্ষতিগ্রস্তদের পুনর্বাসনজনিত ক্ষতিপূরণ প্রদান করতে তাদের কোন আপত্তি নাই। তবে এ ক্ষতিপূরণ বিধি-বিধানের আলোকে যুক্তিসংগত হওয়া প্রয়োজন।

চ. উপজেলা নির্বাহী অফিসার, নবীগঞ্জ, হবিগঞ্জ জানান বিগত ২০০৩ খ্রিঃ সালে বিবিয়ানা গ্যাস ফিল্ডের জমি অধিগ্রহণকালে অধিগ্রহণের ফলে ক্ষতিগ্রস্থ পরিবারের পুনর্বাসনের লক্ষ্যে অধিগ্রহণকৃত মূল্যের অতিরিক্ত শতক প্রতি ১০,০০০/= হাজার টাকা করে অতিরিক্ত প্রদান করা হয়েছিল। বর্তমান প্রেক্ষাপটে জমির মূল্য অনেক বৃদ্ধি পেয়েছে। তিনি আরও বলেন বিদ্যুৎ স্টেশন স্থাপনও জাতীয় স্বার্থের সাথে সম্পৃক্ত। এর পাশাপাশি স্থানীয় জনগণের অসুবিধার কথাও বিবেচনায় নেয়া প্রয়োজন। তাই তিনি যুক্তিসঙ্গতভাবে উপযুক্ত পুর্নবাসন ক্ষতিপূরণ নির্ধারণের পক্ষে মতামত প্রদান করেন।

ছ. ভূমি অধিগ্রহণ কর্মকর্তা, হবিগঞ্জ জানান ভূমির মূল্য নির্ধারণী আইন ও বিধির আলোকে যথাযথ প্রক্রিয়া অনুসরণ করেই করা হয়েছে। কাজেই এক্ষেত্রে মূল্য পুনঃনির্ধারণের কোন সুযোগ নেই। তবে জনগণের কথাও বিবেচনায় নিতে হবে। অনেকক্ষেত্রেই জমি ক্রয়-বিক্রয়কালে প্রকৃতমূল্যের চেয়ে কমমূল্যে রেজিস্ট্রি করার প্রবণতার কারণে নির্ধারিত মূল্য বাস্তবের তুলনায় কম হয়। তাই ক্ষতিগ্রস্ত ব্যক্তিদের বর্তমান অবস্থা ও সার্বিক প্রেক্ষাপট বিবেচনায় নির্ধারিত মূল্যের সাথে অতিরিক্ত হিসেবে ক্ষতিপূরণ প্রদান করা যেতে পারে। ঢাকা-সিলেট হাইওয়ে এবং বিবিয়ানা গ্যাস ফিল্ডের ভূমি অধিগ্রহণকালেও এরূপ ক্ষতিপূরণ প্রদান করা হয়েছিল।

উপরোক্ত আলোচনা ও বক্তব্যের প্রেক্ষিতে সভাপতি উপস্থিত ক্ষতিগ্রস্থ ব্যক্তিদের উদ্দেশ্যে বলেন দেশের বিদ্যুতের চাহিদা পূরণকল্পে এ বিদ্যুৎ কেন্দ্র স্থাপন জাতীয় গুরুত্বপূর্ণ বিষয় হিসেবে বিবেচিত হয়েছে। কাজেই এ বিদ্যুৎ কেন্দ্র স্থাপনের কার্যক্রম দ্রুত সমাপ্তির জন্য তাগিদ রয়েছে। পাশাপাশি ক্ষতিগ্রস্তদের বিষয়টিও বিবেচনায় নিতে হবে। জেলা প্রশাসক হিসেবে সকলের স্বার্থ বিবেচনা করা তার দায়িত্ব। এমতাবস্থায় ক্ষতিগ্রস্থদের পুর্নবাসনের জন্য তার সাধ্যমত চেষ্টা অব্যাহত থাকবে। সেক্ষেত্রে সকলের সহযোগিতা প্রয়োজন। সার্বিক আলোচনা শেষে নিম্নোক্ত সিদ্ধান্ত গৃহিত হয়।

চলমান পাতা-০৩-

সিদ্ধান্ত ঃ

ক. প্রত্যাশী সংস্থার প্রতিনিধি ও ক্ষতিগ্রস্থ ব্যক্তিদের প্রতিনিধি এবং স্থানীয় জনপ্রতিনিধিদের বক্তব্যের প্রেক্ষিতে সরকার কর্তৃক নির্ধারিত ক্ষতিপূরণের প্রদানের পাশাপাশি ক্ষতিগ্রস্থদের পুর্নবাসনের জন্য অতিরিক্ত হিসেবে অধিগ্রহণকৃত প্রতি শতক জমির বিপরীতে ২৫,০০০/- টাকা (পঁচিশ হাজার টাকা মাত্র) করে পুনর্বাসন ক্ষতিপূরণ প্রদান করার সিদ্ধান্ত গৃহিত হয়।

খ. অধিগ্রহণকৃত ভূমির মধ্যে ঠিকাদার কর্তৃক কোন সংস্কারমূলক বা উন্নয়ন কাজে ক্ষতিগ্রস্থ ব্যক্তিগণ কর্তৃক বাধা/আপত্তি প্রদান না করে সর্বাত্মক সহযোগিতা প্রদান করার বিষয়ে সর্বসম্মতিক্রমে সিদ্ধান্ত গৃহিত হয়।

সভায় আর কোন আলোচনা না থাকায় সভাপতি সকলকে পুনরায় ধন্যবাদ জানিয়ে সভার সমাপ্তি ঘোষণা করেন।

(মোঃ আবুল কাসেম তালুকদার)
জেলা প্রশাসক
হবিগঞ্জ।

স্মারক নং-জেপ্রহ/এল.এ/২০০৯- ২৬৭(১৫)　　　　তারিখ ঃ ১৬/০৯/২০০৯ খ্রিঃ।

সদয় অবগতির্থে অনুলিপি প্রেরণ করা হলো ঃ

০১। সচিব, বিদ্যুৎ বিভাগ, বিদ্যুৎ, জ্বালানী ও খনিজ সম্পদ মন্ত্রণালয়, বাংলাদেশ সচিবালয়, ঢাকা।
০২। সচিব, ভূমি মন্ত্রণালয়, বাংলাদেশ সচিবালয়, ঢাকা।
০৩ চেয়ারম্যান, বাংলাদেশ বিদ্যুৎ উন্নয়ন বোর্ড, ওয়াপদা ভবন, মতিঝিল বাণিজ্যিক এলাকা, ঢাকা।
০৪। চেয়ারম্যান, বাংলাদেশ তৈল, গ্যাস ও খনিজ সম্পদ কর্পোরেশন (পেট্রোবাংলা), ০৩ কাওরান বাজার, ঢাকা, ১২১৫।
০৫। কমিশনার, সিলেট বিভাগ, সিলেট।
০৬। উপজেলা নির্বাহী অফিসার, নবীগঞ্জ, হবিগঞ্জ।
০৭। প্রকল্প পরিচালক, সিলেট ১৫০ মেগাওয়াট কম্বাইন্ড সাইকেল বিদ্যুৎ কেন্দ্র নির্মাণ প্রকল্প, বাংলাদেশ বিদ্যুৎ উন্নয়ন বোর্ড, ১নং আব্দুল গণি রোড, বিদ্যুৎ ভবন, ঢাকা-১০০০।
০৮। সহকারী কমিশনার (ভূমি), নবীগঞ্জ, হবিগঞ্জ।
০৯। চেয়ারম্যান, ০৫ নং আউশকান্দি ইউনিয়ন, নবীগঞ্জ, হবিগঞ্জ।
১০। জনাব---

(মোঃ আবুল কাসেম তালুকদার)
জেলা প্রশাসক
হবিগঞ্জ।

[illegible] — [illegible]

১. মো: এ. বি. সিদ্দিক প্রকল্প পরিচালক, [illegible] — [illegible] ২১/২/০৩

২. [illegible], UNO, [illegible] — [illegible]

৩. [illegible] নির্বাহী প্রকৌশলী, বিদ্যুৎ উন্নয়ন বোর্ড — [illegible]

৪. মো: [illegible] — [illegible]

৫. H.M. MOSSADDAR ALI H.M. AKBOR ALI H.M. [illegible]

৬. মো: তারা মিয়া পিং মৃত ইউনুস উল্লা — [illegible]

৭. মো: আহমদ উল্লা পিতা মৃত [illegible] উল্লা — [illegible]

৮. মো: [illegible] হক পিতা মৃত [illegible] মিয়া — [illegible]

৯. মো: [illegible] মিয়া পিতা মৃত [illegible] মিয়া — [illegible]

১০. মো: [illegible] মিয়া পিতা মৃত হাজি [illegible] উল্লা — [illegible]

১১. [illegible] আলী পিতা মৃত আমান উল্লা — [illegible]

১২. [illegible] আহমদ পিতা মৃত [illegible] — [illegible]

১৩. মো: আ: [illegible] পিতা মৃত [illegible] — [illegible]

১৪. মো: [illegible] মিয়া পিতা মৃত আ: রব — [illegible]

১৫. [illegible] মিয়া পিতা মৃত [illegible] উল্লা — [illegible]

১৬. মো: আ: মালিক পিতা মৃত সুলেমান মিয়া — [illegible]

১৭. মো: [illegible] মিয়া পিতা [illegible] মো: [illegible] উল্লা — [illegible]

১৮. মো: [illegible] মিয়া পিতা [illegible] উল্লা — [illegible]

১৯. মো: [illegible] মিয়া পিতা মৃত হাজি [illegible] উল্লা — [illegible]

২০. [illegible] পিতা মৃত আ: নূর — [illegible]

২১. মো: [illegible] মিয়া পিতা মৃত আ: নূর — [illegible]

২২. মো: [illegible] উল্লা পিতা মৃত আহমদ উল্লা — মো: [illegible]

২৩. [illegible] আলী পিতা মৃত আমান উল্লা — [illegible]

২৪. [illegible] মিয়া পিতা মৃত সুলেমান মিয়া — [illegible]

২৫. মো: [illegible] মিয়া পিতা হাজী [illegible] মিয়া — মো: [illegible]

২৬. মো: [illegible]

২৭. [illegible]

Environment Clearance Certificate from the DOE, Sylhet for Sand Mining

"প্রাকৃতিক সপ্তাশ্চর্য নির্বাচনে সুন্দরবনকে ভোট দিন"
অংশগ্রহণ করুনঃ www.New7wonders.com

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
সিলেট বিভাগীয় কার্যালয়
বাড়ী নং-১৮, রোড নং-৩৭, ব্লক-সি,
শাহজালাল উপশহর, সিলেট।

নং-পঅ/সিবি/বালু ও পাথর কোয়ারী/০১/১ম খন্ড/২০০৩/১০২৮

তারিখ- ১২/০৪ /১৪১৮বাং
২৭/০৭ /২০১১খ্রিঃ

বিষয় : বালু বা মাটি উত্তোলনে পরিবেশগত অনাপত্তি প্রদান প্রসংগে।
সূত্রঃ জনাব নওশাদ মিয়ার গত ২৬/০৭/২০১১খ্রিঃ এর আবেদন।

উপর্যুক্ত বিষয়ে আপনার আবেদনের প্রেক্ষিতে দাখিলকৃত কাগজপত্রাদি যাচাই বাছাই পূর্বক দেখা যায় যে, ভূমি মন্ত্রণালয়ের পক্ষে জেলা প্রশাসন-মৌলভীবাজার হতে সুনরাই মৎস্যজীবি সমবায় সমিতি লিঃ, প্রোঃ নওশাদ মিয়া এর অনুকূলে মৌলভীবাজার জেলার সদর থানার চানপুর মৌজার জেএলনং-৩৪,খতিয়ান নং-০১ এর দাগ নং-১/১৮৪, ১৪/১৮৫ এ বর্ণিত তফসিল অনুযায়ী হাইড্রোগ্রাফিক চার্ট অনুসারে চিহ্নিত বালুমহাল এর মনুমুখ নদীর তলদেশ হতে ড্রেজার পদ্ধতিতে [illegible] উত্তোলনের নিমিত্তে বিধিবদ্ধ পদ্ধতিতে ২২শে আষাঢ়, ১৪১৮বাং হতে ৩০শে চৈত্র, ১৪১৮বাং সনের জন্য ইজারা প্রদান করা হয়।

এমতপ্রেক্ষিতে, বালুমহাল ও মাটি ব্যবস্থাপনা বিধিমালা, ২০১১খ্রিঃ অনুযায়ী জেলা প্রশাসন কর্তৃক বর্ণিত তফসিল হতে বালু বা মাটি উত্তোলনের জন্য ইজারা প্রদান করায় ইজারা চুক্তির শর্ত অনুযায়ী ২২শে আষাঢ়, ১৪১৮বাং হতে ৩০শে চৈত্র, ১৪১৮বাং সন পর্যন্ত ইজারাগ্রহীতা কর্তৃক বালু বা মাটি উত্তোলন করে নদীর নাব্যতা সৃষ্টি করা হলে পরিবেশগত ক্ষতির সম্ভবনা নেই।

২৭/০৭/১১

(মোঃ [illegible] রহমান)
উপ-পরিচালক
ফোনঃ ২৮৩০২৭৮

জনাব নওশাদ মিয়া
সভাপতি, সুনারাই মৎস্যজীবি সমবায় সমিতি
সাং-সুনারাই, ডাকঃ মনুমুখ বাজার, মৌলভীবাজার।

বিতরণঃ সদয় অবগতির জন্য।
১। মহা-পরিচালক, পরিবেশ অধিদপ্তর, সদর দপ্তর ঢাকা।
২। জেলা প্রশাসক, মৌলভীবাজার।
৩। অফিস কপি।

বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষ

BANGLADESH INLAND WATER TRANSPORT AUTHORITY

স্মারক নং-পিটিডি/অপস/মাটি খনন/না'গঞ্জ/১৩২/১১০৬-   তারিখ : ২৭-[illegible]

সচিব
নৌ-পরিবহন মন্ত্রণালয়,
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
বাংলাদেশ সচিবালয়, ঢাকা।

দৃষ্টি আকর্ষণ : যুগ্ম-সচিব (প্রশাসন)।

বিষয়: হবিগঞ্জ জেলার তাজাবাদ, মৌজাপুর ও পাহিলপুর মৌজায় সুর্মা/সুনিয়ারা নদী হতে বালি/মাটি উত্তোলনের অনাপত্তি প্রদান প্রসঙ্গে।

সূত্র : (ক) নৌ-পরিবহন মন্ত্রণালয়ের স্মারক নং-নৌপম/টিএ-২৮/[illegible](অংশ-৩)/১০৭ তারিখ: ১৯-[illegible]।
(খ) হবিগঞ্জ জেলা প্রশাসকের স্মারক নং-[illegible] তারিখ: [illegible]

উপর্যুক্ত বিষয়ে সূত্রস্থ 'ক' স্মারকের অনুসরণে নির্দেশক্রমে জানানো যাচ্ছে যে, সূত্রে 'খ' স্মারকের মাধ্যমে হবিগঞ্জ জেলা প্রশাসকের কার্যালয় হতে মেসার্স ন্যাশন ট্রেড ইন্টারন্যাশনাল-এর অনুকূলে মনোনয়ন প্রদান আব্দুল ওয়াহিদ, পিতা মৃত-[illegible] কর্তৃক [illegible], [illegible], থানা-নবীগঞ্জ, জেলা-হবিগঞ্জ কর্তৃক হবিগঞ্জ জেলার তাজাবাদ, মৌজাপুর ও পাহিলপুর মৌজায় সুনিয়ারা নদী হতে বালি/মাটি উত্তোলনের অনাপত্তি প্রদানের জন্য অত্র কর্তৃপক্ষকে অনুরোধ করা হয় (কপি সংযুক্ত)। তাছাড়া সুনিয়ারা নদীর নাব্যতা বৃদ্ধি, নৌযান চলাচলের সুবিধা এবং সরকারের রাজস্ব আয়ের স্বার্থে মেসার্স ন্যাশন ট্রেড ইন্টারন্যাশনাল-এর অনুকূলে নদীর [illegible] বালি/মাটি উত্তোলনের অনাপত্তি প্রদানের জন্য মাননীয় সংসদ সদস্য (২৪১ হবিগঞ্জ-৩) [illegible] মাননীয় নৌ-পরিবহন মন্ত্রী বরাবর একখানা ডিও লেটার প্রেরণ করেন (কপি সংযুক্ত)। উক্ত ডিও লেটারের উপর মাননীয় মন্ত্রী "অনাপত্তি পত্র দিতে [illegible]" মর্মে নির্দেশ প্রদান করেন। উক্ত পত্রের প্রেক্ষিতে হাইড্রোগ্রাফিক জরিপ চার্ট নং NED 866/2009 (A&B)-এ [illegible] স্থান হতে (কপি সংযুক্ত) নিম্নবর্ণিত শর্তে ৪৫,০০,০০০ (পঁয়তাল্লিশ লক্ষ) ঘনফুট মাটি/বালি মেসার্স ন্যাশন ট্রেড ইন্টারন্যাশনাল কর্তৃক [illegible] ড্রেজার-এর মাধ্যমে উত্তোলনের জন্য অত্র কর্তৃপক্ষের অনাপত্তি প্রদান করা হলো :-

(১) বালি/মাটি উত্তোলনের উপযোগী চিহ্নিত স্থানসমূহ হাইড্রোগ্রাফিক জরিপ চার্ট নম্বর NED 866/2009 (A)-এ [illegible] এলাকায় এবং জরিপ চার্ট নম্বর NED 866/2009 (B)-এ [illegible]-দুর্গাপুর ও মধুপুর এলাকায় [illegible];

(২) হাইড্রোগ্রাফিক জরিপ চার্ট নং- NED 866/2009 A [illegible] (দৈর্ঘ্য=৮৫০.০০ মিটার, প্রস্থ=৪০.০০ মিটার এবং গড় গভীরতা [illegible] মিটার), হাইড্রোগ্রাফিক জরিপ চার্ট নং- NED 866/2009 B-এ [illegible] হতে ৪০,০৪০ [illegible] (দৈর্ঘ্য=[illegible] মিটার, প্রস্থ=[illegible] মিটার এবং গড় গভীরতা=১.৮২ মিটার) এবং হাইড্রোগ্রাফিক জরিপ চার্ট নং NED 866/2009 B-এ [illegible] ২০,০০,০০০ ঘনফুটের (দৈর্ঘ্য ১১৫০ মিটার, প্রস্থ ৫০ মিটার এবং গড় গভীরতা ১.০০ মিটার) সর্বমোট ৪৫,০০,০০০ (পঁয়তাল্লিশ লক্ষ) ঘনফুটের (প্রায়) অধিক মাটি/বালি উত্তোলন করা যাবে না;

(৩) মাটি/বালি কাটার পর সর্বনিম্ন পানি সমতল (Lowest Low Water) থেকে পানির সর্বোচ্চ গভীরতা ১২ (বার) ফুটের বেশী হবে না;

(৪) নদীর উভয় তীরে সর্বনিম্ন পানি সমতল রেখা (Lowest Low Water Line) হতে কমপক্ষে ৪০ (চল্লিশ) মিটার বাদ রেখে বালি/মাটি উত্তোলন করতে হবে;

(৫) নৌ-চলাচল যাতে কোনরূপ বিঘ্ন সৃষ্টি না হয় সে লক্ষ্যে ড্রেজার/বলগেটসমূহ বিক্ষিপ্ত অবস্থায় রাখা যাবে না;

(৬) নদীর তীর যাতে কোনভাবে ভাঙ্গন সৃষ্টি না হয় সে দিকে লক্ষ্য রেখে ড্রেজিং করতে হবে;

(৭) ড্রেজিং চলাকালে কোন পাইপ লাইন না রাখা [illegible] বা অন্য কোন ভাবে নৌ-চলাচলে বাধার সৃষ্টি করা যাবে না এবং রাত্রিকালে বালি/মাটি খনন করা যাবে না;

(৮) প্রস্তাবিত ৪৫,০০,০০০ (পঁয়তাল্লিশ লক্ষ) ঘনফুট মাটি উত্তোলনের কাজটি অনুমতি পত্র প্রাপ্তির তারিখ হতে সর্বোচ্চ ১২০ (একশত বিশ) দিনের মধ্যে সম্পন্ন করতে হবে এবং নির্ধারিত সময়ের মধ্যে কাজ সম্পন্ন করতে ব্যর্থ হলে উক্ত [illegible] মাটি/বালি উত্তোলনের বিষয়ে আর কোন দাবী গ্রাহ্য হবে না;

(৯) উত্তোলনকৃত মাটি কোন অবস্থাতেই নদীর তীরে ফেলা যাবে না;

(১০) ড্রেজিংয়ের সময় ড্রেজিং এলাকায় লাল পতাকা এবং নৌ-সাংকেতিক চিহ্ন প্রদর্শন করতে হবে;

(১১) খননকৃত স্থানে গ্যাস লাইন, ওয়াসা লাইন, টিএন্ডটি লাইন ক্ষতিগ্রস্ত হলে উত্তোলনকারী নিজ খরচে/দায়িত্বে উহা মেরামত করতে বাধ্য থাকবে;

(১২) ড্রেজিং চলাকালীন সময়ে নেভিগেশন আইন অনুযায়ী দিনে ও রাতে ড্রেজার ওয়ার্নিং সিগন্যাল প্রদর্শন করতে হবে;

(১৩) বালি/মাটি উত্তোলনের সময় স্থানীয় জনগণের জায়গা জমি ক্ষতিগ্রস্থ করা যাবে না এবং ক্ষতির সম্মুখীন হলে সংশ্লিষ্ট প্রতিষ্ঠান নিজ উদ্যোগে তা সমাধা করবে। এতে কর্তৃপক্ষ কোনরূপ হস্তক্ষেপ করবে না বা দায়ী থাকবে না;

(১৪) জেলা প্রশাসক-এর কার্যালয় হতে অনুমতি [illegible] কর্তৃক [illegible] মাটি/বালি উত্তোলনের জন্য ০.১৫/- টাকা হারে [illegible] ৫ কম [illegible] অনুকূলে জমা দিতে হবে। এছাড়া আবেদনকারীকে [illegible] পরিশোধ করতে হবে।

(১৫) মাটি উত্তোলনকালীন সময়ে [illegible]

Dredging Narayngonj-I

Sand mining Clearance Certificate from the Department of Environment (DoE), Sylhet

'প্রাকৃতিক সপ্তাশ্চর্য নির্বাচনে সুন্দরবনকে ভোট দিন'
লগইন করুনঃ www.New7wonders.com

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
সিলেট বিভাগীয় কার্যালয়
বাড়ী নং-১৮, রোড নং-৩৭, ব্লক-সি
শাহজালাল উপশহর, সিলেট
e-mail: sylhet@doe-bd.org

নং-পঅ/সিবি/বালু ও পাথর কোয়ারী/৬১(২য় খন্ড)/২০০৩/ ১৬১০ তারিখঃ ২৬/০৪ /১৪১৮বাং / ১২/০৭ /২০১১খ্রিঃ

বিষয়ঃ কুশিয়ারা নদী থেকে বালু উত্তোলনে অনুমতি প্রদান প্রসংগে।

উপর্যুক্ত বিষয়ে আপনার অবগতির জন্য জানানো যাচ্ছে যে, পরিবেশ ও বন মন্ত্রণালয় এর স্মারক নং-পবম/৪/৭/৮৭/৯৯/২৪৫; তারিখঃ ১৯/০৪/১৯৯৯খ্রিঃ মূলে ঘোষিত প্রজ্ঞাপন এর আলোকে বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ এর ৫নং ধারার উপধারা (১) এবং ৪নং ধারায় প্রদত্ত ক্ষমতাবলে আপনার আবেদিত হবিগঞ্জ জেলার নবীগঞ্জ উপজেলার তাজাবাদ, মৌজাপুর, গালিমপুর, ফাদউল্লা ও দিঘলবাক মৌজা প্রতিবেশগত সংকটাপন্ন এলাকার অন্তর্ভুক্ত নয়।

এমতাবস্থয়, যথাযথ আইন ও নিয়ম মেনে জেলা প্রশাসক হতে ইজারা প্রাপ্তি সাপেক্ষে উক্ত মৌজা সমূহের কুশিয়ারা নদীর বালি বেসরকারী ড্রেজার দ্বারা সংগ্রহ করে নদীর নাব্যতা বৃদ্ধি এবং উক্ত বালি পারকুল নামক গ্রামে বিবিয়ানা বিদ্যুৎ প্রকল্প-১ ও ২ এর ভূমির উন্নয়নমূলক কার্যক্রম/অন্যত্র উন্নয়নমূলক কার্যক্রম সম্পন্ন করার জন্য ব্যবহার করা হলে পরিবেশগত ক্ষতির সম্ভাবনা নেই এবং অত্রদপ্তরের কোন আপত্তি নেই। এই অনুমতিপত্র জারীর তারিখ থেকে ০১ (এক) বছরের জন্য প্রযোজ্য হবে।

১৩/০৭/১১

(মোঃ জিল্লুর রহমান)
উপ-পরিচালক
ফোন-২৮৩০২৭৮

জনাব আজিজুল হক
প্রোপাইটর
মেসার্স সিটকো
৬০৭, মানরু শপিং সিটি (৬ষ্ঠ তলা)
চৌহাট্টা, সিলেট।

বিতরণঃ সদয় অবগতির জন্য।

১। মহাপরিচালক, পরিবেশ অধিদপ্তর, সদর দপ্তর, ঢাকা।
২। জেলা প্রশাসক, হবিগঞ্জ।
৩। অফিস কপি।

No Objection Certificate (NOC) from the Local Chairman (UP) of Auskandi Union Parishad for sand mining from the site of Monomukh adjacent to Kushiyara River.

চেয়ারম্যানের কার্যালয়

২নং মনুমুখ ইউনিয়ন পরিষদ

উপজেলা ও জেলা ঃ মৌলভীবাজার ।

সূত্র ঃ তারিখ ঃ

অনাপত্তি পত্র

এতদ্বারা প্রত্যয়ন করা যাইতেছে যে, মোঃ নওশাদ মিয়া , পিতা-মৃত সাজিদ উল্যা, সাং-সুমারাই, ডাক-মনুমুখ বাজার, সভাপতি- সুমারাই মৎস্যজীবি সমবায় সমিতি, থানা ও জেলা-মৌলভীবাজার। তিনি নিম্ন লিখিত মৌজা ও তফসীলের বালু মহাল হইতে ড্রেজিং এর মাধ্যমে বালু উত্তোলনের জন্য সরকারীভাবে ইজারা গ্রহন করিয়াছেন।

উক্ত মহাল হইতে বালু উত্তোলনে অত্র পরিষদ বা এলাকার কোন আপত্তি নাই ।

তফসীল ঃ

মৌজা ঃ চাঁনপুর, জে.এল.নং- , খতিয়ান নং-০১ , দাগ নং ১/১৮৪, এরিয়া ঃ ৬.৫০ একর ।

খতিয়ান নং -০১, দাগ নং ৭৪/১৮৫, এরিয়া ঃ ১৪.৬৬ একর।

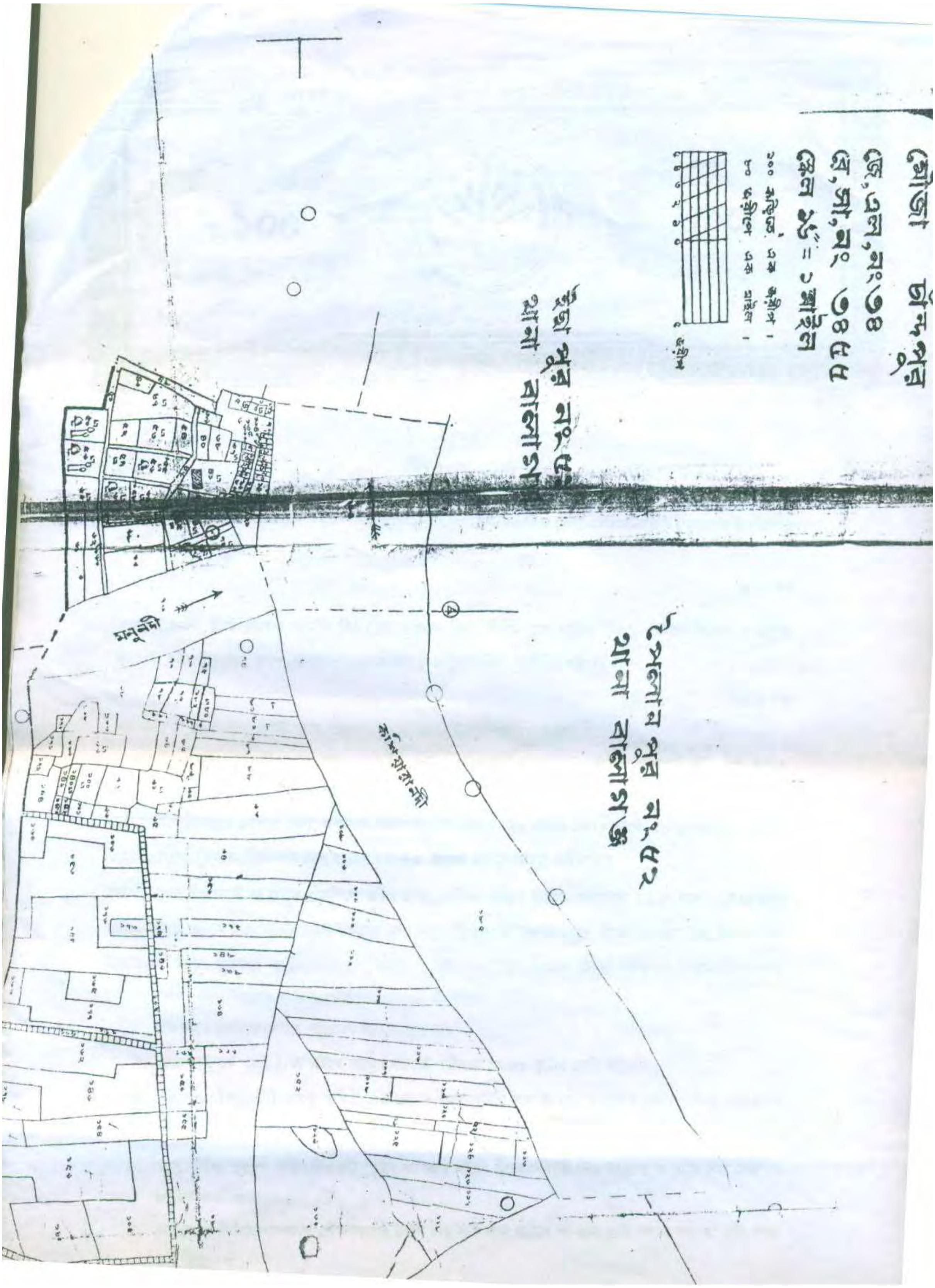
মোট ঃ ২১.১৬ একর।

কথায় ঃ একুশ একর ষোল শতক ভূমি মাত্র।

চেয়ারম্যান

২নং মনুমুখ ইউ/পি

Site Map of the Monomukh for sand mining



Contractual Deed between Contractor and DC Office, Habigonj

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

৳১০০ ৳১০০

একশত টাকা

ল ৪৬৬৪৯৯৯

পরিশিষ্ট-খ

বিধি-১০(৬) দ্রষ্টব্য)

নদীর তল দেশ হইতে ড্রেজিং পদ্ধতিতে বালু বা মাটি উত্তোলনের ইজারা চুক্তি ফরম।

এই ড্রেজিং ইজারা চুক্তিপত্র ভূমি মন্ত্রণালয়ের পক্ষে জেলা প্রশাসক/কালেক্টর জেলা-মৌলভীবাজার (অতঃপর ইজারাদাতা বলিয়া অভিহিত হইবে ।

প্রথম পক্ষ

এবং

সুমারাই মৎস্য জীবি সমবায় সমিতি লিঃ প্রোঃ নওশাদ মিয়া, পিতা- মৃত সাজিদ উল্ল্যা, বর্তমান ঠিকানা ঃ মনুমুখ, সুমারাই ,মৌলভীবাজার, পেশা-ব্যবসা (অতঃপর ইজারা গ্রহীতা বলিয়া অভিহিত হইবে)

দ্বিতীয় পক্ষ

এর মধ্যে ২০১১ সনের জুলাই মাসে ০৬/০৭/২০১১ খ্রিঃতারিখে সম্পাদিত হইলঃ

যেহেতু ইজারাদাতা মৌলভীবাজার জেলায় অবস্থিত নিম্ন তপশিলভুক্ত বালুমহাল ও মাটি ব্যবস্থাপনা বিধিমালা, ২০১১ মোতাবেক হাইড্রোগ্রাফিক জরিপে চিহ্নিত স্থানের মালিকঃ

যেহেতু মৌলভীবাজার জেলার জেলা প্রশাসক (কালেক্টর উক্ত প্রস্তাব গ্রহণ করিয়া ১৪১৮ বাংলা সন (আংশিক) এর জন্য ৩,২০,০০০/= (কথায়- তিন লক্ষ বিশ হাজার) টাকায় ইজারা প্রদানে সম্মত হইয়াছেন;

সেহেতু এখন ইজারাগ্রহীতা কর্তৃক তফশিলে বর্ণিত হাইড্রোগ্রাফিক জরিপে চিহ্নিত বালুমহাল ২২ শে আষাঢ় ১৪১৮বাংলা তারিখ হইতে ৩০শে চৈত্র ১৪১৮ পর্যন্ত সময়ের জন্য নিম্ন বর্ণিত শর্তে ইজারা গ্রহণে স্বীকৃত হওয়ায় এবং উক্ত সময়ের ইজারামূল্য বাবদ সর্বমোট ৩,২০,০০০/= (কথায় - তিন লক্ষ বিশ হাজার)টাকা পরিশোধ করায় ইজারাদাতা ইজারাগ্রহীতার সহিত নিম্নোক্ত মর্মে ও শর্তে অঙ্গীকারবদ্ধ হইলেন ঃ-

১. নৌপথের অবকাঠামোগত পরিবর্তন করা যাইবে না।

২. মাটি কাটিবার পর LLW হইতে পানির সবোর্চ্চ গভীরতা ১২.০০ ফুটের বেশী হইবেনা।

৩. নদী স্বাভাবিক বৈশিষ্ট অক্ষুন্ন রাখিয়া ১:৩ ঢাল সংরক্ষণ করিয়া বালু বা মাটি উত্তোলন করিতে হইবে এবং কোন স্থানে অস্বাভাবিক গভীরতায় নদী খনন করা যাইবে না।

৪. গ্যাস লাইন, ওয়াশা লাইন,টিএন্ডটি লাইন ক্ষতিগ্রস্থ হইলে উত্তোলনকারী নিজ দায়িত্বে ও ব্যয়ে উহা মেরামত করিতে বাধ্য থাকিবেন।

৫. বালু বা মাটি উত্তোলনকালে নৌচলাচলের কোন বিঘ্ন সৃষ্টি করা যাইবে না এবং রাত্রি কালে বালু বা মাটি খনন করা যাইবে না।

চলমান পাতা-০২

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

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একশত টাকা

ল ৪৬৬৫০০০

৬. বালু বা মাটি খননের সময় সর্তকতামূলক ব্যবস্থা হিসাবে লাল পতাকা প্রদর্শন করিতে হইবে এবং যেখানে " নোঙ্গর নিষিদ্ধ " সাইন বোর্ড আছে সেখানে খনন করা যাইবে না ।

৭. বালু বা মাটি উত্তোলনের সময় স্থানীয় জনগনের জায়গা জমি ক্ষতিগ্রস্থ করা যাইবে না এবং ক্ষতির সম্মুখিন হইলে ইজারাগ্রহীতা তা সমাধা করিবে । তাহাতে ইজারাদাতা কোনরূপ হস্তক্ষেপ করিবে না বা দায়ী থাকিবে না

৮. বালু বা মাটি উত্তোলনকালে কোন প্রকার/দূর্ঘটনার জন্য ইজারাদাতা দায়ী থাকিবে না। যে কোন প্রকার ক্ষয়ক্ষতির জন্য ইজারাগ্রহীতা দায়ী থাকিবে এবং কোন প্রকার ক্ষতিপূরনের দাবী আসিলে ইজারাগ্রহীতাকে তাহা বহন করিতে হইবে ।

৯. বালু উত্তোলনকালে নদীর তীর , তীর সংলগ্ন ফসলি জমি বা গ্রামের পরিবেশের কোনরূপ ক্ষতিসাধন করা যাইবে না ।

১০. নদীর তীর/ভূমির ঢাল (Slope) যথাযথভাবে সংরক্ষণ করিয়া বালু উত্তোলন করিতে হইবে ।

১১. জীব বৈচিত্র সংরক্ষণ ও পরিবেশ দূষণ মুক্ত রাখিতে হইবে ।

১২. বালু উত্তোলনের বিষয়ে সরকার কর্তৃক জারীকৃত সকল সার্কুলার, বিধি বিধান ও আইনসমূহ মানিয়া চলিতে হইবে । বর্ণিত কোন শর্ত ভঙ্গ করিলে জেলা প্রশাসক তাৎক্ষণিকভাবে উত্তোলন বন্ধ করিয়া দিবেন এবং ইজারা বাতিল বলিয়া গণ্য হইবে ।

১৩. উত্তোলনকৃত বালু বা মাটি কোন অবস্থাতেই নদীর তীরে বা নদীতে ফেলা যাইবে না।

১৪. বালু বা ম্যাটি উত্তোলনের সময় সরকারী ,আধা-সরকারী, স্বায়ত্বশাসিত ও ব্যক্তি মালিকানাধীন কোন প্রতিষ্ঠানের স্থাপনা বা অবকাঠামোর কোন ক্ষতি করা যাইবে না । কোন ক্ষতি পূরণের দাবী আসিলে ইজারাগ্রহীতা তাহা বহন করিবেন ।

১৫. ড্রেজারের মাধ্যমে বালু বা মাটি উত্তোলন শেষে ড্রেজিং সংক্রান্ত যাবতীয় মালামাল (যেমন-ড্রেজার, পাইপ ইত্যাদি) ইজারাগ্রহীতা দ্রুত সাইট হইতে সরাইয়া নিতে বাধ্য থাকিবেন ।

১৬. প্রস্তাবিত এলাকা হইতে মাটি কাটিবার সময় নৌ-চলাচলের কোন প্রতিবন্ধকতা সৃষ্টি করিতে পারিবেন না ।

১৭. বালু বা মাটি উত্তোলনের ফলে নদীর তীর যাহাতে ভাঙ্গিয়া না যায় সেই দিকে লক্ষ্য রাখিতে হইবে ।

১৮. চুক্তিপত্রের সাথে হাইড্রোগ্রাফিক জরীপ চার্টের চিহ্নিত স্থানের বাহিরে মাটি উত্তোলন করা যাইবে না ।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

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পঞ্চাশ টাকা

২৭৯৫১১৭

২১. কালেক্টর বা নৌ-বিভাগ বা মৎস্য বিভাগের প্রদত্ত সকল শর্ত পালন করিতে ইজারা গ্রহীতা বাধ্য থাকিবেন । এই মর্মে কালেক্টর শর্তারোপ করিতেছেন যে, এই ইজারার মেয়াদ কোনক্রমেই ১৪১৮ বাংলা সনের পূর্ণ বছরের প্রযোজ্য হইবে না। আলোচ্য বালুমহালটি ইজারাগ্রহীতার নিকট ১৪১৮ বাংলা সনের দখলদানের তারিখ হইতে ৩০ শে চৈত্র পর্যন্ত সময়ের জন্য অর্থাৎ ০৯ মাস ০৯ দিনের জন্য ইজারা প্রদান করা হইল। সুতরাং ১৪১৮ বাংলা সনের ৩০শে চৈত্রের পর আলোচ্য বালুমহালের বিষয়ে দেরীতে দখল বুঝে পাওয়া/ বিলম্বে দখল প্রদানের অজুহাত দেখিয়ে কোন প্রকারের স্বত্ব মামলা করা যাইবে না ।

তফসীল

ইজারাধীন/ড্রেজিং ইজারাধীন বালুমহালের বিস্তারিত বর্ণনা ঃ

১।	জেলার নাম ঃ	মৌলভীবাজার।	২। উপজেলার নামঃ	মৌলভীবাজার সদর	
৩	মৌজাঃ	বেকামুরা,পালপুর, চানপুর,সুমারাই	৪। জে.এল.নং	৩২.৩৬,৩৪,৩৩	
৫	খতিয়ান নংঃ	০১	৬। দাগনং	২৩৬৫,১৭১৬,৩৭৮৬,৩৯৫৮,২৪,৪৬৫,৪৬৫/৬৯৮, ৪৯৩,৫৩১,১২৮১,১২৮১/১৬৮৭,১৬৮৪,১/১৮৪, ৭৪/১৮৫,৩৮৫,২১৪৯	
৭	জমির পরিমাণ ঃ	৮৬.৯৮			

উল্লেখ্য , মহামান্য হাইকোর্টের ৪৪৪০/২০০৫ নং রীট মামলায় বেকামুরা,পালপুর,সুমারাই মৌজায় স্থিতাবস্থার আদেশ থাকায় উক্ত মৌজা ব্যতীত চুক্তিপত্র সম্পাদিত হলো । রীট মামলার আদেশ Vacate হওয়ার পর উক্ত মৌজার সম্পূরক লীজ চুক্তি সম্পাদিত হবে। তবে অদ্য ০৬/০৭/২০১১ খ্রিঃ তারিখ হতে সরেজমিনে ইজারা গ্রহীতা দখলদেহী বুঝে পেয়েছেন মর্মে গণ্য হবে। এ বিষয়ে পরবর্তীতে কোন আপত্তি আইনত অগ্রাহ্য হবে ।

চিহ্নিত বালুমহালের জমির পরিমাণ বা ইজারাধীন জমির পরিমাণ এই ইজারা দলিলে উপরোক্ত শর্তসাপেক্ষে উপরে উল্লেখিত তারিখ ও বৎসরে -০৬/০৭/২০১১ খ্রিঃ জেলা প্রশাসকের কার্যালয়,মৌলভীবাজার (ইজারা চুক্তি স্বাক্ষরের স্থান) স্বাক্ষীগণের উপস্থিতিতে উভয়পক্ষ স্বাক্ষর ও সীল (যদি থাকে) প্রদান করিলেন।

স্বাক্ষর [illegible] মিয়া পিতা মৃত আবিদ উল্লা সাং [illegible] সুমারাই, মৌলভীবাজার, ৬/৭/২০১১

ইজারাগ্রহীতা

স্বাক্ষর [illegible] ৬/৭/২০১১

ইজারাদাতা (জেলা প্রশাসক)

জেলা প্রশাসক মৌলভীবাজার

স্বাক্ষী [illegible]

১। পূর্ণ নাম ও স্বাক্ষর [illegible] মিয়া, পিতা- মৃত [illegible] মিয়া সাং- সুমারাই মৌলভীবাজার

ঠিকানা

Annex - 10: Sand Mining and its Impact

1. INTRODUCTION

1.1 Background

Rapid development has led to an increased demand for river sand as a source of construction material. This has resulted in a mushrooming of river sand mining activities which have given rise to various problems that require urgent action by the authorities. These include river bank erosion, river bed degradation, river buffer zone encroachment and deterioration of river water quality. Very often, over-mining occurs which jeopardizes the health of the river and the environment in general.

The Proposed Development proposes to set up a 341MW Combined Cycle Gas Turbine power plants at Bibiyana in the village Parkul at Bibiyana under union Aushkandi in Nabiganj upazilla of Habiganj district. Total area of the Project Site is 25 acres. The project area is located in the south bank of Kushiyara River. Elevation of Flood water level in where the plant area is located is 10.15 m from Mean Sea Level (MSL). Final elevation for site preparation for the plant area is designed to be 11.2 m and original ground elevation of the area is located is 7.8 m MSL. Therefore average 3.4 m land has to be raised for the plant area, switch yard and access road. Nearby Kushiyara sand is the main source of the filling materials of the project. Although the validation survey carried in September/October 2013 identified that the required land raising has already been completed at the Project Site in 2012, with sand mining undertaken at six sites excavating approximately 300,000 m^3, this report summarises the work undertaken prior to sand mining taking place. Details of the sand mining which took place are provided in the main ESIA report.

Sand is deposited in the streambeds or low plains as channel fill or fan deposits at the foothills of Meghalya in the northern region of Bangladesh. The sand is deposited as loose detritus materials. It is found dry and loose above water level and saturated non-cohesive mass below stream water.

IFC requires an Environmental Assessment to be done by BCAS of the dredging operation for sand collection and transportation of sand to the project site. IFC has Operational Directives, which sets guidelines and requirements for carrying out dredging and other activities for land filling purpose.

1.2 Objectives of the Study

The main objectives of this study are as follows

1. To find out the impact of sand mining on river bank erosion and nearby human settlement
2. Impact on socio-economic environment
3. To identify the location specific sand mining impact on fisheries and others aquatic habitats.

1.3 Methodology

Both primary and secondary data has been collected for the preparation of this report. Relevant Maps, Charts and documents of Bangladesh Inland Water Transport Authority (BIWTA) were used. Satellite Image has been analysis to find out river shifting trend, River survey using GPS for identifying the sand collection site was conducted. FGD were conducted on river site inhabitants and fisherman for their opinion and fisheries impact identification. Beside this consultation were done with NEPC contractor who is responsible for the plant filling and monitoring.

1.4 Permission of Sand Mining in Bangladesh

In Bangladesh District Commissioner (DC) give permission for sand mining from rivers. Based on the Bangladesh Water Development Board (BWDB) Hydrographic Chart sand mining area is located and. DC give permission for sand mining through open biding, Government earn royalty from the lease taker. For large scale mining proponent need to take permission from Depart of Environment (DoE)

2.0 BASELINE ENVIRONMENTAL CONDITION

2.1 Hydrology and river system

2.1.1 Origin of Kushiyara River, Tributary and distributaries

From the source in the Manipur Hills of India, near Mao Songsang, the river is known as the Barak River. Near its source, the river receives a lot of little hill streams, including the Gumti, Howrah, Kagni, Senai Buri, Hari Mangal, Kakrai, Kurulia, Balujhuri, Shonaichhari and Durduria. It flows west through Manipur State, then southwest leaving Manipur and entering Mizoram State. The Barak basin lies in India, Myanmar and Bangladesh and drains an area of 41,723 sq. km. The basin is bounded on the north by the Barail range, on the east by the Naga and Lushai hills and on the south and west by Bangladesh.

In Mizoram State the Barak flows southwest then veers abruptly north when joined by a north flowing stream and flows into Assam State where it turns westward again near Lakhipur as it enters the plains. It then flows west past the town of Silchar where it is joined by the Madhura River. After Silchar, it flows for about 30-odd kilometres & near Badarpur, it divides itself into the Surma River and the Kushiyara River and enters Bangladesh aong 24º53´ north latitudes and 92º32´ east longitudes. The principal tributaries of the Barak in India are the Jiri, the Dhaleshwari (Tlawng), the Singla, the Longai, the Madhura, the Sonai (Tuirial), the Rukni and the Katakhal.

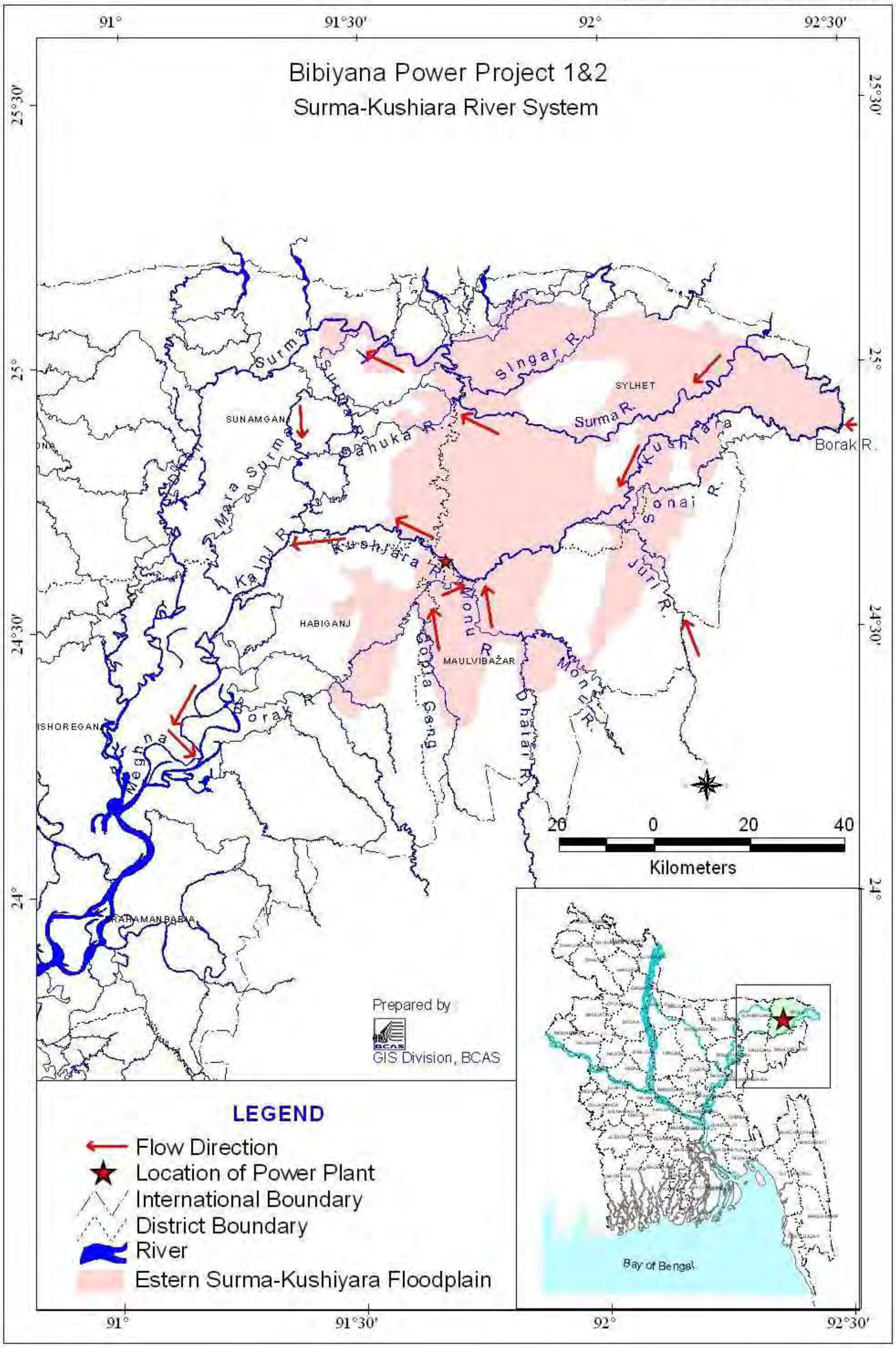
The Barak separates into two branches at Amalshid in the northeast border of Zakiganj upazila of Sylhet district. The northwest arm is the SURMA and the southwestern arm is the Kushiyara

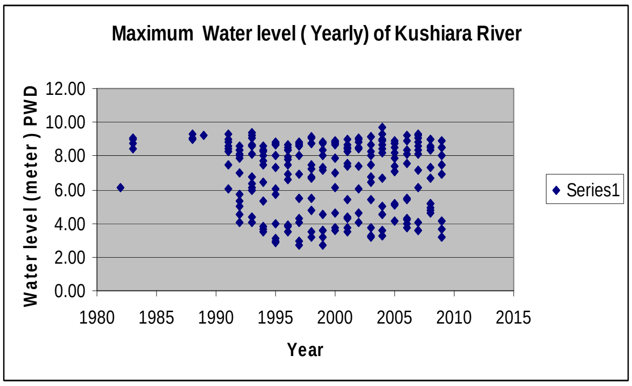
The Kushiyara receives tributaries from the Sylhet Hills and Tripura Hills to the south, the principal one from the Tripura Hills being the Manu. The Kushiyara is also known as the Kalni River after it is joined by a major offshoot (distributary) from the Surma. The southern stream of Kushiyara resumes the original name *Barak* or *Shakha Barak*.

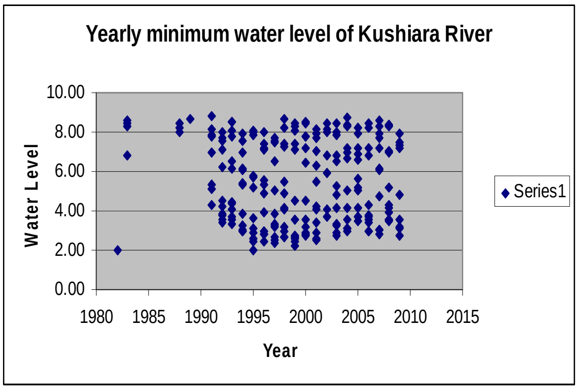
2.1.2 Water level and discharge of Kushiyara River

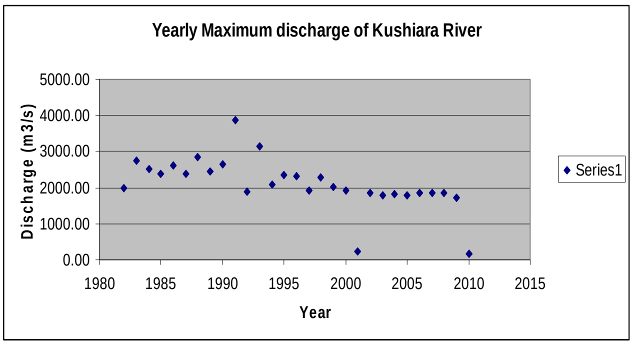
Bangladesh Water Development Board have its gauge station for measurement of water level and discharge data. Danger level of this point is 9.0 meter from Mean Sea Level (MSL), Yearly maximum and minimum water level and Discharge data analysis given

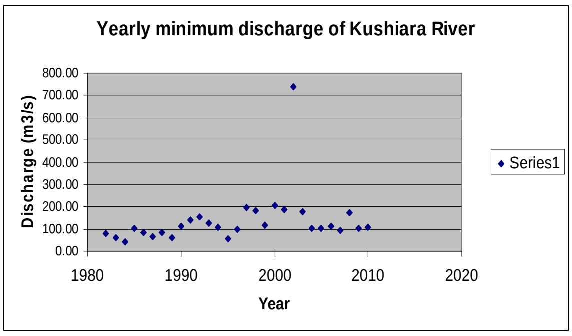
Map 2.4 : Surma-Kushiara River System









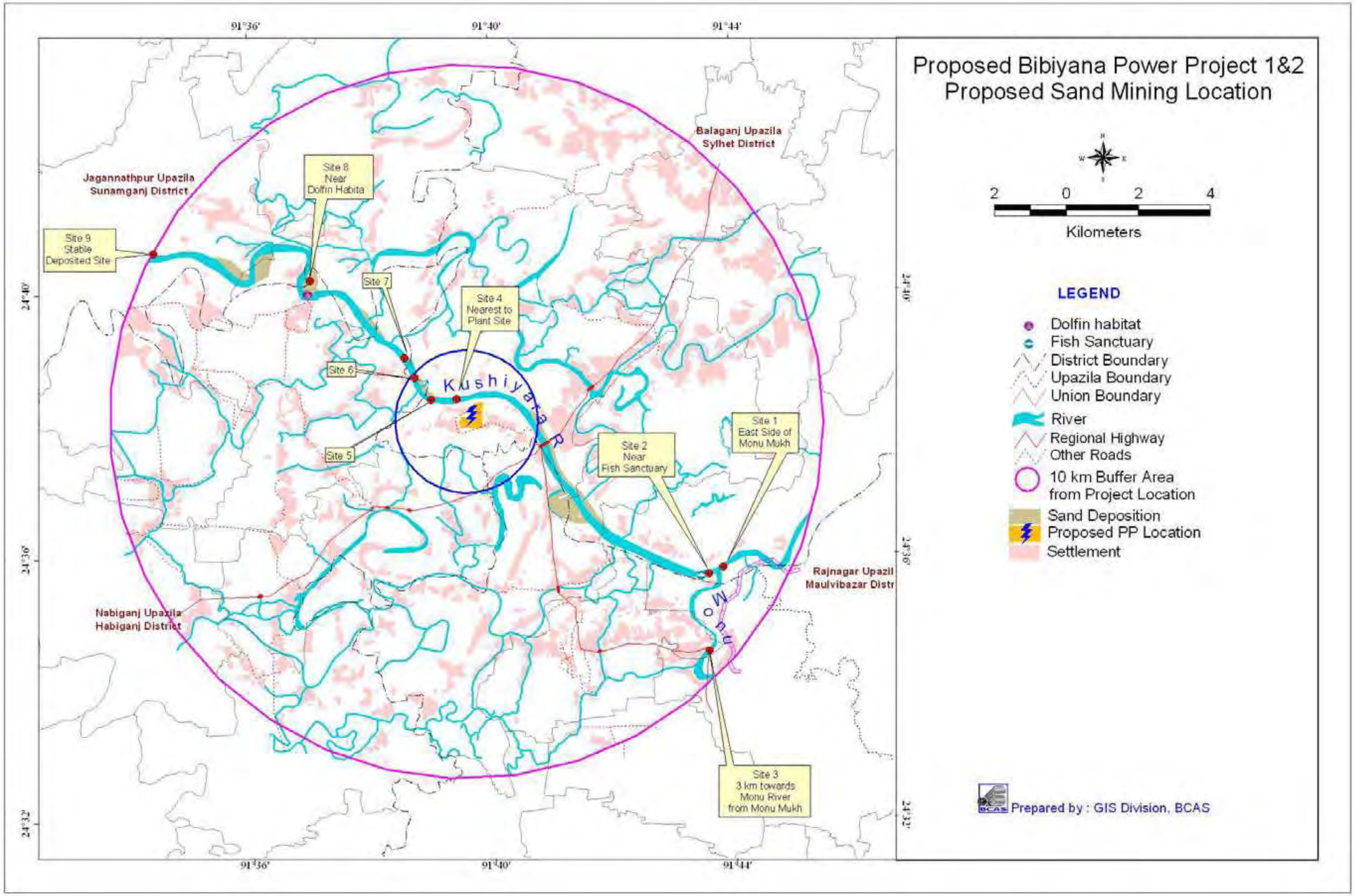


Analysis the water level data at Sherpur bridge point it was found that maximum water level recorded 9.68 m in 2004 flood period and minimum water level was 1.79 m in 1984. Maximum and minimum discharge data recorded 3890 m3/s and 43m3/s in 1991 and 1984 respectively. During high flooding period high sediment carried generally increases the propensity of both erosion and sedimentation process.

2.3. Distribution quantity of sand in the study area

Local contractors interested for sand mining business conducted Bathometric survey adjacent to the project site and undertook investigations to determine the distribution, and quality of sand deposits. Besides this DC office allocate few areas to the local contractor for sand mining. Proposed site for sand mining, Total 9 site were selected initially for sand collection These are:

1. Kushira River, East of Monumukh;
2. Kushira River, wast of Monumukh;
3. Monu River, Monu Mukh to 3 km upper site;
4. Paharpur, west site of project;
5. Kushira River, Kamarkhada;
6. Kushira River, Mathurapur;
7. Kushira River, Galimpur;
8. Kushira River, Hatidighi; and
9. Chatrafut, Kushira/ Bibiyana River.
10. .


Proposed Bibiyana Power Project 1&2
Proposed Sand Mining Location
Kilometers
LEGEND
Dolfin habitat
Fish Sanctuary
District Boundary
Upazila Boundary
Union Boundary
River
Regional Highway
Other Roads
10 km Buffer Area from Project Location
Sand Deposition
Proposed PP Location
Settlement
Prepared by : GIS Division, BCAS
Balaganj Upazila
Sylhet District
Jagannathpur Upazila
Sunamganj District
Rajnagar Upazil
Maulvibazar Distr
Nabiganj Upazila
Habiganj District
Site 9 Stable Deposited Site
Site 8 Near Dolfin Habita
Site 7
Site 6
Site 5
Site 4 Nearest to Plant Site
Site 2 Near Fish Sanctuary
Site 1 East Side of Monu Mukh
Site 3 3 km towards Monu River from Monu Mukh
Kushiyara R
Monu
91°36'
91°40'
91°44'
24°40'
24°36'
24°32'

Among the 9 sites, Sand will be collected from point bar of site 8 (Hatidigi) and Satrafot, Remained 7 sites are the river channel, among these sites , Bathemetric survey were conducted in the 4 (Pharpur), 5 (Kamarkhada), 6 (Mathurapur) and 7 (Galimpur) site of Kushiyara River.

Location wise distribution and geographical features of the sites are given in the Table

Table 2.1: Location wise sand reserve for mining

Sl	Location	Dimension	Total Volume	Remarks
1	Kushira River, East of Monumukh	Length:400 m Width:25 m Depth: 01 m	10,000 m3	Near to connection point of haor
2	Kushira River, wast of Monumukh	Length:400 m Width:25 m Depth: 01 m	10,000 m3	Fish sanctuary located within 1 km down of this site
3	Monu River, Monu Mukh to 3 km upper site	Length:300 m Width:10 m Depth: 01 m	3,00,000 m3	Site is comparatively feasible
4	Paharpur	Length:600 m Width:50 m Depth: 01 m	30,000 m^3	Along the river chanel
5	Kamarkhada	Length:550 m Width:40 m Depth: 1.82 m	40,040 m^3	Along the river channel
6	Mathurapur	Length:1150 m Width:50 m Depth: 01 m	57,500 m^3	Along the river channel
7	Galimpur	Length:1150 m Width:50 m Depth: 01 m	57,500 m^3	Along the river channel
8	Hatidighi	Opposite of Digalbuk	100,000 m^3	Stable deposited site (opposite the deepest part of digalbuk, dolphin/susuk species available
9	Chatrafut, Kushira/ Bibiyana River	1 km west of Bibiyana north pad	1000,000 m^3	Stable deposited site, sufficient sand available

Following figures 1 & 2 shows the location, dimension of mining area and quantity of of sand to be mined from location 5(Paharpur), 5 (Kamarkhada), 6 (Mathurapur) and 7 (Galimpur)

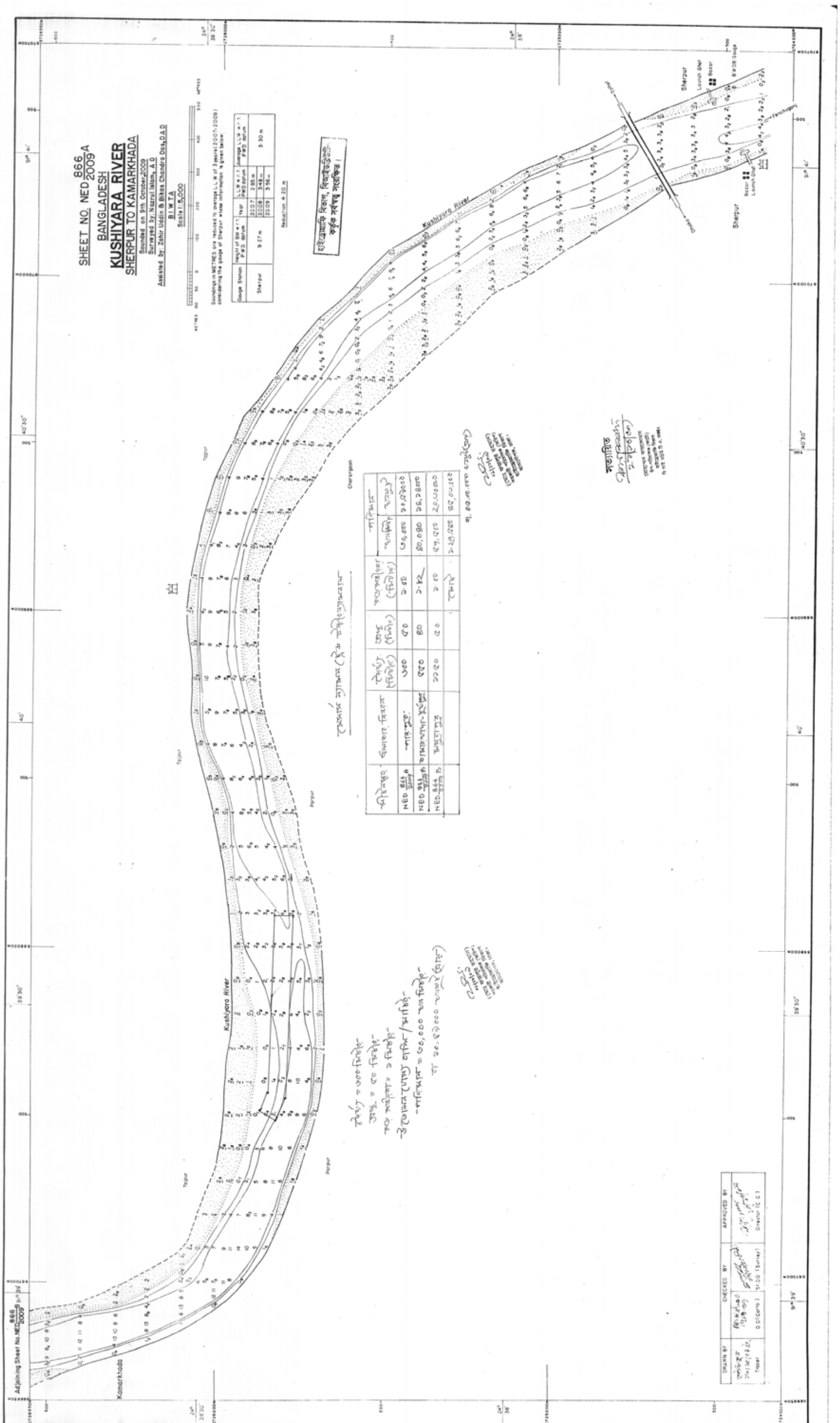


Figure 1: Location of sand mining area

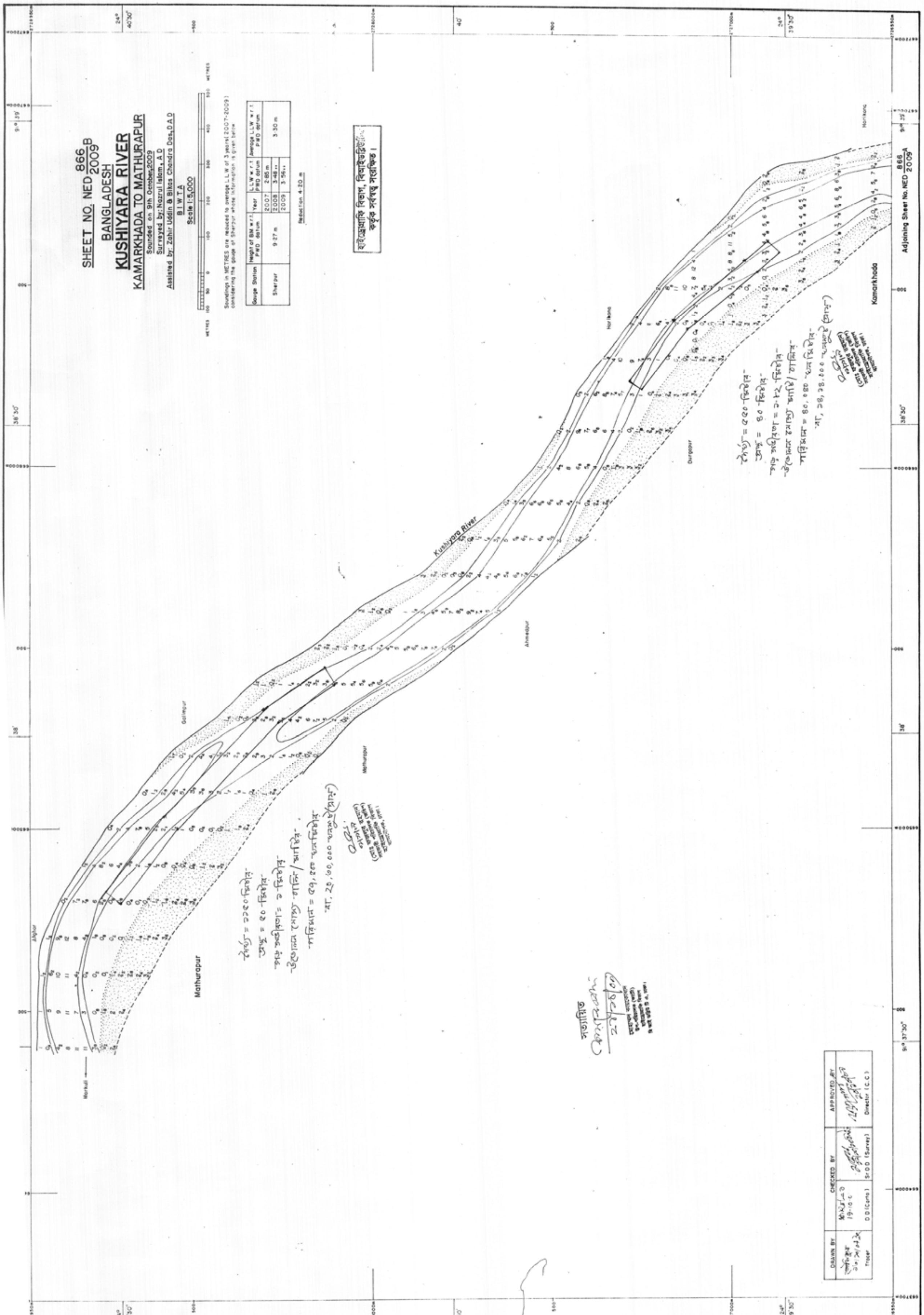


Figure 2: Location of sand mining area

2.4. Aquatic habitant and Fisheries: Kushiyara River is rich in aquatic and fisheries resources. Along the sand mining area, 1 fish sanctuary has been identified, west of mining site 3. This site is managed by Fisheries department of Moulavibazar district. The site is monitor by community level named Monumuk Fisheries Samity consists of 40-50 members. Along the KKushiyara River another dolphin habitat (locally called Shusuk) were identified near the Hatidigi in Kushiyara River. Consultation with the local people it was found that Dolphin are visible in a large number in this site, but this area is not declared as Conservation site by the Government /Fisheries department.   List of the fisheries species has been attached in *Annexure- 1*

2.5. Navigation/ water transport

The Kushiyara River is a important navigation route, with people using it as a route to different districts (Kishoregonj, Sunamgonj, Netrokona). It is also commercially important for sand, stone and others good transportation from north east part to others part of the country.

2.6 Fishing community

In order to identify the sand mining impact among the fishing community, FGD were conducted in three different site, where fishing community including women who participated.

Image 3: Fisherman of fishing village

Image 4: Fish of Kushiyara river

3.0 IMPACTS OF SAND MINING

Due to sand mining and associate activities in the Kushiyara River different types of impact may be occurred on river bank erosion, disturbance of fisheries habitat or species types of impact and social impact especially on the fishing community groups. Description of various types of impact has been given below

3.1 Sand Transport from Rivers

Highest distance of sand mining site is 12 km; Sand will be collected through dredging and transported to the plant site, 6- 8 trawlers will be move daily for transportation of sand. From dredging site to plant site. No major impact likely to be identified due to this trawler as the river is navigable and significant number of traffic move around the year.

3.2 Impact of Sand Mining

Due to sand mining activities from some points impact on natural and social environment could be occurred. Location wise sand mining impact given in the table 2

Table 2.1: Location wise sand reserve for mining

Sl	Location	Impacts		
		Bank Erosion	*Fish/ aquatic habitat*	*Socio economic environment*
1	Kushira River, East of Monumukh	M	M	M
2	Kushira River, wast of Monumukh	L	H	H
3	Monu River, Monu Mukh to 3 km upper site	M	L	L
4	Paharpur	H	L	H
5	Kamarkhada	M	L	L
6	Mathurapur	M	L	L
7	Galimpur	M	L	L
8	Hatidighi	M	H	L
9	Chatrafut, Kushira/ Bibiyana River	L	L	L

Significance's- High, M- Medium, L- Low,

3.2.2. Impact on Hydrological Characteristics

Analysis the Hydrological data it was found that most of the year water level cross the danger level at sherpur bridge point and flood water enter the down stream area, northern site of the project (north of the dykes) are low lying area, Sand mining activities should be done considering the vulnerable , unstable bank site, that might be affected cumulatively during the flooding period, if proper measures are not taken properly.

3.3.3 Socio-economic Impact

River side in-habitants specially fishing community near the river side are more vulnerable than, If river bank erosion increase due to improper sand mining site selection, it will bear enormous suffering for the human settlement, agricultural land as well as livelihood. Incase of negative impact on fish specifies and habitat , fisherman will loss their income, both bank erosion and habitat loss in a certain area will create cumulative impact on natural and human environment.

3.2.4 Aquatic and Riparian Habitat

Kushiyara River is rich with fisheries and Aquatic resources. Along the sand mining sites (25 km long) One fish sanctuary has been identified down to the Monumukh. Besides this near the Bibiyana North pad another fish sanctuary were identified within the southern side of the Kushiyara River.

The area is directly connected with river and it is a conservation site, declared by the district fisheries department of Moulavibazr district. Near the site number 8, where dolphin species are visible according to the local fisherman and in habitants.

Vulnerable for fish and aquatic habitats: site 2 : west of Monumukk of Kushiyara river and Site 8 is comparatively vulnerable due to dredging and sand mining activities, If proper method not followed by the local contractors

4. Environmental Implications of the Sand Collection Activities

4.1 On Landscape/Soil

As sand was collected from the riverbed therefore, there were no impacts on the landscape of the area surrounding the sand collection sites. Sand, which was removed from the riverbed, was transported to the project site by barges and boat, thus there was no impact on the soil quality. The amount of sand removed by dredging operation was partially replenished during the following flooding, thus there was no morphological changes in the channel or fluvial process.

4.2 On Air Quality

The sand collection sites are located in the rural areas, thus experience no air pollution and the background air quality is excellent in terms of enforcement parameters. The locally fabricated dredgers use small engines having low emission, thus added insignificant amount of pollutants in the surround air.

4.3 On Flora, Fauna

The rivers and channels, which were dredged for sand collection, considering the appropriate site which area may cause impact on fish habitat (site 2, site 8) should be taken into account.

4.4 On Up Stream and Down Stream Parts of the Dredged Channels

Upstream dredging could potentially cause sedimentation and channel degradation, and affect fish habitat in the downstream and loss of aquatic habitats. However, the dredging operations were planed and carried carefully to avoid such adverse impacts.

During the wet season dredging was done up stream of the channel as far as the draft of the dredgers and transporting vessel's draft allowed. Thus, substantial parts of the up stream channels were dredged in the upstream. Due this bed of these channels was freed from sediments and allowed free flow of floodwater during the monsoon, which restored the valleys of the channels. The down stream part of the channels were dredged subsequently and continued during the dry season. Thus whatever siltation that took place in the down stream, during the wet season dredging in the up steam, was cleared during this time.

Bank erosion was not seen except in two sites (2, 4, sites) small patches, this impact was avoided by selecting only the shallow point bars section of the channels, no dredging was done on the cut bank side. Thus dredging operations brought about some positive impacts, including increasing the depth of the channels and reducing flood intensities to some extent, which are likely to sustain for several years. It may be mentioned that heavy sand and silt, carried by these channels every year by flash floods, would silt up the channels again in due course.

4.5 On Sound Quality

The dredging operation was done in the open and there are no important settlements in the vicinity, thus it did not cause any adverse impacts on the background sound level.

5. SOCIO-ECONOMIC IMPLICATION

The positive impacts of dredging operations, on the channel mentioned above, have yielded some beneficial socio-economic impacts. During the field visits in the dry season it was observed that portioned of the channels, which were dredged, retained substantial quantity of water, which would otherwise remain dry before dredging. Due to this hundreds of people from near by villages were seen engaged in subsistence fishing activities. The villagers reported that both the amount of fish catch and variety of fish has increased following dredging, which has increased the channel depth this year and has retained water even in the dry season. Water in the channel has made some water available for dry season irrigation and navigation.

Dredging and sand collection has created some temporary jobs for the local people.

6. ENVIRONMENTAL IMPACT MATRIX

Project Title: **Dredging and Collection of Sand for SBPCL I & SBPCL II**

Environmental and Socio-Economic Components

PROJECT UNDERTAKINGS	#	Air Quality	River water Quantity/Quality	Surface Water Flows/Quantity	Siltation of River bed	Soil Stability/Erosion	Soil Fertility/Productivity	River morphology	Sound quality	Agriculture land	Vegetation	Wetlands	Aquatic habitats	Fish Stocks	Terrestrial habitats	Wildlife, Aquatic	Wildlife, Terrestrial/Avian		Biodiversity	Ecosystem Functions, Aquatic	Navigation	Socio-Economic Condition
Dredging point bars in the channels	1	A	A	A*	A	A	A	A*	A	A	A	A	A*	A*	A	A	A		A*	A*	A*	A*
Dredging channel bed	2	A	A	A*	B	B	B	A*	A	A	A	A	B	B	A	A	A		A*	A*	A*	A*
Loading dredge spoil in the vessel hold	3	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A	A	A	A
Transporting dredge spoil to the rpoject site	4	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A	A	A	A

DESCRIPTION OF CODES

A	The project undertaking is not likely to cause significant adverse environmental effects (taking into account appropriate mitigation measures and planning).
B	The project undertaking is likely to cause significant adverse environmental effects that cannot be justified (taking into account appropriate mitigation measures).
C	It is uncertain whether the project undertaking is likely to cause significant adverse environmental effects (taking into account appropriate mitigation measures).
D	The Project undertaking is likely to cause significant adverse environmental effects that can be justified (taking into account appropriate mitigation measures).
E	Public concerns for project undertaking warrant referral to a mediator, review panel or advisory committee.

* Some Positive Impacts.

7.0 MITIGATION PLAN

The following measures have been considered and described in more detail in the sections below:

- Site Selection;
- Controlling Runoff and discharge; and
- Public Consultation and Recommendation.

7.1 Site selection:

The following characteristics have been considered during the site selection procedure for the sand mining activities.

Sl	Location	Characteristics
1	Kushira River, East of Monumukh	• The area located 1 km down to the connecting point to the Beel. • The Fisheries Department has previously undertaken a fish pass project in this area. • Migration of fisheries during the breading period should be considered.
2	Kushira River, west of Monumukh	• Fish sanctuary located 1 km down to the mining site. • Fish breeding and migration period should be considered.
3	Monu River, Monu Mukh to 3 km upper site	• The Monumukh fishing community village is located on both sides of the riverbank. • Anecdotal information collected from fisherman indicated that Sand should be collected 1 km upstream of Monu River, otherwise bank erosion will be increase along the settlement sites.
4	Paharpur	• Located close to the Project Site • Bank erosion issues should be considered
5	Kamarkhada	• Bank erosion issues should considered
6	Mathurapur	• Bank erosion issues should considered
7	Galimpur	• Bank erosion and fisheries issues should considered
8	Hatidighi	• Dredging methods would need to be assessed in relation their suitability for conserving the dolphin habitat

9	Chatrafut, Kushiyara/ Bibiyana River	• Point bar of Kushiyara River, with significant amounts of sand reserves • Fish habitat located 1.5 km upper site and nearer wetland, dredging activity should be taken considering the morphology of the river and fish sanctuary

7.2 Controlling Runoff and discharge

The following measures are proposed to control runoff and discharge:

1. To keep the area from water, contractor shall design temporary design according to the natural condition to drain the rain water, sand filling water and ground water out of plant during construction, culvert or concentrate steel piping shall be placed at the intersection part of the drainage ditch and temporary road;
2. If the level of ground water near the backfilling surface, contractor must set dewatering system to ensure the quality of backfilling. Contractor shall set up the drain pit at the backfilling area as soon as possible and pumping facilities should be provided;
3. To optimize the dewatering equipment, the area shall be drained according to the divided area. The drainage line shall be made of each area of draining water; and
4. A adequate number of submersible machine or electric pump have to be provided to accelerate water sucking capacity and flow out of the freely area.

7.3 Public Consultation and Recommendation

During the field survey public consultation was undertaken relating to the potential for sand mining impacts on natural and human environment. The following recommendations cover the cross sectional community representatives:

1. People think that River dredging is good for river for navigation, and for fisheries resources;
2. Proper site should be selected with consultation with the river bank inhabitants, because they are the most vulnerable due to bank erosion and failure;
3. Near the Monumukh, sand should be collected 1 km upstream of Monu river;
4. Dolphin Habitat and fish sanctuary must not be disturbed;
5. Compensation should be paid for the loss of house, settlement due to improper sand mining; and
6. Adequate environmental management system should be taken for the conservation of fish habitat.

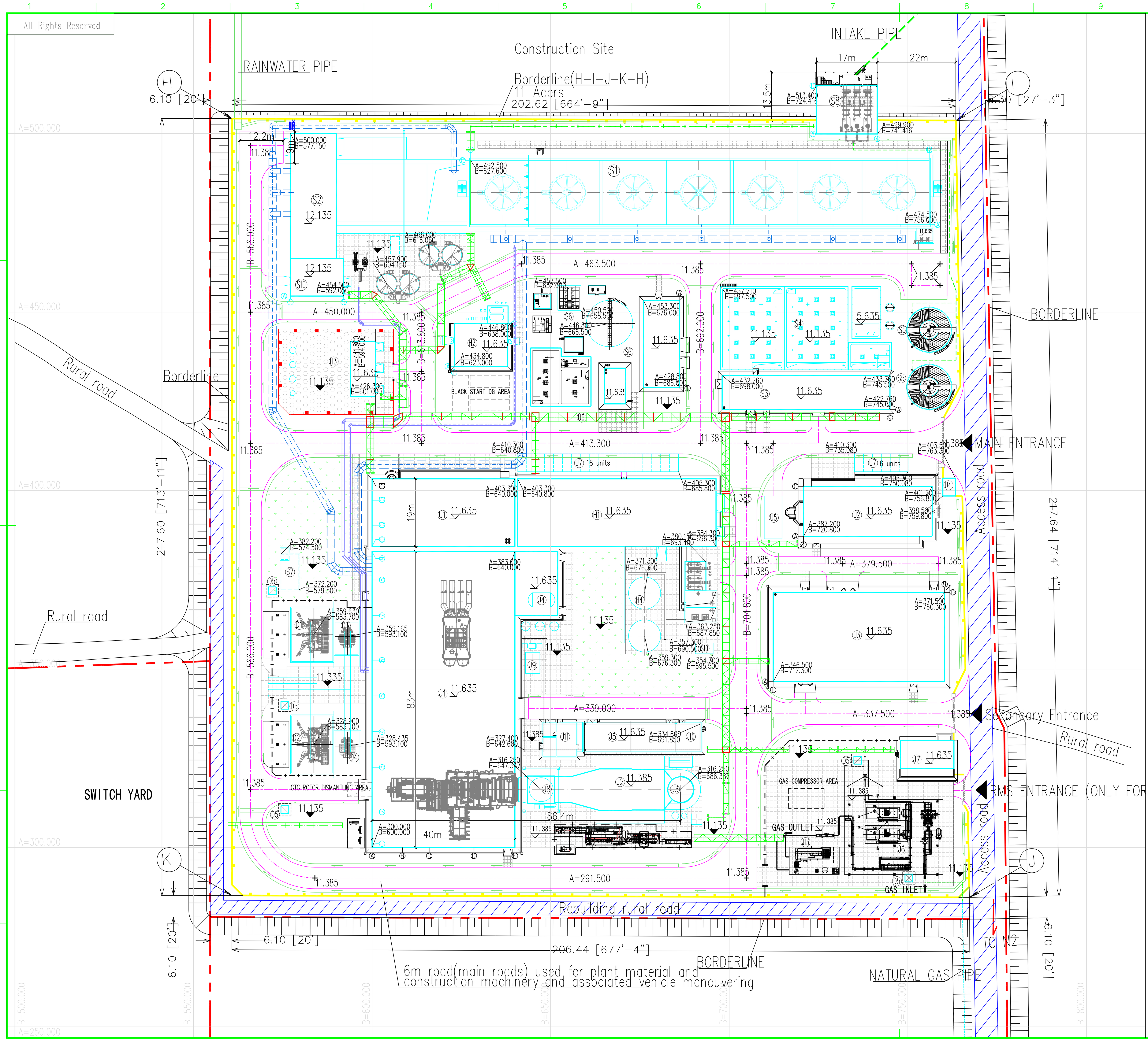
8. CONCLUSION

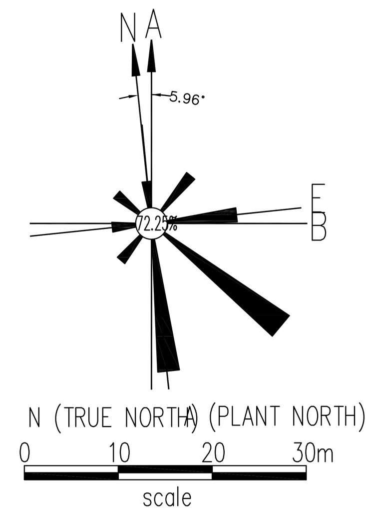
Of the potential sand mining sites identified within the Project AoI, all have environmental considerations which make them sub-optimal mining of sand.

The various methods which could be used for the proposed dredging operation and sand collection would need to be considered and assessed so as to choose the most suitable option and avoid any significant adverse environmental impacts.

It is not anticipated that the activities carried out for the purpose of sand collection and transportation would cause any significant adverse environmental effects. Furthermore, it was identified that the dredging activities may have some positive environmental impacts, which include restoration of degraded channels, improvement of fish habitats in the channels, enhancement of fish catch and species diversity, restoration of channels for navigation purpose during the dry months and availability of water for small scale dry season irrigation.

Annex 11: EPC Contractor Information





MAIN BUILDING LIST 本期建构筑物一览表

No. 编号	NAME 建(构)筑物名称	AREA(?) 占地面积	KKS	NOTE 备注
J1	STEAM TURBINE & GAS TURBINE ROOM 主厂房	3781.5	1 OUMA 1 OUMB	including Air compressor room and Central lube oil storage&purification room 包含空压机房和润滑油存储及处理室
J2	HEAT RECOVERY STEAM GENERATOR 余热锅炉区	629.2	1 OUHA	
J3	MAIN STACK 烟囱	96.5	1 1UHN	
J4	CONDENSATE WATER TANK 凝结水箱	27.0	1 OUGD	on the roof of Central lube oil storage&purification room
J5	HRSG AUXILIARY PUMP HOUSE & DIESEL GENERATOR ROOM	130.0	1 OUHV	
J6	REGULATING AND METERING STATION(RMS)	2232.2		
J7	RMS DORMITORY & RMS CONTROL ROOM	150.0		
J8	BYPASS STACK 旁路烟囱	116.0	1 2UHN	
J9	OIL TANK 储油箱	23.6		
J10	CEMS 烟气检测间	56.4		
J11	DIESEL GENERATOR ROOM 柴油机房	95.0		
J12	FUEL GAS FRONT MODULE 燃气前置模块	228.3		
J13	STEAM BOILER(FOR FUEL GAS HEATING)	107.8		
H1	D.M. PLANT AREA 化水车间	1844.6	1 OUGC	
H2	CW CHLORINATION BUILDING 循环水加药间	259.5	1 OUQC	
H3	HYDROGEN GENERATING STATION 制氢站	879.8	1 OUTG	
H4	DM WATER TANK 除盐水箱			
S1	INDUCED DRAFT COOLING TOWER(IDCT)	2752.8	1 OURB	nearby the pump house is the standby cell
S2	CW PUMP HOUSE 循环水泵房	1208.7	1 OURE	
S3	MULTI-USE WATER PUMP HOUSE 综合水泵房	300.0	1 OUGA	
S4	CLARIFIED WATER STORAGE BASIN 清水池	531.5	1 OUGN	
S5	MECHANICAL AGITATING CLARIFIER	245.4	1 OUGL	
S6	WASTE WATER TREATMENT PLANT 污水站	1240.0	1 OUGU	
S7	EMERGENCY OIL SUMP 变压器事故油池	38.5	1 OUBH	
S8	RAW WATER PUMP HOUSE 取水泵房	281.7	1 1UPC	near the Construction Site
S9	WATER INTAKE HEAD 取水头部	12.0	1 1UPH	in the KUSIARA river
S10	CW CONTROL ROOM 循环水控制室	156.45		
D1	STG GENERATOR TRANSFORMER 汽机主变压器	1201.0	1 1UBF	
D2	GTG GENERATOR TRANSFORMER 燃机主变压器		1 2UBF	
D3	STG UNIT TRANSFORMER 汽机高压厂用变压器		1 1UBE	
D4	GTG UNIT TRANSFORMER 燃机高压厂用变压器		1 2UBE	
D5	LIGHTNING ROD 避雷针	15.0		
U1	CENTRAL CONTROL BUILDING & ADMINISTRATION BUILDING	760.0	1 OUCA	
U2	DORMITORY & CANTEEN 值班宿舍&食堂	625.0	1 OUYB	
U3	WORKSHOP & STORE BUILDING 检修车间&材料库	1296.0	1 OUYX	
U4	GUARDHOUSE 警卫室	30.0	1 OUYF	
U5	FIRE TRUCK PARKING 消防车库	60.0	1 OUYQ	
U6	PIPE SUPPORT 综合管架	807.0	1 OUYZ	
U7	CARPARKING(INCLUDE COVERED) 停车位	375.0	1 OUZD	24 units

LEGEND

SYMBOL 图例	NAME 名称
	BUILDING & CONSTRUCTION
	UNDERGROUND BUILDING
	INTEGRATE TRUSS
turning road elevation radius R9 11.385	ROAD
11.135	OUTDOOR ELEVATION
11.635	INDOOR ELEVATION
	RAINWATER DITCH
	CIRCULATING WATER PIPE
	BORDERLINE
	WALL (BY BRICK)
	FENCE
	DRAINS AND SUMP FOR BUILDING
	CONCRETE GROUND
	SLOPE

CAPTION 说明:

1. PROJECT SCALE: 344.908MW (NET) GAS FIRED COMBINED CYCLE POWER PLANT. ALL COMMON SYSTEM ARE DESIGNED AS ONE UNITS.
   项目规模: 344.908MW 燃气联合循环发电厂. 所有公用系统按照一套344.908MW设计.
2. THE SITE TOPOGRAPHICAL SURVEY WAS PROVIDED BY SUMMIT.
   本图地形图由SUMMIT公司提供.
3. COORDINATE SYSTEM: THE SAME TO THE CONTOUR MAP;ELEVATION SYSTEM: PWD.
   本图坐标系统与地形图统一,高程系统为PWD.
4. HIGHEST FLOOD LEVEL (1988)= 10.135M PWD. THE FINAL SITE LEVELING ELEVATION IS 10.135+1=11.135M. THE BUILDING INDOOR ELEVATION IS 11.135+0.5=11.635M.
   历史最高洪水位是10.135mPWD,室外地坪最终标高为10.135+1=11.135m,室内零米标高11.635m.

MAJOR	CO-SIGNER	DATE	REV.	DATE	DETAILS	PREPARED	CHECKED	APPROVED
CIVIL STRUCTURE	1979	2013.11.30						
HYDRAULIC STRUCTURE		2013.11.30						
ENVIRONMENTAL PROTECTION		2013.11.30						
HVAC		2013.11.30						
MECHANICAL		2013.11.30						
ELECTRICAL		2013.11.30	D	2014.4.16	according to comments of LII	XIAO.H	CHEN.J	CHEN.W
HYDRAULIC TECHOLOGY	2420	2013.11.30	C	2013.10.31	according to comments of LII	CHEN.J	HE.JW	CHEN.W
CHEMICAL	7709	2013.11.30	B	2013.06.04	according to comments of LII	CHEN.J	HE.JW	CHEN.W
ARCHITECTURE	7592	2013.11.30	A	2013.09.02	first issue	CHEN.J	HE.JW	CHEN.W

OWNER	Summit Bibiyana II Power Company Limited
CONSULTANT	Lahmeyer International India
EPC	The First Northeast Electric Power Engineer
Contractor	China Energy Engineering Group
Design Institute	中国能建 广东省电力设计研究院 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE
PROJECT:	344.908MW(NET) GAS FIRED COMBINED CYCLE POWER STATION AT BIBIYANA II,BANGLADESH
DESIGN STAGE:	DETAIL DESIGN

TITLE:

GENERAL LAYOUT OF POWER PLANT

DRAWN: 7683	CHECKED:	SCALE: 1:500	
REVIEWED:		DATE: 2014-4-18	
APPROVED: 1750		COMPANY JOB NO.: FA05611S	
JOB NO. SP322	DRAWING NO. 44-FA05611S-Z0101-02 SP322-ZZZ-BDR-002	SHEET NO.:	REV. D

A1

DOCUMENT SUBMISSION STATUS: For approval

REV	DATE	MODIFICATION	PREPARED	CHKD	APPD
A	2013-02-15	First issue	孙景昌	刘春山	孙丽波

OWNER

SUMMIT

Summit BIBIYANAII Power Company Limited

LAHMEYER INTERNATIONAL INDIA	LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, INDIA
THIS APPROVAL STATUS SHALL NOT RELIEVE THE CONTRACTOR FROM HIS CONTRACTUAL OBLIGATIONS.	
STATUS	
☐ 1	Approved
☐ 2	Approved subject to incorporation of comment/modifications as noted. Resubmit revised drgs./docs after incorporating the comment
☐ 3	Not approved. Resubmit revised drgs/ Docs. Incorporating comment/Modifications, as noted, for approval.
☐ 4A	For Information only without any comments
☑ 4B	For Information only with comments, Resubmit revised drgs/docs
Date:19.04.2013	Transmittal Ref:LII/13006/GEN/EPCC/0002

OWNER CONSULTANT

LAHMEYER INTERNATIONAL INDIA

EPC CONTRACTOR

NEPC 东电一公司 — The First Northeast Electric Power Engineering Co.

CEEC 中国能建 — China Energy Engineering Group

PROJECT TITLE

344.908 MW (NET) GAS-FIRED COMBINED CYCLE POWER STATION
AT BIBIYANA II, BANGLADESH

DOCUMENT TITLE		Signature	Date
PROJECT EHS PLAN	Prepared by	孙景昌	2013.02.15
	Checked by	刘春山	2013.2.15
	Approved by	孙丽波	2013.02.15
	Scale		

Project No.	Document No.	Sheet No.	Rev No.
SP322	S-PL-11-0001	126	A

FOREWORD

The First Northeast Electric Power Engineering Company (NEPC) is committed to achieving EHS excellence, and compliance with all locally applicable EHS regulatory requirements, and our Customer's EHS programs.

This commitment is a responsibility of Management and employees in all functions. NEPC will strive to provide a safe and healthy working environment and to avoid injury and adverse impact to the environment and the communities in which business is conducted. NEPC's EHS programs combine clear leadership and commitment by Management, the participation of all employees and functions, and the use of appropriate technology in developing and distributing NEPC's performance and services.

This Project EHS Plan is applicable to, and it's provisions will be mandatory for, all persons working on or visiting the site, including: NEPC's employees, Partner employees, NEPC's Contractor/Subcontractors and lower tier Subcontractor employees, all vendors and suppliers, Owner's personnel and all project site visitors.

It is the responsibility of each Contractor/Subcontractor to enforce the EHS requirements for its lower tier Subcontractor employees, as well as its own employees. Should conflicts arise between the Construction Project's EHS Plan (referred to as EHS Plan) and any regulatory program or procedure, the more stringent will apply. Nothing in the EHS Plan shall be construed to diminish the employer/employee responsibilities, obligations, and relationship.

All Contractors/Subcontractors are required to ensure that they and their employees, lower tier Subcontractors, and suppliers, while on the jobsite and in the conduct of contracts, comply with the provisions of this program. Failure to comply may result in removal of the Contractor/Subcontractor and/or its employees from the site.

A copy of this EHS Plan will be available to all on site as a reference.

This EHS Plan is subject to approval by NEPC Headquarter EHS Manager including any modification of the Plan.

Prepared By:

Mr. Sun JingFu

Site EHS Manager

NEPC Bibiyana II Project Office

Date:

Verified By:

Mr. Liu ChunShan

Site Manager

NEPC Bibiyana II Project Office

Date:

Approved By:

Mr. Liu YanBing

Project Manager

NEPC Bibiyana II Project Office

CONTENTS

PROJECT EHS PLAN

- **INTRODUCTION**

The intent of this EHS plan is to prepare a document that is easy for all to use, and that provides all the information required to manage EHS in all aspects of the Bibiyana II Project. Employees (and Partners/Contractors) of NEPC have the right to expect that they will be provided with a safe place of work. To keep the plan as simple to use as possible, it is a modular plan, made up of a number of documents that are cross-referenced in each other, but the content will not be duplicated.

The typical Plan is made up of a number of procedures. The number of procedures may be modified if required by customer or specific requirements, or to accommodate changes required by an individual situation of the Project.

It is also NEPC's practice and responsibility to follow operating policies that will safeguard all employees (and contractors) and result in safe working conditions and efficient operations.

The Site EHS Plan will be comprised of a set of site-specific documents and standard procedures. The site-specific documents should reflect both applicable regulatory requirements and any customer contractual EHS requirements. If any National or Local Statute, Regulation, or Requirement demands a higher standard than is contained in these documents the former will take precedence.

The contract Language(s) on this site is English. This Project EHS Plan and other EHS documentation at this site will be available in English, Bangladeshi and Chinese.

- **EHS POLICY AND OBJECTIVES**

NEPC is committed to providing quality products and services in a manner that protects the environment, the health and safety of employees, customers, and the community.

This is accomplished through the application of the following environmental, health and safety commitment:

Achieve and maintain full compliance with all applicable EHS laws and regulations;

Protect the health and safety of our employees in the performance of their assigned work, giving full regard to evolving industry best practices, regulatory requirements and societal standards of care;

Eliminate, where possible, or limit to the lowest practical levels, adverse effects on human health and the environment from its services, facilities and activities;

Ensure that health and safety of our employees and protection of the environment is a priority concern in business activities,

Utilize source reduction to minimize the volume of waste generated,

Ensure all employees are aware of their EHS responsibilities and understand the necessity for EHS adherence, and

Establish realistic and measurable goals to measure EHS progress.

NEPC shall give its full support and commitment to all employees to achieve the objectives of this Environmental, Health and Safety Policy.

- **PROJECT SPECIFIC INFORMATION**

Customer Name and HQ address/ contact details	Summit Bibiyana II Power Company Limited Address: 18, Karwan Bazar Commercial Area, Dhaka – 1215, Bangladesh Telephone: +88 02 9130845 Fax: +88 02 9130853
Contractual Arrangement	Design, procurement, manufacturing, construction/erection, Testing and commissioning of the Plant.
Site Location	Bibiyana, approximately 180 kilometers northeast of Dhaka in Habiganj District, near Sylhet, in Bangladesh
Nearest City/Airport	Nearest City: Sylhet Nearest Airport: Sylhet International Airport, Sylhet
Customer EHS Manager contact name and contact details	Mr. Md. Reaz Uddin Telephone: +88 02 9130 845 Fax: +88 02 9130 853
NEPC Project Manager, name and contact details	Mr. Liu YanBing Email: nepcliuyanbing@gmail.com Telephone: +86 247 2856666
NEPC Site Manager, name and contact details	Mr. Liu ChunShan Email: nepcliuchunshan1974@gmail.com Mobile: +88 017 77954223
NEPC HQ EHS Manager, name and contact details	Mr. Niu FengMing Telephone: +86 247 2856666 Fax: +862472856666
NEPC Site EHS Manager, name and contact details	Mr. Sun JingFu Cell: +88 01777504201

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- **DEFINITIONS**

Contractor/Subcontractor: Any company or individual NEPC has a contract with such as a vendor, company or consultant, including their employees and subcontractors.

Owner: Business entity that has contracted NEPC to perform work on their behalf. The Customer of this project:

Summit Bibiyana II Power Company Limited with principle office at Summit Centre, 18, Karwan

Bazar Commercial Area, Dhaka – 1215, Bangladesh

Consultant/Owners Engineer: Independent company that performs supervision, review and approval work on behalf of Customer.

Lahmeyer International (India) Pvt. Ltd with office at Infinity Benchmark, 9th Floor, Plot No. G1, Block EP & GP, Salt Lake Electronics Complex, Sector V, Bidhan Nagar, Kolkata – 700 091, India

Competent Person: A person who is capable of identifying existing and predictable hazards and who has the authority to take prompt, corrective measures to eliminate hazards.

Authorized Person: A person selected, approved or assigned by the NEPC as being qualified to perform a specific duty or duties, or to be at a specific location(s) at the workplace.

Qualified Person: A person who by possession of a recognized degree or certificate, or who by knowledge, training, or experience has successfully demonstrated their ability in relation to the work and is familiar with the hazards involved.

Serious Accident: An accident that results in a fatality, amputation, injury to more than one employee, hospitalization, investigation by a regulatory agency, 3 or more lost work days, exposure to toxic substances or radiation that requires reporting to any government agency, property damage over $25K, or a serious near-miss.

HQ EHS Manager: Headquarter EHS Manager

NEPC: The First Northeast Electric Power Engineering Company

Project: The Project of implementing of design, procurement, manufacturing, construction/Erection, test and commissioning of 344.908MW(Net) Gas-Fired Combined Cycle Power Station at Bibiyana II, Bangladesh

Project Manager: The NEPC Project Manager for the Project

Site Manager: The NEPC Site Manager for the Project

Site EHS Manager: NEPC Site EHS Manager for the Project

EMP: Environmental Management Plan

EPA: Environmental Protection Agency of the country/region where the activity takes place.

EIS: Environmental Impact Statement

NOV: Notice of Violation

NON: Notice of Non compliance

OSHA: Occupational Safety & Health Administration (USA)

ITO: Inquiry to Order, the project phase before award of contract.

OTR: Order to Remittance, the project phase after award of contract.

- **RESPONSIBILITIES**

- **General Responsibilities**

HQ EHS Management is responsible for managing the Project EHS.

Management and NEPC site personnel will ensure that site conditions within their scope of work conform to the EHS Program requirements.

It is the responsibility of all site personnel, Contractors and Subcontractors to act in accordance with the procedures and policies described in this site EHS plan and Customer requirements. Individuals who are found to be in violation of these procedures and policies may have action taken against them up to and including removal from the project site.

EHS responsibilities for specific positions are described in the following subsections. Refer to site-specific organization chart (Attachment 32) to identify personnel assigned to these positions.

The EHS organization is set up to handle the environment, safety, health and security issues.

- **Project Manager**

Shall ensure adequate and suitable resources are allocated to the project to enable it to be completed, while complying fully with the requirements of this EHS Plan, and all applicable regulatory requirements. Ensure that this EHS Plan is prepared or approved by the NEPC HQ EHS Manager for the project, and submitted to the LII/Summit for approval to meet contractual requirements.

Consult the NEPC HQEHS Manager whenever an EHS or compliance issue requires resolution (including shipping and receiving of hazardous materials), also ensure that the resolution of any issues are incorporated into the Site EHS Plans and communicated to site personnel.

Ensure that any potential contractors have been approved and receive a copy of this EHS plan before they submit an offer for work to be completed on site. This is required so they understand 's EHS programs, and what is expected of them, before they submit a quotation.

- **HQ EHS Manager**

Shall develop a Project EHS Plan, or approve a plan developed by others. The Plan shall be Country and Project specific. Moreover, the plan will identify all EHS requirements that need to be implemented to ensure, at a minimum, compliance with applicable regulatory requirements and programs.

Prepare an Audit schedule for the project, and ensure audits are carried out by appropriately trained persons, with the knowledge and experience required to identify compliance issues. Ensure all audits are documented, and the report and any required corrective actions are clearly communicated to all those required to take actions.

Advise and assist in the investigation of serious accidents and dangerous occurrences. Where required, assist in the reporting of all such cases to regulatory agencies.

Identify EHS training required by people involved in the project execution, and provide assistance in organizing such training. Coordinate with Site Managers and, where appropriate, advise on training to improve the existing knowledge of personnel on Environmental, Health, and Safety matters.

Liaise with the representatives of enforcement agencies.

Liaise with customer EHS and Operations staff, to ensure NEPC meets their EHS expectations for the project, and quickly addresses and responds to any EHS concerns they raise.

Provide EHS support to the Project Manager, Site Manager, Site EHS Representative, and other project staff as required.

Approve suitably qualified Site EHS representatives.

Manage and mentor the site EHS representatives.

Ensure all required internal and external EHS reporting is completed on time.

- **NEPC Site Manager**

Shall ensure all elements of this project EHS plan and updates are communicated and implemented at the site.

Ensure all works, acts and emissions on site under the responsibility of NEPC, comply fully with all applicable regulatory requirements.

Correct or cause to have corrected, noted or reported any EHS deficiencies.

Ensure persons under the control of NEPC are not assigned tasks or asked to operate equipment they are not trained or competent to undertake.

Ensure adequate security provisions are in place and fully implemented. Where higher risks are identified, a Security Plan will be developed as an attachment to the plan. The Site Manager shall ensure the resources and facilities required to implement this plan are in place before mobilization and remains in place until demobilization.

Coordinate all activities with Customer and other Contractors/Subcontractors on the project site.

Ensure implementation and execution of the Lock Out and Tag Out (LOTO) program, including training, development and revision of procedures, and periodic auditing of program compliance. Where the NEPC LOTO program is not implemented, NEPC LOTOEHS Manager shall review and approve the program to be implemented and the competence of those holding key roles and responsibilities in the execution of the program.

Ensure all work on site only proceeds when required Safety Risk Assessments (SRAs) have been completed and reviewed by a competent person, and communicated to those who can be impacted by the hazards identified.

Ensure all staff and visitors have the required and/or Customer orientation training.

Support or participate in the investigation of all accidents and reportable occurrences.

Ensure adequate facilities, procedures and trained personnel are available for all foreseeable emergencies.

Ensure all personnel under NEPC control wear all required PPE for the environment they are in and the tasks they are performing.

As applicable to site activities, support the Customer's obligations to protect adjacent property, ensure safety of third party employees, and ensure the safety of the public.

Require NEPC, Contractor and Subcontractor superintendents and job foremen to understand the provisions of the locally applicable safety and health regulations for construction and have access to up-to-date regulations.

Not knowingly permit any construction means, methods, techniques, or activity which compromises safety and health in the workplace.

Take responsibility for the project's environmental performance and ensure that all operations comply with environmental policies and all relevant regulatory requirements.

Personally deliver a Weekly EHS Communication to employees under their supervision. Document the communication in accordance with the Supervisor Metrics Program.

Ensure Weekly EHS Inspections are conducted and documented in accordance with the Supervisor Metrics Program.

Ensure this EHS Plan is enforced, including documentation of disciplinary actions taken for violations of established rules, regulations, procedures, and programs.

- **Site EHS Manager**

Shall coordinate the NEPC site EHS programs and assist the Site Manager in implementing the Site EHS Plan, including Environmental and Emergency Preparedness sections.

Conduct frequent and regularly scheduled EHS inspections of NEPC, Contractors and Subcontractor's construction activities to monitor compliance with their own EHS program, applicable regulations and this EHS Plan. The Weekly EHS Inspection will be scheduled, completed, and documented in accordance with the Supervisor Metrics Program.

Audit the implementation of the site security provisions to ensure NEPC and contractor personnel are protected from security threats. Immediately bring any non-conformances that could cause a security issue to the attention of the Site manager and the responsible security director.

Update and develop as required, this EHS Plan including Environmental and Emergency Preparedness sections. Ensure all revisions and updates are reviewed and approved by the NEPC HQEHS Manager responsible for the project.

Issue a work stoppage directive where conditions exist which are Immediately Dangerous to Life or Health (IDLH) or damaging to the environment. The work stoppage will remain in effect until the condition has been corrected. In conjunction with a work stoppage, refer as appropriate to the Hazard Identification/Notification Process (Attachment 2: Project Sites Hazard Identification and Notification Process), SCAR (Attachment 1: Safety Corrective Action Request).

Be responsible for the managing of incident reporting, investigation system including mitigation measures taken.

Advice the management of appropriate NEPC/Contractor/Subcontractor of unsafe acts/conditions observed on the project site for prompt corrective action to eliminate the unsafe act/condition.

Either conduct EHS orientations or assist the Contractor/Subcontractor's EHS representative with conducting EHS orientations for all construction personnel and visitors reporting to the project site. Ensure no one is allowed on site unaccompanied unless they understand the site's Emergency Response Plan.

Attend a sample of NEPC/Contractor/Subcontractor's weekly EHS meetings and "tool box" safety talks, and verify that personnel signature sheets are properly completed for later reference.

Either conduct, or assist in conducting accident investigations, analyzing causes, and formulating recommendations for corrective/preventative actions.

Liaise with Contractors/Subcontractors, insurance representatives, local medical services, local fire and police departments, local regulatory agencies, and Customer/Client on EHS related matters.

Conduct the EHS portion of the weekly coordination and EHS meetings.

Verify that local regulatory agency's required posters are posted and kept current by each Contractor/Subcontractor.

Verify that NEPC and each Contractor/Subcontractor is providing adequate and proper record keeping as required by local regulatory agencies and maintaining documentation of EHS training, EHS audits and inspections and occupational safety and health monitoring activities.

Maintain recordkeeping for this and as required by this plan.

- **SITE EHS MANAGEMENT**

- **Security**

Where deemed necessary, the Site Manager, in conjunction with the responsible Site Security Director shall establish a security plan for personnel working on the project. All site personnel shall be briefed on the plan.

The Security Plan (SP322-S-PL-11-0002) shall be an attachment to the EHS Plan.

- **Harassment**

The Site Manager shall ensure that the work environment is free of harassment, such as harassment directed at a person because of his or her race, color, religion, national origin, sex, pregnancy, sexual orientation, age, disability, veteran status or other characteristics protected by law.

The Site Manager shall ensure any reported incident of Harassment is investigated, and if warranted, disciplinary action is initiated against anyone found to be involved in harassment.

- **EHS Orientation Training and Communication**

Prior to starting work, all NEPC/Contractor/Subcontractor and visitors shall receive the training and orientation necessary to enable them to perform assigned tasks in a safe manner. (Attachment 4: Site EHS Orientation Booklet)

The planning, control and quality of safety and any other training shall be kept under the responsibility of -NEPC.

Documentation of all training and orientation shall be maintained in the NEPC or contractor's site EHS files and made available for review upon request.

The following shall be included in the orientation program:

Project EHS rules

Hazardous activities and restricted areas

Review of the Emergency Response Plan requirements including Information on the emergency evacuation assembly points and evacuation procedures and reporting requirements

Review rescue and first aid services at the site

Environmental rules and procedures

The NEPC/Contractor Site EHS Manager will be responsible for ensuring site training and staffing activities are correctly implemented and administered. NEPC is to manage NEPC personnel; Contractors are responsible for their personnel.

The site shall be required to install and maintain a safety notice board or boards, in areas of the site where the information posted can be viewed by all. Information displayed shall be in languages all personnel on site can read and understand.

- **High Risk Activities**

~~A competent person must be identified to manage all higher risk activities. This may be a NEPC or contractor employee.~~

A third party qualified Assessor shall be appointed by -NEPC to carry out quantified risk assessment. The report must be made ready soon and compliance management is to be ensured with the same. Examples of higher risk activities will include:

Excavation and/or trenching

Scaffolding

Use of explosives and/or blasting

Underground construction, caissons, cofferdams, and use of compressed air

Crane and lifting operations

Work at heights and Scaffolding

Demolition

Other operations where local statutes or regulations require specific training.

- **Project EHS Meetings**

NEPC personnel, including the Site Manager and the Site EHS Manager shall participate in a weekly safety meeting to coordinate related activities among each technical discipline and to facilitate site safety training and awareness. The Contractor's Site Manager and Site EHS Manager shall also attend these meetings.

Documentation showing the following specifics of safety meetings shall be distributed to each attendee and maintained on file at the site. (Attachment 5: Weekly EHS Meeting Record).

Time and Date of meeting

Attendees

Topics/Comments

Assignments - Party responsible/Date corrected (if applicable)

Person conducting the meeting

- **EHS Inspections**

The Site Manager shall have primary responsibility for ensuring that site EHS inspections are conducted on a weekly basis.

EHS inspections shall be conducted as follows:

Specific daily documented inspections required by local statute and regulations, these will include:

Scaffolding

Excavations

Mobile and Lifting Equipment

Confined Spaces

Weekly site safety inspection shall be conducted and the results documented using the Weekly Inspection Checklist. (Attachment 6: Weekly Site Inspection Checklist). Inspections shall be completed by the Site EHS representative, and representatives from each contractor.

Weekly inspections to monitor the implementation of the LOTO program, shall be conducted by the

Site EHS Manager, or designated other person, whenever LOTO is in use at the site.

- **Audits**

Site EHS Audits will be conducted by the NEPC HQEHS Manager. Audit results will be provided to the Site Manager and Contractor management. Audit findings and related corrective actions will be documented and maintained in the site EHS file.

The schedule for area-wise audit and the corresponding check lists must be maintained for each month. Shortcomings and improvement areas shall be also listed.

Audit findings will be documented into ATS and assigned to the Site Manager as the Responsible Person. Findings will be closed rapidly and where possible before the due date assigned by the audit leader.

- **Management of the closure of findings from inspections and audits**

The site shall establish a system to track all open EHS issues through to completion of the required corrective actions.

This system shall require the finding and required corrective action to be documented, and a required by date for the corrective action to be identified. The system shall also record the responsible person and the actual completion date.

The system can be either paper or computer based, but should be available for review by NEPC on request.

It is recommended that the system be able to manage trending and produce statistics for management review.

- **Safety Corrective Action Requests (SCAR)**

When an EHS hazard is identified, the Site Manager, or designee may, at their discretion, issue a SCAR to the responsible party requiring prompt correction. (Attachment 1: Safety Corrective Action Request).

In cases of imminent danger, the person observing it shall immediately advise the persons at risk to stop the activity and leave the danger area. The Site Manager shall prohibit personnel from working in the affected area until the hazard has been corrected.

- **Permit to Work**

Sites that implement a permit to work program outside of the LOTO program should define the system here or in a separate appendix to this plan.

- **Accident Reporting, Investigation and Recordkeeping**

Accidents resulting in a fatality, amputation, injury to more than one employee, hospitalization, or investigation by regulatory authorities shall be reported to the Site Manager or designee, the Project

Manager and the NEPC HQEHS Manager immediately. (Attachment 8: Incident Report Form)

The NEPC HQEHS Manager will be responsible for ensuring all required internal and external reporting obligations are met to include monthly reporting of hours and site safety status using (Attachment 9: Injury and Illness Log).

Accidents resulting in fires, explosions, oil/hazardous material spills shall be investigated and reported to the Site Manager or designee, the Project Manager and NEPC HQ EHS Manager immediately.

All other accidents including injuries, accidents involving company vehicles, property damage and significant near misses and hazards shall be reported to the Site Manager or designee immediately and to the NEPC HQEHS Manager within 24 hours.

All accidents and some incident should report to Owner/Consultant subject to approval from Site Manager.

All mandatory reporting for accidents to local authorities shall done by -NEPC as per prevailing rules and in consultation with the Owner.

All Accidents shall be investigated and documented using the Accident Investigation Report. (Appendix 9: Accident Investigation Report) Sites staffed with full time NEPC EHS personnel shall report all injuries and first aids. Sites not manned with EHS staff are required to send a written report from the Site Management to the responsible NEPC HQ EHS Manager.

Accident investigations must be initiated as soon as possible after the accident occurs and no later than 24 hours after the accident. Completed Accident Investigation Reports will be forwarded to the Site Manager or designee, Project Manager and the responsible NEPC HQ EHS Manager.

Information on the cause of the accident and corrective actions to be taken will be communicated to site personnel through postings, EHS meeting, and/or toolbox talks. The anonymity of personnel involved in the accident or who provided information during the investigation will be maintained.

Corrective actions identified by the accident investigation will be tracked to closure. Safety Corrective Action Requests SCARS (Attachment 1: Safety Corrective Action Request) may be issued following completion of the accident investigation. Documentation of completed corrective actions will be maintained in the site EHS files.

All accidents involving injury or property damage to members of the public resulting from work related activities shall be immediately reported verbally to the Site Manager, Project Manager and the responsible NEPC HQ EHS Manager.

A first aid log shall be maintained at the project. Every injury or illness reported, no matter how slight, must be recorded. Entries shall be made promptly following treatment. (Attachment 10: First Aid Log).

For NEPC Contract employees requiring medical treatment from a physician, hospital, or clinic off the jobsite, (Attachment 11: Physician Clinic Referral Form) must be given to the Attending Physician before a worker is to receive treatment. Supervisory employees are responsible for ensuring that this form is properly completed. When a worker returns from the physician, hospital, or clinic, the worker must present the completed Clinic Referral Form prior to being allowed to return to work.

- **Near Miss and Safety Observation reporting**

The site shall establish a program for reporting of all near misses.

All persons on site should also be required to bring to the attention of their supervisor/manager any safety observations, or ideas for safety improvements.

The requirement for both of the above will be communicated to all persons during their site EHS Orientation training, and at regular intervals at safety/toolbox meetings to remind them of the requirement.

The site shall be required to record all near misses and safety observations and provide reports to CEEC HQ EHS Manager as required. Near misses and safety observations shall be included in all metric reports produced by the site.

The site EHS team shall also review all reported near misses and safety observations and take actions appropriate to the severity. Corrective actions implemented shall be communicated to all on site who may be affected by possible recurrence of the incident/issue reported.

- **Site EHS Files and Document Management**

The documents required to be contained within the site safety files will be listed in a summary document, as an attachment, (Attachment 12: Site Safety File Contents) this is specific to this EHS Plan.

On completion of the project as part of the demobilization, documents from the site safety files, will either be incorporated into a site turnover package, to be retained at site, or archived and shipped to the project management HQ.

- **Site Chemical Management (Hazard Communications - HazCom Program)**

A Chemical Management program shall be prepared for the site and this will be included in this EHS Plan as an appendix.

Either NEPC or NEPC contractors will be required to prepare and maintain for the life of the project, an inventory of substances on site, and an indexed file containing Material Safety Data Sheets (MSDS) for each hazardous material used and or stored on the project site. MSDSs must meet any requirements regarding availability in local languages or languages spoken by employees present at the site.

- **Regulatory Agency (e.g. OSHA) Administrative Requirements**

At project mobilization:

Post any required regulatory agency posters. EHS to check local requirements.

Post Emergency Response phone numbers. (Attachment 7: Emergency Contact List).

Maintain site illness and injury records as required.

Any agency inspections, visits or citations, NOVs, etc, received by the site shall be immediately reported to the responsible NEPC HQ EHS Manager.

A Log and Summary of Occupational Injuries and Illnesses, OSHA 300 Form. This log must be retained for five years following the end of the calendar year to which it relates. Instructions on how to complete the OSHA 300 Form can be found accompanying the form.

A Supplementary Record of Occupational Injuries and Illnesses (OSHA 300A) Form.

- **Contractor Administration**

The Site Manager, and where applicable, Site EHS Manager shall hold an EHS Pre-Planning Meeting with Contractor Management prior to their commencement of work using (Attachment 14: Contractor Orientation).

The requirements for Contractors are detailed in section 7 of this EHS Plan.

- **Welfare Arrangements**

The Site Manager is responsible for ensuring the following minimum welfare facilities and arrangements are available at the site:

Potable water for drinking, with clean cups or alternative hygienic arrangement for drinking.

Suitable washing/shower facilities segregated by gender, dependant on expected requirement at site. Facilities must include soap/cleanser, and either supply towels or drying facilities for those providing their own towels.

Adequate sanitary facilities, segregated by gender, for the numbers on site.

Clean facilities outside of the work area for meal breaks.

A suitable area for workers expected to need to change out of work clothes on site should be provided with somewhere to change and store clean and dirty clothes, with facility to dry wet work clothes before re-use.

Waste receptacles in line with the requirements of the site Environmental Plan.

- **Hazard Analysis and Risk Management**

A third party qualified Assessor shall be appointed by -NEPC to carry out quantified risk assessment. The report must be made ready soon and compliance management is to be ensured with the same.

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For each phase of the work a Safety Risk Assessment (SRA) and Method Statement (MS) shall be developed (Attachment 16: Safety Risk Assessment Process and Procedure). Attachment 30: Risk Assessment Guide is available to assess the risk associated the pre-placement of construction trailers, break trailers, smoking areas, and similar personnel facilities.

Original SRAs and MSs shall be maintained by the job supervisor and be available for review by employees involved with the task. Copies of completed RA & MS shall be kept in the site EHS file.

The applicable SRA and MS Form and guidance are provided in (Attachment 16: Safety Risk Assessment Process & Procedure). The analysis shall be job specific and address at a minimum the following areas:

- Activity being performed including all of the major tasks
- Sequence of work
- Health and safety hazards including chemical, physical, and ergonomic stressors in the hazard analysis
- For jobs involving the use of chemicals, the hazards associated with the chemical, along with protective measures such as PPE, must be included on the SRA and reviewed with personnel prior to starting work.
- Control measures or precaution actions include PPE, fall protection measures, fire protection measures, barricades, work practices etc.

The responsible NEPC/Contractor's/Subcontractor's Supervisor shall review all work activities/tasks.

The completed SRA and MS package shall be submitted to the Site EHS Representative for review. When the SRA has been reviewed by the Site EHS Representative, it will be returned to the originating Contractor/Subcontractor Supervisor. The Supervisor will sign the SRA and MS, making it a formal document.

All risk elimination and or management required by the SRA and MS, must be in place and complete, before the planned task is permitted to begin.

The Supervisor shall review the SRA and MS, including any revisions, with all employees involved in the work activity/task and ensure they understand the requirements identified, and what is expected of them. This understanding shall be confirmed by each employee's signature. This can be done as a toolbox talk or job preparation meeting or pre-work meeting.

The SRA and MS shall be updated whenever there are significant changes in the work plan, methods or materials to be used, work environment, or a new crew or subcontractor is assigned to conduct the work. Any changes/revisions to the SRA and MS shall undergo the same review process as the original SRA and be assigned a revision number to allow changes to be tracked.

- **Drug and Alcohol Policy and Testing**

NEPC does not allow the unauthorized or illegal possession or use of alcoholic beverages, drugs or other intoxicants on job site assignment. No person shall be permitted to bring unauthorized or illegal alcoholic beverages, drugs, or other intoxicants onto any location where work is being performed; nor shall any such person be allowed to perform work under the influence of alcoholic beverages, drugs, or other intoxicants. NEPC reserves the right to prohibit any person from property owned or controlled by the NEPC, by denial of access, suspension or revocation of access authorization, peremptory expulsion, or by other means. NEPC may notify law enforcement authorities of any such suspected criminal violation concerning possession and use of alcohol and drugs. Contractors are responsible for requiring that their personnel and their subcontractors' personnel comply with these requirements.

- **Rewards and Recognition**

NEPC encourages good EHS performance by providing a rewards and recognition program for its employees. NEPC would recommend all contractors implement a reward and recognition program at site. This may be based on individuals, teams or other groups EHS performance.

Any rewards and recognition program should be transparent in application and based on trusted data, so the program is recognized as a true reward for EHS performance.

- **Program Compliance/Disciplinary Policy**

Failure to comply with any part of the Project EHS Program will not be tolerated. Employees who are discharged from the project site for noncompliance with the Project EHS Program will not be eligible for re-employment on the project. Disciplinary actions should be documented using Attachment 3: Disciplinary Process.

When an unsafe act is observed, the person observing has the responsibility to stop the unsafe act and initiate the Compliance process if deemed necessary. The First Line Supervisor has primary responsibility for administering the Compliance action to his crewmembers.

First Infraction

This is an oral communication between Supervisor and Employee where the first infraction is identified and corrective action and coaching is provided to the employee. The Supervisor will document this first incident.

Second Infraction - Level II

This is a written communication given by a Supervisor to an Employee who had previously been given a verbal warning. The supervisor shall identify the safety infraction and provide coaching toward desired corrective action with the employee. Documentation of this incident is mandated, requiring the signature of the employee. This step may result in “Time Off” for the affected employee.

Third Infraction – Level III

This is the final written communication given by a Supervisor to an employee who had previously been given a verbal and written warning. The supervisor identifies the safety infraction and the employee is given severance of employment. Documentation of this incident is required and will not require the signature of the Employee.

Serious Infraction

Examples of "serious" include LOTO violations, non-compliance with fall protection or Confined Space Entry requirements, or reckless actions that endanger life.

The NEPC Site Manager or Contractor Site Manager may take action up to and including immediate dismissal from the project site for these infractions.

The site disciplinary policy should be clearly communicated during the site EHS Orientation Training provided to all.

- **Site EHS Improvement Program**

At sites where EHS performance and ownership of EHS management is below expected standards, NEPC recommends the implementation of a 'Responsibility Zoning Program'.

Responsibility zoning requires a plan of the site to be prepared, and work areas are divided into zones. Each zone has supervisor/manager identified as the person responsible for implementing the site EHS programs in that area.

Regular site EHS inspections are conducted, and any findings from these inspections are recorded against the responsible person/zone. Any injuries, near misses or disciplinary cases are also recorded against the responsible supervisor/manager.

At periods to be decided by the site, but typically monthly, the supervisor/manager with the best EHS performance will receive a reward and recognition. The supervisor/manager with the worst performance, will receive either help to improve, or if applicable disciplinary action up to and including replacement.

- **CONTRACTOR SITE EHS ACTIVITIES**

- **Contractor Responsibilities**

NEPC will provide a copy of this EHS Plan to all first tier contractors. First tier contractors shall be responsible for implementing the requirements of this EHS Plan, as it is applicable to their work. The minimum EHS Site expectations for Contractors by NEPC are included in Attachment 15 respectively.

First tier contractors shall ensure that this EHS Plan is communicated to any subcontractors and they understand that they must implement its requirements, as they are applicable to their work at the site.

The requirement to comply with this EHS Plan shall be included in any contract between contractors and subcontractors.

All Contractors shall be solely responsible for carrying out all activities in their scope while complying with the requirements of this plan, maintaining safe and healthy work conditions, and preventing environmental impacts.

Overall responsibility for the EHS performance of contractor personnel will rest with the Contractor's Site Manager.

The Contractor's Site Manager will be responsible for the effective implementation of the mitigation measures during the project by assigning a competent person in the role of EHS Representative and supervising the execution of this plan.

Each Contractor and Subcontractor shall provide a competent EHS representative designated to NEPC in writing. The competence of the EHS representative a contractor is required to provide shall be dependent of their scope, and agreed by NEPC.

- **Record keeping**

The Contractor will be required to keep all records and documentation required to comply with local regulatory requirements and this plan. Records must be on site, and available for review by NEPC Management.

- **Supervision**

The Contractor will co-operate with instructions from NEPC Site EHS representatives, where these require correction of identified non-compliance with regulatory requirements or this plan.

The Contractor shall assign qualified supervision and Competent Persons to perform work, as required by applicable law and these instructions.

- **Contractor EHS Orientation, Training and Staffing**

The Contractor shall provide employees with the training and orientation necessary to enable them to perform work assignments in a safe manner.

All safety orientation and training courses conducted shall be documented and made available upon request.

The Contractor Site Manager will designate a Competent Person as Site Safety Representative responsible for administration of Contractor site safety activities. NEPC shall have the right to refuse or approve appointed persons based on their competency.

If the Contractor’s work force on the project site is 25 or more (or a lesser number as hazard or regulations dictate), the competent safety representative shall be a full time position.

For Contractors with less than 25 people on site, a competent safety representative must be nominated or designated but need not serve full time in this position.

The contractor may be required to mobilize other EHS specialists to the site for specific tasks needing such support.

- **Contractor EHS Meetings**

Weekly Contractor Supervisor EHS Meetings shall be held by the Contractor Site Manager with supervisors to coordinate related activities among their workers/subcontractor and facilitate EHS training.

Each Contractor Supervisor shall hold a minimum Tool Box EHS Meeting with their workers weekly. Topics discussed should be pertinent to the work being performed and workers shall have the opportunity to ask questions regarding safety. All attendees shall sign the attendance record so that documentation reflects attendees and topics discussed. Records shall be kept at the project.

- **Contractor Program Audits and Inspections**

The Contractor shall inspect their work areas daily for hazardous conditions and environmental risks and take required corrective actions immediately.

The Contractor Site Safety Representative shall conduct a documented weekly inspection of the Contractor's work areas.

HQ EHS Auditors shall have the right to review contractor documentation and work areas, as part of audits carried out at the site.

Audits/Inspections findings will be reported to the Contractor Site Manager for corrective actions to be tracked to closure.

The Contractor Site Manager will be responsible for providing prompt corrective measures to eliminate any and all unsafe acts/conditions as they are reported.

- **Accident Reports and Record keeping**

The Contractor and any subcontractor shall comply fully with the requirement for reporting and investigating accidents and incidents identified in 6.11 above.

The Contractor shall maintain accurate accident and injury reports. Copies of all correspondence related to an accident shall be made available to the NEPC Site Manager or designee upon request.

The Contractor shall complete and forward a Monthly Summary of Occupational Injury and Illness form related to his employees and employees of his subcontractors to the NEPC Site Manager or designee no later than **five calendar days** following the end of each month.

- **PROJECT EHS GUIDELINES**

- **Medical/First Aid**

The NEPC site Manager will ensure that competent medical/first aid care is available to anyone who may be injured in connection with his or her work. Where Emergency Medical Response Services are not immediately (within 15 minutes) available, they will ensure that a suitably trained and equipped medical response service is available during work hours to respond to a medical emergency on the project. (Attachment 7: Emergency Contact List).

The detailed requirements are specified in Medical Plan.

- **Fire Protection**

Fire-fighting equipment (fire truck, hose, nozzles, fire buckets, fire extinguishers) will be available when the project begins.

Fire extinguishers will be provided and maintained at the following locations:

For each 3,000 square feet (278.7 square meters) of a protected building and within 75 feet (22.9 m) of uninterrupted travel

Within 50 feet (15.2 m) of where more than 5 PRC gallons (18.9 L) of flammable or combustible liquids or 5 pounds (2.3 kg) of flammable gases are being used

In open storage yards within 75 feet (22.9 m) of uninterrupted travel

At storage areas for flammable or combustible liquids

At any fuel dispensing or service area

On all motorized equipment

At all locations where electric welding or oxy fuel gas equipment is in use.

NEPC and Contractors shall:

Maintain suitable, (based on assessed risks) fire extinguishers readily accessible for use in all work areas and offices. NEPC Site EHS Manager or other competent persons to review and confirm arrangements are adequate.

Inspect fire extinguishers monthly.

Return used fire extinguishers promptly for recharging.

Train personnel in the use of fire extinguishers.

Keep combustible and flammable materials away from ignition sources.

Maintain clear access to fire apparatus, aisles, traffic lanes, and emergency exits.

Ensure all on site understand the requirements of the emergency preparedness plan and know the location of fire exits.

Prohibit the re-fueling of equipment while it is running or hot.

Provide properly trained and equipped fire response personnel during working hours, to respond to any fire emergency, where sufficient off-site firefighting services are not immediately available. This will require coordination with any off site service to ensure suitable cover is always available.

- **Housekeeping**

NEPC and Contractors shall maintain work areas and walkways clear of obstructions, and the accumulation of tripping hazards, slipping hazards, protruding nails and combustible debris.

NEPC and Contractors shall ensure that workers return tools and equipment to storage facilities at least daily.

NEPC and Contractors shall ensure that workers remove waste and debris from the work area, at least daily, and before it creates a hazard.

Compliance with these requirements should be determined by regular safety inspections.

- **Hot Work**

A Hot work permit system shall be used whenever combustible or flammable, solids, liquids, or gases are present or could reasonably be expected to be present in the area where hot work is conducted. The permit system will be implemented dependant on the assessed risks at the site. For example in the construction phase, where risks are lower, permits could be issued for a period of one week, for an area or building. In the final stages the risks could be assessed such that it is deemed necessary to issue permits for a maximum of one day, and for a specific task.

Hot work permits will be reviewed and signed prior to issue by a competent person who has been approved by NEPC site manager or /NEPV Site EHS manager.

Hot work permits will only be issued when a suitable risk assessment for the task/area has been reviewed and the competent person has confirmed that the control measures on the permit are suitable for the assessed risks. (Attachment 17: Hot Work Permit).

A copy of all hot work permits must be either posted in the work area, or retained by the responsible supervisor in the work area, whenever Hot work covered by the permit is in progress.

Copies of all completed permits will be retained in the Site Safety File by either the Contractor or NEPC.

Supervising and/or carrying out Hot work without a permit shall be a disciplinary offence.

- **Confined Space Entry**

NEPC or contractors shall be required to identify all confined spaces on site, as they are installed/created. All work in confined spaces will be managed in compliance with the Confined Space Entry Management Program incorporated in this Site EHS Plan.

Non-compliance with any aspect of the attached confined space entry procedure shall be a disciplinary offense; workers and supervisors involved will face disciplinary action.

- **Lockout/Tagout**

Prior to first energization on site, the Customer/NEPC/Contractors shall agree which organization's LOTO program shall be implemented at the site. As determined by NEPC EHS, the program selected must provide protection at least equal to the NEPC LOTO Program, a copy of which is incorporated in this Site EHS Plan. The following key elements must be included in any program:

The program must require the use of locks and tags to control energy sources.

The program must be managed by a Competent Person or Persons and inspected weekly.

All affected persons shall receive the appropriate level LOTO training, as defined by the implemented program.

- **Appropriate Attire**

Everyone on site will be required to wear shirts with sleeves at least 4inches (100mm) off the shoulder, long pants/trousers and all PPE identified in section 8.8 below.

- **Personal Protective Equipment (PPE)**

All PPE used at the site shall be in full compliance with the applicable local standard. Where no standard is available, PPE shall be in compliance with an accepted international standard.

All persons entering any NEPC controlled work area shall wear/use:

Safety Helmets. (Metal hard hats are prohibited.)

Safety footwear with toe protection and where required, ankle supports.

Hearing protection will be mandatory in all designated areas and whenever noise levels are greater than 85 dBA. Hearing protection will be made available to all on site who may be exposed to noise. Any risk assessments should consider the requirement to wear hearing protection may mean workers cannot hear audible alarms, and some other form of alarm may be required.

Fall protection equipment, full body harness and two lanyards complete with shock absorbers - 100% tie-off, shall be used whenever a person is exposed to a fall hazard/hazardous condition, where such a fall would be likely to cause injury, and they are not protected by a standard guardrail, or equivalent fall protection system.

Any person who may be exposed to an Arc flash incident shall be required to wear work clothing/PPE based on the risk profile of the maximum Incident Energy from a fault that the person can be exposed to.

Where a possible hand injury is identified in the SRA, suitable gloves will be supplied and must be worn whenever there is an exposure to the risk.

Respirators will be required for persons exposed to hazards by inhalation of fumes, vapors, gases, etc. Respirator selection shall be by competent persons. Persons required to wear respirators shall be trained in how to use, clean and care for the respirators. Where required, persons will be fit tested before being required to wear respirators.

Other PPE will be required, where a requirement is identified by the SRA for the task.

High visible clothing must be worn in all construction areas where required by site requirements.

A competent person from NEPC/Contractor shall confirm all PPE to be used at the site is in compliance with the applicable standard referenced above.

All persons issued with PPE shall be trained in its use and how to care for it.

All PPE that requires regular documented inspection, such as fall protection harnesses, shall be in an inspection program, managed by the user’s employer. As part of safety inspections NEPC/Contractors shall check the implementation of the inspection requirement.

Allowing persons to work without the required PPE, or wear/use inadequate or defective PPE, or PPE that has not been inspected as required will be a disciplinary offence for supervisors/managers.

- **Signs, Signals and Barricades**

All persons on site shall observe and adhere to all warning signs, signals, and barricades.

Supervisors responsible for areas where hazardous conditions exist, or higher risk activities are planned, shall post/erect signs, signals or barricades necessary to advise personnel of the possible hazards.

Signs and warnings shall be in the local language when required and/or use pictograms to communicate hazard.

To uniformly identify particular hazards on the project, a barrier tape identification system will be used. The identification system shall be developed so that any person working on the site, regardless of employer, can recognize and avoid a hazard when properly marked. Any barrier tape identification system used will comply with local rules or regulations. A typical example system is:

Yellow Tape (May have black in it) - “Use Caution when crossing the tape”. Used for open manholes, trenches, excavations, etc.

Red Tape (May have black in it) - “Do Not Cross” unless authorized to do so. Used for open wiring, switchgear, etc.

Yellow and Magenta (Purple) Tape - “Do Not Cross”. Used for possible radiation hazard, x-ray, etc.

The Contractor erecting the barrier or tape shall hang a tag that indicates:

The hazard

Name of Contractor

Name of person erecting the tape

The barrier or tape shall be erected far enough back from the hazard to allow adequate warning and protection from the hazard.

The barrier shall be constructed to withstand adverse weather conditions and construction traffic.

Erection of rigid barricades constructed of wood or similar material shall be considered when excavating next to roadways, sidewalks, driveways, other heavily traveled areas, or whenever site conditions warrant. The NEPC Site EHS Manager shall authorize any deviation from constructing rigid barricades and will approve an alternative means of warning.

If the hazard is of a magnitude, which requires additional protection, it shall be the Contractor's responsibility to provide additional protection.

It will be the responsibility of the Contractor erecting the barrier to maintain it as long as the hazard is present.

It will be the responsibility of the Contractor erecting the barrier to remove it when the hazard condition no longer exists.

- **Scaffolds**

All scaffolding shall be designed, erected, and inspected by competent persons to ensure it is safe for its intended use. At a minimum, the scaffolding will comply with standards and any locally applicable regulations.

All scaffolding shall be erected level, plumb and on a firm base with appropriate feet/mudsills.

Where required, all scaffold platforms must be equipped with a standard 1000m (h) guardrail rigidly secured, standard 500mm (h) mid-rail, completely decked, and fitted with rigidly secured toe boards on all open sides.

Scaffold designs should provide a safe and convenient access to the working level. Working levels must not be accessed, by climbing the scaffold.

A Competent Person shall inspect all scaffolds prior to use daily, to confirm they have been properly erected and not been modified or damaged since erection. Scaffolds should only be used after such inspection has been documented and when a "Competent Scaffold" (Green), or "Warning This Scaffold – Incomplete/Defective" (Red), tag has been attached at a place visible from the access point.

Sal bally and bamboo should not be used for scaffolding and staging.

Incomplete or defective scaffolding shall be tagged accordingly at the point of access and not used. Incomplete or defective scaffolding shall be either repaired, or dismantled as soon as possible.

Alteration of a scaffold via welding, burning, bending, etc. is prohibited.

Riding on mobile scaffolds is prohibited.

- **Ladder Safety**

NEPC and contractor personnel shall use and maintain ladders in a manner that complies with regulatory, NEPC and site requirements. NEPC and contractor personnel shall:

Use ladders or stairways for access to elevated work areas.

Not use site constructed ladders unless authorized by the NEPC Site EHS manager to do so.

Inspect ladders before each use. Ladders that fail inspection shall be immediately withdrawn from service, tagged out, and either repaired or destroyed.

Use fiberglass or wooden ladders for work near electrical equipment and always verify that the ladder type to be used is compatible with hazards and the environment.

Use ladders with rungs, cleats and steps that are:

Parallel, level and uniform

Spaced 300mm apart maximum, or country equivalent

2cm in diameter if metal and 3cm in diameter if wood

Knurled, dimpled or coated with skid-resistant material if metal

Free of grease, oil, dirt and other foreign material

Place ladders only on stable, firm and level surfaces that can support both the ladder and the load, secure ladders at the top or ‘foot’ at the bottom to prevent accidental displacement, and where required, use a barricade to keep activities or traffic away.

Ensure ladders used to access an elevated area, extend at least 1m above the step off level.

Use ladders with three limbs in contact with the ladder, center of gravity kept between rungs, body facing forward at all times, and hands and footwear that are free of grease, oil and mud. No tools or equipment shall be carried while climbing or descending ladders. Hand lines or tool pouches shall be used to raise or lower material.

Not use ladders to support more than one individual at a time (unless specifically designed to accommodate multiple persons), load ladders beyond the maximum intended load or manufacturer’s specifications; paint, tie, splice or fasten ladders together to create longer sections (unless specifically designed); or use ladders in a horizontal position as runways or scaffolds.

Store ladders in areas that are designated and prevent or minimize ladder deterioration.

- **Elevated Work Areas**

All elevated work areas shall be provided with standard guardrails or equivalent protection, or those persons exposed to a fall hazard that could cause injury required to access such areas, will be required to wear suitable personal fall protection.

Safe and convenient access and egress to such elevated work areas shall be provided.

Any holes or openings that may present a fall risk to persons on site shall be either barricaded or covered by materials capable of supporting the weight of any traffic, vehicle or pedestrian, that may access the area. Barricades or coverings shall be clearly signed to show the fall hazard, using either pictograms or warning signs in languages person on site can understand.

Aerial platforms shall be inspected prior to use (Attachment 25: Aerial Platform Inspection).

- **Crane and Motorized Equipment Operation (Including powered access platforms)**

Only qualified and authorized operators shall be permitted to operate cranes and motorized equipment. The Contractor shall make available, upon request, documentation supporting operator's qualifications.

All cranes and motorized equipment shall be operated within the manufacturer's specifications and limitations.

All cranes and motorized equipment shall be operated with a banksman/signalman to provide signals and/or instructions to the driver.

All motorized equipment shall be fitted with Roll Over Protection (ROPS) around the operator's position when there is a risk of overturning, and such equipment can be installed. Seatbelts shall be used when fitted.

Cranes fitted with Outrigger legs, shall have these fully extended, and where required, have mudsills in place, before any lifting operations.

NEPC/contractors shall ensure that any relevant information related to the safe operation of a crane, such as operating speeds, load rating, special hazard warnings, or instructions, are clearly posted on, or if not practicable, in the immediate vicinity of the crane.

The following general requirements will be applicable to all lifting operations:

Only Competent Person(s) shall be permitted to rig loads.

Exclusion zones will be established around lifting operations.

Loads shall never be lifted over personnel; if required, areas will be cleared to allow safe lifting operations. Tag lines will be used to remove the requirement for persons to be under loads.

Lift plans shall be completed by a Competent Person and submitted to the Site EHS Representative for review. Lift plans shall be developed for lifts, which meet any of the following criteria:

Lifts using more than one crane

Lifts greater than 70% of the crane's capacity

Lifts that are large or awkward in shape or that would have a tendency to act as a "sail".

Crane operations that require cranes to operate close to, or pass below, overhead power lines

All lifting operations shall be planned and carried out in such a way that no part of a crane or load passes within the safe approach distances of energized cables or conductors.

The wind speed shall be monitored during all lifting operations. The crane driver or lift supervisor will have the right to stop lifting activities when the wind speed is greater that the safe operating specification of the crane.

Where slings or lifting attachments are required to pass around or over sharp corners on a load, padding or softeners will be used between the load and the slings.

No vehicle on site shall leave its engine running when not in use.

Operators shall remove keys from vehicles and equipment when they exit the cab, to prevent unauthorized use.

Persons in the basket of Powered access equipment shall at all times wear a fall protection harness that is attached to an anchor point in the basket.

NEPC and contractor personnel shall not operate any installed overhead gantry or Goliath cranes unless the test certificate for the crane has been checked to ensure the crane is tested.

NEPC and contractor personnel shall not operate any installed overhead gantry or Goliath cranes unless they have the required training to operate that crane in that country/region, and the owner of the crane has given written authorization.

- **Crane and Motorized Equipment Inspections**

A competent person shall inspect all cranes and motorized equipment at the beginning of each shift to ensure all parts, equipment and accessories that affect the safe operation are operating as designed. These inspections shall be documented using the applicable Attachments (Attachment 22: Daily Crane Inspection or Attachment 24: Overhead Crane Daily Inspection).

NEPC/Contractors shall ensure that cranes and rigging to be employed have been inspected in accordance with regulatory requirements. In addition, cranes and rigging shall be visually inspected prior to each use. Cranes with deficiencies shall not be used until the deficiencies have been corrected; rigging with deficiencies shall be removed from service immediately.

A Competent Person must conduct and document a monthly crane inspection. Certification and other test/inspection documentation must be available for review upon request. (Attachment 23: Overhead Crane Monthly Crane Inspection).

Annual crane inspections must be conducted by a qualified and approved organization and must be documented. Certification and other test/inspection documentation must be available for review upon request. (Attachment 21: Annual Crane Inspection)

Any deficiencies affecting safe operation must be corrected before the equipment is placed in service.

- **Crane Suspended Personnel Platforms**

The use of a crane or derrick to hoist employees on a personnel platform is only permitted when no other system of gaining access to the work area is possible, or would create a higher risk. For instances requiring the use of a personnel platform, a permit system will be used and the task supervised by a Competent Person to safeguard personnel while working in a crane suspended work platform.

Where a crane suspended personnel basket is used, a safe work procedure including a SRA must be produced and reviewed by the competent person issuing the permit. All work using crane suspended Personnel Platforms must comply with applicable local regulatory requirements.

Personnel in a crane suspended platform shall wear fall protection harnesses and attach a lanyard to the hook of the hoisting device.

All crane suspended personnel platforms shall be inspected and tested. Test certificates shall be available for review, and they shall reference a unique identifier or serial number that is clearly identified on all crane suspended platforms.

The safe working load or capacity shall be clearly identified on the platform.

The crane driver shall remain at the controls, and in contact with the person directing the left whenever persons are suspended from the hook of the crane.

The Site EHS Representative, where authorized, or the NEPC EHS HQ Manager will review any use of crane suspended personnel platforms.

- **Fall Protection**

NEPC and contractors shall ensure that fall hazards are considered in all risk assessments for work at the site. When identifying control measures for fall hazards, the hierarchy of control shall be used, starting with elimination, control and only considering PPE on its own as the last option. PPE may be used to support other control measures.

NEPC and contractors shall ensure that all persons required to access areas where they are exposed to a fall risk that is not controlled by a guardrail system, are required to wear personal fall protection.

All persons required to wear fall protection harnesses shall receive training in the use and care of the harness before being permitted to use such equipment.

Fall hazard training shall be provided to all employees working at heights. This training shall include recognition of fall hazards, installation and use of fall protection systems, and means to prevent falls through floor/roof openings. Qualified persons shall conduct all training.

All harnesses and lanyards shall be inspected at least annually, and more frequently if required by local regulations. Site EHS Manager will confirm requirements. (Attachment 27: Fall Protection Equipment Monthly Inspection)

Persons using fall protection harnesses must be provided with two lanyards and a suitable anchor system or point. 100% tie off is required whenever a person is exposed to an uncontrolled fall hazard. Where running lines are installed, competent persons shall inspect them, to ensure they will provide the required protection.

Failure to wear and attach fall protection equipment to a suitable anchor point will be a disciplinary offence that may result in immediate removal from the site. Supervisors who permit or instruct workers to work in areas that expose them to a fall hazard, without fall protection equipment, shall also be subject to disciplinary procedure, up to removal from site.

- **Equipment Inspections**

All tools, electrical cords, welding leads, fork trucks and rigging equipment shall be inspected for safety defects prior to use. Fork truck inspections shall be documented (Attachment 28: Daily Forklift Inspection).

Damaged or unsafe tools, electrical cords, fork trucks or rigging equipment, shall be immediately removed from service and marked/labeled to identify its status. All such equipment will be quarantined until it is either repaired or disposed off, to prevent its use.

Tools, electrical cords and welding leads shall be thoroughly inspected and tested as appropriate on a quarterly basis. Rigging equipment (Attachment 29: Monthly Rigging Inspection and Attachment 26: Come-along Chain-falls Monthly Inspection) shall be inspected monthly. Inspection shall be documented using tags, color codes, logs, or other means to indicate that the equipment has been inspected.

- **Compressed Gas Cylinders**

Before any gas cylinders are brought on site, a suitable storage facility shall be erected. This will enable full and empty cylinders to be segregated. It will also segregate fuel gas and oxygen cylinders. These must either be separated by a solid wall, or by 6m, (20 feet) distance.

Storage facilities must be clearly labeled in languages understood by all using the facility, with signs to show hazard and any other restrictions such as smoking.

All gas cylinders must be stored and transported in the upright position, and at all times secured to prevent them from falling.

Safety caps shall be fitted to all cylinders when not in use.

Hoses on fuel and oxygen gases shall be fitted with flashback arrestors.

Flush back arrester to be provided with the gas cutting sets.

All fittings on hoses shall be secured by crimped fixings, not screw type hose clips.

Hoses, fittings, gauges and torches shall be inspected by the user before use, and by a competent person quarterly. After quarterly inspections, the status of equipment shall be identified by color-coding in compliance with the requirement of the Equipment Inspections section above.

- **Temporary Electrical Power**

NEPC and Contractors will ensure that all Temporary Electrical Power installations on site comply with the following requirements:

All electrical panels will be labeled or marked to identify the circuit and voltage.

All main disconnects shall be clearly identified.

All energized panels shall have all covers in place to ensure that no access to energized conductors is possible.

All temporary wiring shall be protected by using Ground Fault Circuit Interrupters (GFCI) /Residual Current devices (RCD) as part of an Assured Equipment Grounding Program.

Welding earth connection should be with proper cable not with reinforcement bar, flats & angles etc. All the welders working at site should have appropriate qualification / certificate.

Electrical cords, welding leads, and air hoses shall be run either overhead, underneath, or otherwise kept out of walkways, stairs and entry ways to prevent both damage to them, and them becoming a trip hazard.

Any damaged wiring, extension cords, and leads shall be immediately removed from service.

Temporary lighting or wiring shall be protected with appropriate guards. Temporary lights / hand lamps will be equipped with guards to prevent accidental contact with their bulbs. Temporary lights / hand lamps shall not be suspended from their electric cords. Temporary electric lighting used in wet or damp locations shall be operated at a maximum of 12 V dc.

Installation and use of temporary power shall be planned in advance and no supply equipment shall be overloaded.

NEPC and contractors will ensure all temporary electrical generators will be:

Stored and used over secondary containment, unless this is built into the design.

Will be connected to a suitable ground/earthing rod when in use.

Will not be used inside buildings unless the exhaust is ducted out of the building.

Will not be refueled while running.

- **Electrical Safety**

NEPC/Contractor personnel shall ensure that only competent persons perform work with or near electrical equipment, and that they do so in a manner that complies with all regulatory, NEPC Electrical

Safety Procedure, and site requirements. NEPC and Contractor personnel shall:

Never initiate work with or on a piece of equipment until they fully understand the operation and are confident that adequate safety precautions are in place. If there is anything unfamiliar or unclear about the adequacy of the safety precautions in place, the person(s) to perform work shall seek additional guidance from a supervisor or other knowledgeable source.

Not perform electrical switching or other work where they may be exposed to unguarded / uninsulated electrical conductors (even in a de-energized state) unless qualified.

Not approach electrical lines or exposed energized parts of equipment unless qualified. Approach limits for unqualified personnel are:

For electrical lines and equipment energized at 50 kV or less, the distance is 3050mm.

For electrical lines and equipment energized at more than 50 kV, the distance is 3050mm plus 100mm for every 10 kV over 50 kV

Only perform the following work on energized electrical equipment, when qualified and the requirements of NFPA 70e have been assessed and implemented:

Electrical switching

Lockout / Tagout

Selected testing / inspection of selected electrical equipment in accordance with related sections of the Electrical Safety Procedure

NEPC and contractor personnel shall review and comply with all relevant sections of the NEPC Electrical Safety Procedure when undertaking permitted energized electrical work.

NEPC and Contractors will use electrical equipment rated and designed for the environment in which it will be used. Only battery powered electrical equipment shall be used in wet or damp environments. Hands shall not be wet when plugging / unplugging electrical equipment or extension cords. Ground Fault Circuit Interrupters (GFCI) or RCDs shall be used for all electrical tools used in close proximity to wet or damp areas.

and contractors shall keep work areas, walkways and similar locations, clear of extension cords so as not to create a hazard to personnel. Extension cords shall be covered or elevated to protect them from accidental damage. Flexible electric cords shall not be hung with staples or any other devices that could cause damage to the insulation. Flexible electric cords shall not be used for raising or lowering tools or equipment.

NEPC and contractors will only use ladders with non-conductive side rails, when performing electrical work.

- **Industrial Hygiene (IH)**

The requirements for chemical management are detailed in the Chemical Management attachment to this plan. This section covers the personal requirements to protect persons from general exposure to IH issues.

During the construction period, a water treatment and a waste water treatment system shall be deployed to produce qualified drinking water and treat the domestic waste water and industrial waste water to meet the corresponding standards before discharging to the KUSIARA River.

NEPC and contractor personnel shall work in a manner that complies with regulatory, and the site's industrial hygiene standards. NEPC and contractors personnel shall:

Follow local environmental laws during the construction period.

Provide water spraying arrangements to suppress fugitive dust during construction period.

Manage properly the water emitted from construction and rainy water to meet local standard.

Provide rest rooms for workers at suitable area, and nobody is allowed to take lunch/food other than rest room at site.

Provide safety goggles to all the workers as the site is filled with silt which during strong wind may fly and there could be possibilities of eye problem.

Not smoke, eat, drink, or apply makeup in areas where they are engaged in any tasks involving potential chemical exposures.

Thoroughly wash exposed skin (i.e., hands, face and neck) after exiting work areas and before engaging in any non-chemical handling task (i.e., eating, drinking, smoking, etc.).

Use appropriate techniques to minimize heat stress (e.g., increase ventilation, use dehumidifiers, use sun shields, wear well-ventilated clothing, well ventilated PPE (when appropriate) and hats, take rest breaks away from extreme environment, drink plenty of fluids, etc.).

Use anti-vibration tools, anti-vibration gloves, and proper work practices, as appropriate.

Treat blood and other potentially infectious materials in accordance with the Bloodborne Pathogen information in the Emergency Preparedness section of this EHS Plan.

Implement a hearing protection program for any workers who may be exposed to noise above applicable threshold values for the country they are working in, or noise that can cause hearing loss/impairment. This shall include:

A communication program and training for all personnel on site at the site EHS orientation.

Provision of appropriate hearing protection when exposure is possible and supervisory enforcement of the use of such protection.

Administrative controls including job rotation to minimize exposure to high noise levels.

Health screening including audiometry/audiograms for all workers known to be exposed to noise at work above threshold values identified in local standards.

- **Pre Existing Hazardous Material**

NEPC and contractor personnel shall prevent any persons from being exposed to hazardous materials that are found in the work area. NEPC and contractors shall also prevent such materials found from being disturbed and released to the environment. This will include:

Asbestos Containing Material (ACM)

Lead Paint

All suspected materials shall be identified by competent and/or qualified persons to confirm substance constitution and state, prior to the start of any work in the area.

Where it is confirmed any hazardous materials are present in the work area, it will be cordoned off to prevent exposure and any disturbance. NEPC will liaise with the customer to agree on an abatement plan, to make the work area safe, before work is allowed to commence.

- **Demolition**

Before any planned demolition work a Professional Engineer or other Competent Person must perform an engineering survey and establish a demolition plan to determine the condition of structure(s), location of existing utilities (e.g. water, electric, gas, steam, process lines, sewer and storm drainage, etc.), protection, isolation, removal and/or rerouting of such utilities and safe disassembly/demolition sequence.

All demolition work shall be performed in accordance with locally applicable regulations and in accordance with the engineering survey.

Work must only begin after a SRA has been completed and communicated to anyone who could be impacted by the planned activity.

- **Excavations**

The Contractor Supervisor or Competent Person in charge of the work shall determine what is needed to complete a safe excavation job. A soil check should be a prime factor determining whether to shore, slope, or step back and how much of this will be required. A soil check, along with a study of flood level and tidal changes, will also be a factor in determining if a water hazard exists and if a dewatering system is needed.

Portable trench boxes or sliding trench shields may be used for the protection of personnel in lieu of a shoring system or sloping. Where such trench boxes or shields are used, they shall be designed, constructed, and maintained in a manner, which will provide protection equal to or greater than the sheeting or shoring required for the trench.

Prior to excavation, a review of available information shall be made to determine whether underground installations (i.e. sewer, telephone, water, electric, etc.) will be encountered. Utility companies shall be contacted and advised of proposed excavation work prior to the start of actual excavation. Once underground utilities have been installed at the site, a pre dig permit shall be completed prior to excavation. The Pre Dig Permit provided in (Attachment 18: Pre-Dig Permit) may be used for this purpose.

Open excavations shall be barricaded. Walkways, crosswalks, and roadways shall be provided as needed. Bridging, walkways, etc. shall include a standard guardrail.

Additional shoring or protection shall be used when there is a risk of cave-in or fall-in due to a source of vibration or heavy vehicle movements.

Safe access and egress into any trench 1m or more in depth must be provided and maintained as the job progresses. Means of egress (stairway, ladders, ramps, etc.) from the trench excavations shall be located so as to require no more than 8 m lateral travel for employees.

A Competent Person shall inspect excavations daily or more frequently when additional hazards are present. The Excavation Inspection Form (Attachment 19: Excavation Inspection Form) may be used for this purpose. Excavations shall be recorded in the Daily Excavation log. (Attachment 20: Daily Excavation Log).

- **Steel Erection**

NEPC and contractor personnel shall ensure that the steel erector is provided with documentation that footing, piers, and walls have either 75% of the intended minimum compressive design strength or sufficient strength to support loads imposed during steel erection. Information on any repairs, replacements, and modifications to anchor bolts shall also be provided.

SRAs for steel erection shall identify the fall protection measures to be used by all persons exposed to a fall hazard. Fall protection shall be required for all employees working at heights where a fall could cause injury. (Add local regulatory requirements if specific heights are identified.) Fall protection systems shall be installed, inspected, and maintained by a competent person.

NEPC or contractors shall ensure that adequate access roads are maintained and that a firm, properly graded, and drained area readily accessible to the work is provided for storage of materials and operation of equipment.

All hoisting and rigging operations shall be in compliance with section 8.13 above

Working and walking surfaces shall be maintained free of tripping hazards including shear connectors, reinforcing bars, anchors, or threaded studs which may project vertically from beams or other work surfaces.

Temporary decking shall be secured against displacement at the end of the shift or when environmental conditions may cause it to move. Decking shall not be removed until immediately prior to installation of permanent equipment or fixtures.

All materials, equipment and tools used at heights shall be secured from falling when not in use.

- **Ergonomics**

NEPC and contractor management shall require personnel on site to perform work in a manner that complies with NEPC Ergonomics requirements and site ergonomic principles. and contractor personnel shall, whenever practicable:

Eliminate or minimize the effects of undesirable environmental conditions, such as excessive heat, humidity, cold, noise or poor illumination.

Select and use tools and equipment that 'fit' hands and have features designed to control or limit vibration.

Reduce manual lifting/moving of materials to minimum; wherever possible use mechanical aids. If a manual lift/move cannot be avoided, NEPC and contractors shall ensure that SRAs identify safe lifting practices, breaking down loads into smaller items, team lifting, pushing rather than pulling equipment on wheels.

- **Motor Vehicle Safety and Traffic Management**

NEPC and contractor personnel shall operate motor vehicles in a manner that complies with regulatory, NEPC Motor Vehicle Safety policies. NEPC and contractor personnel shall:

Not use site motor vehicles on site unless authorized by the customer or controlling entity to do so.

Not operate a motor vehicle without a valid driver's license; this applies on site as well as public roads.

Comply with all local laws associated with the safe use of motor vehicles.

Wear seat belts when driving or riding in motor vehicles.

Drive motor vehicles defensively and courteously at all times.

Not operate motor vehicles when over-tired, ill, emotionally upset, on medication or under the influence of drugs or alcohol, or any other condition that would impair the ability to drive safely.

Not attempt to read a map or written directions and drive at the same time.

Only receive incoming calls on hands-free phones while operating a motor vehicle. For all other cell-phone use, the driver must stop the vehicle in a place it is safe to do so.

Not program any satellite navigation or other system that distracts driver attention while driving.

Secure equipment and other loose objects in cars, vans and trucks with restraint cords / ropes or other devices. Tools, instruments, heavy books, or other objects shall not be transported on the rear seat or window shelf of a motor vehicle.

Never transport hazardous materials in company-owned, leased or rented vehicles, or personal vehicles.

Report any accident that occurs to the appropriate supervisor and EHS representative immediately. The driver shall contact the appropriate insurance carrier, rental car agency and / or police department, as applicable. All reportable accidents shall be reported and investigated per the NEPC Incident Reporting, Investigation and Follow-Up Program.

All vehicles should have reverse signal alarm not limited to crane or heavy vehicle.

One to three vehicle maintenance and service shops shall be contracted to provide the vehicle maintenance and service at site to the vehicles, equipment and machinery (other than cranes).

NEPC and Contractors shall review the site layout and determine if a site traffic management plan is required.

A traffic management plan should be developed if there will be areas of the site where it can be expected that traffic will be congested, or there is limited space for vehicles and pedestrians to pass safely.

The traffic management plan, where developed, will identify:

Site Speed limits

Restrictions on vehicle movements in some areas or at specific times

'One way' systems

Pickup, drop off areas for worker transportation

Access under overhead power lines

- **X-Ray and Radiography**

NEPC and Contractor personnel shall ensure that all work involving X-Ray or Radiography equipment is carried out in compliance with applicable local regulations and standards and:

Is under the supervision of competent persons who, where required, are licensed for the equipment/task.

Any radioactive sources are stored such that they do not allow anyone to be exposed to the hazard, and with adequate security to prevent theft.

All work using X-Ray and Radiography is carried out in an exclusion zone, so only persons involved in the task are in the area where exposure is possible. Signs shall be fixed to warn persons of the hazard around the exclusion zone.

All work using X-Ray and Radiography is communicated to others on site a minimum of 12 hours before it commences.

- **Precautions for Working in the Turbine Compartment of an Operating Gas Turbine**

A Permit System shall be used to safeguard Personnel while working in the turbine compartment of an operating gas turbine. A copy of the permit shall remain in the work area until the authorized person has verified that all persons have exited the turbine compartment and it is safe to remove the permit.

- **Application of Site Rules**

Any persons on site under the control of NEPC and their contractors, will be subject to being removed from the site, if found violating any Customer or site safety requirement or otherwise engaging in conduct that is likely to cause personal injury, illness or property damage. Contractors shall be solely responsible for the discipline of their subcontractors and employees.

- **Working at Night, or in Areas With Low Natural Light**

Adequate lighting for the work being performed shall be provided for all work activities conducted at night, or in areas with low or no natural light. SRAs shall consider lighting requirements.

Workers in areas with no, or low natural light, where no emergency lighting system is operational, shall be provided with a means of finding a safe egress. This may be personal flashlights.

Adequate lighting shall also be provided for walkways, roadways and parking areas.

All vehicles operated at night shall be equipped with lights.

- **Waste Management**

/NEC and Contractor personnel shall ensure that the site has suitable facilities to manage waste in compliance with local regulations and the requirements of the Environmental Plan included in this EHS Plan. This will require them to:

Ensure adequate waste collection receptacles (bins/dumpsters) are available around the site, and that they are regularly emptied to prevent the uncontrolled accumulation of waste materials.

Ensure hazardous wastes are segregated and hazardous waste is managed.

Ensure all waste is disposed of using licensed waste management companies.

Where facilities are locally available for recycling, require segregation into waste streams that can be recycled. Where this is possible, provide separate waste containers (bins/dumpsters) for each waste stream.

Ensure all waste containers are labeled in languages persons on site can understand, so materials will be placed in the correct container.

Ensure waste management areas have an impervious floor, or other means of containment to prevent any release to the environment.

- **Smoking Policy**

Smoking, if permitted, will be in designated smoking areas with adequate means of cigarette disposal and means to fully extinguish any potential fire source. Smoking will not be permitted in any NEPC office. (Attachment 31: Smoke Free Policy).

- **ATTACHMENTS**

The attachments mentioned in this plan are attached hereafter.

- **Attachment 1: Safety Corrective Action Request**

SAFETY CORRECTIVE ACTION REQUEST

Safety Representative	Date
Site Location	Company

Discrepancy	Action Taken (please initial after each discrepancy)

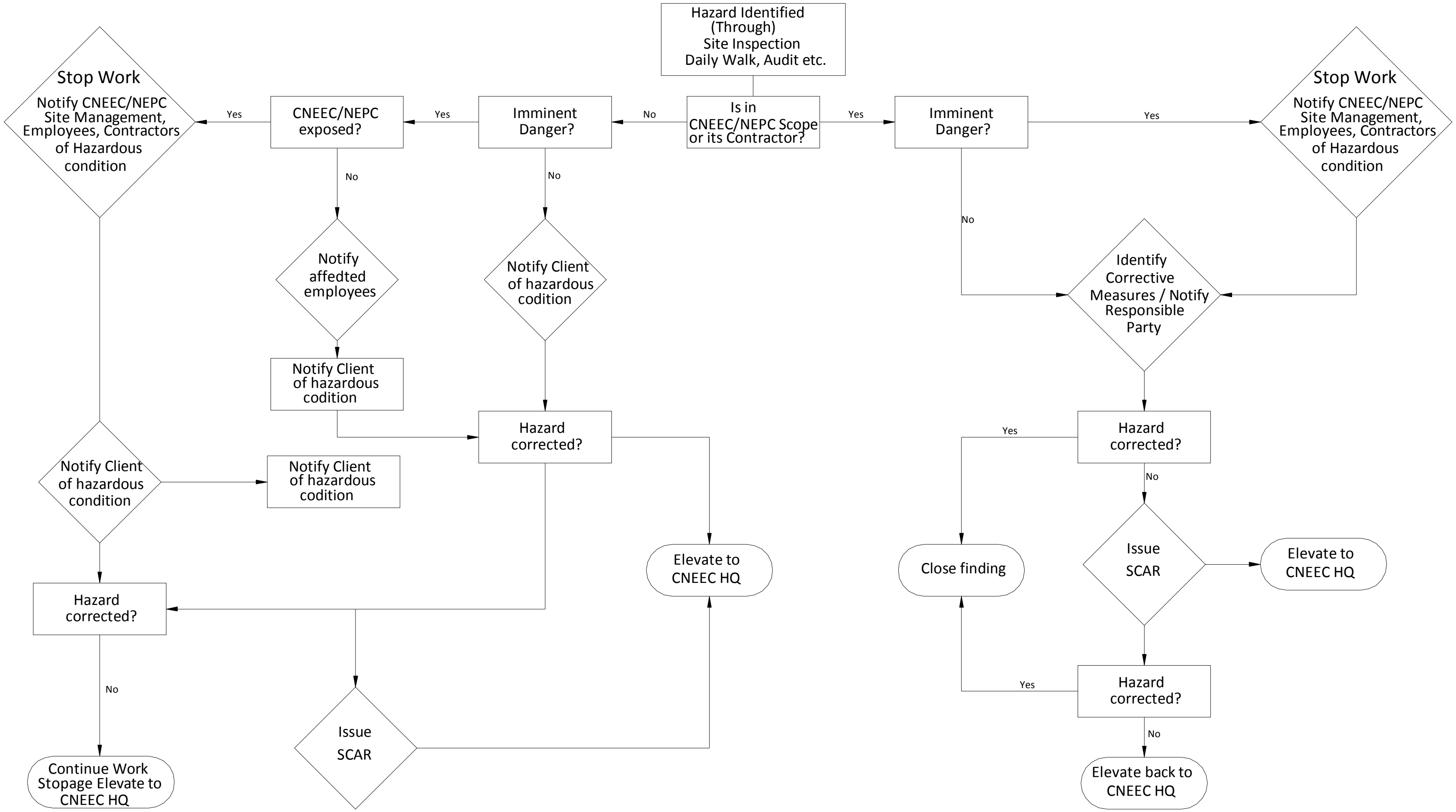
Person Performing Corrective Action Name Title

This copy to be returned to

No later than Calendar days after incident

- Attachment 2 – Project Site Hazard Identification and Notification Process

PROJECT SITE HAZARD IDENTIFICATION AND NOTIFICATION PROCESS



- **Attachment 3: Disciplinary Process**

Written Communication of Infraction

Level II

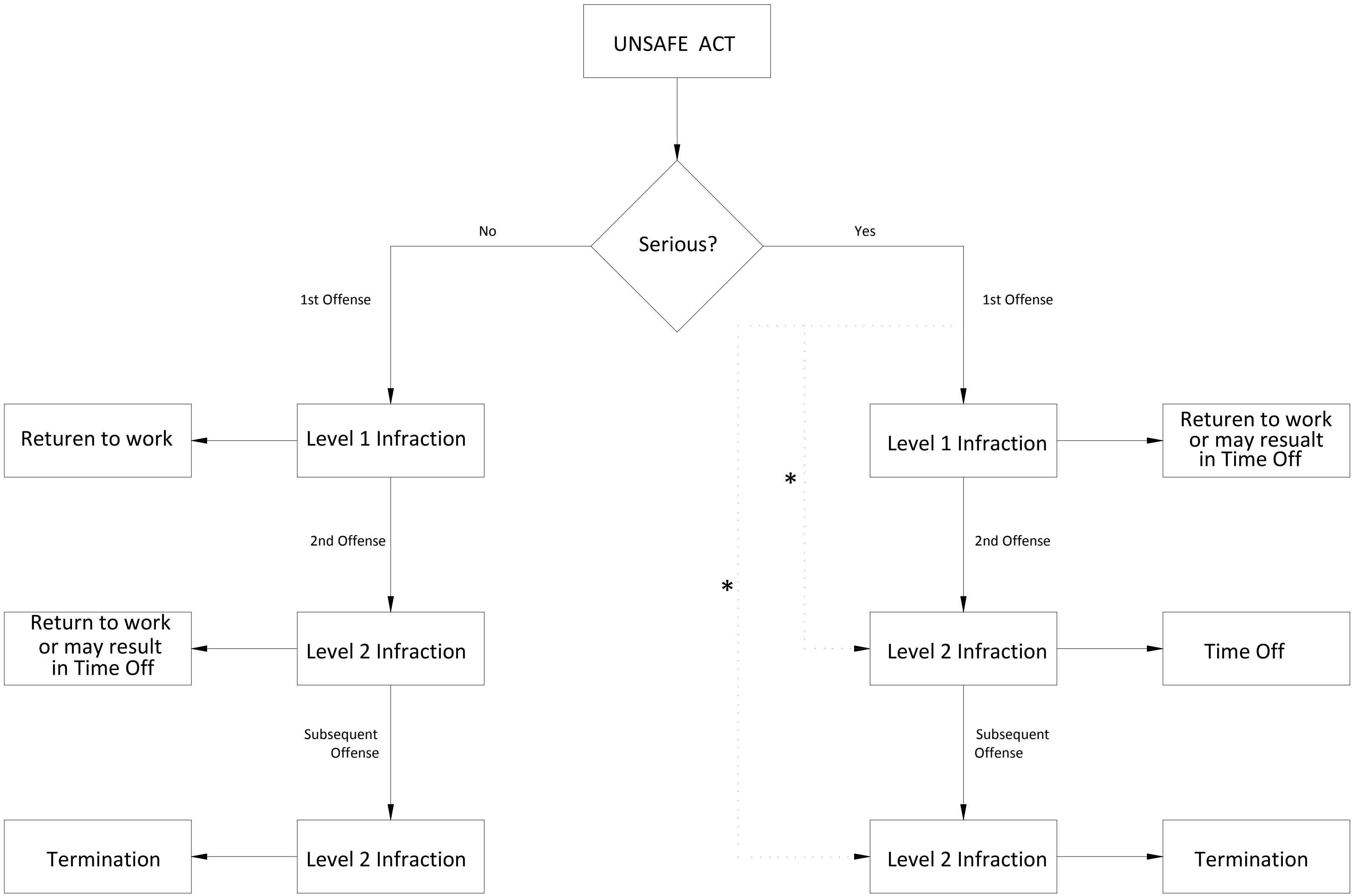
<table>
<tr><td>* Employee’s Name</td><td colspan="2">* Date Of Infraction</td><td colspan="2">* Flowchart of Infraction</td></tr>
<tr><td colspan="5">Ensure the following objectives were achieved. Supervisor’s Checklist:
✧ The counselling was conducted in private
✧ The Compliance Policy was explained to the employee
✧ The action is consistent with established project policy
✧ The employee was informed and understands why the compliance was warranted</td></tr>
<tr><td colspan="2">Has the employee been warned before? Yes No
If yes, how? Verbal Written</td><td colspan="3">By Whom? Date of Warning</td></tr>
<tr><td colspan="5">Reason for this Infraction</td></tr>
<tr><td colspan="5">Specific details of infraction and counselling comments:</td></tr>
<tr><td colspan="3">Supervisor’s Name</td><td colspan="2">Supervisor’s Signature & Date</td></tr>
<tr><td colspan="3">My signature here upon does not necessarily signify my agreement with the above, but attests that I have read and understand the serious nature of this report. A repetition of this action or other acts of a similar nature may result in a more serious corrective action and/or termination of employment</td><td colspan="2">Employee’s Signature & Date</td></tr>
<tr><td colspan="3">✧ Safety Supervisor’s Review & Concurrence
(if required)</td><td colspan="2">Safety Supervisor’s Signature</td></tr>
<tr><td colspan="3">Site Manager’s Review and Concurrence
(if required)</td><td colspan="2">Site Manager’s Signature</td></tr>
</table>

WRITTEN INFRACTION

LEVEL III

Employee's Name	**Date Of Infraction**	**Flowchart of Infraction**
Project Name	Length of Service	Termination Date
Has the employee been warned before? No Yes If yes, how? Verbal Written		By Whom? Date of Warning
Why is the employee being given a Level III Infraction resulting in termination? (Provide details of infraction)		
What Policy/Procedure or other conduct rule has not been adhered to?		
Provide background information concerning any previous Non-compliance / Infraction issued.		
Supervisor's Name	Supervisor's Signature & Date	
Safety Supervisor's Review and Concurrence	Safety Supervisor's Signature	
Site Manager's Review and Concurrence	Site Manager's Signature & Date	

COMPLIANCE PROGRAM FLOW CHART



* REQUIRES CONCURRENCE BY SAFETY SUPERVISOR & SITE MANAGER

Attachment 4 – Site Safety Orientation

SITE SAFETY ORIENTATION

(344.908MW(Net) Gas-Fired Combined Cycle Power Station at Bibiyana II, Bangladesh**)**

General Safety Rules

- NEPC prohibits the unauthorized or illegal possession or use of alcoholic beverages, drugs or other intoxicants at Project site. No person shall be permitted to bring unauthorized or illegal alcoholic beverages, drugs, or other intoxicants onto any location where work is being performed; nor shall any such person be allowed to perform work under the influence of alcoholic beverages, drugs, or other intoxicants.
- Fighting, horseplay, or harassment of any kind will not be allowed. Personal firearms are not allowed on Project site.
- Site Smoking Policy: Smoking, if permitted, will be in designated smoking areas with adequate means of cigarette disposal and means to fully extinguish any potential fire source. Smoking will not be permitted in any NEPC office.
- Site layout including location of washrooms, eating areas, employee's work area.

Housekeeping

- Combustible materials such as oil-soaked and paint-covered rags, waste, packing and other rubbish shall not be allowed to accumulate on the benches, floors, or yards, but shall be stored in areas or receptacles designed for them and appropriately identified.
- Stairways, aisles, exits, walkways, and storage areas shall be kept free of debris and other obstructions. Scrap and waste shall not be allowed to accumulate in the work areas.
- Materials and supplies shall be stored in an orderly, stable manner to prevent their falling, rolling or spreading.
- Floors and platforms shall be kept free of oil, grease, water, and other slippery materials.
- Protruding nails shall be bent over or removed.
- Electrical cords, welding leads, and air hoses shall be run either overhead, underneath, or otherwise kept out of walkways and stairs.

Personal Protective Equipment

- Workers shall wear work gloves suitable for the work to be performed on jobs where gloves will help prevent hand injuries (i.e. handling rough or sharp metal objects).
- Personnel are required to wear approved head protection (Metal hard hats are prohibited). Hard hats shall not be defaced, painted or reshaped. Hard hats shall not be worn reversed with the exception of welders who may reverse their hats in order to use a welding shield.
- Approved protective devices, either muffs, earplugs or both shall be used in high noise exposure areas (>85dB) or as required by local regulations. (General rule - if you cannot talk in a normal voice to someone 3 feet away from you – you need hearing protection).
- Safety glasses equipped with side shields must be worn. Goggles or face shields shall be worn when standard safety glasses with side shields do not provide adequate protection (i.e. when chipping concrete or grinding metal).
- Respiratory Protection will be used where administrative or engineering controls fail to reduce air contaminants within prescribed limits. Where respirators are required, employers shall develop a written respiratory protection program.
- Body harness and lanyard(s) (100% tie-off) shall be used when working in excess of 2 meters:

1. On all stages, floats and any other type of suspended scaffolding.
2. On all scaffolds with incomplete decking.
3. On all scaffolds and platforms without standard guardrails.
4. On sloping roofs.
5. When removing floor planks from last panel in temporary floor.
6. On ladders near edge of floor or roof openings.
7. When placing any tying reinforcing steel in walls, piers or columns.
8. Within 2 meters of floor edges, floor openings and roofs where there are no guardrails or wire rope railings

- Lanyard(s) shall be positioned to prevent a fall of not more than six feet. Body harnesses shall be worn with the D-ring positioned at the back. Prior to each use, a visual inspection of the body harness, and lanyard(s) shall be made.
- Footwear shall be suitable for the environment in which the individual is required to work. When working in areas where there is a danger of foot injuries due to falling or rolling objects or object piercing the sole, approved safety footwear shall be worn. Metatarsal guards shall be worn when working with equipment, which presents a crushing hazard.

Sign, Signals and Barricades

- Post/erect signs, signals or barricades necessary to advise personnel of hazardous conditions in work areas. In order to uniformly identify particular hazards on the project, a barrier tape identification system will be used.

Yellow Tape (May have black in it) - *"Use Caution When Crossing*". Used for open manholes, trenches, excavations, etc.

Red Tape (May have black in it) - *"Do Not Cross" unless authorized to do so.* Used for imminent dangers.

Yellow and Magenta (Purple) Tape - *"Do Not Cross".* Used for possible radiation hazard, x-ray, etc.

- The barrier tape shall be erected far enough back from the hazard to allow adequate warning and protection form the hazard.
- Rigid barricades constructed of wood or similar material shall be erected when excavating next to roadways, sidewalks, driveways, other heavily traveled areas, or whenever site conditions warrant.

Chemical Handling

- All containers containing oil and chemicals must be labeled, tagged, or marked with the following information:

Identity of the Material

Appropriate Hazard Warnings

Name and Address of the Manufacturer

- All Oil or Chemical storage areas shall be provided with containment and protected from the elements using a roof, tarp, or approved hazardous material storage cabinet.
- Chemicals must be segregated by their hazard characteristics, classification, and compatibility. The area will be well defined and labeled.
- Storage of chemicals at the point of use will be limited to those amounts necessary for one operation or shift. Containers in-use will be properly labeled and of minimum size.

Emergency Procedures

- All site employees must be trained on site-specific emergency procedures. This training shall include the following:

o Alarms and other emergency communications used both at the site and at the customer/host facility as applicable.

o Evacuation procedures including routes and assembly areas to be used.

- o All occupational injuries or illnesses must be reported immediately. Unless the injury requires immediate transportation for medical treatment, the employee should immediately report the injury to his or her supervisor and then report to the project first aid designee.
- o Location of first-aid kits and identification of first-aid providers.
- o Report ALL spills to your supervisor immediately. If safe to do so, prevent further spillage, but don't begin cleanup until directed to do so.

Fire Protection

- Flammable liquids shall be used only in small amounts in approved; self-closing safety cans and shall be stored in approved flammable liquid cabinets.
- "NO SMOKING" signs shall be posted where appropriate and will be strictly observed.
- Access to fire extinguishers and other fire fighting equipment must not be obstructed.
- Fire extinguishers shall be inspected at least monthly and shall be maintained fully charged.
- A Hot Work Permit shall be issued before welding or cutting in close proximity to flammable and combustible material.

Lockout and Tagout

- Machines or equipment are to be isolated from all potentially hazardous energy, and locked out and tagged out before employees perform any servicing or maintenance activities where the unexpected energization, start-up, or release of stored energy could cause injury. Employees shall adhere to the requirements of the Company's Lockout and Tagout Program.

Confined Space Entry

- Employees shall adhere to the requirements of the Company's Confined Space Entry Program. (Confined spaces include tanks, vessels, enclosures with limited access such as hatchways and manholes) All confined spaces shall be posted. An entry permit shall be issued only after sampling is complete. Sampling must be for oxygen, combustible gases and toxics. Sampling must be done by a trained person with knowledge of the testing equipment being used. This permit must be signed prior to entry. A new permit is required at the beginning of each shift. No entry permit shall be issued if the oxygen content is less then 19.5% or greater than 23.5%, or combustibility is above 10% of the Lower Explosive Level (LEL).

Excavation, Trenching, and Shoring

- Open excavations shall be barricaded.
- Walkways, crosswalks, and roadways shall be provided as needed. Bridging, walkways, etc. shall include standard guardrails.
- Excavations must be properly shored, shielded, sloped to the angle of the repose, stepped back, or otherwise supported to eliminate possible exposure to cave in. No one is to enter such excavation until this has been done.
- The edges of excavations shall be cleared back at least two feet to ensure that soil piles and other items will not fall into the trench.
- Proper access into any trench 4 feet or more in depth must be provided and maintained as the job progresses. Access shall be located to ensure no more than 25 feet of lateral travel.
- All protruding rebar onto which an employee could fall, shall be guarded to prevent the hazard of impalement.

- **Motor Vehicles**

- Site Speed limit is 15 kg/h.
- Where provided, all occupants shall properly fasten their safety belts before vehicles are operated.
- The driver is responsible for checking to ensure that passengers are safely in the vehicle.
- Operators of vehicles shall have a valid driver's license and shall comply with applicable motor vehicle laws and highway rules and regulations.
- A signalman or guide shall be used when backing up whenever there is an obstructed view.
- Vehicles operating outside of daylight hours shall be equipped with lights.
- The driver should not use a mobile phone while driving unless a hands free device is used.

- **Mechanized Equipment**

- All vehicles in use shall be checked at the beginning of each shift to ensure that parts, equipment, and accessories that effect safe operation are in proper operating condition and free from defects. All defects shall be corrected before the vehicle is placed in service.
- Safety belts shall be fastened before equipment is operated.
- Heavy earth moving equipment shall be equipped with a reverse signal alarm, which will operate automatically with backward movement. The alarm shall give an audible signal suitable for the conditions.
- Flagmen shall be provided with or shall wear a red or orange warning garment while flagging. Warning garments worn at night shall be reflective.

- Only competent personnel who have been trained in the safe operation of specific mechanized equipment (i.e. forklifts) shall be allowed to operate such equipment.

- **Cranes**

- Only trained and qualified operators shall operate cranes. Cranes must have current annual and monthly inspections available.
- Equipment shall be inspected before each use and all deficiencies corrected, prior to operation.
- Areas within the swing radius of the revolving superstructure shall be barricaded.
- No part of a crane or its load shall be operated within 3m of a line rated 50 kV or below.
- For lines over 50 kV, add 1m for each additional kV.
- Tag lines shall be used to control loads.
- Safety latches shall be provided on all crane hooks.
- Cranes shall be moved only when directed by a signal man.
- Whenever possible, the boom shall be lowered to the ground when the machine is stored overnight or for extended periods of time.
- Operators shall not leave the machine while a load is suspended.
- Loads shall not be suspended over any person or occupied buildings.
- Outriggers on cranes shall be fully extended.
- Mudsills shall be used when the crane is placed on unstable or uneven surfaces such as earth, mud or asphalt.

- **Rigging, Hoisting and Jacking**

- Prior to initial use and on a daily basis, all rigging equipment shall be inspected and defective equipment removed from service immediately.
- Do not load rigging equipment in excess of its recommended safe working load.
- Rigging equipment shall be properly stored at the end of each work shift.
- Slings shall be protected from sharp edges.

- **Fall Protection**

- All surfaces on which employees may walk or work must have the structural integrity to safely support the workers and the materials, which are placed upon the surface.

- Fall protection is required whenever employees are exposed to height above 1.5m, or employees are exposed to falls into dangerous equipment or other hazards.
- Guardrail Systems shall consist of top rails and midrails or the equivalent. Typically guardrails are constructed of lumber or tubular steel.
- Only commercially purchased full Body Harnesses with locking Snap Hooks and Deceleration Devices shall be used. Safety belts shall not be used for fall arrest.
- Lifelines shall be designed, installed, and used under the supervision of a Qualified Person. The system shall maintain a safety factor of at least two. When vertical Lifelines are used, each employee shall be attached to a separate lifeline.
- Anchorage points shall be capable of supporting at least 5,000 pounds per person.
- When used as a warning line system, ropes, chains, wires, and stanchions shall be erected not less than 2m from the Roof edge and flagged with high visibility material at intervals not exceeding 2m No employee shall be permitted in the area between the roof edge and the warning line unless the employee is performing work in that area.
- Falling object protection must be provided when a hazard is or may be present. When Toe boards are used for falling object protection, they shall be at least 120mm high. When tools, equipment, or materials are piled higher than the Toe board, paneling or screening shall be installed for a sufficient distance to protect workers below.
- Floor openings shall be securely protected through use of a secured guardrail or cover. If a cover is used, it shall be secured and identified. Also, it shall be of sufficient strength (2x the intended load) to support personnel or material that may pass over it.
- Aerial lifts shall be operated in accordance with manufacturer's requirements. Tie-Off of personnel in aerial lifts is mandatory. The employee must tie-off before operating the aerial lift.

- **Scaffolding**

- Scaffolds shall be erected on firm foundations. The footing or anchorage shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement.
- Guardrails and toe boards shall be installed on all open sides and the ends of platforms more than ten 3m above the ground floor. Scaffolds 1.2m to 3m having horizontal dimension in either direction shall have standard guardrails on all open sides.
- Working platforms shall be capable of sustaining 4 times the maximum working load required.
- Stationary scaffolds shall be secured to a fixed structure every 8m vertically and every 10m horizontally.

- Proper access to scaffold platforms shall be provided. Framework shall not be used to ascend or descend scaffolding.
- Scaffolds shall be erected only by competent personnel
- Prior to use, the supervisor responsible for erection of a scaffold shall verify that it has been properly erected and attach a "Complete Scaffold" (Green), a "Warning This Scaffold Incomplete/Damaged - Safety Required" (Red), or a "Caution – 100% Tie-Off Required" (Yellow) tag as indicated by the inspection.

- **Ladders**

- The side rails of a ladder shall extend 1m above the landing.
- Portable metal ladders shall not be used for electrical work or where they may contact electrical conductors.
- No one shall use a straight or extension ladder unless the ladder is provided with safety feet and is held, tied or otherwise made secure to prevent slipping or falling.
- The person shall face the ladder and use both hands for support when ascending or descending. A person's feet shall never be placed higher than the third rung from the top of the ladder, unless the ladder is placed against a structure which affords a support that can be used for holding onto with the hands.
- A stepladder shall be used in the open position. It shall be opened fully and locked. Personnel shall not stand on the top board of any stepladder.
- The use of ladders with broken or missing rungs or steps, broken or split side rails, or other faulty construction is prohibited.

- **Hand Tools, Electric Power Tools, and Extension Cords**

- All tools shall be kept in good repair, used only for the purpose for which they are designed, and stored in a safe manner.
- Electric extension cords for general maintenance work, as well as for portable electric power tools, shall be flexible, heavy-duty, reinforced, sheathed with rubber or equivalent, and in good condition.
- Electric extension cords shall not be used for permanent installations.
-

- **Welding and Burning Operations**

- Personnel using gas-welding equipment shall inspect acetylene/oxygen bottles, hoses, and regulators prior to each use.

- When burning or welding, approved eye protection with suitable filter lenses shall be worn. Approved eye protection shall be worn under welding shields.
- The welder shall be in a screened area, which permits adequate ventilation at floor level. Workers or other persons adjacent to the welding areas shall be protected from the rays by flameproof screens/shields or they shall be required to wear eye protection.
- A fire watch with a suitable fire extinguisher shall be assigned to all burning and welding operations in any area that contains combustible or flammable material. The fire watch shall remain in place for 30 minutes after welding and burning has been completed.
- An approved fire extinguisher shall be available in the immediate area where welding is being conducted. When welding or burning in areas where there are large amounts of combustible or flammable materials, additional extinguishers shall be provided.
- When burning, welding, or cutting in poorly ventilated places, mechanical ventilation and/or respiratory protection shall be used and operators shall be under close observation by another person who is not exposed to the hazard. Entry into any confined spaces must be done in compliance with the Company's Confined Space Entry Program.

- **Compressed Air and Gases**

- Cylinders shall be secured in an upright position. Valve protection caps shall be in place when cylinders are not in use.
- When cylinders are hoisted, they shall be secured on a cradle or sling board. They shall not be hoisted by means of choke slings or magnets.
- Cylinders containing oxygen, acetylene, or other fuel gas shall not be taken into confined spaces.
- All compressed gas cylinders shall be considered explosive and shall be handled with care.
- Cylinders may be stored in the open but should be protected to prevent rusting. Cylinders may be stored in the open or other locations but not exposed to temperatures above 50°C.

- **Electrical**

- Electrical panel boxes shall be marked to identify the circuit and the voltage. Substantial covers, either manufactured metal covers, plywood, or equivalent shall be in place on any energized panel box.
- Temporary lighting shall be strung a minimum of seven (7') feet from the floor where possible. Bulb guards or shatterproof bulbs shall be used.
- Temporary electrical wiring on extension cords shall be covered or elevated to protect them from damage.

- Each cord set and related attachments shall be visually inspected by the user before each day's use. Equipment found damaged or defective shall not be used until repaired.
- All 15 and 20 amp receptacle outlets on single-phase circuits for construction projects shall be equipped with approved ground fault circuit interrupters (G.F.C.I.'s).
- All 120 volt, single phase 15 and 20-ampere receptacles shall be of a grounding type, and their grounding contacts shall be grounded by connection to the equipment grounding conductors of the circuit supplying the receptacles.
- All 120-volt extension cords shall have an equipment-grounding conductor, which shall be connected to the grounding contacts of the connector(s) on each end of the cord.

- **Temporary Heaters**

- Heaters used in the vicinity of combustible tarpaulins, canvas, or similar coverings shall be located at least 10 feet from the coverings. The coverings shall be securely fastened to prevent ignition or upsetting of the heater due to wind action on the covering or other material.
- Flammable liquid-fired heaters shall be equipped with a primary safety control to stop the flow of fuel in the event of flame failure. Barometric or gravity oil feed shall not be considered a primary safety control.

- **Program Compliance/Disciplinary Policy**

- Failure to comply with any part of the Project Safety Program will not be tolerated. Employees who are discharged from the project site for noncompliance with the Project Safety Program will not be eligible for re-employment on the project.
- When an unsafe act is observed, the person observing has the responsibility to stop the unsafe act and initiate the Compliance process if deemed necessary. The First Line Supervisor has primary responsibility for administering the Compliance action to his crewmembers.

a. First Infraction

This is an oral communication between Supervisor and Employee where the first infraction is identified and corrective action and coaching is provided to the employee. The Supervisor will document this first incident.

b. Second Infraction

This is a written communication given by a Supervisor to an Employee who had previously been given a verbal warning. The supervisor shall identify the safety infraction and provide coaching toward desired corrective action with the employee. Documentation of this incident is mandated, requiring the signature of the employee. This step may result in *"Time Off"* for the affected employee.

c. Third Infraction ---

This is the final written communication given by a Supervisor to an employee who had previously been given a verbal and written warning. The supervisor identifies the safety infraction and the employee is given severance of employment. Documentation of this incident is required and will not require the signature of the Employee. This step may result in permanent removal from the site.

d. Serious Infraction

Supervision may issue a written warning for a first infraction if the seriousness of the infraction warrants this action. Serious infractions may result in permanent removal from the site.

EMPLOYEE ORIENTATION AND EMPLOYMENT RULES ACKNOWLEDGEMENT FORM

PROJECT NAME ________________________________

NAME (Print)_____________________________________

DATE ____

EMPLOYEE ID NUMBER __________________________

EMPLOYEE SIGNATURE _________________________

WITNESSED BY _________________________________

REPRESENTING ________________________________

Attachment 5 – MOM of Environment, Health and Safety Meeting

MOM OF Environment, Health and Safety Meeting

Project / Facility: **Date:**

Meeting Led By: **Duration**:

Agenda/Topics Covered

IN ATTENDANCE: (Copy to Each, if Desired)

(Print Name)	*(Sign Name)*	*(Company)*

SUGGESTED FORMAT:

I. Review of Related Safety Topics - Attach Suggested Safety Talk

II. Review of Corrective Status of Outstanding Items

III. Comments by Participants - Assign Corrective Action Required

IV. Schedule of Next Safety Meeting

- **Attachment 6 – Weekly Inspection Checklist**

WEEKLY SITE INSPECTION CHECKLIST

		INSPECTION BY:	**CHECK**
CUSTOMER	____________	SITE REPRESENTATIVE	____________
SITE ADDRESS	____________	SERVICE SUPERVISOR	____________
	____________	OPERATIONS MANAGER	____________
	____________	SERVICE MANAGER	____________
SITE SAFETY REP	____________	OTHER - (Specify)	____________
DESCRIPTION OF JOB	____________	DISTRICT	____________
INSPECTOR SIGNATURE	____________	FSR NO.	____________
DATE INSPECTED	____________	WORK CODE	____________
REVIEWED BY	____________	JOB START DATE	____________
DATE REVIEWED		SCHEDULED END DATE	

Status Codes: Y - Yes, N - No, N/A - Not Applicable

	COMMUNICATION	**STATUS**		**DATE CORRECTED / COMMENTS**
1.	Jobsite Safety Planning Guide or equivalent used on this job?			

2.	Corrective Action Items on previous safety inspection(s) corrected by responsible parties?			
3.	Results of this inspection reviewed with NEPC employees at site?			
4.	Corrective Action Items on this report assigned to a responsible party for resolution?			
5.	EHS (or other required) regulatory poster displayed so it can be easily recognized?			
6.	Fire department, ambulance, hospital, and physician phone numbers posted?			
PERSONAL SERVICES		**STATUS**		**DATE CORRECTED / COMMENTS**
1.	Person(s) trained in first aid on site?			
2.	First aid kit(s) available and inspected weekly?			
3.	Potable water available, with fountain or disposable cups?			
4.	Proper sanitation facilities available, kept clean, and adequately supplied?			
GENERAL		**STATUS**		**DATE CORRECTED / COMMENTS**
1.	Hard hats worn where there is danger of head injury?			
2.	Safety glasses worn by all NEPC employees when required?			
3.	Hearing protection available and used when needed?			
4.	Other personal protective equipment, such as respirators, used when required by job conditions (such as working with asbestos)?			

5.	Safety tags used by NEPC to indicate "DANGER - DO NOT OPERATE" situations?			
6.	Potentially hazardous toxic substances used, handled, and disposed of properly to prevent employee exposure or environmental contamination in excess of limits?			
FIRE PROTECTION		**STATUS**		**DATE CORRECTED / COMMENTS**
1.	Access to fire plugs, standpipes, etc., clear and equipment in good condition?			
2.	All fire extinguisher stations plainly marked and clear for quick access?			
3.	All fire extinguishers properly mounted, and marked for type of fire to be used on?			
4.	Fire extinguishers periodically inspected, maintained, and tagged?			
5.	Travel distance to nearest fire extinguisher does not exceed 100 feet/18m?			
6.	One fire extinguisher per 3,000 square feet of protected building area?			
7.	Fire escapes and exits clear and plainly marked?			
8.	Approved metal safety containers, marked as to contents, used for more than one gallon of flammable or combustible liquids?			
9.	All flammable liquid supplies are kept in sealed containers away from work area?			
10.	Bulk flammable liquid containers (drums, tanks, etc.) are electrically bonded together and grounded?			

11.	Containers are bonded when transferring flammable liquids?			
12.	All loose oily rags and waste removed from area or stored in proper covered containers?			
13.	All trash and combustible material removed from premises as necessary?			
14.	Welding/cutting operations conducted in safe manner, with portable fire extinguisher immediately available?			
15.	Smoking areas designated?			
16.	Temporary heating devices properly installed and used?			
17.	Solid fuel salamanders prohibited in building and on scaffolds?			
18.	Temporary buildings, when located within another building or structure, are either of noncombustible construction or of combustible construction have a fire rating of not less than one hour?			
ELECTRICAL HAZARDS		**STATUS**		**DATE CORRECTED / COMMENTS**
1.	115V ac 15- and 20-ampere receptacle outlets are of the grounding type with grounds connected?			
2.	All temporary 120V single phase 15- and 20-ampere receptacle outlets, including extension cords, provided with ground fault protection, such as ground-fault circuit interrupters?			
3.	Covers installed on all outlets, switches, junction boxes, pullboxes, panel boards, etc.,			

	that are in service?			
4.	All circuits identified at panel board?			
5.	Extension cords used are all three-wire type (including any used with double insulated tools)?			
6.	Extension cords and drop lights in good condition (not frayed, broken)?			
7.	Extension cords and other temporary wiring protected from damage and arranged so as not to create tripping hazards?			
8.	Temporary lights equipped with guards to prevent accidental contact with the bulb?			
ELECTRICAL HAZARDS CONTINUED		**STATUS**		**DATE CORRECTED / COMMENTS**
9.	Portable electric lighting used in moist and/or other hazardous locations (e.g., drums, tanks and vessels) is operated at a maximum of 12 volts?			
10.	All metallic structures, and the non-current-carrying metal parts of fixed, portable, and/or plug connected electrical equipment (other than double insulated) are grounded?			
11.	Metal ladders not used around electrical equipment?			
12.	All work on electrical equipment done in accordance with electrical safety procedures required by the NEPC EHS Manuals?			
13.	Tagging and lockout procedures used in accordance with policies and procedures?			

14.	Warning signs posted where any part of an energized electric power circuit, exposed or concealed, is so located that the performance of the work may bring any person, tool, or matching into physical or electrical contact with it?			
15.	Temporary barricades used in accordance with procedures?			

HAND AND POWER TOOLS		**STATUS**		**DATE CORRECTED / COMMENTS**
1.	All tools (Company and personal) in safe condition?			
2.	Guards used on all power tools designed for use with guards?			
3.	Moving parts, such as belt or chain drives, and gears, pulleys, shafts, couplings, etc., including temporary set-ups, guarded?			
4.	All portable electric power tools either grounded or double insulated?			
5.	Unguarded wheels on portable grinders limited to two-inch diameter, or less?			
6.	Goggles provided and used when grinding or chipping?			
7.	Other personal protective equipment provided and used as necessary to protect from other tool-generated hazards?			
8.	Safety clips or retainers used with pneumatic impact tools?			
9.	Compressed air used for cleaning purposes is reduced to less than 30 psi (at discharge)?			
10.	Fan guard openings no larger than 1/2 inch			

	when fan periphery is less than 7 feet from the floor?			
WALKING WORKING SURFACES		**STATUS**		**DATE CORRECTED / COMMENTS**
1.	Housekeeping well maintained?			
2.	Lumber and debris kept clear of work areas?			
3.	Work areas kept free of slipping and tripping hazards, such as oil, grease, rags, pieces of pipe and lumber, etc.?			
4.	Openings, including temporary openings, effectively protected by covers or guardrails and toe boards?			
5.	Guardrails provided for open-sided floors or platforms six feet above adjacent floors or surfaces?			
6.	Guardrails provided for runways four feet above floor or ground level?			
7.	Stairs (including temporary stairs, such as stairs provided for trailers) having four or more risers provided with required stair railing(s) or hand rail(s)?			
LADDERS		**STATUS**		**DATE CORRECTED / COMMENTS**
(If ladders are not used on the job, mark "N/A" and omit remaining ladder items)				
1.	Ladders provided for safe access to elevations where there are no temporary stairs, or suitable ramps or runways?			
2.	Areas around top and bottom of ladders kept clear?			
3.	Ladder side rails extend at least 36 inches			

	above the landing?			
4.	Portable ladders equipped with safety feet?			
5.	Portable ladders tied, blocked, or otherwise secured while in use?			
6.	All ladders in safe condition?			
7.	Defective ladders destroyed, or tagged as defective to prevent further use?			
8.	Makeshift ladders not used?			
9.	Metal ladders not used around electrical circuits?			
	SCAFFOLDING	**STATUS**		**DATE CORRECTED / COMMENTS**
(If scaffolding is not used on the job, mark "N/A" and omit remaining scaffolding items)				
1.	Footings or anchorages for scaffolding sound, rigid, and capable of carrying maximum intended load without settling or displacement?			
2.	Access ladder or equivalent safe access provided for all scaffolding or work platforms?			
3.	Open sides and ends of platforms more than 10 feet above the ground or floor have guardrails (or equivalent) and toe boards?			
4.	Overhead protection provided and used when personnel on scaffolds are exposed to overhead hazards?			
5.	Scaffolds constructed and used in accordance with policies and procedures?			
	WELDING	**STATUS**		**DATE CORRECTED / COMMENTS**

(If there is no welding on the job, mark "N/A" and omit remaining welding items)				
1.	Fire extinguishing equipment immediately available at all welding locations?			
2.	Persons exposed to welding flame or arc provided with and use eye protection?			
3.	Goggles used when chipping slag?			
4.	Welding or burning areas well ventilated?			
5.	Special precautions used when welding or cutting in confined spaces?			
6.	Special precautions used when welding or cutting metals of toxic significance (e.g. beryllium, cadmium, lead, zinc, mercury, or chromium)?			
7.	Special precautions used when welding with inert gas/metal-arc process?			
8.	Compressed gas cylinders:			
a.	Stored upright in ventilated area at least 20 feet from combustibles?			
b.	Oxygen and fuel gas cylinders (empty and full) stored at least 20 feet apart or separated by non-combustible barrier at least 5 feet high?			
c.	Secured against falling?			
WELDING CONTINUED		**STATUS**		**DATE CORRECTED / COMMENTS**
d.	Caps on unused cylinders?			
e.	Contents plainly marked?			
9.	Frames of all arc welding machines grounded (except engine driven)?			
10.	Arc welder lead terminals protected from accidental electrical contact by personnel or			

	by metal objects?			
11.	Non-combustible or flameproof screens used whenever practicable to protect other persons from direct arc rays?			
SLINGS AND RIGGING		**STATUS**		**DATE CORRECTED / COMMENTS**
(If slings are not used on the job, mark "N/A" and omit remaining sling items)				
1.	Rigging equipment inspected prior to use on each shift, and as necessary during use?			
2.	Eyes in wire rope bridles, slings, or bull wires are not formed by wire rope clips or knots?			
3.	Only slings in good condition are in use?			
	Note: Slings having any of the following conditions are NOT ACCEPTABLE. Such slings must be immediately removed from service, and either tagged as defective or destroyed to prevent inadvertent reuse.			
a.	Total number of visible broken wires in any length of eight diameters exceeds 10 percent of the total number of wires?			
b.	Fraying, kinking, crushing, bird-caging, or other damage resulting in distortion of the wire rope structure?			
c.	Evidence of heat damage from any cause?			
d.	End attachments that are cracked, deformed, or worn?			
e.	Corrosion of the rope or end attachments?			
f.	Hooks that have been opened more than 15% of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook?			
4	All sling hooks, shackles, and other			

	attachments in good condition and used in accordance with manufacturer's recommendations?			
	Note: Job- or shop-made hooks, links, or makeshift fasteners formed from bolts, rods, steel plate, etc., or other such attachments are NOT ACCEPTABLE.			
CRANES AND DERRICKS		**STATUS**		**DATE CORRECTED / COMMENTS**
(If cranes and derricks are not used on the job, mark "N/A" and omit remaining crane and derrick items).				
1.	Equipment inspected by competent person before each use?			
2.	Rear of portable crane barricaded to prevent injury to persons while crane is in use?			
3.	Only wire rope in good condition is in use?			
	Note: Wire rope having any of the following conditions is NOT ACCEPTABLE. Such rope must be immediately removed from service, and either tagged as defective or destroyed to prevent inadvertent reuse.			
a.	Wear or scraping of one-third the original diameter of outside individual wires.			
b.	Crushing, bird-caging, or other damage resulting in distortion of the rope structure.			
c.	Evidence of heat damage from any cause.			
d.	Running rope: Six broken wires in one lay, or three broken wires in one strand in one lay.			
e.	Standing rope: Two broken wires in one lay beyond end connections, or one broken wire at an end connection.			
4.	Tag lines used to control loads?			
5.	No one allowed under load?			
6.	No one allowed to ride load?			
7.	Adequate clearance maintained from any part of the crane or load to power lines (Minimum			

	10 feet from 50kV and below)?			
	Excavations and Trenching	**STATUS**		**DATE CORRECTED / COMMENTS**
(If there is no excavating or trenching on the job, mark "N/A" and omit remaining excavations, trenching and shoring items)				
1.	All walkways, runways, and sidewalks on site clear of excavated material or other obstructions?			
2.	Excavations, trenching, and shoring inspected daily?			
3.	Material used for sheeting and sheet piling, bracing, shoring, and underpinning is in good, serviceable condition?			
4.	If shoring not used, sides of trenches or embankments are sloped to prevent collapse?			
5.	Excavated materials stored and retained at least 2 feet/600mm from the edge of the excavation?			
6.	All spoil banks of excavated materials more than five feet high shored, laid back to a stable slope, or some other equivalent means of protection provided to prevent worker exposure to moving ground or cave-ins?			
7.	Adequate means of exit, such as a ladder or steps, provided within 25 feet of persons working in trenches four or more feet deep?			

MENTS:

Attachment 7 - Emergency Contact List

EMERGENCY CONTACT LIST

Customer:

Emergency Contact:

Medical:

Location of first aid kit(s):

Name of First Aider(s):

Ambulance Phone Number:

Local Hospital:

Phone number:

Address:

Physician/Clinic:

Phone number:

Address:

Hours:

Other Emergency:

Police

Emergency:

Other:

Fire Department:

Emergency:

Other:

Hazardous Material Spills

Name:

Phone Number:

EHS Manager

Name:

Phone Number:

Attachment 8 - Incident Report Form

INCIDENT REPORT FORM

Incident Occurrence:

<table>
<tr><td colspan="4">General Information</td></tr>
<tr><td>Incident Date:</td><td></td><td>Incident Time:</td><td>______ AM PM</td></tr>
<tr><td>Employee Name:</td><td></td><td>Employee Occupation</td><td></td></tr>
<tr><td>ID Number:</td><td></td><td>Department/Segment:</td><td></td></tr>
<tr><td>Privacy Concern Case?</td><td>No Yes</td><td>Direct Manager/Supervisor:</td><td></td></tr>
<tr><td>Check all that applies:</td><td colspan="3">Close Call / Near Miss Fire Injury / Illness
Explosion Material Loss/Property Damage Spill / Release
Air / Water Permit Violation No-Injury Accident Other</td></tr>
<tr><td>Shift</td><td></td><td>Date Incident Reported:</td><td></td></tr>
<tr><td>Contract Employee?</td><td>No Yes</td><td>Site Incident Number:</td><td></td></tr>
<tr><td>Injury Case Type?</td><td>Injury Illness</td><td>External Response Team Required?</td><td>No Yes</td></tr>
<tr><td>OSHA Recordable?
EHS To Complete</td><td>No Yes</td><td>Recordability Rationale EHS to Complete (Indicate why recordable or not recordable)</td><td></td></tr>
<tr><td>Did incident occur on Company premises?</td><td>No Yes</td><td>Place of Accident or Exposure:</td><td></td></tr>
<tr><td>If Customer Site provide site name and location:</td><td></td><td>List PPE Worn:</td><td></td></tr>
</table>

JSA Reference:		**Object or Substance Involved (injured or exposed):**	
Injury/Illness General Information			

Principle Body Part Affected:		**Detailed Body Part**	
Case Extent: (Required for	Death Job Transfer/Restriction Day(s) Away Work Other Recordable	**Illness Types**	Skin Disorder Poisoning Respiratory Condition Other Illnesses
Days Away From Work	**Start Date:** **End Date:**	**Transfer or Work Restriction**	**Start Date:** **End Date:**

Incident Description: Describe in Detail specifics of wheat the employee was doing when the injured, how the accident occurred. Do not input employee name or other personal details, description is used in generic reports and e-mails.

Incident Response: Describe immediate response activities to contain, control, incident (Ex. cleaned area to visibly clean; transported to medical; roped off the area):

Medical Response:

Incident Investigation:

Was Employee treated on Off-site?	No Yes	**Provide Contact Information for Treating Hospital Clinic (Name, Address,**	
Employee Hospitalized?	No Yes	**Multiple Employees Admitted?**	No Yes

EHS Incidents Additional Information:	
For Fire or Explosion:	Source of ignition or detonation: _____ Extinguishing Method: _____
For Material Release:	Material Released (raw material): _____ Quantity: ______ Contained: YES NO - If No, Explain _____

Communication: (List persons contacted – internal & external)

Date	Time	Person Contacted	Summary Discussion
Air: , Explain _____			
Other: , Explain _____			
For Waste Generated: Number of Drums/Containers: ________ Waste Code(s): _________________			

Investigation Result: (identify root cause for the incident):

____

Root Cause:
Corrective Actions: (identify actions, responsible person(s) and target date) Enter in the EHS Audit Tracker

Date Initiated:		**Time:**	
Team Members (Name & Title):			
Person Interviewed (Name & Title):			

-
-
-
-
-
-
-
-
- **Attachment 9 - Injury and Illness Log**

Injury and Illness Log	**Date:**
	Project :

Report Completed By (Signature & Date):	
EHS Review (Signature & Date):	
Responsible Leader or Manager Review (Signature & Date):	

Contractors	Total Occupational Injuries & Illnesses	Fatal Injuries & Illnesses	Lost Workday Cases Involving Days Away From Work	Workdays Away From Work	Lost Workday Cases Involving Days Away From Work or Days of Restricted Work Activity or Both	Days of Restricted Work Activity	Employee Monthly Hours	Employee YTD Hours Worked	Case Incident Rate: Total Cases	Case Incident Rate: Days Away From Work
	A	B	C	D	E	F	G	H	I	J
Totals Monthly	0	0	0	0	0	0	0	0		
Totals Year	0	0	0	0	0	0	0	0		

To Date										
Totals Project to Date	0	0	0	0	0	0	0	0		

Notes:

Prepared by:

Date:

Attachment 10 - First Aid Log

FIRST AID LOG

Date	Injury & Body Part Injured	Contractor	Craft	Employee Name	Weather Conditions	Follow Up Conducted	Event Description	Location of Event

Attachment 11 - Physician/Clinic Referral Form

PHYSICIAN/CLINIC REFERRAL FORM

Physician/Clinic		● *NEPC Care Manager*	
Telephone		● Telephone	
Fax		Fax	
Address		Address	
Date of Referral		Date of Injury	
Employee Name		Employee SSO	

Please review the "General Information for Physicians" on the reverse side of this form for 's medical management and return to work commitment.

●

●

●

● Based on my evaluation of: on

● For the following injury:

● After review with the Medical Department, the above employee is released as of:__________________

●

● For Return to: Normal Duties Modified work with the following restrictions:

● The employee was provided:

No Medication Non Prescription Strength OTC Medication Prescription Medication

●

● Name and purpose of Medication provided:

General Electric's Objectives for Work Place Injury Management

- Allow employees to maximize the value of their employment, healthcare benefits, salary and pension.
- Provide a safe working environment for our employees
- Accommodate injured or restricted duty employees
- Reduce/eliminate OSHA Recordables and Lost Work Days
- Provide quality cost effective medical care

What Happens to the Employee When They Are Away From Work

- Compensation levels may be reduced to state workers' compensation rates
- Pension contributions are impacted
- Pension qualifying work time is impacted
- Contributions to flexible spending accounts are impacted
- Quality of life is impacted

OSHA Recordables/Non-Recordables

- Any injury requiring treatment beyond first aid is considered to be recordable.
- Tetanus shots and negative X-rays are considered first aid and would not be recordable.
- Non Prescription Strength Over the Counter Medications do not make the injury recordable.
- Wound closures using bandages, band-aids, gauze pads, steri-strips is non-recordable
- Wound closures using a stitch or more and glues are recordable
- Massage, as a modality is not considered recordable, PT or Chiropractic treatment is.

Restricted Work

OSHA regulations require reporting of restricted work injuries. OSHA considers restricted work as any condition affecting the employees' ability to perform all or any part of their assigned tasks.

NEPC is required by OSHA to report an injury accurately. As a result, we need specific restrictions for our injured employees to compare to the actual physical demands of the employees' job to determine recordability. The /NEPC Care Manager, upon request, will provide this job specific information to the physician.

If the physician determines the employee needs to be on restricted duty, NEPC will make every effort to modify jobs to accommodate the employee. We are able to accommodate up to 12 weeks if he/she is progressing toward his/her regular duty job. Therefore we frequently see success with aggressive treatment protocols.

Please contact the CARE Manager at the number provided if there are any questions.

Attachment 12 - Site Safety File Contents

SITE SAFETY FILE CONTENT

Copy of Contractor EHS Program Requirements

Copy of Contractor Safety Requirements

Copy of Project Safety Plan

Copy of NEPC's Contractors'/Partners' EHS Program & Project Safety Plan

Completed Contractor Management EHS Orientation Checklists (documentation of competence for supplied contractors)

Completed Weekly Safety Inspection Checklists

Records of Weekly Safety Meetings

Monthly Safety Status Reports

Monthly Project Injury and Illness Reports

Daily Excavation Inspections

All operator's certifications (crane, atv forklift, heavy equipment)

Documentation of training for contractors performing certain types of work (aerial lift, respiratory training, confined space, high voltage)

Closed Confined Space permits

Monthly crane inspections

Gas monitor calibration sheet

Attachment 13 - Demobilization EHS Turnover Packages

DEMOBILIZATION EHS TURNOVER PACKAGES

(a) All SCAR's - 9.3.02 – Site EHS OSHA Log and Reports - Site

(b) OSHA or Government audits and letters if any 9.3.02 – Site EHS OSHA Log and Reports - Site

(c) HQ final audits – 9.03.01 Site EHS Inspections & Audits - HQ

(d) A copy of all waste oil manifest spill reports, bill of lading, contaminated soil reports and disposal records. 9.3.02 – Site EHS OSHA Log and Reports - Site

(e) All incident, accident, near miss reports. Both Contractor and NEPC (Include root cause and corrective action) - WEB Reporting - Site

(f) Monthly Reports I&I and Monthly safety status reports 9.3.02 – Site EHS OSHA Log and Reports - Site

(g) Weekly safety meeting topics and attendees, special safety meetings or talks – 9.3.02 Site EHS Meetings Minutes - Site

(h) Weekly safety inspections (NEPC lead) - 9.03.01 Site EHS Inspections & Audits - Site

(i) Site Safety Plans – 9.3.04 Site EHS Plans - HQ

(j) On self-implemented projects retain all closed permitted confined space permits.

(k) On self-implemented projects All closed LOTO request forms.

(l) EHS daily log.

Note:

All documents should be retained in ring binders. EHS personnel shall label both the spine and the cover of the turnover binders. All sections of the turnover package shall be tabbed to indicate section i.e.(SCAR’s, OSHA audits, HQ finial audits). When possible use only original documents.

PROJECT INFORMATION:

PROJECT: ______________________ DATE: ______________________

ADDRESS: ______________________ JOB #: ______________________

____

CONTRACTOR INFORMATION (Provided by the Contractor):

SITE MANAGER: ______________________ PHONE: ______________________

SITE EHS REPRESENTATIVE: ______________________ PHONE: ______________________

HQ EHS MANAGER: ______________________ PHONE: ______________________

COMPETENT PERSON-EXCAVATION SAFETY: ______________________ N/A ☐

COMPETENT PERSON-CRANES & RIGGING: ______________________ N/A ☐

COMPETENT PERSON-SCAFFOLDS: ________________			N/A	☐
EHS MANUAL ON FILE?	YES	☐	N/A	☐
TRAINING RECORDS PROVIDED?	YES	☐	N/A	☐
HAZCOM PROGRAM ON FILE?	YES	☐	N/A	☐
INVENTORY AND MSDS FOR CHEMICALS TO BE USED ON FILE?	YES	☐	N/A	☐
CRANE OPERATOR QUALIFICATIONS ON FILE?	YES	☐	N/A	☐
ANNUAL CRANE INSPECTION REPORT FOR EACH CRANE ON FILE?	YES	☐	N/A	☐
RESPIRATOR PROTECTION PROGRAM?	YES	☐	N/A	☐
GROUND FAULT PROTECTION TO BE USED?	GFCI	☐	WRITTEN PROGRAM	☐

EHS INFORMATION (Provided by NEPC):

PROJECT SAFETY PLAN REVIEWED?	YES	☐	N/A	☐

PROJECT EMERGENCY PROCEDURES REVIEWED?	YES	☐	N/A	☐
PROJECT WASTE MANAGEMENT PROCEDURES REVIEWED?	YES	☐	N/A	☐
CUSTOMER EHS REQUIREMENTS REVIEWED?	YES	☐	N/A	☐
CUSTOMER EHS TRAINING, DRUG SCREENING, ETC., REVIEWED?	YES	☐	N/A	☐
PROJECT TAGOUT/LOCKOUT PROCEDURE REVIEWED?	YES	☐	N/A	☐
PROJECT CONFINED SPACE PROCEDURE REVIEWED?	YES	☐	N/A	☐
OTHER PROJECT-SPECIFIC EHS PROCEDURES REVIEWED?	YES	☐	N/A	☐
IF YES, PLEASE LIST:				

-
-
-
-
-
-
-

- **Attachment 14 - Contractor Management EHS Orientation Checklist**

CONTRACTOR MANAGEMENT EHS ORIENTATION CHECKLIST

Acknowledgments:

Contractor Lead:________________________Date:_______________

Attachment 15 - EHS Site Expectations For Local Contractors

EHS SITE EXPECTATIONS FOR LOCAL CONTRACTORS

1. Training

Provide all training records for those individuals with specific training requirements such as Equipment operation, Confined Space, Scaffolding, and any other required training. Provide each trainee with a card or other form of documentation that shows the type of training received, date, name and name of the trainer.

2. Welding leads_

All welding leads and extension cords will be run so that they do not present a tripping hazard. At no time will welding leads or extension cords be placed in an area where they can be driven over without proper protection. All damaged cords and leads shall be removed from the site. **A quarterly inspection shall be done on all cords and leads.**

3. Sign, Signals and Barricades

Signs and symbols required by this subpart shall be visible at all times when work is being preformed, and shall be removed or covered promptly when the hazard no longer exist. Barricade tape will be an acceptable means of limiting access to hazardous areas. Barricade tape may be used around excavations but must not assume a fall protection role. All types of barricade tape shall have tags stating the type of hazard, date inspected, and shall state ownership. Tags shall be place on all sides. **"Red barricade tape will only be used when there is imminant danger"!**

4. Excavations

All barricades placed to satisfy fall protection requirements will be of rigid construction. Excavations that are next to roads or high traffic areas will have flashing lights at night.

Pre-Dig Permits may be required for both Temporary and Permanent Utility Lines.

5. Hygiene

All items that are a part of this directive will be adhered to. Also all drinking water coolers will have the lid taped and the date displayed on the tape. There will be designated eating areas.

6. Fall Protection

There is a 100% tie off policy for this site, 6' and above. This policy also addresses elevated platforms, which are accessed by ladders. If a ladder is used to reach a platform >25' there must be a mechanical fall arrest device in place to prevent a fall. This device must be used going up the ladder and coming down the ladder. Fall protection will be used on **incomplete** platforms.

7. Personal Protective Equipment

Any PPE furnished by an employee will be inspected and records kept on site of the inspection.

8. Respiratory Protection

Historical data or Industrial Hygiene test data must be available on site to validate the selection of respiratory protection. All Fit Test and Pulmonary Function test results should also be available for each employee wearing respiratory protection.

9. Rigging

All rigging shall be done according to this standard. All rigging equipment, including but not limited to, (wire ropes, synthetic slings, lifting chains, shackles, hooks, chain falls, and come-a-longs) will be inspected and marked quarterly. Marking shall be color-coordinated site wide and should coincide with the electrical quarterly inspection color.

10. Housekeeping

This must take place on a daily basis as work progresses. All 55-gallon drums used for trash will be labeled properly.

11. Environmental

Proper storage for all chemicals, oils, fuels, and paint containers including tanks, 55 gal. drums, and 5 – 10 gal pails shall be provided. Proper storage is defined as, containment, protection from the elements and required labels. All spills will be reported to NEPC and cleaned up immediately. All contaminated soil must be cleaned up and placed in a drum for disposal.

All hazardous and non-**hazardous waste must be accumulated in a approved waste storage area. This storage area must have containment, signs, barricades and be limited to authorized personal only.**

<u>A copy of the manifest and a certificate of disposal are required to be sent to NEPC each time hazardous and non-hazarous waste is removed from the site.</u>

12. Welding, Cutting and Heating

Arc welding and cutting operations, shall be shielded by noncombustible or flameproof screens, to protect employees and other persons in the vicinity from direct arc rays. Hard Hats will be worn under welding hoods.

13. _Access and Egress

All elevated access points (load compartments, generator compartments, accessories buildings etc.) on each unit will have either steps or ramps equipped with guardrails as required.

14. Fire Extinguishers

Fire fighting equipment shall be conspicuously located and readily accessible at all times, shall be periodically inspected, and be maintained in operating condition.

15. Lighting

Construction areas, ramps, runways, corridors, offices, shops and storage areas shall be lighted to not less than the minimum illumination intensities in Table D-3 while any work is in progress. All temporary lighting will be provided with bulb cages to prevent the incidental contact with the bulb.

16. Scaffolds

Each employee who performs work on a scaffold shall be trained by a ***qualified person.*** The training shall include such topics as the nature of electrical hazards, fall hazards, falling object hazards, the maintenance and disassembly of the fall protection system; the use of scaffolds, handling of materials, and the maximum intended load carrying capacity.

17. Motorized equipment

All equipment in use shall be checked at the beginning of each shift to ensure that all parts, equipment, and accessories that effect safe operation are in proper operating condition and free from defect. All defects shall be corrected before the vehicle is placed in service.

All equipment having an obstructed view of the rear shall have an audible reverse signal alarm or the operator will ensure that an observer is present to assist in operation while alarm is unavailable.

18. Cranes and lift equipment

Annual and Monthly certifications shall be available for review on all cranes and carry decks while on site. All cranes equipped with outriggers will use mud mats regardless of foundation conditions. Accessible area within swing radius of counterweight shall be barricaded to prevent employees from being struck.

A Pre-lift plan will be submitted to NEPC Site Management or his designee prior to lifts greater than 70% of the crane capacity, lifts involving more than one crane, or large or awkward lifts. Any lift over 90% of the crane's capacity, shall be detailed in writing by a certified engineer.

19. Typical Documentation requirements by/to NEPC

Daily Submittals

Pre-Dig Permits

Pre-lift plans

First Aids/Accident / Incident Reports/ Near Miss (as needed)

Excavation Inspections

Safety Risk Assessment

Weekly Submits

Safety Inspection

Safety meetings

Follow up on Safety Audit / Closure of

compliance issues

Hazardous Waste Inventory / Activity / Manifest (as needed)

Monthly Submittals

Man Hours

Equipment Inspection

Training

Scaffolding

Confined Space

Excavation

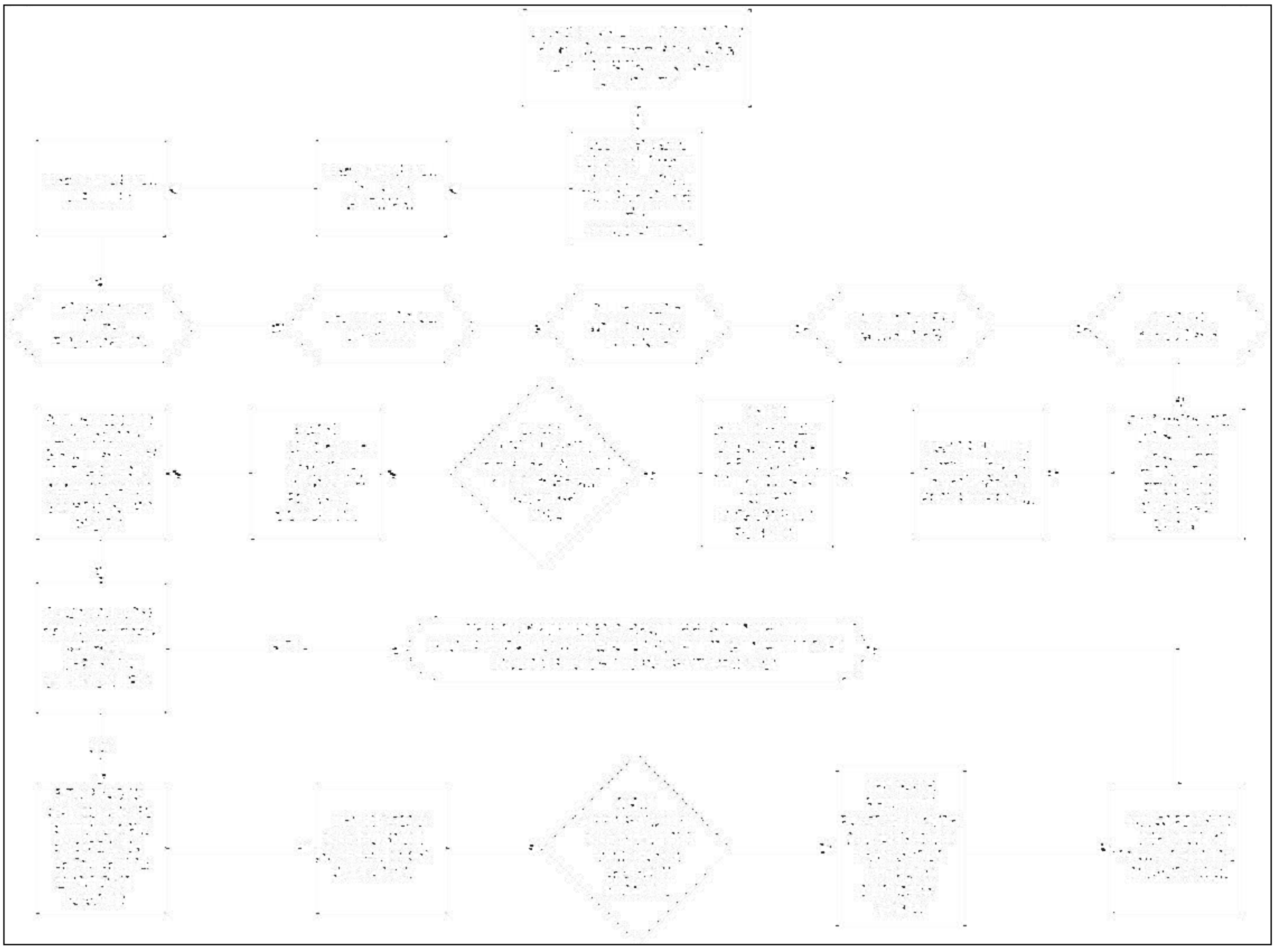
Powder Activated tools

LOTO

Respirator Fit Testing

Operator Certs.

Attachment 16 - Safety Risk Assessment Process and Procedure



Attachment 17 – Hot Work Permit

HOT WORK PERMIT

Permit Date: ____________Permit Duration: Start Time: __________End Time: _________________

Location of Hot Work: ____Permit Issuer: ___________ _________

Work Description: ____

Define Hazards: ____

	Y/ N NA	Date	Time	Comments	Completed By:	
					Supervisor	Employee
35-foot Minimum Clearance from Combustible/Flammable Materials						
Flammable Materials Removed or Closed						
Combustibles Left in Work Area Isolated/ Enclosed/ Soaked With Water						
Fire Watch with Extinguisher Established						
Fire Alarm Box or Phone Location (note in comments section)						
Work Zone Designated/Signs or Warning Tape Posted						
Sprinklers in service						
Floors swept clean (and wet down if combustible)						
Cutting and welding equipment in good condition						

	Y/ N NA	Date	Time	Comments	Completed By:	
					Supervisor	Employee
Respirator(s) Required						
Other Personal Protective Equipment (note in comments section)						
Permits (e.g. CONFINED SPACE ENTRY PERMIT)						
Floor Openings Protected/Drains Covered						
Welding Gas Cylinders Securely Anchored to Wall, Building Support, or Welding Cart						
Mechanical and Electrical Energy Sources to Work Object Shutdown with Lockout/Tagout						
Parts, equipment, containers, tanks, ducts, etc. cleaned/purged of flammable vapors, liquids, dusts, and any hazardous materials						
Flammable Gas/Vapor Concentration Measured (where conditions known or expected to be present)						
Oxygen (%)						
Flammability/Explosivity (%LEL)						
Other (Specify):						

	Y/ N NA	Date	Time	Comments	Completed By:	
					Supervisor	**Employee**
Flammable/combustible transfers stopped						

Permit Approval:

Hot Work Supervisor

Signature

Worker(s) Performing Hot Work:

Worker #1 (if applicable)

Signature

Worker #2 (if applicable)

Signature

Worker #2 (if applicable)

Signature

Attachment 18 - Pre-Dig Permit

PRE-DIG PERMIT

Date-Issued Coordinates:

- Start-Date Finish-Date:
- Sketches Attached: Y N Pre-Dig Permit #:

REQUIREMENTS:

Underground or Buried Service Line: When it is necessary to excavate, drill, or break into ground, walls, or other locations where service lines are embedded, the contractor or supervisor in charge of the work shall be responsible for having all maps and prints checked for location of such lines. This also includes revised AS-BUILT drawings to verify that there are No Lines (pipe, water, electrical, or phones) etc, in the vicinity of the work to be preformed.

1. Specific Location and Description of Work including excavation dimensions: ____________

____

____

____

____

2. All drawings including as-built have been reviewed and checked?______________________
3. Lines in Vicinity of Work

Electrical____________________Telephone_________________Water________________________

Sewer______________________Fuel____________________Process (specify)_______________

Gas _________________________ Drain___________________Other (specify__________________

4. Other Obstructions

Footings____________________Pilings___________________Other (specify)_________________

5. Precautions (specify all that apply)

De-energize lines_________________________Ground Tools______________________________

Barricade_______________________________Hand Excavate______________________________

6. If applicable reference following documentation:

LOTO Clearance ________________________Excavation Inspection ________________________

7. Review and Certification

Contractor / Supervisor in Charge ____

Contractor Safety/Competent Person _______________________________________

NEPC EHS Manager ___________

Attachment 19 – Excavation Inspection Form

Project:		Date:	Weather:	Soil Type:
Trench Depth:	Length:	Width:	Type of Protective System:	

EXCAVATION INSPECTION FORM

Yes	No	N/A	Excavation
			Excavations and Protective Systems inspected by Competent Person daily, before start of work.
			Competent Person has authority to remove workers from excavation immediately.
			Surface encumbrances supported or removed.
			Employees protected from loose rock or soil.
			Hard hats worn by all employees.
			Spoils, materials, and equipment set back a minimum of 2' from edge of excavation.
			Barriers provided at all remote excavations, wells, pits, shafts, etc.
			Walkways and bridges over excavations 6' or more in depth equipped with guardrails.
			Warning vests, or other highly visible PPE provided and worn by all employees exposed to vehicular traffic.
			Employees prohibited from working or walking under suspended loads.
			Employees prohibited from working on faces of sloped or benched excavations above other employees.
			Warning system established and used when mobile equipment is operating near edge of excavation.

Yes	No	N/A	Utilities
			Utility companies contacted and/or utilities located.

			Exact location of utilities marked when near excavation.
			Underground installations protected, supported, or removed when excavation is open.
Yes	**No**	**N/A**	**Wet Conditions**
			Precautions taken to protect employees from accumulation of water.
			Water removal equipment monitored by Competent Person.
			Surface water controlled or diverted.
			Inspection made after each rainstorm.

Yes	**No**	**N/A**	**Hazardous Atmosphere**
			Atmosphere tested when there is a possibility of oxygen deficiency or build-up of hazardous gases.
			Oxygen content is between 19.5% and 21%.
			Ventilation provided to prevent flammable gas build-up to 20% of lower explosive limit of the gas.
			Testing conducted to ensure that atmosphere remains safe.
			Emergency Response Equipment readily available where a hazardous atmosphere could or does exist.
			Employees trained in the use of Personal Protective and Emergency Response Equipment.
			Safety harness and lifeline individually attended when employees enter deep confined excavation.

Signature of Competent Person________________________	Date: ______________________________________

- **Attachment 20 – Daily Excavation Log**

Daily Excavation Log

Location of Excavation: Competent Person:

Contractor Name: Week Ending:

Answer Y/N/NA	Mon	Tue	Wed	Thur	Fri	Sat*	Sun*
Excavation free of water?							
Excavation properly barricaded?							
Loose soil and equipment back 2 feet from the edge?							
Benching, sloping, or shoring system in place?							
If hazardous atmosphere, has monitoring been done?							
Monitoring Results (indicate value or nothing detected)							
Excavation face free from cracks or cave-ins?							
Means of egress every 25 feet?							
All exposed rebar capped?							
Walkways over excavation equipped with guardrails?							

Comments:

Corrective Actions:

Responsibility for Corrective Actions: Actions Completed:

*If no work taking place on weekend indicate NW (not working)

Attachment 21 – Annual Crane Inspection Log

ANNUAL CRANE INSPECTION LOG*

(This form may be used for more than one crane)

IF THE ITEM CHECKED IS OK, TYPE YOUR INITIALS IN THE APPLICATION BOX. IF NOT, PLACE AN "X" IN THE BOX, AND INITIAL WHEN CORRECTED.

ITEM CHECKED	EQUIPMENT I.D.		EQUIPMENT I.D.			
	INITIALS	DATE	INITIALS	DATE		
MEMBERS					1	Deformed, cracked, or corroded members.
Deformed						
Cracked						
Corroded						
BOLTS OR RIVETS:					2	Loose bolts or rivets.
Loose						
SHEAVES, DRUMS:					3	Cracked or worn sheaves and drums.
Cracked						
Worn						
PARTS (pins, etc.)					4	Worn, cracked or distorted parts, such as pins, bearings, shafts, gears, rollers, locking and clamping devices.
Worn						
Cracked						
Distorted						
BRAKE PARTS					5	Excessive wear on brake system parts, lining, pawls, and ratchets.
Excessive Wear						
LOAD/WIND INDICATORS					6	Load, wind, and other indicators over their full range, for any significant inaccuracies.
Inaccuracies						
POWER UNIT					7	Gasoline, diesel, electric, or other power plants for improper performance or non-compliance with applicable safety requirements.
Safety Requirements						

DRIVE SPROCKETS/CHAIN					8	Excessive wear of chain drive sprockets and excessive chain stretch.
Wear or Stretch						
CONTROL CONTACTS LIMIT SWITCHES PUSH BUTTONS					9	Electrical apparatus, for signs of pitting or any deterioration of controller contractors, limit switches and push-button stations.
Pitting or Deterioration						
CONTROLS					10	Controls should be properly identified and legible.
Identified						
Legible						

*For a crane or hoist which has been idle for a period of over six months, a daily, monthly, and yearly inspection must be conducted prior to use. You must also refer to the Manufacturer's Manual for items above and beyond the items on this list.

Print Inspector’s Name: Signature:

Print Inspector’s Name: Signature:

SEE OTHER SIDE FOR LOG

ANNUAL CRANE INSPECTION ITEMS*

(Signed Log Required)

CRANE:			**MANUFACTURER:**			**DATE**		
S=Satisfactory **U**=Unsatisfactory								
WALK AROUND	S	U	MACHINERY	S	U	OPERATIONAL	S	U
Safety Guards & Plates			Housekeeping			Gauges / Warning / Indicator Lights		
Carrier Frame / Rotate Base			Lubrication			Controls / Functions		
Wire Rope / Reeving			Engine Compartment			Load Rating Charts		
Block / Hook / Sheaves			Lights			Safety Devices		
Bloom / Jib			Glass			Boom Angle Indicators		
Walks / Ladders / Handrails			Warning Tags / Labels			Limit Switches		
Tires / Wheels / Chocks			Fire Extinguisher(s)			Unusual Noises/ Conditions		
Leaks / Fuel / Lube / Oil / Water								
Remarks:			**Operators Signature**					
			Date					
			Supervisor's Signature					
			Date					

INSTRUCTIONS: Inspect all applicable items indicated, each shift. Suspend all operations immediately when observing an unsatisfactory condition which might create a hazard. In addition, suspend operation when any unsafe condition is observed and immediately notify supervisor. Other conditions affecting safety shall be noted under "REMARKS" and reported to supervisor.

CRANE:			**MANUFACTURER:**			**DATE**		
S=Satisfactory **U**=Unsatisfactory								
WALK AROUND	S	U	MACHINERY	S	U	OPERATIONAL	S	U
Safety Guards & Plates			Housekeeping			Gauges / Warning / Indicator Lights		
Carrier Frame / Rotate Base			Lubrication			Controls / Functions		
Wire Rope / Reeving			Engine Compartment			Load Rating Charts		
Block / Hook / Sheaves			Lights			Safety Devices		
Bloom / Jib			Glass			Boom Angle Indicators		
Walks / Ladders / Handrails			Warning Tags / Labels			Limit Switches		
Tires / Wheels / Chocks			Fire Extinguisher(s)			Unusual Noises / Conditions		
Leaks / Fuel / Lube / Oil / Water								
Remarks:			**Operators Signature**					
			Date					
			Supervisor's Signature					
			Date					

INSTRUCTIONS: Inspect all applicable items indicated, each shift. Suspend all operations immediately when observing an unsatisfactory condition which might create a hazard. In addition, suspend operation when any unsafe condition is observed and immediately notify supervisor. Other conditions affecting safety shall be noted under "REMARKS" and reported to supervisor.

Attachment 22 - Daily Crane Inspection Items

DAILY CRANE INSPECTION ITEMS

CRANE:	**MANUFACTURER:**	**DATE**

S=Satisfactory **U**=Unsatisfactory

WALK AROUND	S	U	MACHINERY	S	U	OPERATIONAL	S	U
Safety Guards & Plates			Housekeeping			Gauges / Warning / Indicator Lights		
Carrier Frame / Rotate Base			Lubrication			Controls / Functions		
Wire Rope / Reeving			Engine Compartment			Load Rating Charts		
Block / Hook / Sheaves			Lights			Safety Devices		
Bloom / Jib			Glass			Boom Angle Indicators		
Walks / Ladders / Handrails			Warning Tags / Labels			Limit Switches		
Tires / Wheels / Chocks			Fire Extinguisher(s)			Unusual Noises/ Conditions		
Leaks / Fuel / Lube / Oil / Water								

Remarks:	**Operators Signature**	
	Date	
	Supervisor's Signature	
	Date	

INSTRUCTIONS: Inspect all applicable items indicated, each shift. Suspend all operations immediately when observing an unsatisfactory condition which might create a hazard. In addition, suspend operation when any unsafe condition is observed and immediately notify supervisor. Other conditions affecting safety shall be noted under "REMARKS" and reported to supervisor.

CRANE:	**MANUFACTURER:**	**DATE**

S=Satisfactory **U**=Unsatisfactory

WALK AROUND	S	U	MACHINERY	S	U	OPERATIONAL	S	U
Safety Guards & Plates			Housekeeping			Gauges / Warning / Indicator Lights		
Carrier Frame / Rotate Base			Lubrication			Controls / Functions		
Wire Rope / Reeving			Engine Compartment			Load Rating Charts		
Block / Hook / Sheaves			Lights			Safety Devices		
Bloom / Jib			Glass			Boom Angle Indicators		
Walks / Ladders / Handrails			Warning Tags / Labels			Limit Switches		
Tires / Wheels / Chocks			Fire Extinguisher(s)			Unusual Noises / Conditions		
Leaks / Fuel / Lube / Oil / Water								

Remarks:	**Operators Signature**	
	Date	
	Supervisor's Signature	
	Date	

INSTRUCTIONS: Inspect all applicable items indicated, each shift. Suspend all operations immediately when observing an unsatisfactory condition which might create a hazard. In addition, suspend operation when any unsafe condition is observed and immediately notify supervisor. Other conditions affecting safety shall be noted under "REMARKS" and reported to supervisor.

Attachment 23 - Overhead and Gantry Crane Daily Inspection

OVERHEAD AND GANTRY CRANE DAILY INSPECTION

Employee________________________ Date____________

Date of last annual inspection:________________ Crane Make/Model___________________

Crane Type_________________________________Crane Capacity______________________________

____

***Examiner:** Mark Satisfactory, Unsatisfactory, or Not Applicable next to those items the operator performs*

1) Crane Inspection

______________________A. Condition of Control Box (pendant / remote control)

______________________B. Bridge Frame

______________________C. Trolley

______________________D. Wire rope / reeving

______________________E. Block / Hook / Sheaves

______________________F. Track

______________________G. Stop Blocks

______________________H. Electrical Disconnect

Comments: ____

____

____

2) Operational Check

_______________________1. Raise / Lower

_______________________2. Limit Switch

_______________________3. Bridge Travel forward and back

_______________________4. Bridge Brakes

_______________________5. Trolley Travel side to side

_______________________6. Trolley Breaks

Comments: ____

____

____

- **Attachment 24 - Overhead and Gantry Crane Monthly Inspection**

OVERHEAD AND GANTRY CRANE MONTHLY INSPECTION

CRANE MAKE	● **INSPECTOR**
● **MODEL**	● **INSPECTION DATE**
● **PROJECT LOCATION**	**PROJECT NUMBER**

ITEMS TO BE INSPECTED	ACCEPTED	REJECTED	N/A
1. Pendent controls operate correctly.			
2. Instruction card on pendent.			
3. Trolley & bridge track properly aligned.			
4. Trolley and bridge stable.			
5. ALL LIMIT SWITCHES OPERATE CORRECTLY.			
6. Load capacity marked on trolley.			
7. Certified operators listed on pendent.			
8. All travel blocks in place.			
9. Cables are "DEFECT" free.			
10. Cables are not twisted.			
11. Pendent equipped with locking cover.			

12. Control switches on pendent "AUTOMATICALLY" return to the "OFF" position when released.			
13. Load hook has safety (throat) latch.			
14. Load hook is "DEFECT" free.			
15. Certification of "LOAD TEST" on file at the jobsite.			
16. Preventative maintenance program has been established as per manufacturer.			
17. Electrical phasing is correct with reference to hoist / travel - pendent.			

____

Inspector's Signature and Position Title

ECORD DEFICIENCIES ON PAGE 2

DEFICIENCIES / REMARKS

____

____

____

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- **Inspector's Signature and Position Title** **Date**

Attachment 25 - Aerial Platform Inspection

AERIAL PLATFORM INSPECTION

Company:	Project:	Manufacturer:
Month	Location	Type (Gas, Diesel, Electric)
Date	ID#	Capacity
Hour Meter Start	Hour Meter Finish	Shift

Note: If the Aerial Work Platform, (JLG, Sizzor Lift, etc), is not in good operating condition, It Shall Not Be Used.

	Place a check mark in the appropriate box.		
General	**Good**	**defective**	**Comments**
Appearance			
Load Charts			
Hydraulic System			
Out-Riggers			
Tire Condition			
Brakes			
Electrical-Lights			
Basket			
Safety Override			
E-Stop			
Alarms - Horn			
Flashing Yellow Light			
Fire Extinguisher			
Coolant Level			
Oil Level			
Controls-(Basket)			
Controls-(Ground)			
Battery Meter			
Battery			
(PPE: splash goggles, face shield, rubber gloves, rubber apron)			

Inspector:	Supervisor:

Attachment 26 –Come-Along And Chain-Fall Monthly Inspection Form

COME-ALONG AND CHAIN-FALL MONTHLY INSPECTION FORM

GA/P Hoist (GH), Come-Along (C), and Chainfall (CF)

Date	Inspection Color and Size	Serial #	Safety Latch	Cable Chain	Clutches	Free Chain Lever	Up & Down Lever	Handle	Damage or Cracks	Load Test 125% of Rated Loads	End Ring	Excessive Wear	(Oil) Smooth Operating Condition	External and Internal Parts Cond.	Other	Approved By

-
-

- **Attachment 27 - Fall Protection Equipment Monthly Inspection**

FALL PROTECTION EQUIPMENT MONTHLY INSPECTION

Site: ____Inspected by: ____

Please print

Name of foreman: ____

Date: ________________________________

Please print

EMPLOYEE NAME:	**ID NO.**	**ACCEPTABLE**		**REMOVE FROM SERVICE**		**COMMENTS**
		YES	**NO**	**YES**	**NO**	
FULL BODY HARNESS						
SAFETY BELT (for positioning only)						
ROPE LANYARD						
REBAR HOOK						
HINGE-O-GRAB (BUTTERFLY)						
						EMPL. INT:

EMPLOYEE NAME:	**ID NO.**	**ACCEPTABLE**		**REMOVE FROM SERVICE**		**COMMENTS**
		YES	**NO**	**YES**	**NO**	
FULL BODY HARNESS						
SAFETY BELT (for positioning only)						
ROPE LANYARD						
REBAR HOOK						
HINGE-O-GRAB						

(BUTTERFLY)						
						EMPL. INT:

EMPLOYEE NAME:	**ID NO.**	**ACCEPTABLE**		**REMOVE FROM SERVICE**		**COMMENTS**
		YES	**NO**	**YES**	**NO**	
FULL BODY HARNESS						
SAFETY BELT (for positioning only						
ROPE LANYARD						
REBAR HOOK						
HINGE-O-GRAB (BUTTERFLY)						
						EMPL. INT:

Attachment 28 – Daily Forklift Inspection

DAILY FORKLIFT INSPECTION

Company:	Project:	Manufacturer:
Month	Location	Type (Gas, Diesel, Electric)
Date	ID#	Capacity
Hour Meter Start	Hour Meter Finish	Shift

Note: If the Fork;ift is not in good operating condition, **IT SHALL NOT BE USED**.

	Place a check mark in the appropriate box.		
General	**Good**	**defective**	**Comments**
Appearance			
Chains			
Hydraulic System			
Tire Condition			
Load Chart			
Brakes			
Parking Brakes			
Electric			
Gages			
Horn			
Back Up Alarm			
Flashing Yellow Light			
Fire Extinguisher			
Coolant Level			
Oil Level			
Battery Meter			
Battery			
(PPE: splash goggles, face shield, rubber gloves, rubber apron)			

Inspector:	Supervisor:

Attachment 29 –Monthly Rigging Inspection Form

MONTHLY RIGGING INSPECTION FORM

Name of the inspector (print)	**OK** (pass inspection)	**Comments** (did not pass inspection)

Foreman ____(please print)

Date ______________________________________ (turn in monthly)

Number of wire rope that pass inspection ____________

Number of wire rope that did not pass insp. _____________

Rejected slings will be tagged out-of-order and separated from the good ones or destroyed.

Rejection Criteria:

1. Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay. Snagged, nicked, or severely bent wires count as broken wires.
2. Abrasion, scrubbing, or peening causing loss of more than 1/3 of the original diameter of outside individual wires.
3. Evidence of rope deterioration from corrosion.
4. Kinking, crushing, or other damage that results in detrimental distortion of the rope structure.
5. Any evidence of heat damage including bare electrical conductor, ground, or welding arc.
6. Any marked reduction in diameter either along the entire main length or in one section.
7. Unlaying or opening up of a tucked splice.
8. Core protrusion along the main length and on slings if you can see the red inside is not good.
9. End attachments that are cracked, deformed, worn, or loosened.
10. Any indication of strand or wire slippage in end attachments.
11. More than one broken wire in the vicinity of a zinced-on or swaged fitting.

Attachment 30 –Risk Assessment Guide

RISK ASSESSMENT GUIDE

For the Placement of Personnel Facilities

This risk assessment guide is intended for the pre-placement of construction trailers, break trailers, smoking areas, and similar personnel facilities. The guide should be used in conjunction with customer input regarding process equipment.

Proposed break room or office trailer location:

	Yes	No	NA
● **Pre-placement Site Review Confirmation** Has the customer reviewed the above-described planned placement of the facilities? Notes:			
● **Blast Radius Clearance** Has the customer confirmed the planned placement of the facilities is out of the blast radius of any processing unit? Notes:			
● **High Risk Operations Clearance** Has the customer confirmed the planned placement of the facilities is a safe distance from higher risk operations such as processing units in start-up or shutdown situations? Notes:			
● **Potential Toxic Release Review** Has the customer confirmed the planned placement of the facilities will not be in areas of potential toxic gas or vapor releases? Notes:			
● **Area Mobile Equipment Review** Would the planned placement of the facilities and personnel traffic-ways be clear of construction traffic? Notes:			

• **Other Area Considerations** Has a site review with the customer verified site-specific potential hazards have been evaluated for the planned placement of the trailers? ▪ Electrical overheads or similar hazards. ▪ Pipeline or other right of way obstruction, ▪ Flammables storage areas, ▪ Other area construction activities, ▪ Other site specific potential hazards Notes:			

This risk assessment conducted by:

________________________ ____________

Name: Date

________________________ ____________

Summit/LII: Date

- **Attachment 31 – Smoke Free Workplace Policy**

SMOKE FREE WORKPLACE POLICY

I. PURPOSE AND SCOPE

There are significant personal health hazards related to the use of tobacco products (cigarettes, pipes, cigars, smokeless tobacco (e.g. snuff, chew), etc.), including a well-established linkage between the use of such products and cancer and/or respiratory disease. The health hazards related to smoking tobacco impact both the smoker and the non-smoker who is exposed to second-hand smoke. NEPC is committed to the protection of employees, contingent workers, customers and visitors from these health hazards. This policy's objective is the creation of a smoke free work environment.

II. APPLICABILITY

To the extent that it does not conflict with applicable law or regulation or existing labor collective bargaining agreements and is not subject to information and/or consultation with existing employee representative groups, this policy applies to all employees and contractors at all NEPC-controlled facilities where NEPC work is being performed, including offices, manufacturing and service facilities, project sites or other locations where work is being performed on behalf of NEPC. Where negotiation, information, and/or consultation with employee representatives is appropriate, such will occur with the goal of instituting the same or similar policy.

III. SMOKE FREE AREAS

Smoking is prohibited in all areas of the workplace, including all indoor facilities and NEPC's vehicles. Smoking is prohibited in private enclosed offices, conference and meeting rooms, cafeterias, lunchrooms, or employee lounges. Smoking is also prohibited in any enclosed compartment or area inside the Units (turbine enclosure, generator collector cab, accessory module, exhaust duct, filter house, etc.)

Smoking is also prohibited outside of buildings if within 6 meters, of an entrance, window, or air intake duct. Smoking is only permitted in designated areas outside of all buildings.

All designated outdoor smoking areas must be supplied with appropriate receptacles for extinguishing and disposing of smoking material.

lV. SIGN REQUIREMENTS

"No Smoking" signs must be clearly posted at all entrances, restrooms, stairwells and other prominent places. No ashtrays are permitted in any indoor area.

V. COMPLIANCE

Compliance with the smoke free workplace policy is mandatory and covered employees who violate this policy will be subject to disciplinary action. Covered contractors who violate this policy will be discontinued from NEPC work.

Any covered employee who believes that he/she has been adversely impacted by the Company's application or interpretation of this policy may appeal his/her disciplinary action through existing appeal or dispute resolution procedures.

VI. SMOKING CESSATION OPPORTUNITIES

NEPC encourages all employees to quit smoking and/or stop using smokeless tobacco products.

VII. RESPONSIBILITIES

NEPC Health Services shall**:**

- Cooperate with site management, Human Resources and EHS to implement a comprehensive tobacco-free education and cessation program consistent with the spirit of this policy.

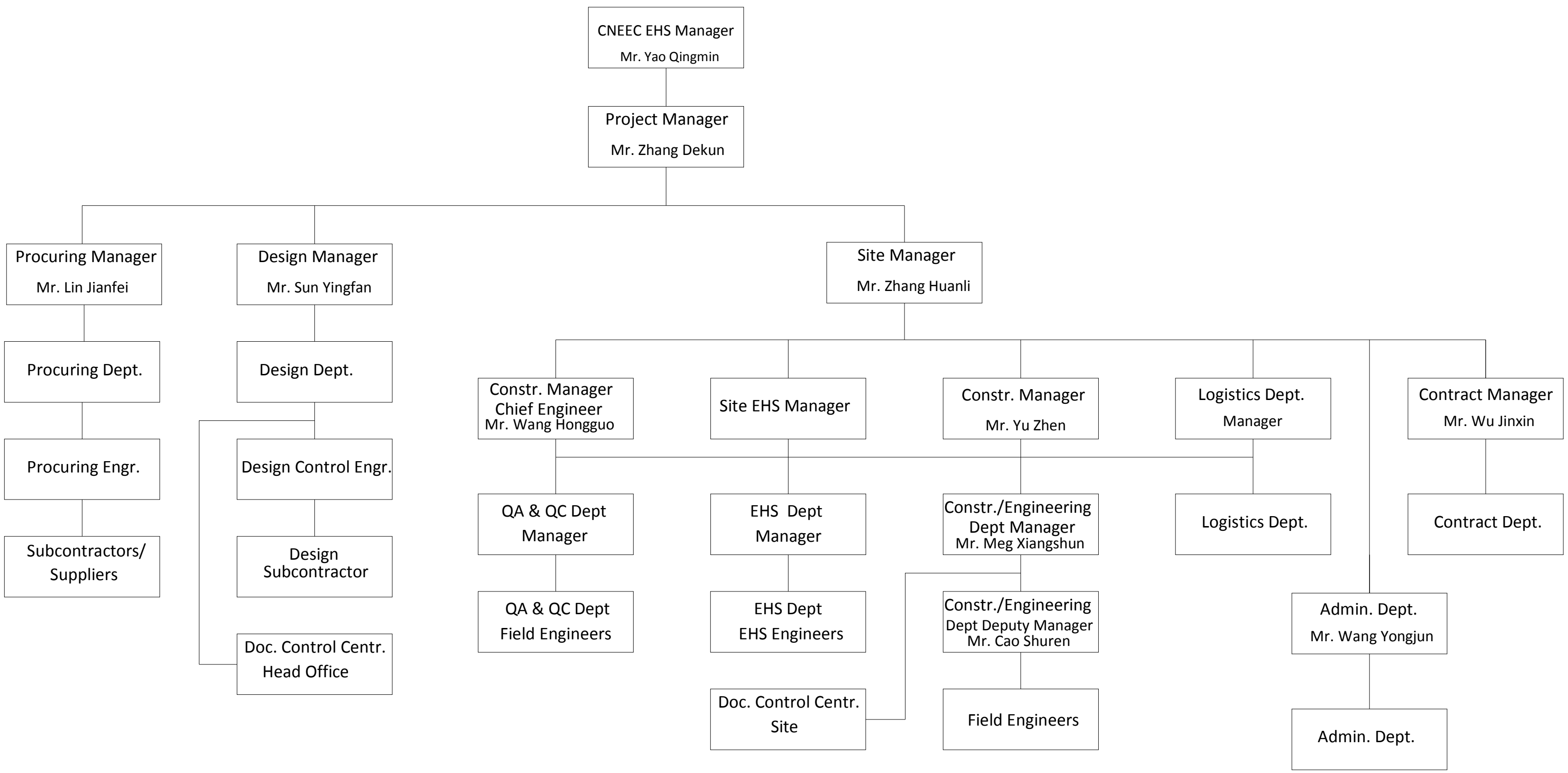
Managers shall:

- Develop a communication plan to notify all employees of NEPC's Smoke Free Work Place Policy.
- Cooperate with Health Services to establish and implement the NEPC smoking cessation and education programs and monitor the effectiveness of such programs.
- Cooperate with the NEPC Health Services to establish a comprehensive smoking cessation and education program consistent with the spirit of this policy.
- Ensure implementation and enforcing of all elements of the policy

Employees shall:

- Abide by this policy. All employees share in the responsibility for adhering to and enforcing this policy.

Attachment 32 – EHS Organization Chart



BIBIYANA Safety Organization Chart

Project manager
Liuyanbing

Site Manager
Liu chunshan

HSE Manager
Sun Jingfu

Construction Department
Safety Officer
Qi Guofeng

GTG/GT Department
Safety Officer
Yang Xingwei

Boiler Department
Safety Officer
Zhao Zhenqiang

Mechanization Department
Safety Officer
Tang Tianxue

Electrical Department
Safety Officer
Gao Xiangyun

General Discipline Department
Safety Officer
Zhao Xuejun

Sub-contractor
Safety Officer

Welding Department
Safety Officer

Purchasing Department
Materials
-Handling Team

应急准备和响应措施

Emergency Preparation and Response Measures

1 编制说明：Bibiyana 项目经理部建立并保持应急预案，目的是在异常、事故发生和紧急情况下的事件，尤其是火灾、人员伤害、食物中毒、辐射及其他环境污染等重大事故发生时，所采取的迅速反应措施和救援措施预防、控制或减少职业危害和伤害。

Introduction：BIBIYANA II site management establish this emergency response program in order to take the rapid action and rescue measures to prevent, control and reduce occupational hazard and injuries when accident and emergency situation happened, especially for fire hazard, human injuries, food poisoning, radiation and other environment pollution.

2 编制依据：预防事故措施方面依据项目部的《危害辩识与风险评价清单》、《重大风险因素及其控制计划清单》、《电力建设安全工作规程》（火力发电厂部分）DL5009.1-2002 和 Bibiyana 现场的实际情况，现场急救部分依据《现场触电急救和创伤急救》(中国水利水电出版社)、孟加拉国相关法规等。

Basis of compilation: according to《hazard distinguish and risk evaluation list》,《major risk factors and its control program list》,《Specification of safety operation of electric construction》(coal-fired power plant)DL5009.1-2002 and the actual situation on site, the first aid at site is as per《electric shock and injury rescue》(China WaterPower Press) and associated laws and rules in Bangladesh.

3 紧急事故应急处理组织机构：organization:

组　长：刘春山

Team leader: chunshan Liu

副组长：胡爱民　于震　　曹敏　于文华　王海清　黄新永

Deputy team leader: aimin Hu, zhen Yu, min Cao, wenhua Yu, haiqing Wang, xinyong Huang

成　员：王建民 王一军 关山宇 郑培军 李敬东 崔建飞 李树新

Member: jianmin Wang, yijun Wang, Sam Guan, peijun Zheng, jingdong Li, jianfei Cui, shuxin Li

孙景富 杜亚东 代启超 吴炳全及各工地主任、分包单位负责人。

Jingfu Sun, yadong Du, qichao Dai, bingquan Wu, all the directors of departments and person in charge from all the subcontractors.

应急指挥办公（值班）室设在安保部。

HES office will be arranged as emergency control office.

对内联系电话：01777504201

Internal contact number: 01777504201

对外部联系电话：01777398106

External contact number: 01777398106

紧急事故应急处理主要领导人员职责和联系电话

Responsibilities and contact numbers of key persons:

序号 SL	姓名 NAME	职务 TITLE	联系电话 CONTACT NUMBER	应急职责 RESPONSIBILITY

1	刘春山 Chunshan Liu	组长 Team leader	01777954223	负责项目部紧急事故应急处理的全面工作。 In charge of emergency measures of whole site.
2	曹 敏 Min Cao	副组长 Deputy team leader	01777899889	主抓项目部应急处理工作财务管理相关事宜。 In charge of financial management for emergency measures.
3	于 震 Zhen Yu	副组长 Deputy team leader	01758709101	协助经理抓好项目部紧急事故应急处理工作。 Assist site manager to perfect the work.
4	于文华 Wenhua Yu	副组长 Deputy team leader	01760870573	负责后勤保障及相关事宜。 In charge of logistical support and etc.
5	胡爱民 Aimin Hu	副组长 Deputy team leader	01777660088	主抓项目部触电、人员伤害、射源事故、大型机械事故的应急处理工作,组织事故调查处理工作。 In charge of electric shock, human injury, radiation accident, machinery accident and corresponding first aid, organize the inspection and management.

6	王海清 Haiqing Wang	总工程师 Chief engineer	01771153786	负责审批项目部应急与响应措施，提供安全技术措施和事故调查处理的技术支持。 In charge of emergency measures, provide the technical support to safety measures and inspection of accident.
7	黄新永 Xinyong Huang	经理助理 Manager assistant	01777954226	协助经理抓好项目部紧急事故应急处理工作。 Assist site manager to perfect the work.
8	孙景富 Jingfu Sun	安全经理 HES manager	01777504201	组织制定项目部应急准备与响应措施，负责项目部触电、人员伤害、射源事故、大型机械事故的应急处理工作，进行事故调查分析处理工作，组织制定反事故措施，杜绝事故的重复发生。 Organize and prepare emergency response measures, In charge of electric shock, human injury, radiation accident, machinery accident and corresponding first aid, organize the inspection and management, make sure to prevent the accident not happen again.
9	代启超 Qichao Dai	保卫主任 Security director	01775182957	负责项目部火灾、爆炸、交通、中毒事故的应急处理工作，进行事故调查分析处理工作，制定反事故措施，杜绝事故的重复发生，负责组织项目部的应急演习并对应急设施

				有效性进行管理。 In charge of handling the fire hazard, explode, traffic and poisoning accident, process the inspection and analyses, take effective actions to avoid accident happen again, organize the emergency practice and manage the emergency devices.
10	杜亚东 Yadong Du	物资供应 Purchasing manager	01777611976	负责应急救援物品的采购供应，并确保及时性、有效性。 In charge of purchasing and supplying emergency materials timely and effectively.
11	郑培军 Peijun Zheng	办公室 officer	01773869995	负责应急车辆及相关事宜。 In charge of arrangement of emergency vehicle.
12	关山宇 Sam	经理助理 Manager assistant	01777398106	对外部联系，保证联系网络有效。 In charge of external communication, make sure the communication effective.
13	各工地主任 Director of each			成立本工地紧急事故应急救援小组，确保当紧急事故发生时，项目部应急准备与响应措施能在本工地得到有效实施。 Organize the emergency rescue team; perform the emergency measures properly in case any

	department			accident happens.
14	应急人员职责 Emergency contactor			发生紧急事故时，立即抢救伤者，保护事故现场，同时采取最快的方式报告项目部，组织进一步的救援工作，并在事故调查时如实反应情况，分析事故时积极提出改进意见和防范措施 Rescue the injured person and protect the accident site when accident happened, report to site management rapidly and truthfully, give the improvement suggestions and precautionary measure when analyzing the accident.

4 应急准备和响应措施范围：

Emergency Preparedness and response measures

4.1 火灾：包括易燃易爆液（汽）体，可燃物体，化学品（酸、碱）；

Fire: Including flammable and explosive liquid (steam), flammable objects, chemicals (acid, alkali)

4.2 触电；

Electric shock

4.3 人员伤害；

Personal injury

4.4 食物中毒；

Food Poisoning

4.5 大型机械事故。

Large mechanical accident

4.6 溺水事故；

Drowning accident

4.7 辐射事故；

Radiation accident

4.8 其他环境污染事故；

Other environmental pollution accident

4.9 去医院途中

On the way to the hospital

5 信息传递渠道：固定电话、手机、对讲机、网络等

Information transmission channel: telephone, mobile phone, walkie- talkie, Internet, etc.

6 信息传递：

Information transmission

6.1 内部信息传递：24 小时紧急电话

Information transmission within company: 24 hours Emergency Call

安保部：01777504201

HSE department

保卫： 01775182957

Security Guard

对外部 ：01777398106

当地警察局：01713374409

Police office

当地火警：0831-61111

0831-62560

Fire fighting office

现场医务室：01719431325

Infirmary in site

医院：0821-760718

Hospital

6.2 外部信息传递：

External information transmission

医院联系电话： 0821-760718

Hospital TEL:

发生紧急事故后，项目部救护车,立即将伤员送往当地就近医院进行救治，电话请求救援。同时掌握道路状况的信息。

After the emergency accidents, the ambulance, take the injured to the nearby hospital for treatment immediately, call in the rescue. Know about the information of road conditions at the same time.

7 应急器材配备

Equipped with emergency equipments

对讲机、手机　　　内部办公电话

Walkie Talkie、Telephone　　　Phone within company

急救箱（急救药品）　氧气袋

First-aid box (First-aid medicine)　　Oxygen bag

急救车辆　　　　　救护车及项目部所有车辆

Ambulance　　　　Ambulance and all cars in the Project

射线防护服　　　　射线报警仪

Ray protective clothing　　　Ray alarming device

警示绳　　　　　　灭火器

Warning line　　　Extinguisher

8 应急响应措施：

Emergency response measures

8.1 火灾、爆炸事故

Fire and explosion accidents

8.1.1 火灾、爆炸事故的防范措施

Fire and explosion accident prevention measures

8.1.1.1 消防工作必须贯彻“预防为主，防消结合”的方针，坚持专门机关与群众相结合的原则，实行“谁主管，谁负责”的防火安全责任制度。按区域划分责任，明确责任人。建立消防管理制度。

Fire work must implement the "prevention first, combining anti-consumer" approach, adhere to the principle of combining the specialized agencies and the masses, the implementation of "Who's in charge, which is responsible for" fire safety responsibility system. Divide responsibility by region and clear responsibility individually. Establish fire management system.

8.1.1.2 凡属施工、生产用的易燃、易爆物品，使用单位必须提出书面申请，经保卫部门领导签字，由供应部门统一购买。

All the flammable and explosive materials used by construction and production departments, the user must submit a written application, signed by the leadership of the defense sector and the supply department of the purchase will purchase together.

8.1.1.3 对贮存易燃、易爆物品的单位，实行一级管理，设立专用库房，指派专人负责，对性质相抵触的物品要分库贮存，严禁与其它物品混放。必须设置在相对独立的安全地带，配备必要的消防器材。

For the storage of flammable and explosive materials units, the implementation of a management, the establishment of a dedicated warehouse, assigned responsibility, contrary to the nature of the library items to be stored with other items prohibited mix. Must set at a relatively independent safety zone and equip with the necessary fire equipment.

8.1.1.4 严格易燃、易爆物品的出入库检查。对收存和发放的易燃、易爆物品，必须进行登记，做到帐目清楚，帐物相符。

Check the flammable, explosive materials strictly .To keep and release of flammable and explosive materials, must be registered, so that the accounts clear, consistent account book.

8.1.1.5 对运输、贮存、使用易燃、易爆物品的单位，必须建立和执行严格的安全技术操作规程和安全管理制度，严禁无关人员进入库区。进入库内人员禁止穿化纤晴纺服装和带铁钉的鞋，严禁在库区内吸烟和用火，严禁在库区内住宿和进行

其它活动。

Transport, storage, using flammable and explosive materials, must establish and implement strict safety procedures and safety management system technology, non-independent entry into the reservoir. Enter the warehouse, can’t wear chemical fiber clothes and the shoes with nails, No smoking and fire in the warehouse, don’t sleep and do any other things in the warehouse.

8.1.1.6 使用保管化学易燃、易爆品的设备和容器，必须符合防火、防爆要求，凡能产生静电而引起燃烧、爆炸的物品，必须装设导电设备。

Use the chemical flammable, explosive devices and container must comply with the fire, and explosion conditions, which can produce the electrostatic and cause burning and explosion, must be installed electrical equipment.

8.1.1.7 动用在 45℃燃点以下的化学易燃物品时，操作人员必须严格遵守操作规程和各项制度，落实防燃措施。

Using in 45 ℃ below the ignition point chemical flammable materials, the operator must strictly comply with operation procedures, implement burning measures.

8.1.1.8 对易燃、易爆物品和剧毒物品，必须由懂得其性能的人负责管理，并做到经常检查。

Flammable, explosive materials and toxic materials must be by the know about function person in charge, and check it always.

8.1.1.9 施工单位用火要严格控制，确需用火时，必须填写用火申请单，经施工、安监、保卫等部门审批，方可动火。

Construction department using fire should strictly control , using fire when really necessary, must write the application with fire, after construction, safety, safeguard and other departments for approval before they flare up.

8.1.1.10 在办公区、生活区内不得乱拉乱接电源，不得随意使用各种电热器具（电褥子、电炉子、电暖气等），如特殊需要，必须写出申请，经施工、安监、保卫等部门审批，方可使用。

In office area and living area shall not disorderly connect the power line, can’t use the electric appliances privately(including electric blanket、electric furnace、electric radiator and so on),Such as special needs, must write the application, after construction, safety, safeguard and other departments for approval before use.

8.1.1.11 消防工作的重点控制区域消防器材配备齐全，并设有消防栓。

The important area for fire work, fire equipments equipped and has the fire hydrants.

8.1.2 消防工作的主管部门为保卫部，保卫部全权负责 Bibiyana 项目经理部的安全防火工作，保卫部、供应部负责消防器材的配备购买工作，做到配备齐全有效，过期或用过的及时更新。各基层单位设立义务消防队，消防工作的重点区域是办公区、生活区、土建木材模板加工厂和库房。

Fire department in charge of the work is the Security Department; Security Department has overall responsibility for fire safety work for Bibiyana project. Security department、purchase department is responsible for fire equipment equipped with purchase. Fully equip and timely updates. Each basic department should set up obligatory fire brigade; the important area of fire control is the work office, living area, civil wood template processing factories and warehouses.

8.1.3 发生火灾、火情、爆炸事故时，迅速报告保卫部和经理部领导，由保卫部组织进一步的救火工作，联系电话：０１７７５１８２９５７。特殊情况需要人力、物力支援的请示领导批准，火势严重、情况紧急拨打火警电话，请求急救。

When fire and explosion accident happened, should report to security department and manager in time, the security department in charge of the fire work, contact number:０１７７５１８２９５７.The special circumstances need manpower and material resources to support, should report to the manager, if the fire is serious, call the fire police for help.

当地火警电话 0831-61111　 0831-62560

Fire police number: 0831-61111　 0831-62560

8.1.4 响应措施

Measures

8.1.4.1 发生火灾、火情、爆炸事故时，各单位应急救援人员立即组织救火，抢救伤员，就近使用消防器材，利用灭火器、沙子、消防栓等器具紧急扑灭或控制火灾、火情，同时组织其他人员安全撤离，重要物品、资料转移，在积极扑救火灾的同时，立即通知项目部保卫部和项目部领导，等待进一步的救援工作，还应尽量保护事故现场，待保卫科到达后接管。

When fire and explosion accident happened, each department should fire fighting immediately, rescue the wounded, use the nearest fire equipment, with the fire extinguisher, sand, fire hydrant and other appliances to control the fire, at the same time organize the other people evacuate, important materials, data transfer.

8.1.4.2 当事故发生情况比较严重时，项目部现有消防器材不能扑灭时，立即联系当地消防局进行进一步的救援工作。

When the accident is serious, the fire equipment in project can’t extinguish fire, immediately contact the local fire department for further rescue work.

8.1.4.3 火灾、爆炸事故的调查处理工作由保卫科负责调查，处理由项目经理部安全防火委员会研究决定，必要时报请当地公安消防部门进行查处。

The Security Department in charge of the fire、explosion accident work,the work is determined by project fire safety committee intends to study, call the local security fire department to investigate in necessity.

8.1.4.4 消防器材、设施，各单位要按规定配齐、配足，特别是易燃易爆重点部位。项目经理部适量储备一些灭火器材，具体工作由保卫负责。

The fire equipments, each department should equipped with complete, especially the inflammable and explosive place. The security department is in charge of fire fighting equipment in site.

8.2 触电的应急准备与响应措施

Preparation and measures for electric shock

8.2.1 防范措施

Precautions

8.2.1.1 电气专业人员，必须进行专业技术培训和安全规程学习，经有关部门考试发证后方可持证独立进行操作。

The Electrical professional person must have the professional technical training and safety procedures study, after identified can operate.

8.2.1.2 施工现场配电柜、电源盘、操作箱及临时电源设置，必须符合技术规范和安全规程。手持电动工具必须安装漏电保安器。

The distribution panel, power pane, electrical box and temporary power, must conform to the technical specification and safety regulations. Hand-held power tools must be installed the leakage protector.

8.2.1.3 电气专业人员在带电及部分带电区域作业时，应制定安全技术措施。高压带电作业及临近高压带电体作业时，除制定安全技术措施外，施工前应填写安全施工作业票。同时根据具体实际情况，办理电气一种或二种作业票，经审批后，应持票作业。按规定要求完工后，必须办理消票手续。

Electrical person operator in the electrification area should enact the safety technology measure. During high voltage and near high voltage operation, except the safety technical measures, before construction should fill in the safety construction work permit. Depending on the actual situation, filling in the fires type or second type work permit, after approval, should operate with the work permit.

8.2.1.4 电气专业人员施工作业时，必须戴安全帽、穿绝缘鞋、着工作服和绝缘手套，并一人工作，一人监护。

When the electrical person operating，must wear safety helmet, insulation shoes, work clothes and insulation gloves, and one person work, one tutelage.

8.2.1.5 220 伏照明线路要同时设输送零线，禁止用“一线一地”方式供电；线路及灯头距地高度应大于 2.5 米；行灯、机床工作灯，电压均不得大于 36 伏；在金属容器内或特别潮湿地点不得大于 12 伏。

220V lighting to set transmission zero at the same time, can’t one line one ground; the lines and lamp is apart from the ground should be more than 2.5 m; the voltage for portable light, lathe light can’t more than 36V; in the metal container or special place can’t more than 12v.

8.2.1.6 拉闸停电作业时，开关必须设专人监护并在此处悬挂“禁止合闸”的警告牌，否则严禁作业。

When cutting power for operating, should have person in charge and set uo "No closing" warning sign beside switch, otherwise can’t operate.

8.2.1.7 各种电器设备完工后，作业人员应进行通电检验，确定完好，做好移交记录后，方可交用户使用。

After operating, the operators should have electric inspection, make sure in good condition, complete the transfer of records before hand in users.

8.2.1.8 除电气专业人员外，其他人员严禁从事电气作业，不准私拉、乱接电源。施工时一些电气设备需要移动时应通知工程部，不得擅自移动或丢弃。

Except electrical person, other people can’t operate the electric work. No connecting the power privately. Some electrical equipments need move, should inform engineering department, don’t move or discard privately.

8.2.1.9 电气设备附近应配备适合于扑灭电气火灾的消防器材，发生电气火灾时，应首先切断电源。

Near the electrical equipments should have fire fighting equipments for the electrical fire, when it happened, should cut off the power.

8.2.1.10 严禁将电线直接勾挂在刀闸上或直接将线头插入插座内使用。

Don’t connect the wire to the knife switch or to the multi-plug directly.

8.2.1.11 严禁用其它金属丝代替熔丝。开关应控制火线。

Don’t use other metal wire instead of fuse wire. Switch should control the wire.

8.2.1.12 手动操作开启式空气开关、刀闸开关或管型接断器时，应戴绝缘手套或使用绝缘工具。

Open air switch, knife switch or pipe breaker, insulating gloves should be worn or use insulated tools.

8.2.1.13 所有盘（柜）均应上锁并指定专人负责。

All the panels should be locked and have the person in charge.

8.2.1.14 所有盘（柜）均应安装漏电断路器且盘（柜）的总开关必须是漏电断路器；盘（柜）内的电器保护套（盖）应保持完好。

All the panels should be installed residual current circuit breaker, and the main switch of all the panels is residual current circuit breaker; the electrical protective cover inside must be intact.

8.2.1.15 电源班负责将电源送到施工电源盘一次线（含电源盘及盘内配电装置），各单位严禁私拉乱接电源。

Power Team is responsible for the power supply to the construction of a line drive(Including the power panel and switchgear).

8.2.1.16 各分包单位内部电源须由专业电工维护管理，严禁非专业人员代替上岗。

The power must be maintenance by a professional electrician of each sub-contractor and prohibited non-professionals instead of posts.

8.2.1.17　3 千瓦（含 3 千瓦）以上负荷接线必须在电源班的监督下进行。

More than 3 kW (including 3 kW) the load wiring must be operator under the supervision of the power team.

8.2.1.18 各单位用电需提前向工程部提出申请，申请内容包括又电地点、机械名称、负荷容量及用电时间，经工程部批准后，由电源班负责实施。

Each department before use electricity should to apply to the engineering department in advance, including the location、machine name、load capacity and time, after approved by the engineering department, the power team in charge.

8.2.1.18 各单位用电需提前向工程部提出申请，申请内容包括又电地点、机械名称、负荷容量及用电时间，经工程部批准后，由电源班负责实施。

Every unit should apply to the Engineering Department in prior when it is necessary to use electricity, the application should contain place, machine, load capacity and time, the power maintain team is responsible for the implementation after the application is allowed by Engineering Department.

8.2.1.19 现场使用的绝缘导线应绝缘良好，无破皮、露芯现象，严禁超负荷使用。

The insulated wire used at site should insulate well and no broken, it is strictly banned overload using.

8.2.1.20 电源线路不得接近热源或直接挂在金属物件上；在金属脚手架上架设时

应设木横担。

The electric wire shall not be close to the heat source or directly on the metal objects, when set up on the mental scaffold it should prepare wooden cross arm before.

8.2.1.21 现场使用的电动机械必须有明显接地，且接地良好、牢固。地线的连接应采用焊接、压接或螺栓连接等方法。严禁简单缠绕或勾挂。

Field use of electric machinery must have obvious grounding, and well grounded, solid. Ground wire connection should be the methods of welding, pressure welding or bolt connection. It is forbidden to simple coil or hook.

8.2.1.22 严禁两台及两台以上电动设备共用一个开关。

It is strictly prohibited that two or more electric equipments share a switch.

8.2.2 安保部是触电事故的应急准备与响应的主责部门，统一管理项目经理部触电事故的急救工作，各工地配合。

Security Department is the main responsibility department for emergency preparedness and response of electric shock incident, to unified deal with emergency work about electric shock incident of project, each site cooperate with security department to deal with relevant work.

8.2.3 发生触电事故时，除了现场简单急救外，立即用对讲机或电话通知安保部，由安保部再向主管安全的副经理和总经理汇报，及时组织进行进一步救援工作。

Security Department should be noticed as soon as electric shock incident happening, except first aid, Security Department should report to the deputy general manager and general manager of security, and organize for further rescue timely.

8.2.4 响应措施

Respond Measure

发生触电事故时，根据具体情况可分为现场简单急救、送往医院，现场急救的具体操作可分为迅速解脱电源、简单诊断和对症处理三大部分。

When electric shock incident happened, according to the condition, it can be divided into scene simple first aid and taken to hospital, the operation of scene simple first aid can be divided into break away from power, simple diagnosis and symptomatic treatment.

8.2.4.1 迅速解脱电源

break away from power

一旦发生触电事故时，切不可惊慌失措，束手无策，首先要设法使触电者脱离电源。

When the accident happened, don’t scared, try to make the people get an electric shock break away from the power.

使病人脱离电源的方法一般有以下几种：

There are some methods of make the people break away from the power as follows:

8.2.4.1.1 切断电源。当电源开关或电源插头就在事故现场附近时，可立即将闸刀打开或将电源插头拔掉，使触电者脱离电源。必须指出普通的电灯开关（如拉线开关）只切断一根导线，且有时断开的不一定是相线，因此，关掉电灯开关并不能被认为是切断了电源。

Power abscission, immediately open the strobe or pull out the plug when the power switch or the power plug is near the accident scene, to make the people get away from power. It must be indicated that the common switch(such as pull switch) can’t be break down the power source for only cut off one wire, sometimes the wire be cut off is not used to import the current, so turn off the switch is not equal to break down the power.

8.2.4.1.2 用绝缘物移去带电导线。当带电导线触及人体引起触电，且不能采用其它方法解脱电源时，可用绝缘的物体（如木棒、竹杆、手套等）将电线移掉，使病人脱离电源。

Wire moving with insulation. There is no method to help people who get an electric shock break away from the power, we can move wire with insulation(such as wooden, bamboo, gloves etc.).

8.2.4.1.3 用绝缘工具切断带电导线。出现触电事故，必要使可用绝缘的工具（如带有绝缘柄的电工钳、木柄斧以及锄头等）切断导线，以断开电源。

Wires cutting off with insulated tools. When electric shock incident is appearing, wires with electricity must be cut off with insulated tools (such as pliers with insulated handle, axe with wooden handle and hoe etc.), to break down the power.

拉拽触电者衣服，使之摆脱电源。若现场不具备上述三中条件，而触电者衣服干燥，救护者可用包有干毛巾，干衣服等干燥物的手去拉拽触电者的衣服使其脱离电源。

Pull the people’s clothes to help he break away from the power. If there is no condition as above, but his clothes is dry, ambulance man could wrap up hand with dry towel, dry clothes and other things dry firstly, and then pull the people’s clothes to help he break away from the power.

必须指出，上述办法仅适用于220/380v“低压”触电的抢救。对于高压触电应及时通知供电部门，采用相应的紧急措施，以免产生新的事故。

It must be indicated that, the method above only apply to 220/380v “low voltage” electricity shock rescue, “high voltage” electricity shock should notice power supply department in time to adopt the corresponding emergency measures for fear that new accident happened.

总之，在现场可因地制宜，灵活运用各种方法，迅速安全地使触电者脱离电源。必须注意触电者脱离电源后，因不再受电流刺激，肌肉会立即放松，故有可能会自行摔倒，造成新的外伤（如颅底骨折等），特别事故现场在高处时，危险性更大。因此在解脱电源时应辅以相应措施，避免发生二次事故。此外，解脱电源时，除应注意自身的安全外，还需注意不可误伤他人。

Generally speaking, various methods could be adopted according to the situation at site to help the people break away from the power. It must pay attention to that after people get away from power maybe fall down immediately and make new trauma (such as the fracture of the skull base, etc.), because current doesn’t stimulate body again, people’s muscle will relax immediately, especially the scene of the accident is at height, the risk is bigger, when break away the power should be supplemented with auxiliary measures for avoiding secondary accident. Furthermore, ambulance man not only paying attention on their safety, but also pay attention to protect others from hurt.

8.2.4.2 简单诊断

Simple diagnosis

解脱电源后，病人往往处于昏迷状态或“临床死亡”阶段，因情况不明，故应尽快对心跳和呼吸的情况作一判断，了解是否处于“假死”状态。只有作出明确的诊断，才能及时正确地进行急救。

After break away from power, people will in coma, ambulance man should judge the condition of breath and heartbeat. Only the right diagnosis can give the right first aid treatment.

8.2.4.2.1 判断是否丧失意识

Judge whether sober or not

首先轻轻摇动触电者的肩部（绝对不允许摇动头部），并对之呼叫，最好直呼其姓名，看看有否反应，以判断是否丧失意识。有反映者，肯定有心跳、呼吸

存在；若无反映，即丧失意识，这时用一手手掌托住伤员颈部，以防止颈部弯曲，另一手握住其上臂近肩端，并以此处为力点，平稳地翻转至仰卧位。翻转时，必须使触电者的头、颈、躯干，臀部同时转动，以防止扭曲，发生新的损伤，随后应立即将其上衣和裤带放松。一般昏迷的触电者常有气道阻塞，故必须马上畅通呼吸道，否则，人工呼吸及人工心脏挤压法都将完全无效。此时，我们可用一手的手掌将其项部向上方托起。另一手的手掌放于额部，向下用力，使其头部向后仰翻，以达到开放气道的目的。

Firstly, shake shoulder slightly (it's not allowed to shake brain absolutely) and calling him to judge whether sober or not according to the respond. If there have respond, there must have breath and heartbeat correspondingly. If not, it means lose awareness, and support injurer's neck by one hand in case of neck curving, then grasp the top of arm and make the injury lie down on the ground. During the process of making the injury ling on the ground, the head, neck, body and buttocks must turn around at the same time for fear that any of body sprain, then loosen jacket and waistband. People who get an electric shock often have trachea blocking and we must take treatment quickly, or it will make artificial respiration and artificial heart extrusion failing. At this point, we can support its neck to the top by hand, then press its head turned to the back by another hand, in order to make trachea unobstructed.

8.2.4.2.2 观察有否呼吸存在

Observe whether there is breathing

在保持呼吸道畅通的情况下，将耳朵贴向触电者的口鼻处，用听觉及面额的感觉来判断触电者是否有因呼吸所产生的气体流动，并侧头观察触电者的胸廓及上腹部有否呼吸时所产生的运动。如能观察到胸廓或腹壁有呼吸产生的起伏运动，或者感觉到触电者口鼻处有气体的吹拂感（呼吸时气体流动所致），则判定触电者有呼吸存在；反之，则呼吸已停止。当不便观察时，也可用手触摸胸部或腹部，以感觉有无呼吸运动。整个观察时间不能过长，一般不得超过 5 秒钟。

In the case of keeping the trachea unobstructed, judge the injury's breath is normal by make ear close to nose and mouth of the injury, and observe whether there is up and down of chest caused by breathing or not. If fluctuating, or there is blowing (caused by breathing), then determine the breathing is normal; contrary, the breathing has stopped. When it's not convenient to observe, touch the chest or abdomen to feel the presence or absence of respiratory movement. Entire observation time is not more than 5 seconds.

8.2.4.2.3 检查颈动脉有否搏动

Check carotid pulse

颈动脉是人体的大动脉，位于胸锁乳突肌的前缘，相当于喉结水平。颈动脉是中心动脉，在周围动脉搏动消失时，仍能触及颈动脉的搏动。颈动脉位置比较浅，很容易感觉到它的搏动。检查时不必脱衣，极为方便。我们将颈动脉是否有搏动，作为是否有心跳的依据。

Carotid artery is the body's main artery, located in the leading edge of the sternocleidomastoid, equivalent to the level of the Adam's apple. Carotid artery is the center, when the pulses around carotid artery disappeared, carotid artery still be touched. Carotid relatively shallow position, it is easy to feel the beat. Examination need not undress, very convenient. Whether Carotid artery is hitting or not is a basis for heartbeat.

检查时，可将中指和食指合并一起，指尖部置于喉结部位，然后，慢慢向颈侧移动，其移动轨迹与人体长轴相垂直。移动过程中，同时对气管旁软组织进行触诊，若能感到颈动脉搏动则伤员仍有心跳，若无感觉则心脏已停止跳动。检查应在 5 秒钟内完成。触诊应轻柔，不能加压。

During inspection, combined with the middle finger and index finger, placing fingertip on the laryngeal, and then moves toward the neck slowly, which moves perpendicular to the long axis of the human body locus. The process of moving, palpating the soft tissue around the trachea, if you feel the carotid pulse is still hitting, contrary, the breathing has stopped. Checking should be completed within 5 seconds. Palpation should be milt, don’t pressurized.

值得注意的是，如发现触电者呼吸已停止，则应立即作四次连续的口对口人工呼吸，然后检查颈动脉有否搏动。检查时，一手掌部仍需放在病人额部，使其头部仍保持后仰姿势。

It is noted that, as found the injury has stopped breathing, consecutive mouth resuscitation should adopt immediately for four times, then check whether carotid pulse hitting. Ambulance man’s hand still support forehead during inspection, make the head remains back.

8.2.4.2.4 观察瞳孔是否扩大

Judge whether pupil is expand or not

瞳孔的作用有点类似照相机的光圈，但人的瞳孔是由大脑控制而自动调节的。当大脑细胞正常时，瞳孔的大小会随外界光线强度的变化自行调节，使进入眼内的光线强度保持适中，以便于观看。当处于“假死”状态时，大脑细胞严重缺氧，处于死亡边缘，整个自动调节系统中枢失去了作用，瞳孔也就自行扩大，这时瞳孔对光线的强弱不起反映。所以，瞳孔扩大说明了大脑组织细胞严重缺氧或已遭受损害死亡，此时人体也就处于“假死”或更严重的状况。

Pupil’s foundation is similar as the aperture of camera, but pupil is controlled by brain, and justify by itself. Pupil’s expansion or lessening will change according to the light from outside, and keep in appropriate ntensity. When the brain is in suspended animation, cell is seriously lacking of oxygen, pupil is expanding by itself. At this time, pupil has no respond for the light from outside, it means that brain cell is seriously lacking of oxygen or has destroyed, and people is in danger.

通过以上简单的检查，我们即可判断触电者是否处于“假死”状态。并依据“假

死”的类型，有的放矢地对症处理。

Though the simple inspection above, we can get the result of people who get electricity shock whether in suspended animation or not, and make right treatment on the basis of the situation.

8.2.4.3 处理方法

Treatment measures

经过简单诊断后的病人，一般可按下列情况分别处理：

After diagnosis we can take following treatments according to different situations:

8.2.4.3.1 病人神志清醒，但感乏力、头昏、心悸、出冷汗，甚至有恶心或呕吐，因让其就地安静休息，以减轻心脏负荷，加快恢复；情况严重时，应小心送往医疗部门，请医务人员检查治疗，在送往的路途中，需严密观察病人，以免发生意外。

The injury is conscious, but fatigue, dizziness, palpitations, cold sweats, even nausea or vomiting, a quiet place is needed to rest to reduce cardiac stress and recover quickly. While serious, should be carefully taken to the medical department, and take examination and treatment by medical personnel. The injury should be closely observed to avoid accidents on their way for treat.

8.2.4.3.2 病人呼吸、心跳尚存在，但神志不清。应使其仰卧，保持周围空气流通，注意保暖，并且立即通知医务室，或用担架将病人送往就近医院，请医务人员抢救，在此同时还要严密观察，作好人工呼吸和体外心脏挤压急救的准备工作。一旦病人出现“假死”情况应立即进行抢救。

The injury have breathing and heartbeat, but unconsciousness. Ambulance man should make him lie on the ground and keep air circulating and warm to notify the clinic immediately, or to the nearest hospital by stretcher, it is noticed that closely observed must be adopted in the same time, artificial respiration and external cardiac squeeze pressure emergency must be prepared. The injury should be rescued immediately as soon as the situation of "suspended animation" appearing.

8.2.4.3.3 假如检查，发现病人已处于“假死”状态，则应立即针对不同类型的“假死”进行对症处理；若呼吸停止，则用口对口人工呼吸法维持气体交换；若心脏停止跳动，则用体外人工心脏挤压法来重新维持血液循环；若呼吸、心跳全停，则需同时施行体外心脏挤压和口对口人工呼吸。同时应立即向医疗部门告急求救。

If the injury has been in "suspended animation" during inspection, different treatment should be taken immediately for different types of "suspended animation" symptomatic; If the injury has stopped breathing, ambulance man should take mouth-to-mouth breathing to maintain gas exchange; If the heart has stopped beating, ambulance man should take the artificial cardiac compression method to maintain blood circulation; If breathing and heartbeat all have stopped, cardiac compression and mouth to mouth resuscitation should be adopt in the same time. Meanwhile, emergency help should be sent to the medical department immediately.

抢救工作不能轻易中止，即使在送往医院的途中，也必须继续进行抢救，边送边救直至心跳、呼吸恢复为止。

Rescue work can’t be aborted, even on the way to the hospital, treatment and send people simultaneously until heartbeat, breathing restored.

8.3 人员伤害（施工现场由于高处坠落、物体打击、起重伤害、机械伤害、淹溺等造成的人员伤害）应急准备与响应措施

Preparation and respond measures for personnel injury(due to fall down from height, attack, crane hurt, machine hurt, drowning etc.)

8.3.1 预防措施

Prevent measure

8.3.1.1 在制定施工方案时，尽量考虑地面组合，减少高处作业的频次。

During the formulation of construction project, try to consider constructing on the ground and reduce high operation.

8.3.1.2 高处作业的平台、走道、斜道等装设 1.05m 高的防护栏杆和 18cm 高的挡脚板，或设防护立网。

The platform, walkways, ramps of the height should be installed protective railings of 1.05m, and block feet of 18m, or set up protective grid.

8.3.1.3 高处作业区周围的孔洞、沟道等处设盖板、安全网或围栏。

The holes, trenches around high operating area should set safety net or fence.

8.3.1.4 特殊高处作业与地面设联系信号或装置并由专人负责。

There should be set contract signal or communication device between special high operating area and ground, and in the charge of specialized personnel.

8.3.1.5 在夜间或光线不足的地方进行高处作业，布置有足够的照明。

There should be set enough lighting in the high operating area, for fear that people working in the night or light insufficient.

8.3.1.6 遇有六级及六级以上大风或恶劣气候时，停止露天高处作业。雨天进行露天高处作业时，采取防滑措施。

In case of Force 6 or stronger wind or bad weather, aerial work must be stopped. Slip-resistant measures shall be taken during aerial work in rainy weather.

8.3.1.7 凡参加高处作业的人员全部进行体格检查。经医生诊断患有不宜从事高处作业病症的人员不得参加高处作业。

Workers who are to conduct aerial work shall take the physical examination and those who are diagnosed with diseases unfit to do aerial work are not allowed to take up it.

8.3.1.8 施工人员上下脚手架走斜道或梯子，不沿绳、脚手立杆或栏杆等攀爬，也不任意攀登高层构筑物。

Workers shall take the access ramp or ladder when going up/down the scaffold, climbing along the rope, pole or rail is not allowed, climbing tall buildings are not allowed, either.

8.3.1.9 高处作业区附近有带电体时，传递绳使用干燥的麻绳或尼龙绳，严禁使用金属线。

In case of electrified body near aerial work area, dry hemp rope or nylon rope shall be used as passing rope, metal wires are not allowed.

8.3.1.10 特殊高处作业的危险区设围栏及“严禁靠近”的警告牌，危险区内严禁人员逗留或通行。

Fence and warning board of “No approaching” shall be put up at of special aerial work dangerous area, no one is allowed to stay or pass such area.

8.3.1.11 垂直攀登时，使用安全自锁器；在单梁上行走及作业时，须架设水平扶绳，并且要根据实际情况，铺设安全网。

Secure self-locking device shall be used during vertical climbing; horizontal guide rope shall be set during walking or working on the single beam, safety net may be set based on the actual situation.

8.3.1.12 高处作业地点、各层平台、走道及脚手架上堆放的物件不超过允许载荷，施工用料随用随吊。

Material piled on aerial work spot, each platform, passage and scaffold is not allowed to be overload. Amount of construction material shall be lifted according to the using amount.

8.3.1.13 高处作业人员配带工具袋，较大的工具系保险绳；传递物品时，严禁抛掷。

Tool bags shall be used during aerial work. Larger tools shall be tied with safety ropes. Throwing and casting is not allowed when objects are to be passed.

8.3.1.14 高处作业时，点焊的物件不得移动；切割的工件、边角余料等放置在牢靠的地方或用铁丝扣牢并有防止坠落的措施。

Parts to be spot welded are not allowed to be moved during aerial work; cut parts, minor material etc. Shall be placed at stable place, or fixed with iron wires and meanwhile fall-resistant measures shall be taken.

8.3.1.15 交叉作业场所的通道保持畅通；有危 险的出入口处设围栏或悬挂警告牌。

The access for construction of several units operating together should keep smooth, setting up fences or hanging warning signs at the entrance which is dangerous.

8.3.1.16 隔离层、孔洞盖板、栏杆、安全网等安全防护设施严禁任意拆除；必须拆除时，办理移动防护设施申请，在工作完毕后立即恢复原状并经验收；严禁乱动非工作范围内的设备、机具及安全设施。

It is forbid to remove isolation layer, holes cover, railings, safety nets and other security facility; when it’s necessary to dismantle, relevant department should apply for it, when the construction is completed, the security facility must be rehabilitated immediately and tested.

8.3.1.17 交叉施工时，工具、材料、边角余料等严禁上下投掷，使用工具袋、箩筐或吊笼等吊运。严禁在吊物下方接料或逗留。

During the construction of operated by several units together, tools, materials, and other odd bits are forbidden to throw up and down, these material should be lifting by tool bags, baskets or hoists. It’s prohibited to stay or stay for splice under the hanging.

8.3.1.18 起吊物绑牢。吊钩悬挂点与吊物的重心在同一垂直线上，吊钩钢丝绳保持垂直，严禁偏拉斜吊。落钩时防止吊物局部着地引起吊绳偏斜。吊物未固定时严禁松钩。

Materials should be fastened during lifting. Hook suspension point and the center of gravity of hanging should in the same vertical, hook rope should keep the vertical, it is not allowed incline. During falling, worker should prevent part of material fall to the ground first to causing the wire deflection. It is prohibited loose hanging when the material is not fixed

8.3.1.19 千斤绳的夹角一般不大于 90°，最大不得超过 120°。

The angle of extremely heavy rope generally not more than 90 °, the maximum should not exceed 120 °.

8.3.1.20 当工作地点的风力达到五级时，停止进行受风面积大的起吊作业；当风力达到六级及六级以上时，停止起吊作业。

When the wind reaches five levels in workplace, if the wind area of lifting operations is large, stop lifting operations; when the wind reached six and more than six, stop lifting operations.

8.3.1.21 起重作业人员，持证上岗。

Lifting operation personnel should have certificates when they on work.

8.3.1.22 吊装前严格检查所用的起重机械、吊装工具、绳索是否正常完好。严禁超负荷吊运，对超高、超宽物体的吊装，制订具体的安全技术措施。

Inspect the hoisting machinery, tools and ropes strictly before operating. It is strictly prohibited to overload lifting, hoisting which is super high and super wide, formulate specific safety technical measures.

8.3.1.23 操作人员在吊装物体时，注意力要集中，要留有一避让余地，悬吊物体上下，不准站人和通行。

During lifting, Operator should concentrate on work, to leave a room to elude, it is not allowed to stand and traffic under the hanging objects.

8.3.1.24 在吊装作业时，提升或下降必须平稳，避免有冲击、振动等现象发生，不允许任何人随同吊装设备升降，在吊装过程中，因故（停电等）中断，采取措施进行处理，不得使吊装物体悬空过夜。

During lifting operations, raised or lowered must to be stable, to avoid shock, vibration and other phenomena occur, anyone is not allowed to accompany lifting, in lifting process, the operation is interrupted for some reason (power outage, etc.), workers should take measures to deal with it and don't keep the lifting objects floating overnight.

8.3.1.25 卷扬机除牢固固定外，电气设备接地接零，卷扬机操作人员熟悉机械性能，严禁非操作人员操作，下班之后切断电源。在工作时，钢丝绳卷入卷筒不得有扭转、急剧弯曲、压绳、绳与绳之间排列太松等现象，否则停车排除。

Winch should be fastened and the electrical equipment should be grounded to the zero, the operator of winch should experienced, it is banned that non-operating personnel operate it, the power of winch should be cut off after work. At work, rope reel may not have involved reversing the sharp bend, and so arranged between the pressure is too loose rope, rope and rope, otherwise parking excluded.

8.3.1.26 各种机械在使用时，严格按安全操作规程或规定执行，明确安全负责人，严禁非本专业工种人员操作，各种机械做好接零或接地保护。

During the course of using, all kinds of machinery should be implemented as the operation procedure or regulation, specific responsible for the safety of people, it is prohibited to operated by non-professional personnel, all machineries should be protect of grounding.

8.3.1.27 大型吊车实行专机专人，司机持证上岗，做好交接班记录。

One large crane should to be operated by same person with experience, the driver is certificated, and make shift record.

8.3.1.28 各使用单位做好机械的维护保养工作，保证机械的安全性能，绝对不能带病工作。

Every unit should pay attention to maintain the equipment, to ensure the safety performance of it, it is strictly forbid to work with sick.

8.3.1.2 9 水中或船上作业时，必须穿救生衣。

Operating in water or on boat, workers must wear in life jacket.

8.3.2 人身伤害事故应急准备与响应的主责部门是安保部，安保部负责组织实施人身伤害事故的应急响应措施，综合部车辆配合，发生人身伤害事故单位人员配合救援工作。

Security Department is the main responsibility department for preparation and respond of personal injury, Security Department in charge of organization and implementation of emergency response measures in personal injury accidents, Integrate Department prepare vehicle to help Security Department, injury accident unit coordinate with relief efforts.

8.3.3 施工现场发生了人身伤害事故，除了立即抢救伤员外，马上用对讲机或电话通知安保部，由安保部再向主管安全的副经理和总经理汇报，组织进一步的救援工作。联系对讲机：　　　　　（安保部）、电话０１７７７５０４２０１（孙景富）。

There is personal injury accident occurred on the site, immediately rescue the wounded and inform Security Department at the same time, because the department should report to security department and deputy general manager for further rescue work. Contact NO. (Security Department) ０１７７７５０４２０１（Sun Jingfu）.

8.3.4 响应措施

Respond measure

8.3.4.1 施工现场发生了人身伤害事故，立即抢救伤员，保护事故现场，报告项目部。

If there is a personal injury accident occurred, immediately rescue the wounded, protect the scene of the accident, and report to projects department.

8.3.4.2 现场应急救援人员通过目测或语言交流确定受伤人员的伤害程度，根据具体情况进行现场的紧急救护，然后立即送往当地定点医院救治。

Emergency rescue personnel determine the extent of damage to the injured through visual or verbal communication, according to the situation to take the emergency, and then immediately taken to the designated hospitals for treatment.

8.3.4.2.1 创伤急救的基本要求 Injury First Aid' Requirements

8.3.4.2.1.1 创伤急救原则上是先抢救，后固定，再搬运，并注意采取措施，防止伤情加重或污染。需要送医院救治的，应在立即做好保护伤员的措施后再送医院救治。

The principle of injury first aid is to rescue and fix then carry, meanwhile, taking methods to prevent the situation becoming seriously and wound being infected. If the wounded person need to send to hospital should be after taking protection methods for whom.

8.3.4.2.1.2 抢救前先使伤员安静躺平，判断全身情况和受伤程序，如有无出血、

骨折和休克等。

The wounded person should lie down flatly and quietly before rescue, judging the body situation and wound procedure, whether has the phenomenon of blooding, fracture and shock etc..

8.3.4.2.1.3 体表出血时应立即采取止血措施，防止失血过多而休克。外观无伤，但呈休克状态、神志不清或昏迷者，要考虑胸腹部内脏或脑部受伤的可能性。

Taking methods to prevent body surface blooding,avoiding shock due to over blooding. Surface without wound, but the person has the symptom with shock,obnubilation and coma, taking breast and head injury into consideration.

8.3.4.2.1.4 为防止伤口感染，应用清洁布片覆盖。救护人员不得用手直接接触伤口，更不得在伤口内填塞任何东西或随便用药。

Using clean fabric to cover the wound avoiding the wound be infected. Ambulance man can not use the hand to touch the wound directly as well as randomly use medicine or fill the wound with things.

8.3.4.2.1.5 搬运时应使伤员平躺在担架上，腰部束在担架上，防止跌下。平地搬运伤员时头部在后，上楼、下楼、下坡时头部在上，搬运中应严密面容伤员，防止伤情突变。

When carrying the wounded person, make whom lie down flatly on the stretcher, fastening the waist on the stretcher to avoid falling down. The wounded person head should at rear when carrying on the flat ground, when go upstair, downstair and slope, the head at front.

8.3.4.2.2 止血处理 Hemostatic treatment

8.3.4.2.2.1 指压止血法。根据动脉沿肢体的体表投影，以手指、手掌或拳头用力压迫伤口的血管近心端，以达到临时止血的目的。

Shiatsu hemostatic. According to arteries along the body surface projection, using fingers, palm or fist hard oppression wound near heart blood vessels, in order to achieve the purpose of the temporary stop bleeding.

a) 一侧头顶出血，可用食指或拇指压迫同侧耳前方搏动点进行止血。

a) On one side of the head bleeding, can use index finger or thumb oppression hemostasis with give ear pulse points ahead.

b) 一侧颜面部出血，可用食指或拇指压迫同侧下颌骨下缘，下颌角前方 3cm 处进行止血。

b) One Side of face bleeding, can use the index finger or thumb oppression edge of ipsilateral lower jaw, jaw Angle of front 3 cm to stop bleeding.

c) 一侧头面部出血，可用拇指或其他四指压迫同侧气管与胸锁乳突之间进行止血。

c) On one side of the head bleeding, can use the thumb and other four refers to the oppression on the same side between the trachea and sternoclavicular mastoid to stop the bleeding.

d) 肩腋部出血，可用拇指压迫同侧锁骨中窝中部的搏动点进行止血。

d) Shoulder and axillary region bleeding, oppression in the ipsilateral clavicle nest available thumb pulsation of central point to stop the bleeding.

e) 前臂出血，可用拇指或其他四指压迫上臂内侧二头肌的内侧沟处的搏动点进行止血。

e) Forearm bleeding, can use the thumb and other four refers to the oppression of upper arm medial biceps pulse points in the medial groove to stop the bleeding.

f) 手部出血，互救时可用两手拇指分别压迫手腕横纹稍上处内外侧的各一

搏动点进行止血。

f) When hand bleeding, communal oppression available both thumbs wrist horizontal grain slightly on the inside and outside of the beat of a point to stop the bleeding

g) 大腿以下出血，自救时可用双手拇指重叠用力压迫大腿上端腹股沟中点稍下方的一个强大的搏动点进行止血。互救时，可用手掌压迫，另一手压在其上进行止血。

g) Below thigh bleeding, just yourself, use thumbs of overlapping force oppression thigh top groin slightly below the midpoint of a powerful pulse point to stop the bleeding. Communal, palm oppression are available, and the other pressure on them to stop the bleeding

8.3.4.2.2.2 伤口渗血处理，用比伤口稍大的消毒纱布数层覆盖伤口，然后进行包扎。若包扎后仍有较多渗血，可再加绷带适当加压止血。

Wound oozing blood processing, with a slightly bigger than the wound sterile gauze to cover the wound, then wrap. If still have more bleeding after dressing, can add bandage to enlarge pressure appropriately.

8.3.4.2.2.3 伤口大出血处理。伤口出血呈喷射状或涌出鲜红血液时，按出血部位不同按 8.3.4.2.2.1a)~g)中的方法，立即用清洁手指压迫出血点上方（近心端），使血流中断，并将出血肢体抬高或举高，以减少出血量。

The treatment of wound large bleeding. Wound bleeding sprout or bright red blood, according to bleeding different parts according to 8.3.4.2.2.1 method in a) to g), immediately with a clean finger compression bleeder near heart to disrupt blood flow, and raise bleeding body, in order to reduce the bleeding.

8.3.4.2.2.4 用止血带或弹性较好的布带等止血时，应先用柔软布片、毛巾或伤员的衣袖等数层垫在止血带下面，以左手的拇指、食指、中指持止血带的头端，将长的尾端绕肢体一圈，然后用左手食指、中指夹住尾端后，将尾端从止血带下拉

过，由另一缘牵出，使之成为一个活结，如需放松止血带，只需将尾部拉出即可。

Use tourniquet or better elastic cloth belt such as bleeding, should be with a soft cloth, towel or the sleeve of the wounded several layers of mat underneath the tourniquet, and left thumb and forefinger, middle finger the tourniquet to take the head end, the end of a long round the body, and then use his left index finger and middle finger grip the end, the end from a tourniquet drop-down, by another rim pull out, making it a slipknot, if you need to relax tourniquet, just pull the tail.

8.3.4.2.2.5 对四肢动脉出血，用绷带或三角巾勒紧止血时，可在伤口上部用绷带或三角巾叠成带状或用就便器材勒紧止血。方法是：第一道绑扎做垫，第二道压在第一道上面勒紧，如有可能，尚可在出血伤口近心端的动脉上放一个敷料或纸卷作垫，而后勒紧止血。

For limb artery bleeding, bandage or triangular bandage tighten the bleeding, may be on the top of bandage the wound or triangular bandage folded belt or use a handy equipment tighten the bleeding. Method is: the first tie do pad, on the first line of the second pressure to tighten, if possible, can put a dressing or paper roll cushion on the bleeding wound where close to the heart artery, then tighten the bleeding

8.3.4.2.2.6 用止血带或弹性较好的布带等止血或用绷带和三角巾勒紧止血，止血以刚使肢端动脉搏动消失为度。上肢每 60min，下肢每 80 min 放松一次，每次放松 1~2 min。开始扎紧与每次放松的时间均应书面标明在止血带旁。扎紧时间不宜超过 4h。不要在上臂中 1/3 处和腘窝下使用止血带，以免损伤神经。若放松时观察已无大出血可暂停使用。严禁用电线、铁丝、绳等作止血等作用。

With a tourniquet or elastic cloth belt such as bleeding or bandage and triangular bandage tighten the bleeding, bleeding in just eradicate acra pulses. Upper limb every 60 min, lower limb once every 80 min to relax, relax 1 ~ 2 min each time. Began to tighten and relaxation time should be written every time mark beside a tourniquet. Tighten time should not be more than 4 h .Don't be a third place in the upper arm and

Yan nest used under tourniquet, lest damage nerve. If the relaxation using observations have no bleeding can be suspended. It is forbidden to use wire, iron wire, rope do effects such as bleeding, etc.

8.3.4.2.2.7 高处坠落、撞击、挤压可能使胸腹内脏破裂出血，此时伤员虽然外观无出血，但常表现面色苍白、脉搏细弱、气促、冷汗淋漓、四肢厥冷、烦躁不安静，甚至出现神志不清等休克状态，应迅速将伤员躺平，抬高下肢，保持温暖，速送医院救治。若送院途中时间较长，可给伤员饮用少量糖盐水。

Objects fall from high, hit, squeeze may make chest visceral rupture hemorrhage, although at this time the wounded appearance no bleeding, but often show pale, thin pulse, shortness of breath, cold sweat dripping wet is quiet, faint cold limbs, restless, appear even delirious state of shock, should quickly to the wounded man lay flat, raise the lower extremities, keep warm, send to hospitals as soon as possible. If the hospital is far away, can give the wounded drinking a small amount of sugar, salt water on the way.

8.3.4.2.3 骨折急救处理 Emergency treatment of fracture

8.3.4.2.3.1 肢体骨折可用夹打或木棍、竹竿等将断骨上、下方两个关节固定，也可利用伤员身体进行固定，避免骨折部位移动，以减少疼痛，防止伤势恶化。

Limb fractures can use clip or wood, bamboo, etc. to fix the up and down joints, it also can be fixed by wounded body, avoid fracture movement, to reduce the pain and prevent the further injury

开放性骨折且伴有大出血者，先止血，再固定，并用干净布片覆盖伤口，然后速送医院救治。切勿将外露的断骨推回伤口内。

Open fractures with bleeding, first to bleeding then fixed, covering the cut with a clean cloth, then send to hospitals immediately. Do not push the broken bones back into the wound.

在发生肢（指）体离断时，应进行止血并妥善包扎伤口，同时将断肢（指）用干净布料包裹随送，最好在低温（4℃）干燥保存，切忌用任何液体浸泡。

In the case of severed limb, should take methods to stop bleeding and bind up the wound properly, at the same time, sending the limb with a clean cloth parcel, the best preserved in low temperature (4 ℃), can’t be soaked in any liquid.

8.3.4.2.3.2 若怀疑伤员有颈椎损伤，在使伤员平卧后，可用沙土袋（或其他代替物）放置头部两侧使颈部固定不动。必须进行口对口呼吸时，只能采用抬颏使气道通畅，不能再将头部后移动或转动头部，以免引起截瘫或转动头部，以免引起截瘫或死亡。

If doubt the person with cervical spine injury, after making the wounded lay down, putting sand bag (or other alternative) on both sides of the head to fix neck. Must be mouth to mouth breathing, can only use carry mental make airway unobstructed, can no longer move head or turn the head, lest cause paraplegia or turn head causing paraplegia or death.

8.3.4.2.3.3 腰椎骨折应将伤员平卧在平硬木板上，并将腰椎躯干及两侧下肢一同进行固定，预防瘫痪。搬动时应数人合作，保持平稳，不能扭曲腰部。

The patient with lumbar fractures should lie on hard wooden board, on both sides of the trunk and lower limbs and lumbar spine were fixed together to prevent paralysis. When transferring, several people cooperation, maintain smooth, can not distort the waist.

8.3.4.2.4 颅脑外伤处理 Craniocerebral trauma treatment

8.3.4.2.4.1 发生颅脑外伤后应使伤员采取平卧位，保持气道通畅，若有呕吐，应扶好头部和身体，使头部和身体同时侧转，防止呕吐物造成窒息。

Occurring craniocerebral trauma should make the wounded person lie flatly t, to keep airway unobstructed, if vomiting, should hold the head and body, make the head and body turn at the same time, to prevent choking by vomit.

8.3.4.2.4.2 耳鼻有液体流出时，不要用棉花堵塞，只可轻轻拭去，以利降低颅内压力，也不可用力擤鼻，以防止液体再吸入鼻内，导致逆性感染。

Liquid flow out from ear and nose, don't use cotton plug, only can wipe gently, and reduce the intracranial pressure, nor make an effort to blow nose, in order to prevent the liquid suction nasal again, cause infection.

8.3.4.2.4.3 有碎骨片时，切勿移动嵌压的碎骨片，可用无菌纱布覆盖，并进行相应包扎。

Have broken bones, not moving pressure of the broken bone, using sterile gauze to cover are, and to tie up accordingly.

8.3.4.2.4.4 颅脑外伤时，病情可能复杂多变，应禁止给予饮食，并注意瞳孔、意识和生命体征的变化，速送医院诊治。

Craniocerebral trauma, illness may be complex and changeable, should be banned for food, and pay attention to the pupil, consciousness and the change of vital signs, sending to hospital for a diagnosis and giving treatment.

8.3.4.2.4.5 对有严重休克或呼吸道有梗阻者，禁忌仓促搬动及远道转送。昏迷患者应侧卧或仰卧头侧，以防呕吐后误吸。

In severe shock or respiratory tract obstruction, forbidden to hasty move and long way forward. Coma patients should lie or lie back side, to prevent aspiration after vomiting.

8.3.4.2.5 烧伤急救 burn first aid

8.3.4.2.5.1 对电灼伤、火焰烧伤或高温气、水烫伤均应保持伤口清洁。伤员的衣服鞋袜用剪刀剪开后除去。伤口全部用清洁布片覆盖。防止污染。四肢烧伤时，先用清洁冷水冲洗，然后清洁布片覆盖。防止污染。四肢烧盘时，先用清洁冷水

冲洗，然后清洁布片或消毒纱布覆盖送就近医院。

For electric burn, fire burns or high temperature gas, water scald should keep the wound clean. Using scissors to cut wounded clothes, shoes and socks then put off. All the wound should be covered by clean cloth. To prevent infect. Limb burns, first rinse with clean water, and then covered with clean cloth. To prevent infect. Limb burning, first rinse with clean water, and then clean or cover with sterile gauze then sand to the nearest hospital.

8.3.4.2.5.2 强酸或碱灼伤应立即用大量清水毛底冲洗，并迅速将被侵蚀的衣物剪去为防止酸、碱残留在伤口内，冲洗时间一般不少于 10 min。

Strong acid or alkali burned should rinse immediately with plenty of water, and quickly cut off eroded clothing to prevent the acid, alkali residue inside the wound, the flushing time is generally not less than 10 min.

8.3.4.2.5.3 未经医务人员同意，切忌在烧伤和灼伤创面敷擦任何东西和药物。

Avoid by all means without the permission of the medical staff in burns and burns wounds apply to anything or drugs.

8.3.4.2.5.4 送医院途中，可给伤员多次口服少量糖盐水。

On the way to hospital, can give the wounded oral a small amount of sugar, salt water for many times.

8.3.4.2.6 挤压伤急救处理 emergency treatment for crush injury

8.3.4.2.6.1 挤压伤部位早期处理恰当与否直接关系到病程发展及其预后。

Crush injury early treatment appropriate or not directly related to the development course of the disease and prognosis

8.3.4.2.6.2 应尽早搬除或松懈挤压物，并尽快将伤员移至安全地带。

Removing and releasing extrusion as soon as possible, and taking the injured person to safety place.

8.3.4.2.6.3 有伤口时应包扎伤口，怀疑有骨折时或肢体肿胀时，予以夹板超关节固定。

If had wound should bind up firstly, fracture or limb swelling is suspected, using splint to fix joint.

8.3.4.2.6.4 挤压伤员的患肢严禁抬高、按摩、热敷。

Injured person’s limp is forbidden to lift, massage or hot compress.

8.3.4.2.7 高温中暑急救处理 High temperature heat stroke first aid treatment

发现有高温中暑者时，应立即将中暑者从高温或日晒环境中转移到阴凉通风处休息。用冷水擦浴湿毛巾覆盖身体，电扇吹风，或在头部置冰袋等方法降温，并及时给中暑者口服盐水。严重者送医院治疗。

If there are people in high temperature heatstroke, shall be immediately transfers from the hot or insulation environment to rest in a cool ventilated place. Using cold water to clean and wet towel to cover the body, blowing by electric fan, or putting the cool ice packs on head, in a timely manner to give the oral saline to heatstroke. Serious people sand to hospital for treatment.

8.3.4.2.8 有害气体中毒急救 Poisonous gas poisoning

8.3.4.2.8.1 怀疑可能存在有害气体时，应立即将人员撤离现场，转移到通风良好处休息。抢救人员应在做好自身防护（如现场毒物浓度很高应带防毒面具）后，才能执行施救任务，将中毒者转移到空气新鲜处。

Suspecting there is harmful gas, evacuating the person to the well ventilated place to rest immediately. Rescue personnel should be for their own protection (e.g., if the site with high concentrations harmful gas should wear poison gas proof mask), then to take rescue mission, transferring the victim to the place with fresh air.

8.3.4.2.8.2 对已昏迷中毒者应保持气道通畅，解开领扣、裤带等束缚，注意保温或防暑，有条件时给予氧气吸入。呼吸心跳停止者，应立即进行心肺复苏，并联系医院及早对症治疗。

Keeping airway unobstructed for people in a coma, unlock the collar button, belts and so on, pay attention to the insulation or heat, conditional gives oxygen inhalation. Heart stopped breathing, shall be immediately cardiopulmonary resuscitation, and contact hospital to give a symptomatic treatment as early as possible

8.3.4.2.8.3 迅速查明有害气体的名称，供医院及早对症治疗。

Quickly identify the name of the harmful gas, providing information to hospital for symptomatic treatment as early as possible

8.3.4.2.8.3 护送中毒者要取平卧位，头稍低并偏向上侧，避免呕吐物进入气管。Sending the people in the coma to hospital should carry flatly, and head lower and towards upper to avoid vomit get into weasand.

8.3.4.3 对于发生的各类人身伤害事故，按“四不放过”的原则调查处理，吸取事故教训，制定反事故措施，防止类似事故的发生。

For all kinds of personal injury accidents, according to the principle of "four not pass" to investigate, drawing lessons from accidents and taking anti-accident measures, to prevent similar accidents

8.4 食物中毒 food poisoning

一、常见的几种食物中毒预防措施 precaution of common food poisoning

1、扁豆中毒 hyacinth bean poisoning

扁豆特别是秋扁豆里含有一种对人体有害的凝集素和溶血素。一定要把扁豆焖烂、炒熟，毒素就能破坏掉。

Hyacinth bean contains hemolysin and lectin, which are bad to health. So must eat ripe hyacinth bean.

2、发芽土豆中毒 potato with burgeon poisoning

土豆含有一定时的龙葵素。为了避免土豆发芽，要将土豆放在凉爽、干燥、不见阳光的地方。若土豆已经发芽变绿，吃前一定要把发芽的部分去掉，就绿的部分和皮削去。另外，做前最好先用水把土豆浸泡 2 小时，因为龙葵素能溶解在水里，炒土豆时放上一点醋，不仅味道鲜美，还有解毒作用。

Potato has some solanine. In order to avoid potato sprouting, put the potato in the place of cool, day and without sunlight. If the potato has sprouted and become green, before cooking, cutting down the part with burgeon and green, soaking the potato into water for 2 hours.

3、鲜黄花菜中毒 Fresh Day Lily Poisoning

鲜黄花菜中含有一种秋水仙碱物质。鲜黄花菜吃前应先用工水焯一下，再用凉水浸泡 2——3 小时，因为秋水仙碱易溶水于，浸泡后再吃就不会中毒了。

Fresh day lily contains meadow saffron alkali, before eating, need to soaked into water for 2-3 hours.

4、豆浆中毒 Soybean Milk Poisoning

豆浆原料是大豆，大豆里含有一种耐热性较强的胰蛋白酶抑制物。因此食用豆浆时，必须把豆浆煮开，熟透再喝，发防中毒。

Soybean milk raw material is soybean, soybean contains a kind of heat resistant trypsin inhibitor. So must drink boiled and ripe soybean milk.

5、河豚鱼中毒 globefish poisoning

河豚鱼是海杂鱼的一种，鱼的内脏含有毒的河豚毒素。预防措施不食用。

Globefish is one kind of sea fishes, its entrails has poison. Preventive measures are not to eat

6、变质食油中毒 metamorphic oil poisoning

花生油、炼过的动物油等，若存放时间长，受阳光或炉火烤或受装油的金属桶的影响而氧化变质。预防措施就是不要食用。

Peanut oil, refined animal oil, etc., if the storage time is long, or deteriorating own to oxidation, preventive measures are not to eat.

7、毒蘑菇中毒 Poisonous mushroom poisoning

夏秋季有采食野蘑菇或进食干蘑菇史，多人同食，同时发病。早期或轻者表现为胃肠道症状。严重者，胃肠道症状缓解后立即或经 1~3 假恢复期后，可出现肝、肾及神经损害症状。（1）神经损害型，出现幻听、矮小幻视、摸空、躁狂、精神错乱、迫害妄想、狂歌乱舞、哭笑无常等。（2）肝损害型，主要表现突然恶心、呕吐、腹痛、米汤样大便，病人迅速发生昏迷、抽搐、休克、肝功能衰竭；（3）溶血型，可出现黄疸、血红蛋白尿、贫血，也可断发肾脏损害。急救首先清除毒物，用 1:5000 高锰酸钾液反复洗胃，注意保持呼吸通畅，并速送医院。

People eat wild mushroom and dried mushrooms in summer and fall, several people eat together and become sick at the same time. First or light performance is gastrointestinal symptoms. Severe cases, after gastrointestinal symptoms disappearing, will appear the symptom of liver, kidney, and nerve damage immediately or after 1-3 false recovery period .(1) nerve damage type, auditory hallucination, short op, feel empty, manic, insanity, delusion of persecution, crazy song flurry, crying and impermanence, etc.(2) the liver damage type, main show is suddenly nausea, vomiting, abdominal pain, rice water samples, the patient rapidly coma, convulsions, shock, liver function failure;(3) hemolytic type, the symptoms are that icteric, hemoglobinuria, anemia, kidney damage. First aid to remove toxins, repeatedly wish stomach with 1:50 00 potassium permanganate liquid, pay attention to keep breathing smooth, and send to hospital immediately.

8、螃蟹中毒

吃螃蟹有时也会引起食物中毒，这是因为螃蟹喜欢吃海里小动物尸体，这样螃蟹的胃肠里可能含有一些有毒的物质。另外死螃蟹容易腐败变质，常常带有细菌，更容易引起中毒。因此，一定要吃新鲜的螃蟹，不吃死螃蟹，蒸煮前要净螃蟹洗干净，蒸熟煮透再吃，现做现吃，不吃隔夜的凉螃蟹，螃蟹的胃、肠、鳃等部分不要吃。

Crab Intoxication

Sometimes crab can also cause toxication due to the possible poisonous things in its stomach and intestine because it is fond of eating the small sea creatures corpse. Furthermore, the dead crab is prone to turning bad and decomposition and often has bacteria so that is easy to cause toxication. For that reason, must eat fresh crab, don’t eat dead ones. Clean the crabs prior to seam or boil by water and only eat the completed boiled and steamed crabs. Cook and eat, don’t eat if it is kept next day. Don’t eat stomach, intestines, gill and so on.

9、剩米饭中毒

有一种叫做金黄色葡萄球菌的细菌，在夏季气温较高的情况下（摄氏 37℃左右），最喜欢在米饭上生长繁殖，并能产生大量的肠毒素。这种肠毒素又不易破坏和除掉，冲洗不行，煮也不行，在摄氏 100 度的开水里煮 30 分钟，也破坏不了。人吃了带有金黄色葡萄球菌生长的剩米饭等食物，就会引起中毒。出现恶心、呕吐、头晕、腹疼、腹泻等症状。

Remained Rice Intoxication

One bacteria is named staphylococcus aureus which is fond of reproducing on rice at the higher temperature of summer and produces plenty enterotoxin that can not be destroyed, removed, washed away or boiled; it even can not be killed in 100celsus boiling water by 30 minutes. If people eat the remained rice and the other food which have staphylococcus aureus, he will get intoxication. There will be the symptom such as nausea, vomit, belly pain, diarrhea and so on.

二、食物中毒现场处理

1、 发生了食物中毒，立即向办公室报告，及时安排和抢救病人同时向经理汇报。根据中毒情况组织车辆送往医院急救。

2、 办公室电话：０１７７３８６９９９８。郑培军

3、 了解中毒的原因，中毒人数，引起中毒的食物，病人的症状等情况。找出中毒食物和原因后要立即采取相应措施，防止病情蔓延。

4、 及时向孟加拉国地方卫生防疫部门报告疫情。

Site Treatment for Food Poisoning

1. Once it happens, report to office immediately. Arrange and rescue the patient in time; and report it to the manager. Organize the vehicle to send him to the hospital according to the situation.

2. Office mobile phone: ０１７７３８６９９９８, contact person: Zheng Peijun.

3. Find out the reason, poisoned persons, the causing food, the symptom and so on. Take the responding measures immediately once the causing food and reasons are cleared to prevent it spreading.

4. Immediately report it to Bangladesh local hygiene epidemic prevention department.

三、食物中毒的应急处理

食物中毒应急处理首先应做到迅速排出毒物，采用催吐、洗胃。催吐：用筷子、匙柄或用手指，刺激病人咽喉部引起呕吐。有条件者用 0.5%硫酸铜 50—100 毫升口服催吐。洗胃：用大量清水或淡盐水等，喝下然后用催法法催吐，再喝再催吐，反复进行。增强人体解毒功能，甘草绿豆汤对各种中毒有一定解毒功效，取绿豆 100 克，甘草适量煎汤服下。活性碳具有吸附毒物之作用，可适量服下，也可用烤焦的馒头研末服下。葡萄糖溶液有增强肝脏解毒排泄之作用，现场可采用喝糖水。

Emergency Treatment for Food Poisoning

Firstly excrete the poison by emetic and washing stomach. Emetic: cause vomit by stimulate the patient’s throat using chopsticks, spoon handle or finger. If the conditions are ready, drink 50-100ml 0.5% copper sulfate. Wash stomach: drink a lot of water or diluted salt water and so on, then vomit out by stimulation, repeat that again and again. Build up detoxication capability. Liquorice mung bean soup has certain detoxication effect. Take 100 g mung bean and proper liquorice, decocted for drinking. Drink properly quantity of active carbon which can absorb the poisoning matter; or drink the power of sear steamed bread. Glucose solution can enhance detoxication and excretion function of liver. Drinking sugar water can take effect at site.

8.5 大型机械事故（吊车倾翻、脱轨）应急准备与响应措施

Emergency preparation and response measures for heavy equipments accident(crane toppling, derail)

8.5.1 预防措施 Preventive Measures

8.5.1.1 大型起重机械拆装作业前编制切实可行的方案和安全技术措施，并经作业单位技术负责人、工程部、安保部、质检部、总工审批，作业前对施工人员详细交底，严格按方案要求的程序操作。
Make up applicable plan and safety technical measures prior to dismantle heavy equipments and approved by working department technical in charge, construction department, HSE department, QA/QC department, chief engineer. Make detailed technical to the construction person and conduct by strictly following the plan requirements.

8.5.1.2 起重人员经过培训、考试合格后持证上岗。
Lifting workers take the work with certificate after training and passing the exam.

8.5.1.3 大型吊车的司机设置应为专机专人制，吊车司机持证上岗，在配置吊车司机时应选用有经验的、有责任心的司机，严禁选用初次开吊车的司机（新培训的司机）。
One heavy crane one dedicated operator with certificate, select experienced and responsible operator, no permission for using the fresh operator (new trained operator).

8.5.1.4 吊车在拆装时必须在专业人员的指导下完成。
Must arrange professional person for crane dismantling instruction,

8.5.1.5 悬臂式起重机在工作时，吊臂的最大仰角不得超过制造厂规定，如无明确规定，最大仰角一般不超过 78^0。
When use jib crane, the max elevation can not exceed the manufacturer's regulation. Normally if there is no finite regulation, the max elevation can not be more than 78^0.

8.5.1.6 门式起重机不用时或每天工作完成后，必须用夹轨器或铁鞋固定。
When gantry crane is idle or off work, must use rail clamper or iron shoe to fix it.

8.5.1.7 用一台起重机械的主、副钩抬吊同一重物时，其总载荷不得超过当时主钩的允许载荷。
When use main and auxiliary hooks to lift one object, the total load should not more than the permissible load of the main hook at that working condition.

8.5.1.8 两台及两台以上起重机械抬吊同一重物时，应遵守下列规定：
Use two or above cranes to lift one object, abide the following regulations:

8.5.1.8.1 绑扎时应根据各台起重机械的允许起重量按比例分配载荷。
When lashing, distribute load proportionally in accordance with the allowable weight of each crane.

8.5.1.8.2 在抬吊过程中，各台起重机械的吊钩钢丝绳应保持垂直；升降、行走应保持同步。各台起重机械所承受的载荷不得超过允许起重量（如达不到上述要求时，应降低额定起重能力至 80%）。

During lifting, keep the wire rope straight of every crane hook. Keep the same tune for going up and down and moving. The bearing load for every crane should not the permissible weight (if nor meet the above requirements, reduce the rated lifting capacity to 80%.

8.5.1.9 作业时应有技术负责人、安全监察人员在场。
During operation, the technical in charge and safety supervisor should present at site.

8.5.1.10 大型机械的各种安全限位开关、限制器安装齐全，不得超负荷起吊。
Install complete every kinds of safety limit switch and limiter for heavy equipments and don’t lift overweight.

8.5.1.11 六级以上大风等恶劣天气或夜间照明不足不得进行起重作业。
Don’t lift if the weather is rough such as strong wind which is above six grade or the night lighting is not sufficient.

8.5.1.12 所有的大型机械由机械管理部门和安保部、工程部定期进行联合检查，保障机械性能良好，不带病工作。
All the heavy equipments will be regularly inspected by the joint group of mechanical management department, HSE department and construction department to ensure it good property and sound.

8.5.2 大型机械事故的应急准备与响应的主责部门是安保部。工程部、机械工地配合处理，救援领导小组由经理部领导、安保部、工程部组成，各工地人员配合救援工作。
HSE department is the main responsible department for the emergency preparation and response of heavy equipment accident co-operated by construction department and mechanical site group. The rescue leading team consists of managerial leaders, HSE and construction department. The site group persons co-operate for rescuing.

8.5.3 发生了大型机械事故立即用电话或对讲机通知安保部，由安保部再向主管安全的副经理和总经理汇报，组织救援工作。
If there is heavy mechanical accident, immediately inform HSE department by phone or walkie-talkie, then report it to deputy manger who charges safety and general manager for organizing rescuing.

8.5.4 响应措施

Response measures
8.5.4.1 发生了大型机械事故，立即抢救伤员，采取相应的措施保护现场，设置警示区，禁止无关人员进入，防止事故扩大化。
Once there is heavy equipment accident, rescue the injuries immediately and take the corresponding measures to protect scenery. Set warning area. No entry for an-authorized person to prevent it extending.

8.5.4.2 立即通知经理部领导、安保部、工程部组织进一步的救援工作，伤者立即送往就近医院，其他部分由经理、安保部、工程部组织专业技术人员制定详细的救援方案实施救援工作，工程部调用起重运输设备配合，办公室调用小车配合。Immediately inform managerial leaders, and HSE department and construction department organize further rescuing. Send the injuries to the nearest hospital immediately.

8.5.4.3 进行事故调查处理工作，总结事故教训，制定反事故措施，杜绝各类事故的再次发生。
Handle and invest the accident, summarize and learn. Make the response measures to end the similar accident happening again.

8.6 溺水事故 Drowning

1.溺水原因 Causes

1.手足抽筋是最常见的。主要是由于下水前准备活动不充分、水温偏冷或长时间游泳过于疲劳，小腿抽筋时会感到小腿肚子突然发生痉挛性疼痛。
The most common cause is foot and hand cramp due to insufficient excise prior to going into the water, low water temperature or tied after long time swimming. When the shank cramps, there will be spasm pain in calf.

2.有时因潜入到浅水而造成头部损伤而发生溺水。
Sometimes dive into the low water and hurt head to cause drowning.

3.有时候会因为心脏病发作或中风引起意识丧失，而发生溺水。
Sometimes loss consciousness due to sudden heart attack or apolexia, which can cause drowning,

4.本身会水，在游泳过程中因为不小心吸入少量水进入气管而引发咳嗽，由于没有恰当处理，反而坚持继续游泳，在头沉入水下的过程中呛咳，引起的大量水引入肺部，造成溺水。
Know how to swim, breath some water into trachea carelessly and cause cough; continue to swim without treating properly and cough by choking to lead lot of water flowing into lung which cause drowning.

2 溺水后果 Drowning consequence

主要是气管内吸入大量水分阻碍呼吸，或因喉头强烈痉挛，引起呼吸道关闭，窒息死亡。 人落水后，水、泥沙等杂物阻塞呼吸道，或因呼吸道痉挛而引起缺氧、窒息、死亡。

落水被淹后一般4~6分钟即可致死。
The main consequence is that the trachea breathes in lot of water which blocks breath

or arouse to aspiration tract closing because of strong throat spasm to cause suffocation death. Once fall down into the water, respiratory tract will be blocked by the foreign matters such as water, silt and so on; or cause hypoxia, suffocation or death due to respiratory tract.
Drowning will lead to death within four-six minutes.

3.应急响应 Emergency Response

3.1 溺水者在水中急救措施 Emergency response for drowned person in the water

1.注意：若您未受过专业救人的训练或未领有救生证的人，切记请不要轻易下水救人。谨记一点：会游泳并不代表您会救人。
Attention: don’t go into the water if you don’t get professional training or lifesaving certificate. Remember one point: Be able to swim doesn’t mean you can save life.

2.溺水情形发生时，在岸边的民众不宜直接下水，最好救援的方式是丢绑绳索的救生圈或长竿类的东西，千万不要徒手下水救人，可就地取材，树木、树藤、枝干、木块、矿泉水瓶都可利用来救人。
If someone is drowning, the person on the bank is not suitable to go into the water directly. The best rescuing method is to throw something like buoy or long bamboo tied by rope. Never rescue by free hand. You can use something at the place such as trees, vine, branch, wood or water bottle which can save the person.

3.抢救溺水者需要入水，须先脱衣解裤，以免被溺水者缠住而无法脱身。游到溺水者面前约3至5公尺，先吸大口气潜入水底从溺水者背后施救，才不致于被对方困住。须知当一个人面临死亡的一瞬间，出劲的力量绝对惊人，万一被溺水者缠住，应速设法摆脱，不然必死无疑。
It requires to go into the water to save the drowning person, must take off clothes to avoid from being held by the drowning person. Swim 3-5 meter distance to him, take one heavy breath then dive to the bottom to save the drowning person from behind to avoid being stuck by him. It should be known that the person who faces dying will have astonishing strength. Once one person is stuck by the drowning person, try to escape, otherwise death will come.

3.2溺水抢救措施：为防止万一出现的溺水做准备，要学会人工呼吸、心脏按摩等 起死回生的方法。

首先应做的事：

大声叫人

叫名字以确认是否有意识

检查鼻子测气息，确认是否有呼吸

观察是否有心跳

采取急救措施：
Rescuing measures for drowning person: prepare for the possible drowning, learn how to bring the dying back to life such as artificial breathing, heart message and so on.

Firstly do the followings:

Shout the other person

Call name to confirm if he is conscious

Check nose breath to confirm if there is breath

Observe if there is heartbeat

Take emergency treatment

4. 排除异物

救上来只是工作的一半，使溺水者复苏还有另一半，而且对挽救生命来说是同等重要的！首先清理溺水者口鼻内污泥、痰涕，有假牙取下假牙，救护人员单腿屈膝，将溺水者俯卧于救护者的大腿上，借体位使溺水者体内水由气管口腔中排出，将溺水者头部转向侧面，以便让水从其口鼻中流出，保持上呼吸道的通畅。再将头转回正面。（急救者从后、抱起溺者的腰部，使其背向上，头向下，也能使水倒出来）。
Take out the foreign objects

Rescuing only half work, let the drowning person to recover is anther one; both of those are import to save life. Firstly take out the sludge, sputum nasal mucus from the drowning person's month. If there is artificial tooth, take it out. The rescuer goes down one knee; put the drowning person on the thigh. Expel the internal water from trachea and oral cavity by the body position. Let the drowning person face one side to let water flow out from his mouth and nose and keep the upper respiratory tract smooth. Then face his head to the front (the rescuer holds the waist of the drowning person from behind to keep back up and head down; which can also let water come out.)

5.出水后的救护

注意：适度掌握正确的心肺复苏方法，不要盲目模仿人工呼吸和心肺复苏。如果你有资格并经过训练可以做心肺复苏术（CPR）（民众最好能学习 CPR（心肺复苏术）技巧，救人又救己。）但是如果不知道心肺复苏术时立即寻求援助。当你在等待时可试做口对口复苏术，这能拯救生命。如果溺水者呼吸心跳已停止，立即进行口对口人工呼吸，同时进行胸外心脏按摩。
Treatment after coming out from water

Caution: grasp properly and correct CPR, don't imitate artificial breathing and CPR aimlessly. If you are trained and qualified, you can do CPR (it’s better for the normal person to learn the skills of CPR, which can save himself and the other people). If don’t know CPR, ask for help immediately. When wait, try to do resuscitation, which will save life. If the drowning person breath and heartbeat stop, quickly do month to month artificial breath and message on external heart message.

A、确定一下这位失去知觉的人到底是否在呼吸，看看他或她的胸部，看是否可以见到呼吸的样子。
Confirm if the person who loses consciousness can breathe; watch his or her chest to confirm if there is breath appearance.

B、使溺水者仰卧。
Let the drowning person lie face up.

C、为了采取通用安全措施，尽可能戴上乳胶手套，弄开他的嘴，用你的手指除掉咽部或气道里的任何阻塞物。
In order to take general safety measures, try to wear latex gloves, open his mouth and take out any clogging objects in throat or aspiration tract by hand.

D: 把一只手放在溺水者的下颌，另一只手放在他的前额。翘起他的头直至你能使他的气道通畅，溺水者的口应该是张开的。
Put one hand under the lower jaw of the drowning person and another hand on the forehead. Raise his head to keep air passage smooth and his mouth should be open.

E、捏鼻孔使鼻孔关闭。
Pinch nostril to close.

F、你做深呼吸。
Breath deeply.

G、用你的嘴完全把他的嘴罩住。
Cover the drowning person’s mouth with your mouth.

H、用力吹气进入溺水者的嘴里，连续做4次。
Put forth your strength to blow air into the drowning person’s mouth, continue 4 times.

I、此时停5秒钟然后再重复做第 F 到第 I 步。
Stop 5seconds, then repeat from F to I.

J、重复这一过程
Repeat that process.

6.送往医院

立即通知经理部领导、安保部、工程部组织进一步的救援工作，伤者立即送

往就近医院，办公室调用小车配合。
Send to hospital

Immediately inform manager department leaders, HSE and construction department to organize further rescuing work and send the injury to the near hospital under the co-operation of general office arranged car.

7.进行事故调查处理工作，总结事故教训，制定反事故措施，杜绝各类事故的再次发生。
Perform accident investigation and managing, summary lessons and make up anti-accident measures to end this kind of accident happening again.

8.7 辐射事故的应急准备与响应措施
Radiation accident emergency preparation and response measures

8.7.1 预防措施 Preventive measures

8.7.1.1 对从事射线工作的人员，应加强专项防护知识教育，自觉遵守有关射线的防护规定，避免造成人员伤害。
Strengthen dedicated preventive knowledge education for the persons who take radiation work. Be aware of abide the preventive regulation for preventing radiation to avoid people hurting.

8.7.1.2 凡从事放射性物质工作的单位，必须持有有关部门颁发的许可证，方可使用和从事射线工作。
All the companies taking radiation work can not take this kind of work without the permit issued by relative department.

8.7.1.3 托运、承运和自行运输放射性同位素，必须按国家及孟加拉国有关运输规定进行。
Must follow national and Bangladesh the related transportation regulation for consigning, consignee and self-transporting radiation sotope.

8.7.1.4 放射性同位素贮存场所使用前经劳动部门实测并签发使用许可证后方可使用。
Radioisotope storage place can only be used after the actual test and permit issued by work department.

8.7.1.5 建立射源库时，其地点应远离人群，坚固、防盗，并设有安全防护装置和警告标志。
The radiation source house should be located far away from crowd. Be strong and have preventive facilities of thievery. Equip with safety protection device and warning signs.

8.7.1.6 射源必须有专人负责管理，定期监测，严格领用制度，源库设置双锁。

Arrange dedicated person to manage radiation source. Regular monitor and strict receive system and put double locks for storing room.

8.7.1.7 在施工现场使用 r 射源或 X 光机进行工作时，需设置防护装置和采取防范措施。使用 r 射源工作时，警戒区应在半径 15 米范围内，使用 X 光机工作时警戒区应在半径 10 米范围内，警戒区应拉好警戒绳和放射性物质标志牌，并设专人负责警戒。
Set up protection device and take preventive measures when use r radiation source or X radiating machine. The warning radius should be within 15 meter and 10m for using r radiation source and x radiation machine. Put warning line and radiation matter signs for warning area and assign special person to take the responsible for warning.

8.7.1.8 现场探伤时，应由一人操作，一人监护，严格执行操作程序，配备射线剂量仪器，随时测定放射线剂量的大小。
When perform NDE test in site, one person operates and one guarding. Strictly follow the operation procedure. Prepare radiation dosimeter to measure the radiation quantity at any time.

8.7.1.9 射源处于工作状态时，工作人员严禁离开现场，并密切注视工作现场情况。
When radiation source is active, operation person can not leave the site and carefully watch out working site condition.

8.7.1.10 射源的退役和销毁严格按东电一公司《放射性物品控制管理制度》执行。
Strictly follow 'radiation matter control and managing regulation' of NEPC for radiation source stopping using and destroying.

8.7.1.11 射线工作人员所接受的剂量，必须严格执行国家的规定：
Radiation working person received dosage must strictly follow national regulation:

a .每小时不超过 0.0021R(伦)；
Not more than 0.0021R (Roentgen) per hour.

b .每天不超过 0.021R(伦)；
Not more than 0.021R (Roentgen) per day.

c .每周不超过 0.125R(伦)；
Not more than 0.125R (Roentgen) per week.

d .每年不超过 6R(伦)；
Not more than 0.0021R (Roentgen) per year.

以上剂量为累计剂量，如超过上述剂量需停止工作。
The above quantity is the accumulative quantity, if above that, it requires to stop work.

8.7.1.12 从事放射源操作人员必须经过放射卫生防护知识培训并取得资格证，身体检查合格后方可上岗工作。
The radiation operation person must get the training for radiation health protection knowledge and qualification and take the job after qualified body check.

8.7.1.13 对在进行放射线工作的人员，按规定配备合格的个人防护用品，要定期进行身体复查，并按国家规定享受个人保健津贴和休假制度。
Equip qualified personal PPE according the regulation for the radioactive ray workers who should do regular health recheck and get personal health care allowance and holiday system in accordance with national regulations.

8.7.2 安保部是放射事故的应急准备与响应的主责部门，统一管理项目经理部放射事故的急救工作，实验室配合。
HSE is the principal responsible department of radioactive ray accident emergency preparation and response as well as untied managing the rescuing work of project radioactive accident under the cooperation of lab.

8.7.3 发生放射事故后，立即用对讲机或电话通知安保部，由安保部再向主管安全的副经理和总经理汇报，及时组织进行进一步救援工作。电话：5865（安保部）、
Once there is radioactive accident，immediately inform HSE by walkie-talkie or mobile-phone and it will be reported to deputy manager in charge of safety and general manager. Timely organize further rescuing work. Tel: 5865(HSE)

8.7.4 响应措施

由于放射事故发生原因不同，涉及的对象和引起的后果千差万别，错综复杂，即使是同类型的事故，也会因环境条件和社会因素的不同而表现各异，很难提出一个简单、统一的通用处理方案。但不论何种类型的放射事故，处理时应遵循如下原则：
Response measures

Due to different causes of radioactive accident, the involved parties and the consequences are varies and complicated. Even for the same accident, it will also display different due to environmental and social factors. So it is very hard to make one simple, uniformed response scheme. When handle this kind of accident, follow the following principles:

8.7.4.1 发生放射事故后，肇事单位必须及时采取妥善措施，减少和控制事故的危害和影响，并接受监督部门的处理；
Once there is radioactive accident, the responsible company must take proper measures timely, reduce and control its damage and influence and receive the treatment of supervising department.

8.7.4.2 处理放射事故时，应当首先考虑工作人员和公共的生命安全，迅速安置受照人员就医 ，进入放射工作区参与应急处理人员必须配备个人射线剂量仪以及

其它防护用品（如铅服、眼镜），组织控制区内人的撤离工作，及时控制事故影响，防止事故的扩大蔓延，避免粮食、果蔬作物 、禽畜以及饮用水源等受到污染；

When handle radioactive accident, firstly concerning workers and public life safety. Quickly arrange the radioactive ray receivers to hospital. The emergency handling persons going into the radioactive area must equip with personal radiation receiving meter and the other protection items (such as lead clothes, glasses). Organize and control the evacuation of the people in radioactive area and control accident influence in time to prevent its spreading and avoid its pollution from grain, fruit and vegetable, poultry, livestock, drinking water source and so on.

8.7.4.3 发生工作场所、地面、设备放射性污染事故时，应首先确定污染的核素、范围、水平，并尽快采取相应的去污措施；

If there is radioactive pollution accident from working place, ground and equipments, first to confirm the pollution nuclides, range, level and try as soon as possible to take corresponding measures.

8.7.4.4 发生放射性气体、气溶胶或者粉尘污染空气的事故时，应根据监测数据的大小采取相应的通风、换气、过滤等净化措施；

If there are accidents of radioactive air, air dissolvable glue or powder polluting，take corresponding purification measures such as ventilation, exchanging air, filtration and so on as per the monitored quantity.

8.7.4.5 人员皮肤、伤口被污染时，应迅速去除污染并给予医学处理 ，对体内摄入放射性核素者应采取相应的医学处理措施；

If skin or wound is polluted, immediately remove pollution and give medical treatment. If intake radioactive nuclide, it should take corresponding medical treatment measures.

8.7.4.6 发生放射性物质时，肇事单位应密切配合卫生行政部门、公安部门及孟加拉当地相关迅速查找、侦破 ，尽快追回丢失的放射性物质；

If radioactive matter is stolen, the responsible company should closely co-operate with hygiene and administering department, public security and the related department of Bangladesh to immediately search, detect and chase back the radioactive matters as soon as possible.

8.7.4.7 发生放射事故的单位要及时收集与事故有关的物品和资料，做好调查研究工作，认真分析事故原因，并采取妥善措施，尽量减少事故影响，保护国家财产及公众的安全；

If there is radioactive accident which happens in some company, immediately collect the related items and documentation in time and perform investigation and study; carefully analyze accident reason and take proper measures to minimize its influence and protect safety of national wealthy and the public.

8.7.4.8 放射事故中人员受照时，要通过个人剂量计、模拟实验、生物和物理检测、事故现场样品分析等方法迅速估算人员的受照剂量。对一次受照有效剂量当量超过 0.05Sv 者，应给予医学检查；对一次受照有效剂量当量超过 0.25Sv 者，应及时给予医学检查和必要的医学处理。

If someone is shot during radioactive accident, quickly estimate the receiving dosage of the shot person by personal dosage meter, imitation test, biological and physical test, accident site sample analysis and so on. If one time received effective dosage is more than 0.05Sv and 0.25Sv, do medical check and necessary medical treatment respectively.

8.7.4.9 进行事故调查处理，吸取事故教训，制定反事故措施，杜绝类似事故的发生。

Invest and handle accident, learn lesson and make anti-accident measures to end similar accident happening.

8.8 其他环境污染的预防措施

确保设计有可以循环处理废水的设施。为废水提供隔离分类的容器。

确保排出场外的废水符合排放要求。

现场周围有垃圾箱，并定期清理，以防垃圾堆积。

危险垃圾应隔离管理。确保负责危险垃圾处理的公司有相关专业资质。

确保在废水容器上用人员能看懂的语言打标签，这样材料就能放进正确的容器。

排水设施完好，排洪沟畅通无阻。

The preventive measures for the other environmental pollution

Make sure for designing wastewater recycling treatment facilities, and supply the container for wastewater separation.

Make sure the drained wastewater to meet the drainage requirements.

There is rubbish bin around the site, regularly clean to prevent piling together.

Separation management for danger rubbish to make sure rubbish collection and disposing company has the related professional qualifications.

Put sign on the waste container by using the understand language for the operator to make sure the rubbish will be put into the correct container.

Complete drainage facilities and smooth flood trench.

8.9 去医院途中

由现场至西莱特医院距离约40公里，行程40分钟，途经萨尔铺、瓦力瓦家等。

项目部救护车，人不离车，车不离人。在现场医务室，处于经常待命状态。

救护车内备好氧气及伤员所用应急药品等。出厂后，按最新信息所指路线，就近开往医院。行车途中经常观察伤员情况。

与医院救助通讯保持联系。医院联系电话： 0821-760718

On the way to hospital

There is 40km distance from site to Syhlet and 40 minutes drive, pass Shalpur, Walawajha and so on.

Site ambulance, driver and car should always stay together. Park in site clinic room area for any requirements and there should have enough oxygen and the emergency medicine and so on. After go outside site, drive to the closest hospital according to the latest informed routine. Observe the injuries during the travel to hospital.

Keep in touch with hospital rescuing department. Hospital contact telephone: 0821-760718

Annex 12: QRA of Proposed Power Plant of Summit Bibiyana II Power Company Ltd

QUANTITATIVE RISK ASSESSMENT OF PROPOSED POWER PLANT OF SUMMIT BIBIYANA II POWER COMPANY LIMITED

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1. Introduction

1.1. Background

In order to meet the increasing demand for electricity in Bangladesh, a new power plant has been proposed to be built and operated in Sylhet, Bangladesh. The materials that are being handled in this site are potentially hazardous in nature and also the amount is significant. Thus, the facility itself is potentially hazardous. As one part of the planning approval process, a Quantitative Risk Assessment (QRA) is to be prepared using necessary guidelines.

1.2. Scope and Aim of Study

The objective of this Quantitative Risk Assessment is to present the risks as well as hazards accompanying the power station. Through the estimation of probability and consequence of the main hazards, the risks to the community connected with this proposed power station may be estimated as well as compared to established risk criteria.

The scope of this report includes the following:

- Systematic identification and documentation of the major hazards, based on the information supplied and relevant experience with similar processes;
- Establishment of the consequence of each identified hazard and determination as to their offsite effects. This process is generally qualitative, with relevant quantitative calculations/modeling being completed where necessary;
- Where offsite effects are identified, the frequency of occurrence is estimated based on historical data. If such data is unavailable, assumptions and qualitative discussions are presented;
- Determination of the acceptability (or otherwise) risk by comparison of the quantitative assessment of the identified risks and
- Identification of risk reduction measures as deemed necessary.

At the time this QRA was conducted, detailed plant information was not available for review. In situations where such information could impact on the Initial QRA, assumptions have been made. These assumptions are intentionally conservative and have been stated in the report.

As a result of this conservatism, the results of the QRA are also inherently conservative, and this should be noted in their interpretation and application beyond the scope of this work.

The adherence to these assumptions should be verified at the detailed design stage to ensure that the results of the Initial QRA remain valid.

2. Study Methodology

2.1. Introduction

The methodology for QRAs is quite established in Bangladesh. There are five stages in risk assessment:

<u>Stage 1:</u> Hazard Identification: The hazard identification includes a review of potential hazards associated with all dangerous and hazardous goods to be processed, used and handled at the Power Station and associated pipelines and facilities. The hazard identification includes a comprehensive identification of possible causes of potential incidents and their consequences to public safety and the environment, as well as an outline of the proposed operational and organizational safety controls required to mitigate the likelihood of the hazardous events from occurring.

<u>Stage 2:</u> Consequence and Effect Analysis: The consequences of identified hazards are assessed using current techniques for risk assessment. Well established and recognized correlations between exposure and effect on people are used to calculate impacts.

<u>Stage 3:</u> Frequency Analysis: For incidents with significant effects, whether on people, property or the biophysical environment, the incident frequency are estimated, based on historical data. A probabilistic approach to the failure of vessels and pipes is used to develop frequency data on potentially hazardous incidents.

<u>Stage 4:</u>Quantitative Risk Analysis: The combination of the probability of an outcome, such as injury or death, combined with the frequency of an event gives the risk from the event. In order to assess the merit of the proposal, it is necessary to calculate the risk at a number of locations so that the overall impact can be assessed.

The risk for each incident is calculated according to:

Risk = Consequence x Frequency

Total risk is obtained by adding together the results from the risk calculations for each incident, i.e. the total risk is the sum of the risk calculated for each scenario.

The results of the risk analysis are presented in three forms:

- Individual Fatality Risk, i.e. the frequency of fatality to notional individuals at locations around the site, as a result of any of the postulated fire and explosion events. The units for individual risk are probability (of fatality) per million per year. Typically, the result of individual risk calculations is shown in the form of risk contours overlaid on a map of the development area. For pipelines (as for other transport activities), the individual risk contours are best represented as risk transects, showing the risk as a function of the distance from the pipeline.
- Injury and irritation risk, i.e. the likelihood of injury to individuals at locations around the site as a result of the same scenarios used to calculate individual fatality risk.
- Societal risk takes into account the number of people exposed to risk. Whereas individual risk is concerned with the risk of fatality to a (notional) person at a particular location (person 'most at risk', i.e. outdoors), societal risk considers the likelihood of actual fatalities among any of the people exposed to the hazard. Societal risk are presented as so called *f-N curves*, showing the frequency of events (f) resulting in N or more fatalities. To determine societal risk, it is necessary to quantify the population within each zone of risk surrounding a facility. By combining the risk results with the population data, a societal risk curve can be produced.

Stage 5: **Risk reduction:** Where possible, risk reduction measures are identified throughout the course of the study in the form of recommendations.

2.2. Risk Criteria

Having determined the risk from a development, it must then be compared with accepted criteria in order to assess whether or not the risk level is tolerable. If not, specific measures must be taken to reduce the risk to a tolerable level. Where this is not possible, it must then be concluded that the proposed development is not compatible with the existing surrounding land uses.

2.2.1. Individual Risk Criteria

The individual fatality risk is the probability of fatality to a person or a facility at a particular point. It is usually expressed as chances per million per year (pmpy). It is assumed that the person will be at the point of interest 24 hours per day for the whole year. By convention, no mitigation is allowed, i.e. any possible evasive action that could be taken by a person exposed to a hazardous event, e.g. by walking out of a toxic cloud or a heat radiation. The assessment of fatality, incident propagation and injury risk should include all components contributing to the total risk, i.e. fire and explosion. Table 1 shows the criteria for individual risk of fatality, injury and propagation of an incident[2].

Table 1: Criteria for Tolerable Individual Risk from a New Development

Land Use	Maximum Tolerable Risk (pmpy)
Fatality risk criteria:	
At Boundary (*Risk must not exceed 10 per million per year at the boundary of any new facility*).	10
If risk off-site is between 0.1 and 10 per million per year, all practicable risk reduction measures are to be taken, and residential developments are to be restricted.	0.1-10
Risk levels below 0.1 per million per year are broadly tolerable.	0.1

In order to put these risks into perspective, published information on the level of risk to which each of us may be exposed from day to day due to a variety of activities has been shown in Table 2 below[1]. Some of these are voluntary, for which we may accept a higher level of risk due to a perceived benefit, while some are involuntary. Generally, we tend to expect a lower level of imposed or involuntary risk especially if we do not perceive a direct benefit.

Table 2: Risk to Individuals

Activity / Type of Risk	Published levels of risk (pmpy)
Smoking	5,000
Drinking alcohol	380
Swimming	50
Playing rugby	30
Travelling by car	145
Travelling by train	30
Travelling by airplane	10
Involuntary risks (averaged over whole population)	
Cancer	1800
Accidents at home	110
Struck by motor vehicle	35
Fires	10
Electrocution (non-industrial)	3
Falling objects	3
Storms and floods	0.2
Lightning strikes	0.1

2.2.2. Societal Risk Criteria

Societal risk is concerned with the potential for an incident to coincide in time and space with a human population. Societal risk takes into account the potential for an incident to cause multiple fatalities. Therefore, two components are relevant, namely:

- The number of people exposed in an incident, and
- The frequency of exposing a particular number of people.

The societal risk criteria specify levels of societal risk which must not be exceeded by a particular activity. The same criteria are currently used for existing and new developments. Two societal risk criteria are used, defining acceptable and unacceptable levels of risk due to a particular activity. The criteria in Table 2 above are represented on the societal risk (f-N) curve as two parallel lines. Three zones are thus defined:

- Above the unacceptable/intolerable limit, the societal risk is not acceptable whatever the perceived benefits of the development.
- The area between the unacceptable and the acceptable limits is known as the **ALARP** (as low as reasonably possible) region. Risk reduction may be required for potential incidents in this area.
- Below the acceptable limit, the societal risk level is negligible regardless of the perceived value of the activity.

The interim criteria used by Victorian WorkSafe are presented in Table 3below[2].

Table 3: Criteria for Tolerable Societal Risk

Number of fatalities (N) [-]	Acceptable limit of N or more fatalities per year	Unacceptable limit of N or more fatalities per year
1	1×10^{-4}	1×10^{-2}
10	1×10^{-6}	1×10^{-4}
100	3×10^{-8}	3×10^{-6}

2.3. Risk Calculations

In order to determine the cumulative risk from all identified hazards, manual calculation procedure has been used.

First, base information on the incidents, including type, location, processing conditions and frequency were collected. Then the leak rate for each incident has been calculated using standard orifice flow equations for vapor (as for Natural Gas). The base consequences for each incident in terms of total radiant heat release rate have also been determined.

Then information of consequence and frequency has been considered and risk levels to individuals at all locations within a user-defined grid have been determined. From the output, risk contours can be drawn and overlaid on a site map.

It should be noted that risks to persons in the open or in buildings can be determined. For this study, risks in the open have been determined. In the case of radiation, persons are more at risk in the open due to the lack of shelter, while for explosions the risk is greater inside due to the potential for the building to collapse.

3. QRA Assumptions

The assumptions made in this QRA are listed below. These are critical for the results of this QRA. Should the final design and operation of the Power Station and associated off-site gas supply pipeline differ substantially from these assumptions then the results of this QRA may not be valid.

Table 4: List of Assumptions

Item / Subject Matter	Assumption
Operating conditions and design of Power Station	One operational gas turbine on site. Temperature of Gas is 32^{0}C. Gas increased to (up to) 4.21 MPa for use in Power Station.
Operating conditions and design of upstream gas supply pipeline	Operational pressure up to 0.507 MPa up to gas receiving station. 8 kilometers of gas supply pipeline. Welded connections wherever possible. Minimum number of flanges.
Types of chemicals on-site	Small quantities of combustibles, as follows: Turbine oils (combustible oil) : 1364 L in small IBC; Insulating oil (non PCB): 1364 L in small IBC; Oil for fire pump: 818 L in small IBC; Small quantities of chemicals used in cooling systems loop: Scale inhibitor : 136 L Betz Foam-Trol: 136 L Small quantities of chemicals used for maintenance: Carbon dioxide Nitrogen Acetone

Preventative and protective features in place (on-site and off-site pipeline)	Preventative maintenance of rotating machines; Vibration monitoring; Shut down of machine and repair if out of alignment; Subsidence issues are taken into account through design. Structures and plant are designed to withstand earthquake effects using well-established procedures in accordance with relevant standards. Topography prevents flooding from any rivers or streams. All welds are x-rayed (100%). A detailed Hazard and Operability study will be carried out covering at least the natural gas transport and handing at the off-site pipeline and the Power Station. Monitoring requirements of the off-site pipeline to be established and to comprise patrolling and regular monitoring of cathodic protection. The turbine housings, electrical rooms and control rooms will contain fire suppressants, such as carbon dioxide or other fire quenching material.

4. Hazard Identification

4.1. Hazardous Materials

A list of the types and storage quantities of materials those are likely to be found at the proposed site is included in the following table[1]. Quantities are indicative only.

Table 5: Typical Chemicals Stored Onsite

Plant Area / Use	Chemical/Product	Anticipated Storage Qty
Natural Gas supply	Natural gas	None stored on site. Supplied via pipeline system.
Turbines, pumps, air compressor, lubrication	Turbine oils (combustible oil)	1,364 L in small IBC
Transformers	Insulating oil (non PCB)	1,364 L in small IBC
Fire protection	Oil for fire pump	818 L in small IBC
	Carbon dioxide and/or other proprietary fire protection gases such as Inergen and/or FM200	If and as required, as determined by fire protection review.
Closed loop cooling system	Scale inhibitor	136 L
	Betz Foam-Trol	136 L
Chemicals for maintenance /repair work and clean-up	Carbon dioxide	As required for fuel line purging, in cylinders
	Nitrogen	As required for Gas line purging, in cylinders
	Acetone	100 L for miscellaneous cleaning

The natural gas is currently sourced from Bakhrabad gas field. Natural gas is composed predominantly of methane gas. The typical composition of natural gas is shown in Table 6below[4]:

Table 6: Approximate Composition of Natural Gas Supply

Components	Composition %
Methane	94.20
Ethane	3.65
Propane	0.72
ISO-Butane	0.20
N-Butane	0.10
High Composition	0.24
Nitrogen	0.42
Carbon-di-oxide	0.47

Natural gas is composed predominantly of methane gas. The properties of methane gas are presented in Table 7 below.

Table 7: Properties of Methane Gas

Molecular weight (g/mol)	17
Relative density of the gas (atmospheric temp.and pressure)	0.60
Heat of combustion (MJ/kg)	50
Flammable range (vol. % in air)	5 to 15
Ratio of specific heats ($C_p + C_v$)	1.31
Flash point	-218^{0}C

4.2. Summary of Hazards Identified

The main hazard associated with the proposed site is related to a leak of flammable natural gas.

This would generally only have the potential to cause injury or damage if there was ignition, which resulted in a fire or explosion incident. The factors involved are:

- The pipelines, vessel or equipment must fail in a particular mode causing a release. There are several possible causes of failure, with the main ones being corrosion and damage by external agencies;
- The released material must come into contact with a source of ignition. In some cases this may be heat or sparks generated by mechanical damage while in others, the possible ignition source could include non-flame proof equipment, vehicles, or flames some distance from the release;
- Depending on the release conditions, including the mass of flammable material involved and how rapidly it ignited, the results may be a localized fire (for example a jet fire), a flash fire or an explosion of the vapor cloud formed through the release.;
- Finally, for there to be a risk, people must be present within the harmful range (consequence distance) of the fire or explosion. How close the people are will determine whether any injuries or fatalities result. Environmental damage from gas fire incidents are generally associated with a failure to control fire water used.

Natural gas is a buoyant, flammable gas which is lighter than air (relative density of 0.6). On release into the open, the non-ignited gas tends to disperse rapidly at altitude. Ignition at the point of release is possible, in which case the gas would burn as a jet (or torch) flame. On release in an enclosed area (for example within the gas turbine housing) an explosion or a flash fire is possible.

The gas is non-toxic, posing only an asphyxiation hazard. Due to its buoyancy, any release of credible proportions from operations of this scale, in the open, would not present an asphyxiation hazard. With standard confined space entry procedures and appropriate security arrangements to prevent unauthorized access to any of the facilities the risk associated with asphyxiation from natural gas should be minimal.

Locally, the pressure of the compressed gas may be hazardous in case of an uncontrolled release. These hazards, while of importance for people working at the site, do not have implications beyond the immediate location of the release unless the released gas is ignited.

Therefore, the risk associated with of non-ignited compressed gas does not form part of the scope of the present risk assessment.

5. Consequence Analysis

5.1. Evaluation Techniques

As none of the material used, produced or handled are toxic, the evaluation of consequences requires only the determination of fire radiation.

For both fires and explosions, it is necessary to determine the leak rate and duration for each incident.

Radiation effects are then determined using the point source method. The explanation of the nomenclature used in the equations below is listed in Table 13 at the end of this Chapter.

5.1.1. Leak Rates

The rate at which a fluid leaks from a hole can be determined for gas or vapor flows (as for natural gas), using the following equation:

$$\text{Gas flow rate} = 0.8 \times A \times P \times \sqrt{\frac{M\gamma}{zRT}\left(\sqrt{\frac{2}{\gamma+1}}\right)^{\frac{\gamma+1}{\gamma-1}}}$$

Note that this applies to the condition known as critical or choked flow, which applies when the internal pressure is more than double the atmospheric pressure (approximately).

5.1.2. Duration

The duration of a leak will depend on the hardware systems available to isolate the source of the leak, the nature of the leak itself and the training, procedures and management of the facility. While in some cases it may be argued that a leak will be isolated within one minute, the same leak under different circumstances may take 10 minutes to isolate.

The mass of flammable gas contained in a cloud which could flash or explode is set at the total amount which would leak out in 3 minutes. This is based on the assumption that a cloud travelling in the direction of the wind will either encounter a source of ignition within this time or would disperse to concentrations below the Lower Flammable Limit (LFL).

5.1.3. Radiation Effects – The Point Source Method

Radiation effects are evaluated using the point source method, which assumes that a fire is a point source of heat, located at the Centre of the flame, and radiating a proportion of the heat of combustion. The radiation intensity at any distance is then determined according to the inverse square law, making allowance for the attenuating effect of atmospheric water vapor over significant distances (e.g. 100m or more).

$$I = \frac{Qf\tau}{4\pi r^2}$$

The rate of heat release, Q, is given by:

$$Q = \dot{m}H_c$$

5.2. Impact Assessment

The above techniques allow the level of radiation resulting from fires and explosions to be determined at any distance from the source. The effect or impact of heat radiation on people is shown in Table 8[1].

Table 8: Effects of Heat Radiation

Radiant Heat Level (kW/m2)	**Physical Effect (effect depends on exposure duration)**
1.2	Received from the sun at noon in summer
2.1	Minimum to cause pain after 1 minute
4.7	Will cause pain in 15-20 seconds and injury after 30 seconds exposure
12.6	Significant chance of fatality for extended exposure. High chance of injury
23	Likely fatality for extended exposure and chance of fatality for instantaneous (short) exposure
35	Significant chance of fatality for people exposed instantaneously

For jet flames and fireballs the effect of heat radiation is constant in every direction, hence they are omni-directional in effect. The probability of affecting a target at a location within the effect distance away from the location of the incident is equal in all directions. The relationship between exposure and effect was estimated based on the probit equation for heat radiation.

For the case of pipelines, the hazard must be treated as a linear hazard in the respect that it remains constant along the length of the route, and it only changes if there are special features in the pipeline such as valve stations. For a given location (at a distance **d** away from the fire), the heat radiation could exceed specified levels if **d** is less than, or equal to, the hazard range (or in this case the —effect distance). Hence, this Initial QRA has determined the hazard range of incident scenarios occurring anywhere along the interaction length of the pipeline.

Table 9: Nomenclatures

Label	Explanation
A	Area of hole, m^2
C_p	Average liquid heat capacity, KJ/Kg.K
f	Fraction of heat radiated
H_c	Heat of combustion, KJ/Kg
H_v	Heat of vaporization, KJ/Kg
I	Radiant heat intensity, KW/m^2
M	Molecular weight
m	Mass, Kg
m_v	Mass of vapor (in cloud), Kg
$\dot{m}$	Mass flow rate of leak, Kg/s
P	Pressure, Pa
Q	Heat release rate, KW
R	Universal gas constant, 8.314 J.K/mol
r	Distance from fire/explosion, m
T	Temperature, K
t	Duration of leak/time, seconds
Z	Gas compressibility factor
γ	Ratio of specific heats (~1.4)
ρ	Density, Kg/m^3
τ	Atmospheric transmissivity

5.3. Consequence Calculations

This initial outflow rates estimated for natural gas releases are shown in Table10. The results predict that the rate of decrease in outflow rate for a full bore rupture is dramatic with a drop to less than half of the initial flow within seconds and further rapid decay. However, the present Initial QRA has assumed that the initial release rate remains until isolation can be achieved - this is a highly conservative approach. Further details are in the result section.

Table 10: Release Rates

Release rate [kg/s]	Hole Size		
	Small Leak (3 mm)	Intermediate Leak (50 mm)	Full bore (guillotine)
Upstream of the Pressure Regulator			
Instantaneous	0.208Kg/s	57.5Kg/s	3700Kg/s
Downstream of the Pressure Regulator			
Instantaneous	1.74 Kg/s	482 Kg/s	39200 Kg/s

The distance from the source of the fire to the specified heat radiation and the distance to 100% chance of fatality for jet fire scenarios are listed in Table 11 below.

Table 11: Heat Radiation from Jet Fires

Hole size (mm)	Distance to Heat Radiation (Meters)			
	4.7 KW/m^2	12.5 KW/m^2	23.5 KW/m^2	35.5 KW/m^2 (For 100% Fatality)
Upstream of the Pressure Regulator				
Small leak (3 mm)	5.14	3.15	2.30	1.87
Intermediate leak (50 mm)	85.52	52.44	38.25	31.12
Full bore (guillotine)	686	420.69	306.82	249.63
Downstream of the Pressure Regulator				
Small leak (3 mm)	14.89	9.13	6.66	5.42
Intermediate leak (50 mm)	247.57	151.80	110.72	90.08
Full bore (guillotine)	2231.10	1368.10	997.78	811.81

6. Frequency Analysis

Failure Case Scenarios

Following scenario has been identified for the Natural Gas pipeline inside the plant[3]:

Table 12: Failure case scenario for NG pipeline

Scenario	Temperature (^oC)	Pressure (Pa)		Phase	Service
		$P_{upstream}$	$P_{downstream}$		
Natural Gas Pipeline (within plant boundary)	32	5.07×10^5	4.21×10^6	GAS	Natural Gas

Table 13: Frequencies for different leak size occurrences [1]

Sl. No.	**Scenario**	Frequencies (/yr)		
		Small	Intermediate	Full Bore
1	Natural Gas Pipeline (within plant boundary)	4.52E-08	3.53E-10	0

7. Calculations for Gas pipeline

7.1. Calculation of Z factor

Table 14 shows the calculations done for obtaining the value of Gas Compressibility Factor 'Z'.

Table 14: Calculation of Z (Felder and Rousseau, 3rd edition, Page no: 209)

	T (K)	**P (Pa)**	**T_c (K)**	**P_c (Pa)**	**T_r = T/T_c**	**P_r = P/P_c**	**Z**
Upstream	305	5.07E+05	196.65	4.64E+06	1.55	0.11	0.98
Downstream	305	4.21E+06	196.65	4.64E+06	1.55	0.91	0.96

7.2. Calculation of Flow rates for different leak sizes

R= 8.314 J k/mol

T= 305 K (32^0C)

$\gamma = 1.31$

M_{avg}= 17 g/mol

P_{upstream}= 5.07 E+05 Pa

$P_{\text{downstream}}$= 4.21 E+06 Pa

$$\text{Gas flow rate} = 0.8 \times A \times P \times \sqrt{\frac{M\gamma}{zRT}\left(\sqrt{\frac{2}{\gamma+1}}\right)^{\frac{\gamma+1}{\gamma-1}}}$$

Table 15: Flow rates for different leak sizes

Leak size (m)	Cross section	Flow rate (Kg/s)	Location
3.00 E-03	7.07E-06	2.08 E-01	Upstream of regulator
5.00 E-02	1.96 E-03	5.75 E+01	Upstream of regulator
4.00 E-01	1.26 E-01	3.70 E+03	Upstream of regulator
3.00 E-03	7.07E-06	1.74 E+00	Downstream of regulator
5.00 E-02	1.96 E-03	4.82 E+02	Downstream of regulator
4.50 E-01	1.59 E-01	3.92 E+04	Downstream of regulator

7.3. Consequence Assessment

Assume:

Heat of combustion= 50000 KJ/Kg

Radiation efficiency= 0.15

Duration of exposure= 60 s

Duration of total mass in vapor cloud= 180 s

Mass burn rate= Outflow rate

Length of Jet, L= $6M^{0.5}$ (meters)

M= Mass flow rate (Kg/s)

Table 16: It shows the results for different heat radiations for different leak sizes. Then the length of the jet flame for different leakages has been shown. Finally, heat radiation intensities for each leakage have been demonstrated. This calculation has been performed at different distances from the center of the leakages as shown in the table.

Table 17: In this table, different Probit values for different heat radiation intensities have been shown. Each heat radiation intensity has a certain Probit value. Different heat radiation intensity values have been obtained from table 16.

Table 18: The probit values obtained from table 17 have been used to find the percentage of probit. This percentage of probit is the Probability of Fatality. The respective values have been shown in this table.

7.4. Total risk assessment

The calculations for total risk assessment have been shown in table 19. Here in this table, the risk of fatality has been shown. In order to obtain risk of fatality, the following equation has been used:

Risk = Consequence x Frequency

The consequence value is basically the probability of fatality value. Frequency value has been obtained from historical data and literatures. Then total risk of fatality per meter per year has been calculated and shown. Finally, total risk of fatality per year has been calculated and shown. Calculations have been done for both upstream and downstream natural gas pipelines.

Upstream of regulator	4.00 E-01	3.70 E+03	2.78 E+07	364.97	2.21E+06	8.85E+04	2.21E+04	5.53E+03	885	221
Downstream of regulator	3.00 E-03	1.74 E+00	1.31 E+04	7.91	1.04E+03	41.70	10.42	2.61	0.42	0.10
Downstream of regulator	5.00 E-02	4.82 E+02	3.62 E+06	131.73	2.88E+05	1.15E+04	2.88E+03	720	115	28.81
Downstream of regulator	4.50 E-01	3.92 E+04	2.94 E+08	1187.94	2.34E+07	9.36E+05	2.34E+05	5.85E+04	9.36E+03	2.34E+03

Table 16: Calculation for probit values

Leak size (m)	Location	Burn rate (Kg/s)	Heat Radiation (KW)	Length of Jet flame	Probit value -14.9+ 2.56 ln ($I^{1.333}$ * t)					
				Meters	**1**	**5**	**10**	**20**	**50**	**100**
3.00 E-03	Upstream of regulator	2.08 E-01	1.56 E+03	2.74	12.03	1.05	-3.68	-8.42	-14.64	-20.13
5.00 E-02	Upstream of regulator	5.75 E+01	4.32 E+05	45.50	31.23	20.25	15.51	10.78	4.53	-0.20

4.00 E-01	Upstream of regulator	3.70 E+03	2.78 E+07	364.97	45.43	34.45	29.72	24.99	18.74	14
3.00 E-03	Downstream of regulator	1.74 E+00	1.31 E+04	7.91	19.29	8.31	3.58	-1.14	-7.38	-12.28
5.00 E-02	Downstream of regulator	4.82 E+02	3.62 E+06	131.73	38.48	27.49	22.76	18.03	11.77	7.05
4.50 E-01	Downstream of regulator	3.92 E+04	2.94 E+08	1187.94	53.43	42.50	37.77	33.04	26.79	22.06

Table 17: Calculations for Probability of fatality Table 18: Calculations for different heat radiation intensities at different distances from the Centre of the leaks

Leak size (m)	Location	Burn rate (Kg/s)	Heat Radiation (KW)	Length of Jet flame ($L=6M^{0.5}$)	Heat radiation (KW/m^2) at distance from Centre of Flame (in meters)					
				Meters	1	5	10	20	50	100
3.00 E-03	Upstream of regulator	2.08 E-01	1.56 E+03	2.74	124	4.97	1.24	0.31	0.05	0.01
5.00 E-02	Upstream of regulator	5.75 E+01	4.32 E+05	45.50	3.44E+04	1.38E+03	344	85.90	13.75	3.44

Leak size (m)	Location	Burn rate (Kg/s)	Heat Radiation (KW)	Length of Jet flame	Probability of fatality					
				Meters	1	5	10	20	50	100
3.00 E-03	Upstream of regulator	2.14 E-01	1.07 E+04	2.78	1	0	0	0	0	0
5.00 E-02	Upstream of regulator	5.93 E+01	2.9 E+06	46.2	1	1	1	1	0.32	0
4.00 E-01	Upstream of regulator	3.81 E+03	1.9 E+08	370.35	1	1	1	1	1	1
3.00 E-03	Downstream of regulator	8.6 E-01	4.3 E+04	5.6	1	1	0.08	0	0	0
5.00 E-02	Downstream of regulator	2.37 E+02	1.19 E+07	92.4	1	1	1	1	1	0.98
4.50 E-01	Downstream of regulator	1.9 E+04	9.5 E+08	827	1	1	1	1	1	1

Table 19: Calculations for risk of fatality

Leak size (m)	Location	Risk of fatality from jet fires (per m per year)					
		1	**5**	**10**	**20**	**50**	**100**
3.00 E-03	Upstream of regulator	4.52E-08	0	0	0	0	0
5.00 E-02	Upstream of regulator	3.53E-10	3.53E-10	3.53E-10	3.53E-10	1.13E-10	0
4.00 E-01	Upstream of regulator	0	0	0	0	0	0
Total risk of fatality (per meter per year) (Upstream of regulator)		4.56E-08	3.53E-10	3.53E-10	3.53E-10	1.13E-10	0
Divide pipeline into segments of 100 meters each.							
Total risk of fatality (per pipeline effect zone) (Upstream of regulator)		4.56E-07	3.53E-09	3.53E-09	3.53E-09	1.13E-09	0
3.00 E-03	Downstream of regulator	4.52E-08	4.52E-08	3.62E-09	0	0	0
5.00 E-02	Downstream of regulator	3.53E-10	3.53E-10	3.53E-10	3.53E-10	3.53E-10	3.46E-10
4.50 E-01	Downstream of regulator	0	0	0	0	0	0
Total risk of fatality (per meter per year) (Downstream of regulator)		4.56E-08	4.56E-08	3.97E-09	3.53E-10	3.53E-10	3.46E-10
Divide pipeline into segments of 100 meters each.							
Total risk of fatality (per pipeline effect zone) (Downstream of regulator)		4.56E-07	4.56E-07	3.97E-08	3.53E-09	3.53E-09	3.46E-09

8. Calculation for Turbine Housing

The frequency of explosion inside the turbine housing can be assessed as follows:

Explosion frequency= (Gas release frequency within the enclosure) × (Ventilation fan failure probability) × (Gas detection and emergency shutdown failure probability) × (Ignition probability of accumulated gas) × (Explosion if ignition probability).

Here, some assumptions are made. Those are as follows:

- Gas leak frequency= 2.48×10^{-3} t/year.
- Ventilation fan failure probability= 0.10. It has been assumed that there are two automated protective systems. When the probability of failure of these two systems are considered, P = 0.05 + 0.05 = 0.10. However, it is a highly conservative assumption.
- Gas detection failure and failure of the emergency shutdown = 0.05 per gas detector. It has been assumed that there are two independent detectors. The probability of common mode failure for gas detectors= $(0.05)^2 = 0.0025$.
- Ignition probability of accumulated gas = 0.10. All equipment and instrumented protective equipment used in the enclosure need to be designed for the hazardous zone requirements. Even then, a gas turbine could have hot surfaces above auto ignition temperature of the fluids used even in normal conditions. Operation under faulty conditions may increase surface temperature.

Explosion if ignition probability = 1. It is assumed that all ignitions of flammable gases inside the enclosure would lead to an explosion. This assumption is greatly conservative.

Calculations show:

Explosion frequency= $(2.48 \times 10^{-3}) \times (0.1) \times (0.05 \times 0.05 + 0.0025) \times (0.1) \times (1) = 1.24 \times 10^{-7}$ per year per housing.

9. Risk results and comparison with risk criteria

9.1. Risk calculations for natural gas pipelines outside of the turbine enclosures

9.1.1. Results

Risk contours for the site are shown in the following figures:

- Figure 1 shows the individual fatality contours for risk associated with the Natural Gas pipeline.

Note that all data used in this assessment are for a site operating 100% of the time with the natural gas pipelines pressurized 100% of the time. The quantitative risk results are valid, though conservative, for the plant under the expected operating conditions, which are for the Power Plant expected to operate less than 10% of the time. The concept of societal risk is not applicable for the proposed development and has not been calculated further. Table 20 shows the maximum distance to risk contour from the center of the leakage.

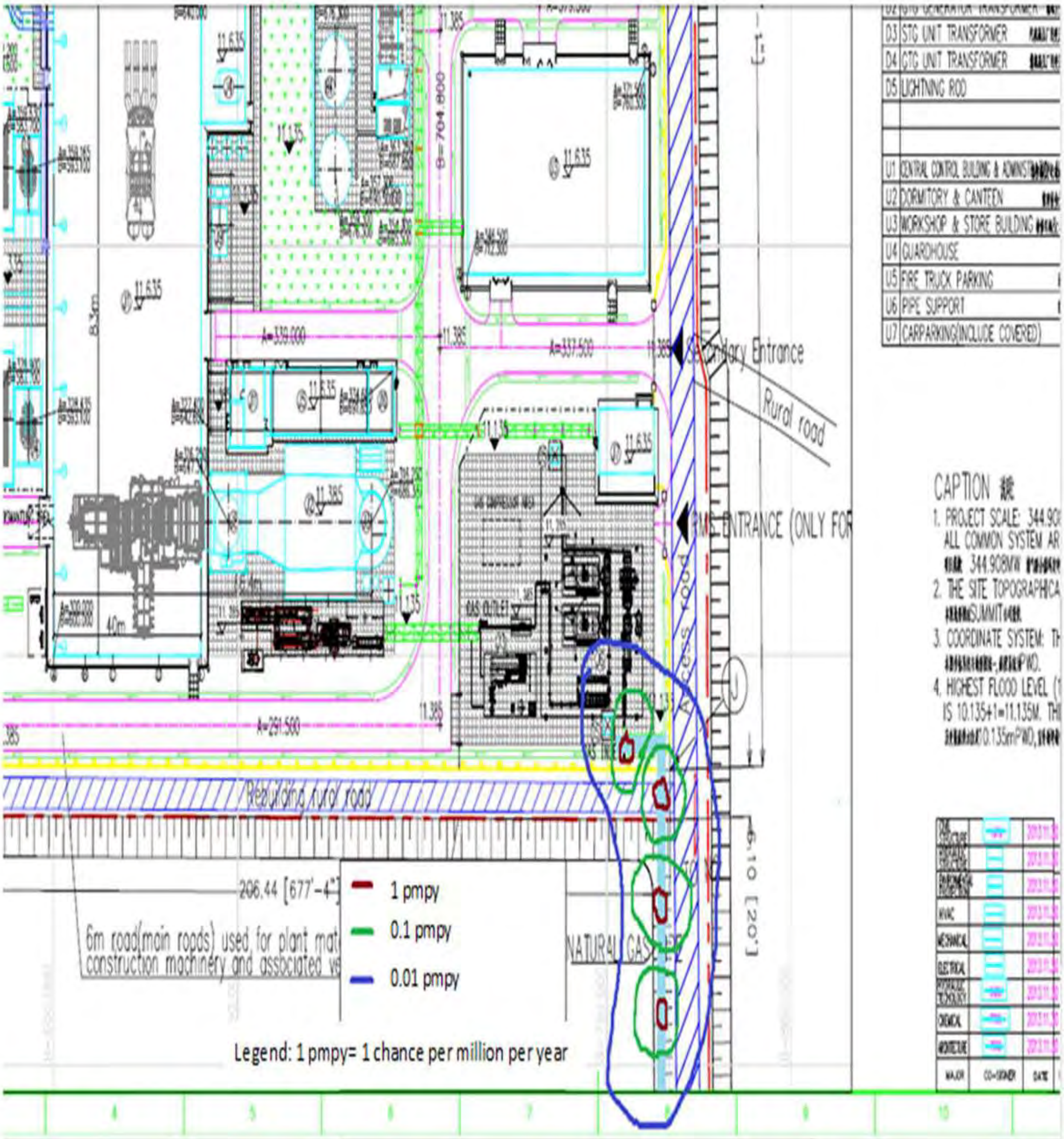

Figure 1: Individual Fatality Risk Contours for NG pipeline

Table 20: Distance to Risk Contours

Risk Contour	Maximum Distance to Risk Contour (meters)
upstream pipeline	
Individual Fatality Risk – 1 pmpy	8
Individual Fatality Risk – 0.1 pmpy	14
Individual Fatality Risk – 0.01 pmpy	50
Downstream pipeline	
Individual Fatality Risk – 1 pmpy	8
Individual Fatality Risk – 0.1 pmpy	14
Individual Fatality Risk – 0.01 pmpy	100

9.2. Gas supply pipeline

9.2.1. Results for upstream natural gas supply pipeline

Figure 2 shows the risk-transect for individual fatality at the upstream natural gas supply pipeline.

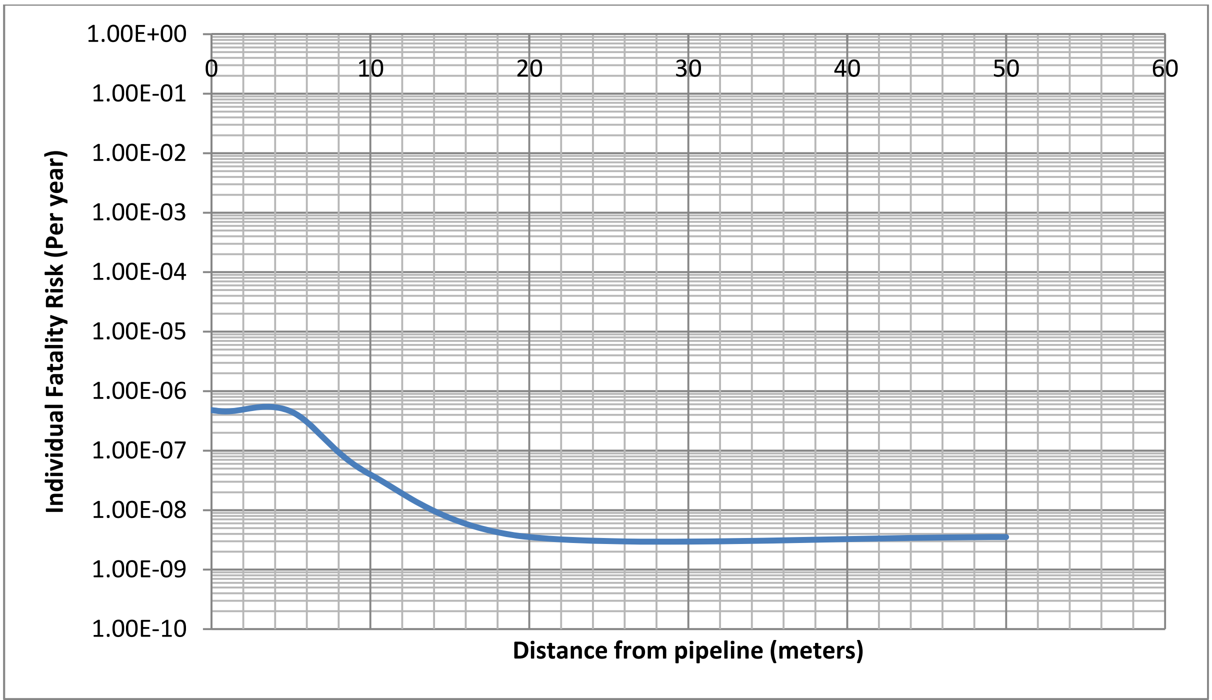

Figure 2: Total individual fatality risk for upstream gas supply pipeline

Discussions

From the criteria for tolerable individual risk from a new development as described in table 3,risk must not exceed 10 per million per year at the boundary of any new facility. In the case of the gas supply pipeline, the 10 pmpy risk contour is never reached and the risk remains below this level at all distances from the pipeline.

The criteria further states that: If risk off-site is between 0.1 and 10 per million per year, all practicable risk reduction measures are to be taken, and residential developments are to be restricted. The distance in this range is 8 meters. So, residential development may need to be restricted for a distance of 8 meters.

9.2.2. Results for downstream natural gas supply pipeline

Figure 3 shows the risk-transect for individual fatality at the downstream natural gas supply pipeline.

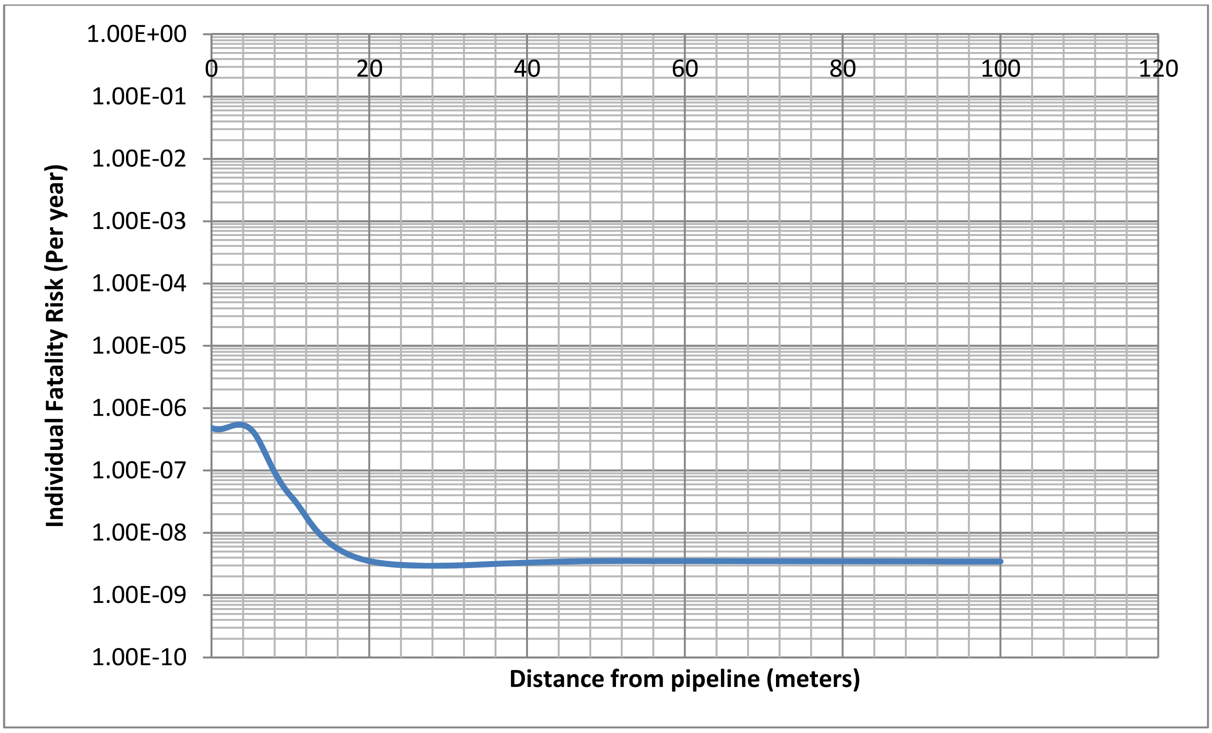

Figure 3: Total individual fatality risk for downstream gas supply pipeline

Discussions

From the criteria for tolerable individual risk from a new development as described in table 3,risk must not exceed 10 per million per year at the boundary of any new facility. In the case of the gas supply pipeline, the 10 pmpy risk contour is never reached and the risk remains below this level at all distances from the pipeline.

The criteria further states that: If risk off-site is between 0.1 and 10 per million chances per year, all practicable risk reduction measures are to be taken, and residential developments are to be restricted. The distance in this range is 8 meters. So, residential development may need to be restricted for a distance of 8 meters.

9.3. Risk of Natural Gas Explosion in Turbine Housing

The following table demonstrates the risk of fatality of turbine housing. There is one turbine in this plant. So, number of enclosures is one.

Table 21: Turbine housing- calculation sheet

Number of Flanges	3.41E+02	
Number of flexible Joints	1.54E+02	Model as flanges
Total	4.95E+02	
Frequency of leak per Flange	5.00E-06	Per flange/joint
Leakage per enclosure	2.48E-03	
Probability of failure of fan, allowing accumulation of gas	1.00E-01	conservative
Failure to detect leak, each detector	5.00E-02	
Number of detectors	2.00E+00	
Common mode failure, gas detectors	2.50E-03	
Probability of ignition	1.00E-01	
Frequency of ignition (per enclosure)	6.20E-08	t/yr
Number of enclosures	1.00E+00	
Total frequency of ignition on site	6.20E-08	
Probability of explosion if ignition	1.00E+00	
Frequency of explosion inside one of the turbine enclosures	6.20E-08	t/yr

Discussions

This frequency is very low. So from the analysis it can be said that it is safe.

A confined explosion may generate high over pressures which could damage neighboring equipment and turbines. It is however understood that the enclosures will be designed with explosions vents (/ panels) which would blow out in case of a pressure event, thereby reducing the effect of the confinement.

10. Conclusion

The results show that the fatality risk levels of the facilities have been found to be acceptable, in accordance to Victorian Work Safe requirements. It is however appropriate to consider that the facility is handling hazardous substances, and likely to impose significant consequence impacts to the personnel nearby if an unwanted event occurs.

Table 22: General Conclusion for Natural Gas Pipelines

Risk Contour	Maximum Distance to Risk Contour (meters)	General Recommendations
upstream pipeline		
Individual Fatality Risk – 1 pmpy	8	• Use of fully welded pipe work wherever possible; • Minimizing pipe-runs (pipe lengths); • Pipes of robust design; • Detectors positioned strategically; • Overpressure protection provided by three methods: • Rapid control valve closure under alarm conditions; • Slam shut isolation valve (or other emergency isolation valve) installed at the inlet to each control valve run; and • Pressure relief valve. • An actuated isolation valve will be installed at the inlet to the Power Station; and • Control and communications equipment to provide remote monitoring and central control of system by operating staff.
Individual Fatality Risk – 0.1 pmpy	14	• Pipes of robust design; • Detectors positioned strategically; • Overpressure protection provided by three methods: • Rapid control valve closure under alarm conditions; • Slam shut isolation valve (or other emergency isolation valve) installed at the inlet to each control valve run; and

		• Pressure relief valve. • An actuated isolation valve will be installed at the inlet to the Power Station; and • Control and communications equipment to provide remote monitoring and central control of system by operating staff.
Individual Fatality Risk – 0.01 pmpy	50	• Detectors positioned strategically; • Rapid control valve closure under alarm conditions; • Slam shut isolation valve (or other emergency isolation valve) installed at the inlet to each control valve run; • Pressure relief valve. • An actuated isolation valve will be installed at the inlet to the Power Station; • Control and communications equipment to provide remote monitoring and central control of system by operating staff.
Downstream pipeline		
Individual Fatality Risk – 1 pmpy	8	• Use of fully welded pipe work wherever possible; • Minimizing pipe-runs (pipe lengths); • Pipes of robust design; • Detectors positioned strategically; • Overpressure protection provided by three methods: • Rapid control valve closure under alarm conditions; • Slam shut isolation valve (or other emergency isolation valve) installed at the inlet to each control valve run; and • Pressure relief valve. • An actuated isolation valve will be installed at the inlet to the Power Station; and • Control and communications equipment to provide remote monitoring and central control of

		system by operating staff.
Individual Fatality Risk – 0.1 pmpy	14	• Pipes of robust design; • Detectors positioned strategically; • Overpressure protection provided by three methods: • Rapid control valve closure under alarm conditions; • Slam shut isolation valve (or other emergency isolation valve) installed at the inlet to each control valve run; and • Pressure relief valve. • An actuated isolation valve will be installed at the inlet to the Power Station; and • Control and communications equipment to provide remote monitoring and central control of system by operating staff.
Individual Fatality Risk – 0.01 pmpy	100	• Detectors positioned strategically; • Rapid control valve closure under alarm conditions; • Slam shut isolation valve (or other emergency isolation valve) installed at the inlet to each control valve run; • Pressure relief valve. • An actuated isolation valve will be installed at the inlet to the Power Station; • Control and communications equipment to provide remote monitoring and central control of system by operating staff.

Table 23: General Conclusion for Turbine Housing

Risk Associated	General Recommendations
6.20E-08	• Elimination or control of sources of ignition as far as reasonably possible (e.g. for control of sources of ignition in potentially explosive atmosphere). • Limitation of the volume of the explosive atmosphere by the application of all or a combination of: o Dilution ventilation. The ventilation system should have additional safety features such as e.g.: ▪ a 100% standby fan; an uninterruptible power supply to the ventilation fans; ▪ interlocks so that the gas turbine cannot start without sufficient ventilation; ▪ proven automatic isolation of fuel supply if ventilation fails; o Flammable gas detection combined with automatic shut-down of turbine and alarms; o Explosion relief, o Explosion suppression.

Moreover, the following best practices should be followed to demonstrate the ALARP (As Low as reasonably Practicable) performance:

- The use of fusible tubing around above ground high risk natural gas piping (e.g. within the turbine housing) to be investigated – such tubing would be linked to automatic shutdown of the fuel source.
- A fire protection system will be installed in the facility.
- Strict ignition control should be ensured.
- The layout and siting of the valve stations will be subjected to a rigorous Hazard and Operability Study (HAZOP) which will result in improvements to the design to limit their hazard potential.
- The gas supply pipelines are to be coated with polyethylene (or other) coating to reduce corrosion problems.
- Regular maintenance and inspection should be performed.
- Ensure availability and effectiveness of Fire & Gas detecting system and the emergency alarm system and means of communication, which would enable early warning to all

personnel in the event of accidental release and subsequently enable all personnel to take appropriate action.

- Natural gas disperses readily upwards, minimizing chances of ignition and making explosion not credible in unconfined situation.However,if possible, all pipelines are to be buried at a depth of at least 750mm (450mm in rock).
- Valve systems are to be surrounded by security fencing.
- The pipeline is to be hydro tested at a minimum of 1.4 times theMAOP (maximum allowable operating pressure).
- High and low pressures of the natural gas supply are to be monitored during (and, if applicable, outside) operation of the Power Plant.

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3) EIA Report for 305-350 MWDuel Fuel Combined Cycle Power Plant at Meghnaghat, Summit Meghnaghat Power Company limited.
4) NATURAL GAS RESERVE (PROVEN & PROBABLE) AND ITS CHEMICAL COMPOSITION, Production and Marketing Division, Perobangla.

Annex 13: Fisheries Survey Report

Draft Fisheries Survey Report

Project Number: 44951-01
November 2011

BAN: Bibiyana I and II Gas Power Project




Prepared by Bangladesh Centre for Advanced Studies for Summit Bibiyana I Power Company Limited and Summit Bibiyana II Power Company Limited

Summit Bibiyana I Power Company Limited
and
Summit Bibiyana II Power Company Limited

Fisheries Survey Report

Fisheries Survey

Chapter 1: Introduction and Background

1.1 Introduction

Fish and fisheries have been playing a vital role not only in providing food security to the Bangladeshis but also in the economy of Bangladesh. Fisheries Sector contributes 3.74% to the GDP, 20.87% to the agricultural income, 58% to the animal protein intake and 4.04% of annual export earnings (DoF, 2009). Moreover, the sector is providing full-time employment opportunities to 1.28 million fishers (DoF, 2009) and an estimated 9.5 million people are involved in subsistence fishing in the country's flood plains, the number exceeds 11 million between June to October each year due to increase in floodplain area during the rainy season (Azim ***et al.***, 2002). In addition, there are 3.08 million fish farmers (1.93 m fish farmers and 1.15 m. shrimp farmers) and 0.45 million fry (fish and shrimp) collectors (DoF, 2003). Around 14,000 fishermen are directly involved in fishing in the Oxbow lakes that directly benefits 70,000 rural people (Hasan, 2000a, Hasan and Talukder, 2004). On the whole about 10% of the populations are directly or indirectly dependent on fisheries for their income and livelihoods.

Apart from the economic benefits, fish have become an important component in the diets of Bangladeshis. The old Bengali proverb "*Machhe Bhate Bangalee*" (Rice and fish make a Bengali) underlines the significance of fish in the lives of the Bangladeshis. Fish is the major contributor of animal protein (58%) and additional nutrients like vitamins and minerals. Several small indigenous species (SIS) of fish are very rich in vitamin A and D contents while some other SIS which are consumed whole are key sources of calcium in the diets where consumption of milk is low. Fish in general are also important sources of iron and zinc. The key finding is that the small wild-caught fishes are the more important sources of micronutrients than the larger carps produced by culture based systems Thompson, ***et al.***, 2002.

Rivers and canals

Rivers and their tributaries are important natural habitats in Bangladesh. A network of 230 rivers and their tributaries covering a total length of about 24,140 km (39.5% of the open inland waters) flow down to the Bay of Bengal. Of them, the major ones are the Ganges-Padma (water area of 69,490 ha i.e. 5.72%), the Jamuna (water area of 73,666 ha i.e. 6.07%) and the Meghna (water area of 73,999 i.e. 6.10%) cover a catchment area of about 1.61 km^2. The rivers support a number of important fisheries and contribute significantly to the total fish production of the country. Table-1 shows region wise distribution of rivers and canals. Rivers and canals cover the maximum area in Barisal region (65,031 ha i.e. 13.56 % of the total area of rivers and canals) and Faridpur region (51,530 ha i.e. 10.74 % of the total area of rivers and canals) while the minimum in Patuakhali region (3,175 ha i.e. 0.66 % of the total area of rivers and canals).

Table-1: Region wise distribution of rivers and canals in Bangladesh

Name of region	Name of rivers and area (ha) covered by the rivers							%
	Ganges	Padma	Jamuna	Meghna (upper)	Meghna (lower)	Others + canals	Total	
Dhaka	57	12,588	2,946	14,299	-	17,487	47,317	9.87
Mymensingh	-	-	5,176	1,497	-	28,823	35,496	7.40
Tangail	-	-	6,991	-	-	6,139	13,130	2.74
Faridpur	2,758	29,199	-	-	1,400	18,173	51,530	10.74
Khulna	-	-	-	-	-	3,375	3,375	0.70
Jessore	-	-	-	-	-	17,482	17,484	3.65
Barisal	-	-	-	-	22,300	42,635	65,031	13.56
Patuakhali	-	-	-	-	-	3,175	3,175	0.66
Kushtia	5,120	-	-	-	-	6,191	11,311	2.36
Rajshahi	10,372	-	-	-	-	10,619	20,991	4.38
Pabna	8,858	-	24,088	-	-	8,432	41,378	8.63
Bogra	-	-	9,824	-	-	3,912	13,736	2.86
Rangpur	-	-	24,641	-	-	21,668	46,309	9.66
Dinajpur	-	-	-	-	-	9,104	9,104	1.90
Chittagong	-	-	-	-	-	9,253	9,253	1.93
Ctg.HillTracts	-	-	-	-	-	20,570	20,570	4.29
Comilla	-	538	-	17,796	9,824	11,347	39,505	8.24
Noakhali	-	-	-	-	6,787	3,453	10,240	2.14
Sylhet	-	-	-	-	-	20,802	20,802	4.34
Total	**27,165**	**42,325**	**73,666**	**33,592**	**40,407**	**262,580**	**479,735**	**100**

Source : SPARRSO (1984)

A number of natural canals link beels to rivers and provide a channel for water movements and migration of fish from rivers to beels and vice versa.

Natural depressions

Natural depressions which get seasonally flooded are mostly rice fields although privately owned forms a common pool during the monsoon with open access to fishing. Beels cover an area of 114,161 ha (9.40% of the open inland waters) are usually deeper depressions in the floodplains (Table-2). Most of them hold water round the year while some got silted and have become seasonal. Haors are extensively deep flooded areas bounded by natural river levees often by submersible embankments in the north-eastern part of Bangladesh, they may contain several beels, some of which are perennial. The area of natural depression is the highest in Sylhet region (32,700 ha i.e. 28.64% of the total area of natural depressions) followed by Mymensingh (29,100 ha i.e. 25.76% of the total area of natural depressions) and Rajshahi regions (19,849 ha i.e. 17.40% of the total area of natural depressions). This is due to the presence of haors in Sylhet and Mymensingh regions while due to the presence Chalan beel, the largest beel of Bangladesh in the Rajshahi region. On the other hand the minimum area of natural depression is in Noakhali region (only 3 ha i.e. 0.0002% of the total area of natural depressions) followed by Barisal region (only 79 ha i.e. 0.07 % of the total area of natural depressions) and Khulna region (only 365 ha i.e. 0.34% of the total area of natural depressions).

Table-2: Area of natural depressions in different regions of Bangladesh

Sl. No.	Name of regions	Area (ha)	% of Total area
1.	Sylhet	32,700	28.64
2.	Mymensingh	29,100	25.76
3.	Comilla	1,103	0.96
4.	Tangail	2,333	2.04
5.	Dhaka	4,918	4.31
6.	Rajshahi	19,849	17.40
7.	Rangpur	5,492	4.80
8.	Dinajpur	1,252	1.10
9.	Bogra	3,801	3.33
10.	Pabna	3,255	2.85
11.	Chittagong and Ctg. Hill Tracts	458	0.40
12.	Noakhali	3	0.0002
13.	Jessore	5,037	4.41
14.	Kushtia	2,197	1.92
15.	Faridpur	1,915	1.70
16.	Barisal	79	0.07
17.	Khulna	365	0.38
	Total	**114,161**	**100.00**

Source : MPO (1986a)

1.2 Background of the survey

The Summit Bibiyana I & II Power Company Limited Project comprising two 341 MW Combined Cycle Turbine power plants has been following the decision of the Government toward partial fulfillment of the objectives of meeting the existing power crisis throughout the country. The proposed project will be built in an area measuring 67 acres of land to the south of river Kushiara in the village Parkul at Bibiyana under union Aushkandi in Nabiganj upazilla of Habiganj district about 180 kilometers north-east of the capital city Dhaka with an investment of approximately US $ 550m.

As lots of interventions will be carried out there fish bio-diversity, their habitat, migration, spawning, etc. might be affected by the activities of the proposed power plant. In view of this, the project has initiated to assess the impact on fisheries sector due to the construction and operation of the power plant.

1.3 Objective: The objective of the survey is to carry out activities which will generate primary data on Aquatic diversity and fisheries on stretches of 1km or 2Km on either side of the project location.

Study Components: The major components of the study were as follows:

a. Biological component: This was included:
   - Fish population dynamics including identification of all fish species available, abundance and richness of the fauna (including seasonal variation of the study area.

- Analysis of the migration route of major economically and commercially important species in the study area
- Analysis of major spawning and rearing grounds of the study area.
- Productivity analysis which included plankton (phyto-plankton and zoo-plankton) and benthos (bottom fauna) analysis including seasonal variation in the study area.

b. Environmental component: This will include:
    - Major causes of reduction of fish production which will include the various aspects environmental causes due to which the fish production are reducing.
    - Water Pollution analysis of the project area.

c. Social component: This will include:
    - Analysis of the general demography of the fishermen community in the study area.
    - Socio-economic condition of the fishing community in the project area.

A rapid baseline survey was conducted to examine present status of open water capture fisheries, limnological and water quality characteristics, socio-economic conditions of fishermen community, fish landing and marketing centers, fish spawning and migration routes. This survey was carried out to obtain the baseline primary data and information in order to make an adequate assessment on these fisheries issues and related subject-matters under study components as mentioned in the ToR of Study Project.

Data were mainly collected on-

- Fish population dynamics (catch and effort, species composition, length and weight measuring, migration behaviour, etc.
- Limnological and water quality parameters survey to identify and quantify aquatic habitat characteristics to know the aquatic habitat conditions as well as water pollution load
- Fish landing and marketing network surveys
- Fishermen community households surveys in the study Area;

2.1 Sampling design and sample size

Samples were collected from high, medium and low impact zones of the proposed power plant. Thereby samples were collected from ± 1Km, ± 4 Km and ± 8 Km from the project site to assess the variations (Table 2.1) for catch and effort survey.

Table 2.1: Distance of sampling sites from the project site

Down stream			**Base point**	**Up stream**		
Jamargaon	Atghoria/ Padullah	Lama Tajpur	Parkul	Char Tajpur	Brahmingaon/ Alipur	Monumukh
8 Km	4 Km	1 Km	Plant site	1 Km	4 Km	8 Km

The sampling techniques used for the study is as follows:

Stations	Sample size/ sampling activities
Catch and effort study	
High impact zone (in 2 places), (± 1 Km) from 0 point (project site)	About 30% of important fishing gears; collect data from both side of the river)
Medium impact zone- 2 places (emphasis on migration routes/ canal mouths) (± 4 Km from 0 point)	About 10% of important fishing gears; collect data from both side of the river)
Low impact zone (± 8 Km from 0 point) • Down stream-near dolphin habitat • Up stream- Monumukh point)	About 10% of important fishing gears (within 1 Km of sampling point); collect data from both side of the river
Length- weight study (major commercially important species only)	Interviewed and non-interviewed (collect fish for survey from market) fishermen. At least 10 fish of each species
Limnological study	Sample should be collected from the same 6 spots as catch and effort study

FGDs with fishermen groups	6 FGDs with male/ mixed groups in the villages close to catch and effort sampling sites. 2 FGDs with female groups (high impact zone) 2 FGDs with arotders in 2 fish landing centers 1 FGD with farias 1 FGD with retailers 2 FGDs with Katha operators
Key Informants Interviews (KII)	Upazila Fisheries Officer-02 President/Secretary of fishermen cooperatives-02

2.2 Methodology
2.2.1 Fish population dynamics survey

This study was conducted from 18 – 26 October 2011 at the Monumukh- Parkul-Jamargaon. The total length of the survey area was about 16 Km. A census of all gears operating in the six sampling study areas was undertaken on daily basis using a gears survey form. Fishing efforts was measured for different gears (Kg/m^2/hour). Total catch by species was recorded for all gill nets, seine nets, lift net, drift net and shangla jal, long lines operating during that census. Furthermore, the mesh size, owner status and number of units used by the fishermen were recorded. A catch assessment monitoring questionnaire developed for the study. Catch monitoring data were collected on daily basis from the fishermen during fishing.

Length-weight frequency data were obtained for key fish species from the fishing boat and two main fish landing centers.

Usually the full moon and new moon issue for catch effort monitoring is considered in the tidal zone areas where the moon has significant influence on water-bodies and tides. Besides, full moon and new moon has also influence on fish during spawning season. Nevertheless, this study was far away from tidal zone with very minimal influence of moon. On the other hand the spawning season is almost completed. Again, the data of only single full moon and new moon do not carry significant importance for this type of study. In this regards, it was decided not to give special importance on full and new moon issue.

Again, mark and recapture method is followed to identify the migration routes of fishes, where fishes are marked/ tagged with stains or tagged (internal or externally), then released and recaptured again after certain intervals. This is a laborious and time consuming process. We have decided to minimize the issue by taking into account the gear orientation (gear set upward or downward direction). This also helped to understand the migration pattern of fishes.

2.2.2 Limnological survey

Benthos

Benthos were collected by Ekman dredge at about 3m depth (shallow region) at Monumukh, Brahmangaon, Lamatajpur, Paharpur, Atgoria and Digholbak of Kushiara river on 23rd October 2011 between 09:00 AM to 04:00 PM. Duplicate samples were collected from the same sampling site. The Ekman dredge with mud sample is then opened above a plastic bag and the sample gently removed on the boat. The sample bags were watertight and transferred to the laboratory in a thermally isolated container cooled with icepacks.

The sample was then sieved with sprinkle water directly onto the mud sample with a low-pressure nozzle in order to prevent any damage to animals. The sieving was performed very carefully in order to avoid any damage to the fragile organisms and to ensure that all animal present in the sample were collected. A sieve of 0.5 mm mesh was used to isolate macro-fauna. Aquatic vegetation present in the sample was cautiously removed from the surface of the sample, rinsed apart and the resulting water sieved.

All material retained on the sieve, including organisms, shell fragments, vegetal debris and coarse sediment grains were transferred to appropriate containers. Containers were labeled indicating the station code, the sample code, sampling date etc.

The sieved material is then fixed as a whole in the plastic container having a 10% formalin solution and preserved until use. The volume of the fixative was approximately three times the volume of the sample.

Rose Bengal strain at 200mg/l was used carefully to accelerate the sorting procedure. A small quantity of unsorted material was placed on a tray for an initial general sorting for larger organisms with the help of a magnifying lens. Shell fragments, vegetal debris or coarse detritus in the sample were rinsed in a separate container and checked for the presence of invertebrates. Large organisms were placed immediately in appropriate containers making sure that no other smaller animals were attached to their bodies. Fine sorting was performed under a dissection microscope. During this phase a small quantity of the sample was spread onto a Petri dish and carefully examined to identify the organisms. Organisms were identified according to the main taxonomic groups, usually bivalves, gastropods, crustaceans, insects etc.

Phytoplankton

Phytoplankton samples were collected at Monumukh, Brahmangaon, Lamatajpur, Paharpur, Atgoria and Digholbak of Kushiara river on 23rd October 2011 between 09:00 AM to 04:00 PM. Monofilament nylon plankton net of 25 μm mesh size was used to collect the sample. For qualitative study, net hauls were made at the surface and at desired depth on the river of the sampling sites. For quantitative analysis, phytoplankton was collected by the plankton net by passing 10 liters of water through it and finally concentrated to 50 mL.

The phytoplankton was fixed as soon as the collection is over to prevent the adverse effects of light and temperature which might cause rapid decay of organisms. Preservation of the samples before analyses was done by addition of 10% buffered formalin in small plastic bottles. Analyses were done on a Sedgewick-Rafter counting cell, under a compound binocular microscope.

Analyses involved transfer of 1 mL sub-sample from each of the samples to the Sedgewick-Rafter counter and counting of cells within 10 squares of the cells, chosen randomly. The cell counts were used for compute the cell density using the Striling (1985) formula where the plankton density is estimated by-

N = (Ax1000xC)/(VxFxL)

Where,

N = No. of phytoplankton cells or units per litre of original river water.

A = Total No. of phytoplankton counted.

C = Volume of final concentrate of the samples in ml.

V = Volume of a field in cubic mm.

F = No. of fields counted.

L = Volume of original river water in liters.

The phytoplankton were then identified up to the genus level and enumerated by the following (APHA, 1992; Bellinger, 1992). The number of plankton was recorded and expressed numerically per litre of river water. Qualitative studies were done according to Peenak (1953), Ward and Whipple (1954), Needham and Needham (1962), Prescott (1964), Bellinger (1992) and APHA (1992).

Zooplankton

Zooplankton samples were collected at Monumukh, Brahmangaon, Lamatajpur, Paharpur, Atgoria and Digholbak of Kushiara river on 23rd October 2011 between 09:00 AM to 04:00 PM. Monofilament nylon plankton net of 50 μm mesh size was used for this purpose. For qualitative study, net hauls were made at the surface and at any desired depth on the river of the sampling sites. Some plankton that remains on the collecting bottle was washed well and collect the sample after the net operations is over. For quantitative analysis, phytoplankton was collected by the plankton net by passing 10 liters of water through it and finally concentrated to 50 mL.

The zoopplankton was fixed as soon as the collection is over to prevent the adverse effects of light and temperature which might cause rapid decay of organisms. Preservation of the samples before analyses was done by addition of 5% buffered formalin in small plastic bottles, before analyses on a Sedgewick-Rafter counting cell, under a compound binocular microscope.

Analyses involved transfer of 1 mL sub-sample from each of the samples to the Sedgewick-Rafter counter and counting of cells within 10 squares of the cells, chosen randomly. The cell counts were used for compute the cell density using the Striling (1985) formula where the zooplankton density is estimated by-

N = (Ax1000xC)/(VxFxL)

Where,

N = No. of zooplankton cells or units per litre of original river water.

A = Total No. of zooplankton counted.

C = Volume of final concentrate of the samples in ml.

V = Volume of a field in cubic mm.

F = No. of fields counted.

L = Volume of original river water in liters.

The zooplankton were then identified up to the genus level and enumerated by the following (APHA, 1992; Bellinger, 1992). The number of zooplankton was recorded and expressed numerically per litre of river water. Qualitative studies were done according to Peenak (1953), Ward and Whipple (1954), Needham and Needham (1962), Prescott (1964), Bellinger (1992) and APHA (1992).

Water Quality Parameter

A centigrade thermometer was used to measure water temperature. Transparency (cm) was measured with a Secchi disc of 24cm diameter. Dissolved oxygen (DO) and pH were measured by HACH Freshwater Kit.

Fig 1: Transparency is measuring with a Secchi disc.

Fig 2: Benthos is collecting by Ekman dredge.

Fig 3: Plankton is collecting with a plankton net.

Fig 4: Water temperature reading

Fig 5: Plankton collection.

Fig 6: Identifying the plankton community

2.2.3 Fish market survey

Fish market survey was done at two main fish landing centers within the study area (Sherpur and Monumukh). Data were collected on value chain pattern, distribution channels, actors involved and their roles, business size and their seasonal variations through questionnaire survey and conducting FGDs.

Fig 7: Rural fish arot (auction place)

2.2.4 Livelihood survey of the fishermen

Fig 8: Conduction of FGD with women group

Eight Focus Group Discussions (FGDs) were conducted with the fishermen groups to analyze the livelihood patterns of them, their asset base, vulnerabilities, affiliations, experience about fish of Kushiyara, etc.

3.1 Fish population dynamics

3.1.1 Fishing Gears

The fishermen here usually fish in the *Kushiyara* main river. During monsoon they use to fish nearby villages, however, during winter and summer they use to go further downstream up to *Markuli* (20 miles down).

A range of verities of fish net they use for catching fish, namely seine net, urthar jal, mobile lift net, fixed lift net, mono-filamentous gill net, shangla jal, cast net, hook/ long line, etc. However, most of the fishermen are engaged in seine netting, since it is labour intensive.

Within the survey area the number of fixed lift net (veshal jal) was the highest (30%) followed by seine net (20%), mobile lift net and mono-filamentous gill net (current jal) (17% each). Also there were uthar jal, shangla jal and hook (16% all together). The Fixed Lift nets were set near the loops or curves of the river and all of them were found facing downstream. It was observed that the number of Fixed Lift net was more in downstream from the plant site compare to up stream. At Jamargaon sampling point 100% fishermen were using Fixed Lift nets. On the other hand seine nets were mostly operated close to the power plant (Table 3.1).

Table 3.1: Types of gear used at different sampling point by percentage

Type of Gears	Jamargaon	Padullah	Lama Tajpur	Char Tajpur	Alipur	Monumukh	All
Fixed Lift net	100	34	50	-	50	3	30
Seine net	-	33.	50	64	-	-	20
Mobile Lift net	-	-	7	36	-	35	17
Mono-filamentous gill net	-	33	-	-	50	16	17
Uthar jal	-	-	-	-	-	16	6
Shangla jal	-	-	-	-	-	14	5
Hook/ long line	-	-	-	-	-	16	5

Several nets are designed to catch many species while others are used to catch a particular species. In the present investigation, lift nets were the main gears followed by seine nets, gill nets and bag nets. Kader *et al.* (1999) also found lift, seine and gill nets as dominant gears in three floodplain rivers in Bangladesh. Small to large size nets were operated in the study area. Seine nets were largest (avg. 8269 m^2) followed by uthar jal (1908 m^2). The average size of shangla jal, which is mostly used for Hilsa fishing, was about 62 m^2. Usually uthar and shangla jal are used for catching larger fish, thereby their mesh size is also large (more than 70 mm) (table 3.2).

Table 3.2: Average Gear Size and Number of People Involvement

Type of Gears	Average Gear Size (m^2)	Average Mesh Size (mm)	Average Number of People
Fixed Lift net (Veshal)	225	22	2
Mobile Lift net (Boat veshal)	128	16	3
Mono-filamentous gill net	794	26	3
Seine net	8269	18	13

Uthar	1908	72	3
Shangla jal	62	77	2

Since seine net is very large in size, is labour intensive to operate. Normally, owner of a boat and net forms a group with 10- 12 fishermen. They are the fishing laborers. In most cases, the owner of the boat and net borrow money from arotders (auctioneers) for making, purchasing or repairing boat and nets and to maintain families in the lean periods. The condition behind is to sell fish in his arot. The Arotder then gets the commission. The fishermen also change their types of fishing gears from season to season; e.g. the same group use seine net for 6-8 months and during winter they catch fish by uthar net and go to different place for fishing.

3.1.2 Fishing Effort and Yield

During the survey period the average fish caught was highest for seine net (28 Kg/gear/day) followed by fixed lift net (12 Kg/gear/day) and the lowest by hook (Table 3.3). The fishermen mentioned during the FGDs that fish catch reaches it peak during mid September to mid of November when water starts receding. Simultaneously, fish catch is low from February to July and lowest catch during June and July.

Table3.3: Average Weight of Catch Fish by Fishing Location

Name of Fishing Location	Average Fish Caught (Kg)						
	Fixed lift net (Veshal)	Mobile lift net (Boat veshal)	Gill net (Current jal)	Seine	Uthar	Shangla	Hook
Jamargaon	20.8	-	-	-	-	-	-
Padullaha	6.4	-	2.7	30.2	-	-	-
Lama Tajpur	5.3	6.5	-	30.4	-	-	-
Char Tajpur	-	3.8	-	24.7	-	-	-
Alipur	5.1	-	2.6	-	-	-	-
Monumuk	3.2	12.3	2.7	-	7.5	4.6	2.3
All	12.2	9.7	2.7	28.0	7.5	4.6	2.3

Total daily catches by gear type were estimated from their average catch rates and average number of gears recorded daily using a model equation developed by de Graff and Chinh (1992).

$$Y_d = \overline{\sum_g CPUE_g} \, . \, \overline{f_g}$$

Where, Y_d = total daily catch for gear (g)
$CPUE_g$= daily mean catch per unit effort for gear
f_g= mean effort (gears,hour-1).

The catch per unit of effort (CPUE) was calculated as the total daily catch (Y_g) divided by the sampled gear area and hour fished.

Although average catch was highest for seine net, nevertheless, catch per unit effort was heist for shangla jal (19.5 g/m^2/hour) followed by mobile lift net (10.8 g/m^2/hour). However, Shangla jal was mostly operated at Monumukh (Table 3.4).

Fishing effort was comparatively higher near Monumukh point. The river Monu has fall into Kushiyara at this point. Also there was a fish sanctuary close to this area. All these effects might have created opportunities for the increase of fish population. Similarly, a canal has connected new Kushiyara and old Kushiara at Padulla, where catch effort is also high.

Table3.4: Fishing Per Unit Effort by Using Different Type of Gears

Type of Gears	gm/m^2/hour						
	Jamargaon	Padullah	Lama Tajpur	Char Tajpur	Alipur	Monumukh	All
Fixed Lift net (Veshal)	7.3	3.5	1.9	-	2.1	51.6	5.1
Mobile Lift net (Boat veshal)	-	-	2.4	6.5	-	13.1	10.8
Mono-filamentous gill net	-	0.9	-	-	1.0	0.7	0.8
Seine net	-	0.9	0.6	1.4	-	-	1.0
Uthar	-	-	-	-	-	1.5	1.5
Shangla jal	-	-	-	-	-	19.5	19.5
Hook						0.9	0.9

3.1.3 Species Composition

A wide range of fish species are caught here. Their variations are also season depended. Usually, late monsoon (Ashwwin- Kartick) is the peak time for fishing. Water starts to recede. Juvenile and adult fishes also come to main river from ***Haor*** and adjacent floodplain areas. Also fish species and their amount of catch usually differ from gear to gear. The most common fish species of this river are Rui, Catla, Ayre, kalbasu, Bacha, Lachu, Gharua, Rani, Chela, Kaski, Chapila, Kajoli, Golda, Hilsa, Rita, Bagha ayre, Eel, Puti, Boal, etc. Lachu, Bacha, Kajoli, Rani, Chela contribute the major portion of total catch (a list of available fish of this area is attached in annex-1).

According to the FGD participants the abundance of fish by species by Bengali months are shown in the table below

Baisakh	Rui, Hilsha, Catla, Ghunia,Ayre, Chela, Chanda,Boal, Kalbasu, Icha
Jaisthya	Hilsha, Icha, Rui, Catla, Kalbasu, Chela, Chotka, Tangra
Ashar	Hilsha, Icha, Rui, Catla, Kalbasu, Chotka, Chapila, Chela, Baim, Tangra
Shravan	Hilsha, Icha, Golda, Chotka, Rui, Catla, Ayre, Boal, Chela, Tangra
Vadra	Chapila, Golda, Baim, Chotka, Tangra, Pabda, Boal,
Ashwin	Kalbasu, Rui, Catla, Lachu, Kazoli, Punti, Chela, Boal, Baim, Gunia, Ghura, Ayre, Tangra, Hilsha
Kartik	Lachu, Chela, Rani, Ghura, Chanda, Kazoli, Punti, Boal, Baim, Tangra, Rita
Agrohayon	Lachu, Chela, Kazoli, Rui, Catla, Punti, Chanda, Tangra
Poush	Ghoura, Tangra, Rita, Chapila, Boal, Baim
Magh	Tangra, Kaski, Ayre, Gharua, Bacha
Falgoon	Tangra, Bacha, Kaski, Ghaura, Hilsha, Ayre
Chaitra	Hilsha, Bacha, Ayre, Kaski

*Baishakh- mid April to mid May

According to the survey data *Cirrhinus reba, Salmostoma phulo, Botia dario, Eutropiichthys vacha, Chanda ranga, Ailia coila, Clupisoma garua, Gudusia chapra, Wallagu attu, Puntius sophore, Prawn sp, Mystus vittatus* and *Hilsa ilisha* occupied about 77% of total catch (Table 3.5).

Table 3.5: Type of Fish Species by Gear Wise

Scientific names	Local names	Fixed Lift net (Veshal)	Mobile Lift net	Gill net (Current jal)	Seine	Uthar	Shangla	Hook	All
Cirrhinus reba	Lachu	9.1	12	25	8.3	-	-	-	10.2
Salmostoma phulo	Chela	8	10	15.3	7.5	-	-	-	8.4
Botia dario	Rani	8.8	11.3	-	8.3	-	-	-	7.9
Eutropiichthys vacha	Bacha	6.6	8.7	20.8	7.1	-	-	-	7.9
Chanda ranga	Chanda	8.3	9.3	1.4	6.3	-	-	-	6.9
Ailia coila	Kajoli	6.6	8	1.4	7.9	-	-	-	6.4
Clupisoma garua	Gharua	3.4	6	15.3	6.3	-	-	6.7	5.6
Gudusia chapra	Chapila	7.1	4	4.2	5.9	-	-	-	5.6
Wallagu attu	Boal	3.4	6	-	3.5	31.3	9.1	26.7	4.6
Puntius sophore	Puti	5.8	4.7	-	5.5	-	-	-	4.6
Prawn sp.	Icha	5.1	3.3	-	1.2	-	-	-	3
Mystus vittatus	Tengra	5.1	0.7	-	2.8	-	-	-	3
Hilsa ilisha	Hilsha	1.1	-	6.9	6.7	-	-	-	3
	Ghagot	2	0.7	-	3.1	18.8	18.2	13.3	2.6
Labeo callbasu	Kalbashu	1.1	1.3	1.4	2	31.3	18.2	-	2.2
Rita rita	Rita	0.9	2	1.4	0.8	12.5	18.2	33.3	2.1
T. cutcutia	Potka	1.4	4	-	2	-	-	-	1.8
Xenentodon cancila	Kakila	2.6	2	-	0.4	-	-	-	1.5
	Poa	-	-	-	3.9	-	-	-	1.2
Labeo ruhita	Rui	0.9	1.3	-	1.2	-	-	-	0.9
C. Mola	Mola	0.9	0.7	-	1.2	-	-	-	0.8
H. fossilies	Shing	1.4	0.7	-	-	-	-	-	0.7
Catla catla	Catla	0.9	-	-	0.4	-	18.2	-	0.7
C.striatus	Shol	1.1	0.7	-	-	-	-	-	0.6
Mastacembelus armatus	Eel	0.3	-	-	0.4	-	-	13.3	0.5
Cirrhinus mrigala	Mrigel	0.3	-	-	0.8	-	9.1	-	0.5
C. punctatus	Taki	1.1	-	-	-	-	-	-	0.5
Ompuk pabo	Pabda	0.6	0.7	-	-	-	-	-	0.3
Labeo gonia	Gunia	0.3	-	-	0.8	-	-	-	0.3
	Kaski	0.3	-	-	0.4	-	-	-	0.2
Notopterus chitala	Chitol	0.3	-	-	-	-	-	-	0.1
Anabas testudineus	Koi	-	-	-	0.4	-	-	-	0.1
	Others	1.4	0.5	1.3	2.1	6.1	9	6.7	2.1

Length and weight of individual fishes were measured for some major species. Age determination was not done by scale or notochord inspection under microscope. However, from the size and weight it was estimated that most ***C. catla, L. ruhita, W. attu, C. striatus*** were mostly from previous year recruit and most other fishes from this year recruits. Status of average length and weight of sampled fishes are given in table 3.6 below-

Table 3.6: Average length and weight of key fishes of the survey area

Species name	Avg. Length of fish (cm)	Avg. weight of fish (g)
Catla catla	33.0 (9.1)	778 (384)
Labeo ruhita	40.1 (6.5)	829 (390)
Puntius sophore	6.7 (0.8)	6 (1.4)
Botia dario	7.8 (0.7)	8 (3)
Wallagu attu	74.1 (16.5)	2338 (1441)
Ompuk pabo	18.8 (1.4)	90 (11)
Ailia coila	11.7 (0.9)	10 (1)
M. Aor	37.4 (5.7)	377 (156)
C. punctatus	16.6 (3.2)	51 (22)
Rita rita	25.9 (4.1)	258 (144)
Mastacembelus armatus	42.3 (12.9)	209 (131)
C. striatus	26.8 (9.3)	400 (267)
Eutropiichthys vacha	21.8 (4.2)	85 (56)
Gudusia chapra	8.3 (1.3)	11 (2)
Hilsa ilisha	30.4 (8.6)	351 (250)
Labeo callbasu	20.3 (11.0)	333 (153)
Clupisoma garua	23.9 (4.6)	129 (37)
Cirrhinus reba	18.6 (2.8)	63 (30)

More studies, on biology and population dynamics of commercially exploited species are also needed to formulate a sustainable management strategy for this river.

3.1.4 Fish migration and breeding

Floodplain fish are often categorised in two groups on the basis of their behaviour (Sao-Lean and Dom Saveun, 1955). White fish migrate to the main river channel in the late dry season in order to avoid the unfavourable conditions on the floodplain. At the beginning of the monsoon, with the rising of the water level, they either spawn upstream in the main channel or spawn in the floodplain. After spawning in the main channel, the eggs and larvae drift passively downstream towards the inundated floodplain (de Graaf ***et al.***, 1999). The main species of white fish comprise Cyprinidae and Schilbeidae. Black fish have a broad environmental tolerance and can sustain the harsh conditions of the floodplain during the dry season. Black fish include members of the Clariidae, Siluridae and Ophiocephalidae.

The river Kushiyara and its adjacent floodplains and haor areas are very much potential for spawning and grazing of many fish species. Although there was no identified spawning ground there. The small indigenous and self-recruiting species (SIS and SRS) spawn in different places of the river where current is high. The fries use to migrate for grazing in the adjacent beels, floodplains or haors and also graze in the shallower part of the river. Now a day the opportunities to migrate to the floodplains and haors have drastically reduced due to limiting the fish migration routes by constructing embankments. Yet feather back (Chitala) breeds in the deeper portion of the river where current velocity is high. They use to lay eggs and stick them with an underwater substrate. There is no identified breeding ground for Indian major carps in this river. Small fishes (e.g. Bacha, Gharua, Kazoli, etc.) start breeding here from mid- February and continue up to September.

The fishermen mentioned that earlier the fish migration was from main river to haor areas in summer and monsoon and from haor to river during late monsoon was very well-known. Now a day the chances of fish migration have reduced significantly.

Government has established one fish sanctuary (near Monumukh point) in 2007 in the main river to increase the fish production. It was effective for first two years and increased fish production significantly. However, due to poor construction works and lack of monitoring the fish sanctuary is poorly working.

Local DoF offices organize awareness campaign every year to ban fishing during breeding period (Mid March – mid May). However, the fishermen hardly follow the restrictions.

There is a huge haor (Kaowadighir haor) adjacen[redacted]t to Kushiyara river and about 10 Km upstream of the proposed power plant site. Wide verities of fish species are available there. The Government has constructed a fish pass and sluice gates at Kashempur in 1996. Currently it is not properly maintained.

3.2 Limnological survey

Various physico-chemico parameters of different sampling points are shown in Table 3.7 Standard value for DO for sustaining aquatic life is 4 ppm where as for drinking purposes it is 6 ppm (Ahmed and Rahman, 2000). It was found from the study that Dissolved Oxygen (DO) ranges from 5.4 ppm to 8.0 ppm, which is pretty good for the fish community in the river. Comparatively high dissolved oxygen indicates accelerated photosynthesis by the high phytoplankton communities. The value of pH ranges from 7.0 to 7.3, which seem almost neutral in nature. Water temperature ranges from 29^{o}C to 31^{o}C. Water transparency value ranges from 19 cm to 28 cm. The minimum value of water transparency was observed at Monumukh, where there was a continuous water supply from Monu river. So, there was turbid water in the sampling spot at Monumukh.

Table 3.7: Physico-chemical conditions at various points of Kushiara River.

Sampling point	DO (ppm)	pH	Temp.(^{o}C)	Transparency (cm)
Monumukh	6.9	7.0	30	19
Brahmangaon	8.0	7.2	31	28
Lamatajpur	7.6	7.3	30	24
Paharpur	8.0	7.2	30	27
Atgoria	7.2	7.3	30	22
Digholbak	5.4	7.0	29	24

Five phytoplankton groups of 20 genera were observed in the study (Table 3.8 and Table 3.9). Among them Chlorophyta was the dominant group followed by Bacillariophytes (Table 3). *Ulothix* under Chlorophyta group was found the most dominant genus ranging from 220 unit/L at Monumukh to 840 unit/L at Brahmangaon sampling site followed by *Melosira* under Bacillariophytes group. The phytoplankton genera that found in different sampling sites on Khushiara river were *Ankistrodesmus, Tetraedron, Scenedesmus, Spirogyra, Ulothix, Microspora, Closterium, Clostridium, Stigeoclonium, Melosira, Tabellaria, Synedra, Navicula, Cymbella, Gyrosigma, Euglena, Trachellomonas, Lemanea, Gleocapsa* and *Oscillatoria.* Presence of diverse phytoplankton indicates a good ecological condition of the river water. There were, however some Cyanophytes, but very small in number as an indominant species; if there is excessive nutrient in the river water due to industrial effluents, runoff from agricultural lands that are excess fertilized, this group may grow abundantly and release toxic compounds, which would cause illness in both aquatic animals.

Table 3.8: Qualitative study of phytoplankton population in Kushiara River

Group	Genus	Monu mukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Chlorophyta	*Ankistrodesmus*	P	P	A	P	P	P
	Tetraedron	A	A	A	A	P	A
	Scenedesmus	P	P	A	P	A	A
	Spirogyra	A	P	A	A	P	A
	Ulothix	P	P	P	P	P	P

	Microspora	A	P	A	A	P	A
	Closterium	P	A	A	A	P	A
	Stigeoclonium	P	P	P	P	A	P
Desmids	*Clostridium*	A	A	A	A	P	A
Bacillariophytes	*Melosira*	P	P	P	P	A	P
	Tabellaria	P	A	A	P	P	A
	Synedra	A	P	A	P	A	A
	Navicula	P	P	P	P	P	A
	Cymbella	A	A	A	P	P	A
	Gyrosigma	A	A	A	A	P	P
Euglenophytes	*Euglena*	P	P	P	P	A	A
	Trachellomonas	P	P	A	A	A	P
	Lemanea	P	A	A	A	A	A
Cyanophytes	*Gleocapsa*	P	A	A	P	A	P
	Oscillatoria	P	P	A	A	A	A

P indicates Present; A indicates Absent

Table 3.9: Phytoplankton population (unit/L) in Kushiyara River.

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Chlorophyta	*Ankistrodesmus*	0	0	0	10	10	0
	Tetraedron	0	0	0	0	10	0
	Scenedesmus	0	10	0	20	90	0
	Spirogyra	0	10	0	0	10	0
	Ulothix	220	840	0	550	240	0
	Microspora	0	0	0	0	10	0
	Closterium	0	0	0	0	10	0
	Stigeoclonium	20	10	0	0	0	0
Desmids	*Clostridium*	0	0	0	0	20	0
Bacillariophytes	*Melosira*	170	40	0	60	0	30
	Tabellaria	20	0	0	30	20	0
	Synedra	0	0	0	10	0	0
	Navicula	0	0	10	50	40	0
	Cymbella	0	0	0	10	0	0
	Gyrosigma	0	0	0	0	10	0
Euglenophytes	*Euglena*	0	0	0	10	0	0
	Trachellomonas	10	10	0	0	0	0
	Lemanea	10	0	0	0	0	0
Cyanophytes	*Gleocapsa*	0	0	0	100	0	0
	Oscillatoria	30	10	0	0	0	0

In the present study, total of 3 groups of zooplankton were recorded consisting of 3 genere of Rotifer, 2 genera of Copepods and 4 genera of Cladocera (Table 3.10 and Table 3.11). The quantification of zooplankton population is illustrated in Table ….. The most dominant group was Cladocera followed by Rotifer. *Moina* of Cladocera was found the most abundance genus ranging from 10 unit/L at Brahmangaon and Atgoria to 25 unit/L at Monumukh sampling sites.

The zooplankton genera that found in different sampling sites on Khushiara river were *Asplanchna, Brachionus, Keratella, Sida, Moina, Daphnia, Diaphanosoma, Cyclops* and *Diaptomus*. Different types of zooplanktons like larval forms of crustaceans, rotifers, cladocerans, copepods and larval forms of different aquatic organisms etc., are considered as natural food for the fish and aquatic organisms in river. Cladocera popularly called as “water flea” prefers to live in deep water and constitute a major item of food for fish. Thus they hold a key position in food chain and energy transformation (Uttangi, 2001). The rotifers play a significant role in aquatic food chain and thereby constitute an important food item to fishes. Besides, rotifers are now being used as an important aquatic faunal component for biomonitoring. Taxonomic dominance of rotifers was reported in several water bodies (Neves *et al.* 2003). Freshwater copepods constitute one of the major zooplankton communities occurring in all types of water bodies. They serve as food to several fishes and play a major role in ecological pyramids.

Table 3.10: Qualitative study of zooplankton population in Kushiara River

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Rotifer	*Asplanchna*	P	P	P	A	A	A
	Brachionus	A	A	A	A	P	P
	Keratella	A	A	A	P	A	A
Cladocera	*Sida*	P	P	P	P	P	A
	Moina	P	P	P	P	P	P
	Daphnia	P	A	P	A	P	P
	Diaphanosoma	A	A	P	A	A	A
Copepods	*Cyclops*	P	P	P	P	P	A
	Diaptomus	P	P	A	P	P	P

P indicates Present; A indicates Absent

Table 3.11: Zooplankton population (unit/L) in Kushiara River

Group	Genus	Monumukh	Brahmangaon	Paharpur	Atgoria	Lamatajpur	Digholbak
Rotifer	*Asplanchna*	5	10	10	10	0	10
	Brachionus	15	5	0	0	10	5
	Keratella	10	5	5	10	0	0
Cladocera	*Sida*	5	5	5	10	15	0
	Moina	25	10	20	10	15	20
	Daphnia	10	0	5	5	10	5
	Diaphanosoma	20	10	5	5	10	0
Copepods	*Cyclops*	5	5	10	5	10	0
	Diaptomus	5	10	5	15	10	10

In the present study, total of 5 groups of benthos were recorded (Table 3.12). The dominant group was *Lamellidens marginalis* found in all sampling sites followed by *Chironomus* larvae. The benthos that found in different sampling sites on Khushiara river were *Chironomus* larvae, *Lamellidens marginalis, Pila globosa, Unio,* Stonefly nymph. Availability of *Chironomus* larvae and gastropod (*Pila globosa, Unio*) indicate the good condition of the water body. Species diversity of benthos in the present study was relatively low. This may be due to unfavorable condition for the organism in the sampling sites. There were some draggers in the Kushiara river near the sampling sites. This may adversely affect the total benthos population. Benthic invertebrates play an important role in transitional ecosystems, by filtering phytoplankton and then acting as a food source for larger organisms such as fish, thereby linking primary production with higher trophic levels. They also structure and oxygenate the bottom by reworking sediments and play a fundamental role in breaking down organic material before bacterial re-mineralization. So, care should be taken not to disturb their habitat.

Table 3.12: Benthos content in Kushiara River.

	Benthos (Number)				
Sampling point	***Chironomus* larvae**	***Lamellidens marginalis***	***Pila globosa***	***Unio***	**Stonefly nymph**
Monumukh	11	18	7	-	-
Brahmangaon	17	24	5	-	-
Paharpur	-	10	4	3	1
Atgoria	6	8	2	3	2
Lamatajpur	9	11	5	2	-
Digholbak	2	9	3	-	-

3.3 Fish marketing

3.3.1 Employment in fish marketing

Fishery is labor intensive and, at all stages, generates employment. An example of this is multi-harvesting, which improves the yield and income and increases the labor requirement.

According to the Economic Census (2001 & 2003) of BBS, there are 61829 establishments engaged in the sale of fish and seafood in the country. The total establishments comprise of 20561 permanent, 38676 temporary and 2592 household based establishments. In other words, there are 33.25% permanent, 62.55% temporary and 4.2% household based establishments. Total number of persons engaged in the sale of fish and seafood is 93377 of which 92809 (98%) are males and 1568 (2%) are females. Of the total establishments engaged in the sale of fish and seafood, 37730 (61%) are in the urban area and the rest 24099 (39%) are in the rural area. The number of establishments in sale of fish is projected at 766041 in 2009 based on an annual growth rate of 3% over the base (Census) year of 2003.

There are two fish arot (auction place) functioning within the study area. One arot at Sherpur, Moulavibazar Sadar and another at Monumukh. Sherpur is one of the eminent fish arot in Bangladesh for fresh water fishes. An overview of the people involved at different levels for different fish marketing activities is shown in the **Table 3.13**

Table-3.13: People involved in fish marketing and their main responsibilities

Local name	English	Brief description/responsibilities	Persons involved at Sherpur fish market
Matsyajibi	Fishermen	Catct fish from river and adjacent floodplains	400-500
Nikari	Middlemen	Collect (buy) fish from fishermen and sell at auction and retail markets. Usually Nikari buy fish within own village and neighbouring villages.	100-150
Arot	Auction house/market	Usually in the established markets there is fixed place for auctioning fish. There are few to several auction houses in a market. The individual auction house is called Arot	24
Arotder	Auctioneer	Owner of individual auction house and runs the auction process. Arotders are the main investors in fish marketing.	24
Paiker	Retailer	Buy fish from auction markets by bidding and retails to consumers at retail markets.	2000-2500
Sharker	Manager Employee of auctioneer and is paid monthly	Maintain records of all kind as required by auctioneer mainly financial records such as payments, providing credit, recovery etc.	24
Koilder	Assist bidding process	Koilder assist auctioneers in the bidding process. He also weighs fish for bidding.	24
Helper	Fish sorter	Sort fishes into different species and sizes, and weight them for bidding. He also sometimes helps in making loading and unloading fish.	70-80
Kuli	Labourer	Unload and load fish. Carry fish from vehicle to auction place and vice-versa.	100-150
Sweeper	Cleaner	Clean the auction market daily usually early in the morning before the auction starts. All sweepers are from lower cast Hindu.	2

Koilder, Sharker, Kuli, helper were employed by auctioneer. Sweepers were contracted by market organizers, but were also paid by arotders. It is important to note that some retailers buy fish from different auction markets and retail at different retail markets on different days.

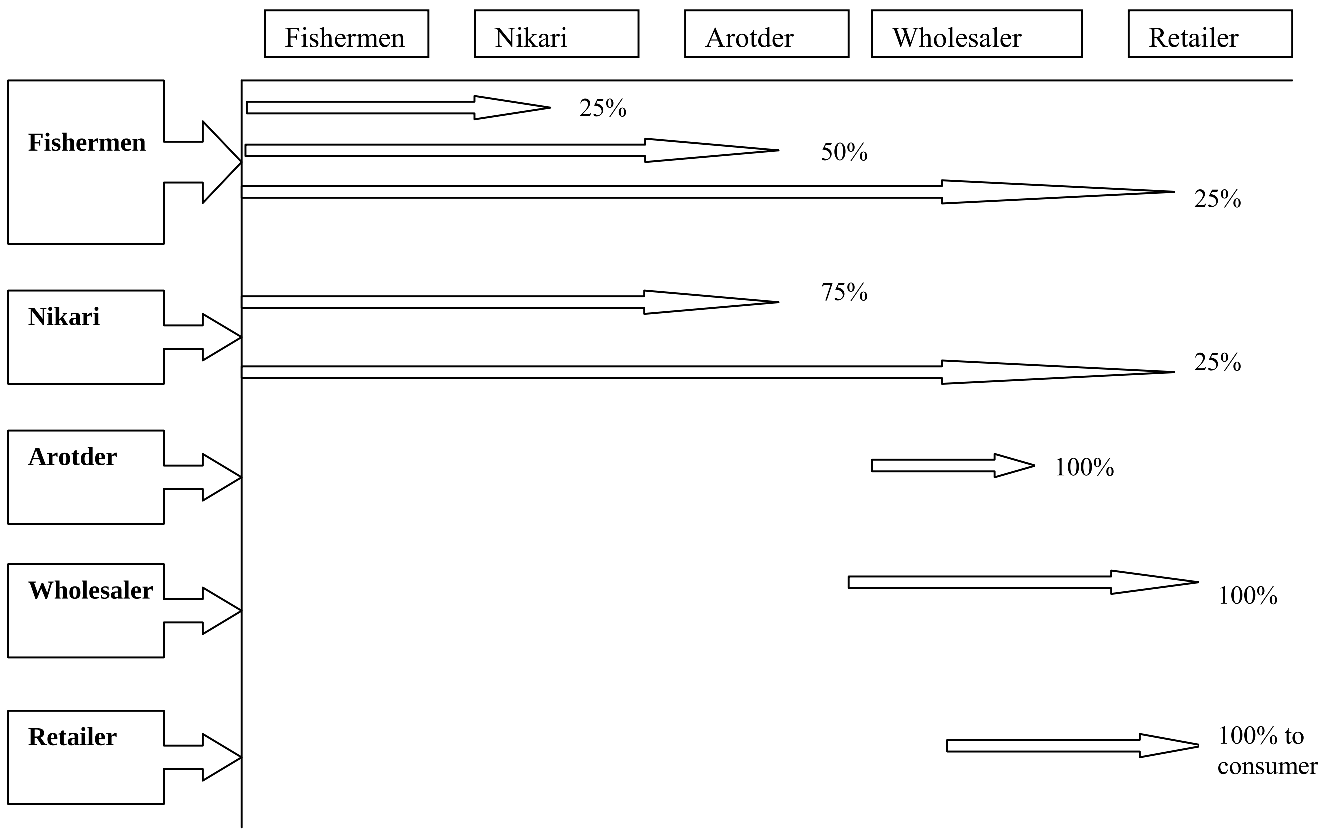
There are four ice factories supplying ice to the arot. Fishes are transport by rucks to distance towns in bamboo or cork sheet baskets.

The fish market at the primary catch stage is very non-competitive. As a result, exploitation by intermediaries, particularly wholesalers/Arotdars, is high in the secondary and higher secondary markets, which resemble oligopoly-type markets. Hence, fishing communities remain poor. Many retailers in primary retail markets compete fiercely among each other. The fishermen usually sell their fish (50% of total catch) to the arotder as they borrow money from them. Also they sell about 25% of their total catch to the local nikari, who use to purchase from boats. Again, as there is no fish arot in the evening the fishermen sell about 25% of their catch in retail market direct to the consumers. The *nikari* use to sell 75% of his fish to the arotders and 25% (evening fish) to the retail market earliers. At the arots the auctioneers use to deduct 3-5%

commission. Prices of fish are determined by demand for and supply of fish quantities in the retail markets. The usual practice for pricing fish is still bargaining based on visual estimations. Strict grading, sifting and price tagging is usually ignored in retailing. No enforcement of any kind exists for maintaining quality or a standard for weighing. Fair pricing according to grade, size, origin and freshness may not be possible in the absence of standard norms of marketing practices and lack of enforcement by the legal authorities.

The broadly used fish market channel (product distribution route) is: Fisherman Nikary ® Bepari/Chalani ® Aratdar ® Paiker/retailer ® consumer.

Below is a map of fish marketing channels



Figure……: Fish marketing map of the study area

At Sherpur fish (mainly cultured sp. And hilsha) also come from different places of Bangladesh (table 3.14)

Table 3.14: Types of in coming fishes in this market from different places of Bangladesh

Fish comes from	Species	Fish comes from	Species
Khulna	Brackish water fishes, shrimp, prawn	Chittagong	Hilsa
Rajshahi	Indian and Chinese major carps	Jessore	Indian and Chinese major carps
Bagerhat	Brackish water fishes, shrimp, prawn	Narsingdi	Pangus, Tilapia
Pabna	Indian and Chinese major carps	Mymensingh	Pangus, Tilapia
Chandpur	Hilsa		

Fish from Sherpur mainly goes to Bhairab Bazar, Dhaka, Chittagong, Sylhet, Moulavibazar, Habigonj, Nabigonj, Jagannathpur, Vanugach. Also fishes of this market are exported to overseas countries (UK, USA, Middle East countries). The main exporting fish species this place are Kajoli, Bacha, Mola, Veda, Pabda, Rui, Catla, Boal, Chital, Batasi, Golda, etc.

3.3.2 Pricing System of the entire fish value chain

The fish marketing margin (the difference between what consumers pay and what farmers receive) varies for different locations, species and time-periods). Ahmed (1983) analysed the marketing margins of representative intermediaries acting between inland producers on the one hand, and consumers in Dhaka and Pabna on the other. The species of fish considered were hilsa, rohu and shingi (Heteropneustes fossilis, a species marketed in live form). In all cases it was found that producers were receiving between 50% and 65% of the retail price. The bulk of the marketing margin was earned by the assembler and the distributor (where applicable) and retail margins were only 5- 10% of the consumers' price. The fishermen’s margin is 3.1% lower when fish is transported by trucks than by launches. An investigation into margins earned through the marketing of marine fish in 1979 (Sabur and Rahman, 1979) produced similar results. Margins between fishermen and consumers in Chittagong and Cox's Bazar were computed for four species, it being found that average fishermen's share was 60.1 % to 63.4% depending on whether he sold on land or at sea. Notably intermediaries' costs represented a larger portion of their gross margin than in Ahmed's (1983) study. These two authors' observations confirm that in the mid seventies and early eighties, fishermen’s share has been around 60-63% of the consumer price.

Based on the recent interviews following rapid appraisal method, focused group discussions and informal conversations with Aratdars and informed persons at Sherpur and Monumukh it was estimated that the prices of fish increase ranges from 10- 30% (table 3,14).

Table3.14: Fish price at different actors

Species name	Fishermen			Nikari			Arot			Retailer		
	3 Kg+ Large (Tk/ Kg)	1-3 Medium (Tk/ Kg)	0-1 Small (Tk/ Kg)	3+ Large (Tk/ Kg)	1-3 Medium (Tk/ Kg)	0-1 Small (Tk/ Kg)	3+ Large (Tk/ Kg)	1-3 Medium (Tk/ Kg)	0-1 Small (Tk/ Kg)	3+ Large (Tk/ Kg)	1-3 Medium (Tk/ Kg)	0-1 Small (Tk/ Kg)
Rui	400-450	225-275	70-80	450-500	350-400	80-100	500-550	380-450	100-150	450-500	300-350	125-150
Catla	225-275	175-250	80-90	250-500	200-250	80-100	300-250	250-300	80-100	325-400	300-325	106-125
Mrigal	300-350	150-200	80-100	325-400	175-250	90-110	350-400	200-300	100-130	400-450	250-350	120-150
Kalbasu	400-450	350-400	100-125	450-500	400-450	126-150	400-500	350-400	150-175	450-550	400-450	200-225
Bagha air	200-400	250-300	125-150	350-450	300-400	150-175	450-500	350-450	175-200	500-550	400-500	200-250
Boal	350-400	300-325	100-125	400-450	340-400	130-150	450-530	350-450	150-175	500-550	400-450	200-225
Chitol	450-500	350-400	150-200	500-600	400-450	200-250	550-650	400-500	200-250			
Ayre	400-500	325-350	125-150	450-550	350-400	195-225	500-600	400-450	200-250			
Lachu			125-150			150-175			180-200			200-250
Bacha			250-300			300-350			400-450			450-525
Kajoli			280-300			300-320			320-350			350-375
Pabda			400-450			450-500			500-550			550-600
Puti			70-80			80-120			100-140			130-170
Koi			200-250			250-300			300-350			350-400
Eel			250-300			300-350		Q	350-400			400-450
Chela			100-130			120-150			150-180			180-220
Ghonia			100-125			125-150			150-175		250-275	175-200
Ghaura			150-175			175-200			200-250			225-275
Rani			250-290			275-300			300-350			300-350
Chapila			100-125			125- 100-125			150-175			175-200
Chanda			40-50			60-80			80-100			100-125
Kakila			100-125			125-150			150-175			175-200
Tengra			80-100			125-150			150-175			125-200
Hilsa			250-300			275-300			300-350		450-550	250-300
M. malcomsoni			275-325			300-350			350-450			
Golda			400-450			450-500			500-550			

3.4 Livelihood of fishermen

In general, fishermen use to live in a cluster form in a village and often are not scattered. However, usually the Hindu and Muslim fishermen live either in different villages or in different paras of a village. Almost all of the households are engaged in fishing. Among them 60% are full time fishers.

Table 3.15: Percentage of full time fishers among fishing households of four villages

Village names	# of fishermen HHs	% full time fishers
Brahmingaon	150	100
Lama Tajpur	45	100
Hamargona	120	60
Daudpur	140	50

The concentration of fishermen within the study area is high in Brahmingaon, Tajpur, Hamargona and Daudpur villages. The main occupation of the villagers here is fishing (table 3.15) followed by fish trading, rickshaw/ van pulling, earth work and agriculture labour, etc. The average annual income of the fishers households is Tk. 1,65,000 and expenditure is Tk. 1,42,000 per household.

About 60% of their income they have to spend for purchasing food stuff followed by 10% for clothing and 10% for transportation. They spend only 2% for the education purpose of their children.

During late monsoon a group (10-12) fishermen can catch 25- 30 Kg of fishes by seine net and can earn Tk. 6000 – 8000 per day. Since, the numbers of fishing gears are many for one place. In this fact, they have a common understanding for rotational fishing. In an average, one group can get chance for 4-6 hours for fishing.

According to the statement of the FGD participants, they can not fish round the year as the river become narrower and shallower during winter. Also effluents of fertilizer factory reduce the amount an quality of fishes. Again, fish population is reducing significantly due to over fishing, construction of embankments, siltation on fish migration routes, etc.

Fishermen normally enjoy open access to the river near their villages, where they use to fish for about eight months in a year. Nevertheless, they have to pay 50% of their total income to local communities or musclemen when they go for fishing to far places. The common practice of income share from fishing is 50% for boat and net owner and the rest 50% is distributed among the group members equally.

Fishermen have observed that the fishes are depleting significantly day by day. Even they have mentioned that the amount of fish has declined by 50% in last 10 years. The major causes of fish population depletion are:

The beel/ hoar/ floodplains are made isolated from the main river by constructing embankments and other infrastructure like roads, bridge, culverts, etc. The adjacent sluice gates and fish passes are very inadequate in number and most of them have become in-effective. In this fact, fish migration for breeding and grazing purpose has significantly disrupted. As a result the recruit of fish population is decreasing very gradually every year.

Over fishing and the use of mono-filamentous gill nets are also major cause of fish depletion. The effluents of the Fenchugonj Fertilizer factory adversely affect the fish population in this river.

3.5 Status of aquaculture among fishermen communities

There are very few number of ponds within the fishing communities. However, the number of ponds is more in the downstream villages and in the northern part of the river. Nevertheless, extensive and semi-intensive technologies are used for aquaculture. Mainly, exotic carp species are cultured there.

3.6 Environmental issues related to fish production

Fenchugonj Fertilizer Factory is about 35 Km upstream from Sherpur. It discharges ammonia gas and other chemicals in the river. The discharge is high during winter season. At the same time the water level and current is low in the river. The effluents directly deteriorate water quality and have very negative impact on fishes. People noticed that from December to February the fishes here get bad smell in their flesh and taste become strange. Through private communication with the Bangladesh Chemical Industries Corporation, who owns the Fenchuganj Fertiliser factory, it has been learnt that the 45 years old factory will be closed down once the new plant is constructed. Therefore, this problem will no longer exist. However, the time scale for this is not certain.

People are aware about the proposed power plant at Parkul. Fishermen are afraid about the potential chances of water pollution and fish depletion by the effluents and hot water discharge in the river from the power plant.

Impact of sand mining	Recommendations
The power plant authorities have decided for earth filling by sand mining from different location of the river. The FGD participants have focused on some possible impact of sand mining, such as- • Sand mining would damage the habitat of the bottom dwellers fishes (e.g. eel, chitala, kalbashu, etc.) and benthos. • It would increase water turbidity and reduce transparency, which will reduce primary productivity of the river as well as disturb fish migration • River bank erosion would increase significantly • It would also damage the spawning and nursery ground of fishes • Once the exposure of clay soil due to sand mining would make the netting difficult (due to	• Sand mining should be done by not exposing the clay soil, thereby it should be done covering wider areas considering the shallower parts of the river • Sand mining should not be done close to fish sanctuary in Monumukh approximately 8 kilometer upsream and dolphin habitat in Jamargaon which is also about 8 kilometers downstream from the plant site. The sand mining activities should be carried out leaving a two kilometer distance from these critical areas. • Sand mining should be done from the straight part of the river leaving the

adhesiveness of clay) • Fish sanctuary would be disturbed • However, dredging of river may impact positively in the long run.	curves to reduce river bank erosion • Power plant authorities should initiate habitat restoration programmes immediately • Further in-depth study could be carried out for selecting sand mining sites.
Impact of power plant	**Recommendations**
• If hot water is discharge directly in the river it would disturb fish migration. It would also reduce plankton propagation. This would increase the rate of flocculation and thereby increase siltation. • During the construction period lots of cargo vessels would navigate through the river. There are chances of oil spillage which would pollute river water. Again, the increasing number of river traffic (during and after construction work) would disturb fish migration and spawning. • Quite a good number of people would be engaged during and after construction work and there are chances of waste disposal in the river, which would reduce fish population. • Noise and vibration of the power plant may affect the spawning activities of fish	• The temperature of the dischargeable water should be adjusted with the river water by cooling down and or by mixing river water with the hot water in a cooling pond/ lake. A zigzag canal could be constructed for this purpose (to reduce loss of lands). • Chemical effluents should not directly discharge in the river. • There should be a compensation package for at least one year for the fishermen who use to maintain their livelihood through fishing there, as their fishing activities and amount of fish catch would significantly reduce during sand mining and construction works. These people do not have alternative livelihood options. • Connecting canal between river and floodplains could be re-excavated to ease the fish migration • Construction of any infrastructure on the bank like permanent jetty can disturb the fish population. Therefore, it is recommended that floating jetty be used. • The efficiency and effectiveness of the sluice gates, fish pass and fish sanctuary should be improved to increase fish production. As part os CSER it recommended that Bibiyana Power Company Limited intervenes financially to increase the productivity of fish at least in the impact zone of the project.

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List of Amphibians recorded in Kusiyara river site and it's adjacent areas

National Threatened Category: VU=Vulnerable, EN= Endangered, NO= Not Threatened

Relative Abundance: C= Common, FC= Fairly Common, O= Occasional, F= Few

Terrestrial Fauna (Amphibians)

Sl No.	Order	Family	Scientific Name	English Name	Local Name	Relative Abundance	Threatened Category (National)
1	Anura	Buforidae	Bufo melanostictus	Common Toad/ Common	Kuno Bang	FC	NO
2		Microhylidae	Microhyla ruba	Red Microhylid/Red Narrow-mouthed Frog	Lal Cheena Bang	FC	VU
3		Ranioae	Euphlyctis cyanophlyctis	Skipper Frog/Indian Skipper Frog	Kotkoti Bang	FC	NO
4			Hoplobatrachus tigerinus	Bull Frog/Indian Bull Frog	Kola Bang/ Sona Bang/ Bhawa Bang	C	NO
5.			Limnonectes Linmocharis	Cricket Frog	Jhi-jhi Bang	O	NO
6			Rana alticola	Boulenger's Frog	Pana	F	VU
7		Rhacophoridae	Polypedates maculatus	Maculated Tree Frog/ Common Indian/ Tree Frog	Pana Bang/ Geche Bang	O	NO

List of Reptiles recorded in Kushiara river site and it's adjacent areas

National Threatened Category: VU=Vulnerable, EN= Endangered, NO= Not Threatened, DD= Data Deficient Relative Abundance: C= Common, FC= Fairly Common, O= Occasional, F= Few, R= Rare

List of Reptilers

Sl No.	Order	Family	Scientific Name	English Name	Local Name	Relative Abundance	Threatened Category (National)
1	Lacertilia	Gekkonidae	Hemidactylus flaviviridis	Common House Lizard	Tiktiki	C	NO
2			Gekko gecko	Wall Lizard/Tucktoo/Gecko	Tokhak/Shanda	FC	VU
3.		Aqamidae	Calotes versicolor	Common Garden Lizard	Rokto-Chosha	FC	NO
4		Scinicidae	Mabuya carinata	Common Shink	Anjoni/Anjon	FC	NO
5		Varanidae	Varanus bengalensis	Bengal monitor Lizard/ Grey Monitor Lizard	Gui Shap	C	VU
6			Varanus Flavescens	Yellow Monitor	Shona Gui/ Holdey Gui/ Hungui Shap	F	EN
7			Varanus flavescens	Ring Lizard	Ram Godi	R	EN
8	Serpentes	Typhlopidae	Ramphotyphlops braminus	Cammon Worm Snake/ Brahminy Snake	Dumukha Shap	O	D
9		Colubridae	Amphiesma stolata	Stripped Keelbac	Dora Shap	C	NO
10			Xenochrophis piscator	Checkered Keelback	Dhora Shap	FC	NO
11			Xenochrophis cerasogaster	Dark-bellied Marsh Snake	Kalo Mete Dhora Shap	FC	VU
12			Ahaetulla Nasutus	Common Vine Snake/ Vine Snake/ Common Green Whip Snake	Laodoga Shap/ Sutanali Shap	FC	VU
13			Coluver mucosus	Rat Snake	Daraj/ Dhaman	FC	VU
14			Elaphe radiata	Copper Head	Dudhraj	D	EN
15		Elapidae	Naja Naja	Binocellate Cobra/ Spectacled Cobra	Khoia Gokhra/ Nega Fokhura	FC	EN
16			Naja Kaouthia	Monocellate Cobra/ Bengal Cobra/ Monocle Cobra	Gokhra Shap/ Jati Shap/ Keauthia	FC	VU
17	Testudines	Tronychidae	Aspideretes hurum	Peacock-marked Softshell Turtle/ Peacock Softshell Turtle/ Indian Peocock Softshell Turtle	Dhum Kasim	O	EN

18			Aspideretes gangeticus	Genges Softshell Turtle/ Indian Softshell Turtle	Khulna Dasim	O	EN
19		Bataguridae	Dachuga tecta	Indian Roofed turtle/ Dhasi Hills Terrapin	Sylhet Kachuga	R	NO
20			Kachuga smithii	Brown Roofed Turtle	Boro Kori Daitta	R	EN
21		Trionychidae	Lissemy punctata	Spotted Flapshell Turtle/ Indo-Gangetic Flapshell Turtle	Shundhi Kasim	FC	VU

List of Mammals recorded in Kushiara river site and its adjacent areas

National Threatened Category: VU = Vulnerable, CR = Critically Endangered,

NO = Not Threatened,DD = Data Deficient, Relative Abundance: C = Common, FC = Fairly Common, F = Few

List of Mammals

Sl. No.	Order	Family	Scientific Name	English Name	Local Name	Relative Abundance (National)	Threatened Category
1.	Insectivora	Soricidae	Suncus murinus	Grey Musk Shrew/ House Shrew	Chika / Chucho	C	NO
2.	Chiroptera	Pteropodidae	Pteropus giganteus	Flying Fox / Indian Flying Fox	Badur	FC	NO
3.		Vespertilionidae	Pipistrellus coromandra	Indian Pipistrelle	Chamchika	C	NO
4.			Scotophislus kuhii	Asiatic Lesser Yellow Bat	Choto Badur	C	NO
5.		Megadermatidae	Megaderma lyra	False Vampire / Indian False Vampire / Greater False Vampire	Badur / Daini Badur	FC	NO
6.	Ceatcea	Platanistidae	Platanista gangetica	Ganges River Dolphin / Gangetic Dolphin / Blind River Dolphin	Shishu / Shushuk / Susu	FC	EN
7.	Carnivora	Canidae	Canis aureus	Jackal / Asiatic Jackal / Golden Jackal	Pati Shial / Shial	C	VU
8.			Vulpes bengalensis	Bengal Fox / Indian Fox	Khek sial	C	VU
9.		Felidae	Felis chaus	Jungle Cat / Swamp Cat	Ban Biral / Wab	O	EN
10.			Prionailurus viverrinus	Fishing Cat	Mecho Biral / Mecho Bagh	R	EN
11.		Herpestidae	Herpestes auropunctatus	Samll Indian Mongoose	Benji / Nakul	C	NO
12.			Herpestes edwardsi	Common Mongoose	Bara Benji	C	VU
13.		Mustelidae	Lutra perspicillata	Smooth-coated Otter / Smooth	Ud Biral / Ud Baodar	FC	CR

Sl. No.	Order	Family	Scientific Name	English Name	Local Name	Relative Abundance (National)	Threatened Category
				Inidan Otter			
14.		Viverridae	Viverricula indica	Small Indian Civet	Khatas / Gandho Gokul	O	DD
15.	Rodentia	Sciuridae	Callosciurus Pygerythrus	Irrawaddy Squirrel	Badami kathbirali	O	NO
16.		Muridae	Bandicota indica	Bandicoot Rat / Large Bandicoot Rat / Greater Bandicoot Rat	Bara Indur / Dhari Indur	FC	NO
17.			Mus musculus	House Mouse	Lengti Indur	C	NO
18.			Bandicota bengalensis	Indian Mole Rat / Lesser Bandicoot Rat	Indur	C	NO
19.			Rattus rattus	Common House Rat / Black Rat	Indur	C	NO

List of Birds recorded in Kushiara river site and it's adjacent areas

National Threatened Category: VU=Vulnerable, EN= Endangered, NO= Not Threatened, DD= Data Deficient, CR= Critically Endangered Relative Abundance: C= Common, FC= Fairly Common, O= Occasional, F= Few, R= Rare

List of Birds

Sl No.	Order	Family	Scientific Name	English Name	Local Name	Relative Abundance	Threatened Category (National)
1	Ciconiif ormes	Accipitrid ae	Elanus caeruleus	Lalck-shouldered Kite	Chil	C	NO
2			Haliastur Indus	Brahminy Kite	Shankho Chil/ Lal Chil	FC	NO
3.			Accipiter badius	Shikra	Turki Baj	R	NO
4			Haliaeecus Leucorphus	Pallas's Fish Eagle	Kura/BO-wol/Koral	FC	CR
5			Ichthyophaga ichthyaetus	Frey-headed Fish Eagle	Maachmoral/ Ukosh	R	NO
6			Spilornis Cheela	Crested Serpent Eagle	Tila Baj/ Shapkhedo Baj	R	NO
7			Milvus migrans	Black Kite	Bhubon Chil	FC	NO
8			Gyps bengalensis	White-rumped Vulture	Sakun	R	NO
9		Falconida e	Phalacrocorax niger	Little Comorant	Paan Dowri	FC	NO
10			Tachybaptus ruficollis	little Grebe	Duduri/ Duballu	R	NO
11		Ardeidae	Ardea cinerea	Grey Heron	Dhushor Bok	C	NO

12			Ardeola grayii	Indian Pond Heron	Kani Bok/ Kana Bok	C	NO
13			Bubulcus ibis	Cattle Egret	Korchey Bok	O	NO
14			Egretta garzetta	Little Egret	Choto Bok	O	NO
15			Ixobrychus cinnomomeus	Cinnamon Bittern	Lal Bok	R	NO
16			Mesophoyx intermedia	Intermediate egret	Maijhal Bok/ Korche Bok	O	MO
17			Nycticorax mycticorax	Black-crowned Night Heron	Waak/ Nishi Bok	O	NO
18		Ciconidae	Anastomus oscitans	Asian Openbill	Shamuk Bhanga/ Shamuk-khol	C	NO
19		Jacanidae	Metopidius indicus	Bronze-winged Jacana	Jolpipi/Pipi	O	
20		Charadridae	Vanellus indicus	Red-wattled Lapwing	lal-lotika Hot-ti-ti	O	NO
21		Laridae	Sterna aurantia	River Tern	Maach Khaikka	O	NO
22			Sterna albifrons	Little Tern	Khudey Gangchil	R	NO
23		Podicipedidae	Tachybaptus ruficollis	Little Grebe	Duburi/ Dubalu	R	NO
24	Anseriformes	Anatidae	Anas Poecilorhyncha	Spot-billed Duck	Pati Hans	O	NO
25			Nettapus Coromandelianus	Cotton Pygmy-goose	Bali Hns/ Bele Hans	O	NO
26		Dendrocygnidae	Dendrocygna javanica	Lesser Whistling- duck	Sharali/ Gecho-Hans	O	NO
27	Gruifonmes	Rallidae	Amaurornis phoenicurus	White-breasted Waterhen	Dahuk	C	NO
28			Gallicrex cinerea	Watercock	Kura	FC	NO
29			Gallinula Chloropus	Common Moorhen	Jol Moorgi	R	NO
30	Columbiformes	Columbidae	Columba livia	Rock Pigeon	Jalal Kobutar/ Kapot/ Paira	O	NO
31			Chalcophaps indica	Emerald Dove	Sabuj Ghughu	FC	NO
32			Streptopelia chinensis	Spotted Dove	Tial Ghughu	O	NO
33			Streptopelia decaocto	Eurasian Collared Dove	Raj Ghughu/ Dhobal Ghughu	O	NO
34			Streptopelia Tranquebarica	Red Collared Dove	Lal Ghughu/ Jongla Ghughu	O	NO
35			Treron phoenicoptera	Yellow-footed Green Pigeon	Horial/Botkol	O	NO

36	Psittaciformes	Psittacidae	Psittacula krameri	Roseringed Parakeet	Tia	O	No
37	Cuculiformes	centropodidae	Cuculus micropteros	Indian Cuckoo	Bou-Katha-kao Pakhi	C	NO
38			Clamator jacobinus	Pied Cuckoo	Papiya	O	NO
39			Centropus sinensis	Greater Coucal	Kanakua/Coucal	FC	NO
40			Eudynamys scolopacea	Asian Cuckoo	Kokil/Kuli	FC	NO
41			Hierococcyx various	Common Hawk Cukcoo	Choghell Pakhi	FC	NO
42		Cuculidae	Cacomantis merulinus	Plaintive Cuckoo	Chatak/Sorgom	O	NO
43	Strigiformes	Tytonidae	Tyto alba	Barn Owl	Laxmi Pencha	R	NO
44		Strigidae	Athene brama	Spotted Owlet	Khuruley Pencha	R	NO
45			Ketupa zeylonensis	Brown Fish Owl	Bhutum Pencha	C	NO
46		Caprimulgidae	Caprimulgusmacrurus	Large-tailed Nightjar	Ratchara	R	NO
47	Apodiformes	Apodidae	Apus affinis	House-Swift	Ababail	R	NO
48			Cypsiurus balasiensis	AsianPalm Swift	Nakati	R	NO
49	Coraciiformes	Alcedinidae	Alcedo atthis	Common Kingfisher	Choto Maachranga	C	EN
50			Halcyon smyrensis	White-throated kingfisher	Maachranga	C	NO
51		Cerylidae	Ceryle rudis	Pied Kingfisher	Pakra Maachranga	D	NO
52		Coraciidae	Coracias benghalensis	Indian Roller	NIlkantha	R	NO
53		Meropidae	Merpos orientalies	Green Bee-eater	Suichora/Banspati	FC	NO
54			Merops philippinus	Blue-tailed Bee-eater	Suichor	FC	NO
55	Upupiformes	Upupidae	Upupa epops	Common	Hudhud/Solaiman Pakhi	R	NO
56	Piciformes	Megalaimidae	Megalaima asiatica	Blue-throated Barbet	Basanta Baori	R	NO
57			Megalaimahaemacephala	Coppersmith Barbet	choto Basanta Baori	R	NO
58			Megalaima lineata	Lineated Barbet	Gurkhod/Begh bou	R	NO

59		Picidae	Dinopium Benghalense	Black-rumped Flameback	Kaththokra	C	NO
60			dendrocoposnanus	Brown-capped Py gmy Woodpecker	Bana Kaththokra	FC	NO
61			celus brachyurus	Rufous Woodpecker	Lalche kaththokra/khairy ghaskurali	FC	NO
62			Picus Flavinucha	Large yellow-naped wood pecker	Bara ghaskurali	FC	NO
63	Passerif ormes	Laniidae	Lanius schach	Long tailed Shrike	Bagha Tiki	R	NO
64		Corvidae	Oriolus xanthornus	Black-headed Oriole	Holdey Pakhi	C	NO
65			Dicrurus Macrocercus	Black Drongo	Fingey	C	NO
66			Artamus fuscus	Ashy Woodswallow	Latora	F	NO
67			Dendrocitta vagabunda	Rufous Treepie	Hanrichacha / Kutum	FC	NO
68			Corvus splendens	House Crow	Pati Kak / Kaua	FC	NO
69			Corvus macrohynchos	Jungle Crow	Dar Kak	FC	NO
70			Aegithina tiphia	Common Lora	Towfik / Fatikjal	R	NO
71			Rhipidura albicollis	White-throated Fantail	Lejnachani	FC	NO
72			Pericrocotus cinnamomenus	Small minivet	Sat Saili	O	NO
73		Sturnidae	Sturnus malabaricus	Chestnut tailed starling	kath shalik	FC	NO
74			Sturnus contra	Asian Pied starling	Gobrey Shalik / Go shalik	FC	NO
75			Acridotheres tristis	Common Myna	Bath shalik	C	NO
76			Acridotheres fuscus	Jungle Myna	Jhuti shalik	R	NO
77			Acridotheres ginginianus	Bank Myna	Gang shalik	R	NO
78		Pycnonoti dae	Pycnonotus cafer	Red-vented Bulbul	Bulbuli	C	NO
79			Pycnonotus jocosus	Red-whiskered	Sipahi bulbuli	FC	NO
80		Sylviidae	Turdoides striatus	Jungel Babbler	Satbhai /satbhaira	O	NO
81			Orthotomus sutorius	Common tailorbird	Tuntuni / Tuni	C	NO
82		Muscicap idae	Culicicapa ceylonensis	Grey-headed Canary/ Flycatcher	Futfuti		
83			Copsychus saularis	Oriental Magpie Robin	Doel	C	NO
84		Passerida e	Anthus rufulus	Paddyfield Pipit		FC	NO

85			Passer domesticus	House Sparrow	Charui	C	NO
86			ploceus philippinus	Baya weaver	Babui /Baoi	FC	NO
87			Motacilla alba	white-wagtail	Khonjona	C	NO
88		Paridae	Parus major	Great Tit	Tit Poke	FC	NO
89		Nectariniidae	Dicaeum erythrorynchos	Pale-billed Flowerpecker	Fuljhuri	O	NO
90			Nectarinia asiatica	Purple-Sunbird	Niltuni / Madhuchuski	R	NO
91			Nectarinia sperata	purple-throated Sunbird	Moutushi	R	NO
92			Nectarinia zeylonica	purple-rumped Sunbird	Moutushi	O	NO

Annex- List of Floral Resources in Bibiyana Power Plant Site, Sherpur, Sylhet

List of Timber Trees

Sl. No.	Local Name	Scientific Name	Availability
1	Raintree	Samanea saman	Available in plenty
2	Kadam	Anthocephalus chinensis	Available in plenty
3	Shilkorai	Albizia procera	Available in plenty
4	Akashmoni	Acacia auriculiformis	Medium
5	Mehagini	Swieteria mahagoni	Medium
6	Chandan		Very Scarce
7	Kalahozra		Plenty
8	Shewla		Plenty
9	Karul		Very Scarce
10	Hizal	Barringtonia acutangula	Plenty
11	Patkhara		Medium
12	Banyan Tree		Very Scarce
13	Pahari Neem		Very Scarce
14	Shimul	Bombax ceiba	Available in plenty
15	Eucaliptus	Eucalyptus spp.	Available in plenty
16	Latim		Available in plenty
17	Merua		Available in plenty
18	Jiga		Available in plenty
19	Bhatipata		Available in plenty
20	Beljam		Medium
21	Chambol	Albizia richardiana	Medium
22	Belgium		Medium
23	Doubgach		Medium
24	Jalmondhir	Erythrina fusca	Medium
25	Murta		Medium
26	Shegun		Available in plenty
27	Taragach		Available in plenty
28	Chini bot		Available in plenty
29	Chatni		Available in plenty
30	Barun	Crataeva nurvala	Available in plenty
31	Jagdumur	Ficus racemosa	Available in plenty
32	Ratin		Scarce
33	Jarul	Lagerstroemia speciosa	
34	Karoch	Pongamia pinnata	

List of Aquatic vegetation

+	Local Name	Scientific Name	Availability
1	Water Hyacinth	Eichhornia crassipes	vailable in plenty
2	Shapla	Nymphaea nouchali	Available in plenty
3	Shaluk		Available in plenty
4	Shingrai	Trapa bispinosa	Scarce
5	Chisrai	Sohoenoplectus articulatus	Scarce
6	Parua		Scarce

7	Tendara		Scarce
8	Aerail	Leersia hexandra	Scarce
9	Nolkhagra	Phragmites karka	Scarce
10	Kolmi Sak	Ipomoea aquatica	Available in plenty
11	Helencha	Enhydra fluctuance	Available in plenty
12	Malancha		Available in plenty
13	Halenga		Available in plenty
14	Keisir		Available in plenty
15	Kutipana		Available in plenty

List of Medicinal plants

Sl. No.	Name of the trees	Scientific Name	Availability
1	Nim	Melia sempervirens	Scarce
2	Aurjun	Terminalia arjuna	Scarce
3	Lazzabati		In Plenty
4	Hatir Shoor		Plenty in medium
5	Bon Jamir		Plenty in medium
6	Ojaru Jarman Lata		Available in plenty
7	Dumaru		Available in plenty
8	Durba Gas		Available in plenty
9	Palui Shak		Available in plenty
10	Amloky	Phyllanthus embelica	Scarce
11	Bohera	Terminalia belerica	Scarce
12	Hartaki		Scarce
13	Roktachita		Scarce
14	Harjora		Scarce
15	Kumari Lata		Available in plenty
16	Cini cham		Available in plenty
17	Mohalom		Scarce
18	Dhutra		Available in plenty
19	Nishinda		Scarce
20	Shatamukhi		Scarce
21	Patharkuchi	Kalanchoe pinnata	Scarce
22	Tunithankuni (Thankhuni)		Available in plenty
23	Bhatipata		Available in plenty
24	Hiyalmati		Available in plenty
25	Helencha		Available in plenty
26	Chaku		Available in plenty
27	Sharnalata	Eupatorium odoratum	Scarce
28	Kalomeg		Scarce
29	Isharmul	Aristolochia indica	Scarce
30	Harengashak		Available in plenty
31	Kheraiya		Available in plenty
32	Dhal Kolosh		Scarce
33	Akond		Scarce
34	Tulshi	Ocimum sanctum	Medium
35	Kheyaghas		Medium
36	Bon Begun		Available in plenty

37	Mankochu	Alocasia indica	Available in plenty
38	Dholkalmi	Ipomoea fistulosa	

Name of the Fruit Trees

Sl. No.	Local Name	Scientific Name	Availability
1	Mango	Mangifera indica	Available in plenty
2	Jackfruit	Artocarpus heterophyllus	Available in plenty
3	Coconut	Cocos nucifera	Available in plenty
4	Payara	Psidium guajava	Available in plenty
5	Jam		Available in plenty
6	Lichee		Scarce
7	Amra		Medium
8	Nut		Available in plenty
9	Boroi	Zizyphus mauritiana	Available in plenty
10	Jambura	Citrus grandis	Available in plenty
11	Lemon	Citrus Limon	Available in plenty
12	Papwa	Carica papaya	Available in plenty
13	Banana	Musa sapientum	Available in plenty
14	Dalim	Punica granatum	Scarce
15	Kamranga		Scarce
16	Pineapple		Scarce
17	Gab	Diospyros	Available in plenty
18	Dewa	Artocarous lacucha	Available in plenty
19	Bel	Aegle marmelos	Available in plenty
20	Mangstan		Medium
21	Tal		Very Scarce
22	Caw		Very Scarce
23	Kalojam		Medium
24	Chalta	Dillenia indica	Scarce
25	Jalpai	Elaeocarpus floribundus	Medium
26	Koichura		Available in plenty
27	Atafal	Annona muricata	Scarce

List of Flowers

Sl. No.	Name of Flower Trees	Scientific Name	Availability
1	Ghadaraj		Very scarce
2	Rose		Medium
3	Hasnahena		Scarce
4	Raktajaba		Available in plenty
5	Urpul		Available in plenty
6	Dumur Flower	Ficus hispida	Available in plenty
7	Pata Bahar		Available in plenty
8	Dalia		Scarce
9	Kamini		Scarce
10	Bakul		Scarce
11	Gasful		Available in plenty

12	Krishna Chura		Scarce
13	Murta		Available in plenty
14	Beliful	Tasminum sambac	Scarce
15	Moragful		Scarce
16	Suryamukhi		Medium
17	Polash	Butea monosperma	Scarce

Annex 14 Climate Change Adaptation Study for SBPCL II Power Plant

Climate Change Adaptation Study for SBPCL II Power Plant

1. Introduction

Climate change may have significant impacts on the generation of electricity, including from combined cycle gas turbine (CCGT). It may do so by causing damage to plant infrastructure, reducing water availability, and increasing air and water temperature.

Higher air temperatures may reduce the power generation efficiency of combined cycle gas turbine (CCGT), leading to a reduction of power generation. Furthermore, an increase in water temperature may adversely impact the operation of the cooling systems of combined cycle gas turbine (CCGT).

The key objective of this report is to demonstrate how a rapid climate change impact assessment can be used to identify the possible impacts of climate change on a combined cycle gas turbine (CCGT) project of the SBPCL II Power Plant.

The most significant potential climate change threats are rising air and river water temperatures. While the historic average annual ambient air temperature is 25.0^{o}C at Bibiyana, it is projected to rise by 2.8^{o}C to 3.4^{o}C over the period 2045–2065. As for water temperature, it is projected that the proportion of the year when river water temperature is at or above the design temperature of 28.5^{o}C will significantly increase.

To date, the potential impacts of rising temperature on electricity demand have attracted most of the attention. However, there is an increasing recognition that climate change may have significant impacts on the generation of electricity by CCGT. It may do so by reducing water availability, as well as increasing air and water temperature.

According to an ADB summary report[1], five climate-related threats have been identified as being of potential significance. The nature of the exposure and impacts of these threats varies. Some, like air and river water temperatures, threaten day-to-day performance of plant operations, while heavy precipitation and flooding can affect maintenance schedules and downtime. Erosion and flooding could potentially cause damage to planned infrastructure.

[1] Adaptation to Climate Change: The Case of a Combined Cycle Power Plant. Asian Development Bank 2012

Direct climate threat		Potential sensitivity of a power plant
Air temperature	→	Gas turbine cycle performance
River water temperature	→	Steam turbine cycle + coolant water cycle performance
Direct precipitation	→	Performance of gravity-driven stormwater management
Flood depth + Duration	→	Asset damage + plant downtime
Erosion	→	Asset damage

Thermoelectric generation is water intensive. It is estimated that on average, each kilowatt hour (kWh) of electricity generated via steam cycles requires approximately 0.95 cubic meters (m3) of water. Climate change may impact water availability in numerous ways, including the following:

- Changes in precipitation patterns may impact the hydrological cycle, including river runoff.
- The retreat of glaciers may increase river discharge over the next several decades followed later by significant reductions in summer flows as glaciers disappear.
- Changes in water use patterns and increasing water demand from sectors other than the power sector may reduce water availability to the power sector.

Simultaneously, changes in air and water temperature may impact power generation efficiency in various ways:

- Higher air temperatures reduce the power generation efficiency of thermal power plants leading to a reduction of power generation. If experienced during heat waves, this reduction may coincide with peak demand; and
- An increase in water temperature may adversely impact the operation of the cooling system of CCGT power plants.

Adaptation responses should include the following:

- **Improving performance of the gas turbine cycle:** Adaptation options are focused on the gas turbine technology and revolve around either pretreatment of the intake air to reduce temperature or redesigning the topping cycle technology to accommodate a warming climate.
- **Improving performance of the cooling water cycle:** Adaptation options are focused on reducing the intake water temperature or increasing the performance of the cooling water system pumps and heat exchangers.

- **Improving management of the coolant discharge:** Adaptation options are focused on reducing the proportion of coolant feedback at the water intake structures and improving mixing of the coolant plume in the Kushiyara River water column.

In a large number of instances, power stations in Bangladesh continue to be designed with the assumption that average and extreme conditions observed to date will continue throughout the design life of the plant. As the threat and impact of climate change become better understood, it is increasingly clear that the assumption of a stationary climate must be questioned. In a warming climate, engineers and urban planners must acknowledge that the design of critical infrastructure should better reflect an increasingly dynamic and uncertain future.

During the lifetime of the SBPCL II Power Plant, the Kushiyara River and Habiganj floodplains are projected to experience significant changes in climate. Sea levels and ambient temperatures are expected to rise, while rainfall will become more variable. Wet seasons will get wetter, while droughts will occur with greater frequency and severity.

2. Climate Change and Bangladesh Scenario

Being a disaster-prone country, Bangladesh almost every year, experiences disasters such as tropical cyclones, storm surges, coastal erosion, floods, and droughts causing heavy loss of lives and property and jeopardizing developmental activities. These natural calamities add an extra burden to the country which is already fraught with many problems such as high population density, shortage of land to accommodate the people, food security, human health, illiteracy, and so on. Bangladesh is likely to be one of the most vulnerable countries of the world affected by the effect of climate change (Ali 1999).

The global warming due to the increase in greenhouse gas concentrations in the earth's atmosphere and the consequent sea level rise (SLR) are going to add fuel to the fire. Almost every sector of the socio-economic lives in Bangladesh is likely to be affected by climate change. Most of the climate change impacts in Bangladesh are likely to come from the south, i.e., from the Bay of Bengal and the adjoining north Indian Ocean (Ali 1999). These waters are the sources of tropical cyclones and storm surges, coastal erosion, monsoon wind, evaporation for monsoon rainfall, floods, and droughts.

Bangladesh is highly vulnerable as it is low-lying, located on the Bay of Bengal in the delta of the Ganges, Brahmaputra and Meghna and densely populated. Its economy strongly depends on agriculture and natural resources that are sensitive to climate change and SLR. The impact of higher temperatures, more extreme weather events such as floods, cyclone, severe drought, and SLR are already being felt in South Asia and will continue to intensify (Haq et al 1998; Karim et al 1998). In this connection proper planning for the management of water resources are important for the country. Long term planning is not possible without an idea of climate change in future. Climate models are the main tools available for developing projections of climate change in the future (Houghton et al 1995, 2001). In recent years, high horizontal resolution MRI-Atmospheric General Circulation Models (AGCM) experiments are conducted using the time-slice method (Bengtsson et al 1996; IPCC 2001), which is a two-tier global warming projection using an atmosphere-ocean general circulation model (AOGCM) and an AGCM with horizontal resolution higher than that of the atmospheric part of the AOGCM. These predictions may be adequate for the area where terrain is reasonably flat, uniform and away from coasts. However, regional climate model is the best tool for dynamical downscaling of climate features for obtaining detailed information for a particular region (Giorgi et al 2001; Jones et al 2004). Dynamical downscaling from regional climate model outputs is important in understanding the local phenomena at a particular place for every country.

Human-induced changes in the global climate and associated SLR are widely accepted phenomena among policy makers and scientists. The Intergovernmental Panel on Climate Change (IPCC) concluded that "the balance of evidence suggests a discernible human influence on global climate" (IPCC 1996). The exact magnitude of the changes in the global climate is still uncertain and is a subject of worldwide scientific studies. The calibration and validation of rainfall and temperature in Bangladesh derived from a Regional Climate Model (RegCM) for the baseline period 1961–1990. Finally, projections are made for rainfall and temperature in Bangladesh for 2050 and 2060.

2.1. Model description and methodology

The Regional Climate Model (RegCM3) system originally developed at the National Center for Atmospheric Research (NCAR) is maintained in the Earth System Physics (ESP) section of the ICTP, Italy. RegCM idea was originally proposed by Dickinson et al (1989) and Giorgi (1990). This idea was based on the concept of one-way nesting in which large scale meteorological fields from General Circulation Model (GCM) provides initial and time-dependent meteorological lateral boundary conditions (LBCs) for high resolution Regional Climate Model (RCM) simulations, with no feedback from the RCM to the driving GCM. RegCM3 is based on hydrostatic primitive equation and grid point containing 16 vertical layers. RegCM3 is made freely available for scientists of developing countries to generate climate change scenarios in the future.

RegCM3 was run at 0.54◦×0.54◦ horizontal grid resolution in a large domain that covers 65◦–117◦E and 5◦–38◦N for the baseline period 1961–1990 to calibrate model outputs with observed data. Grell scheme with Arakawa–Schubert (GAS) and Fritch– Chappell (GFC) assumptions were used as convective precipitation options in model simulation. The Grell parameterization is implemented using two closure assumptions:

1) The Arakawa and Schubert closure (Grell et al 1994) and

2) The Fritsch and Chappell closure (Fritsch and Chappell 1980).

The GFC assumptions were found suitable for rainfall over Bangladesh than other assumptions (Rahman et al 2007). Calibration and validation of RegCM3 are considered for Bangladesh to understand the model performance in simulating climatic parameters such as rainfall and temperature. Surface rainfall data of Bangladesh collected from the Bangladesh Meteorological Department (BMD) observations network is shown in figure 1.

These observations were used for the calibration of model generated rainfall and temperature. While making a grid point over the domain at 0.54◦×0.54◦ resolution, a number of grids are found which do not contain any observation station or site in that grid. For the application purpose of RegCM3, it is very important for Bangladesh to find out the appropriate calibration procedure. So, an analysis was performed on a point-to-point basis (Islam et al 2008).

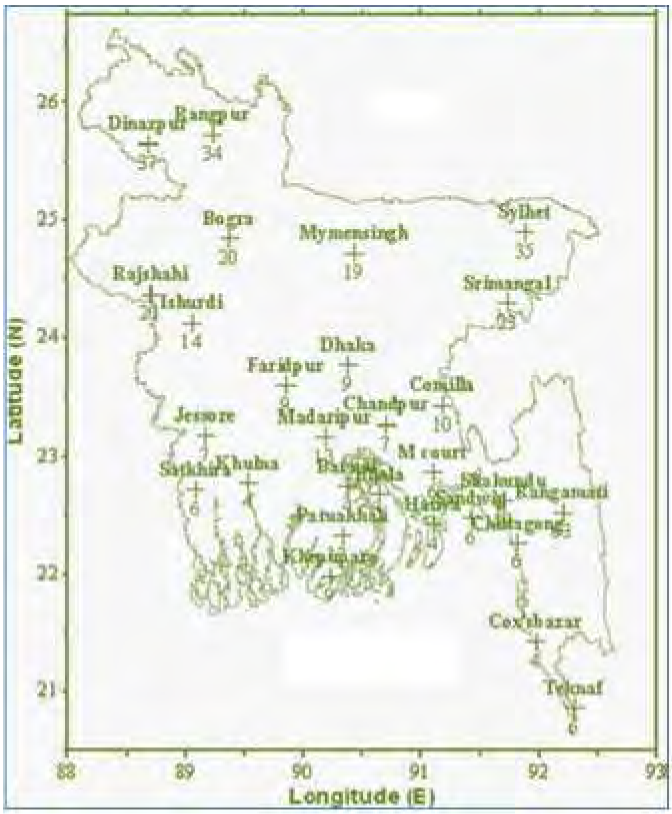


Figure 1: Plus marks represent Bangladesh Meteorological Department (BMD) observation stations. Above plus mark the name of stations and below plus mark the elevation (meters) are shown.

In this procedure, observed data at a particular station/site is considered as the representative of that location. Grid value of the model data is compared with the observed data. If more than one observation stations or sites exist within a grid, then average value of all the observational sites is considered as the representative value for that grid. Daily rainfall data collected from BMD are processed to obtain monthly, seasonal, annual and long term values. Simulated rainfall and temperature are extracted for 28 observational stations/ sites of BMD and then they are converted to monthly, seasonal, annual and long term values. The average over 28 stations is considered as the country average.

2.1.1. Results

The high resolution model simulations generated rainfall over Bangladesh using RegCM3 have been studied in detail to evaluate the model skills during the period 1961–1990.

2.1.2. Monthly rainfall

The mean annual cycles of the Bangladesh monthly rainfall obtained from the simulation (GFC) and observation are shown in figure 2. The model generated annual cycles of rainfall match reasonably well with the observed data. However, there appears to be a significant positive bias in the rainfall during the onset phase of the monsoon. The model produces excess rainfall during the transitional months of May and June. The model overestimates rainfall for the dry month of November to the onset phase of monsoon, i.e., the month of June. During July to October, the model estimates almost the same as the observed rainfall.

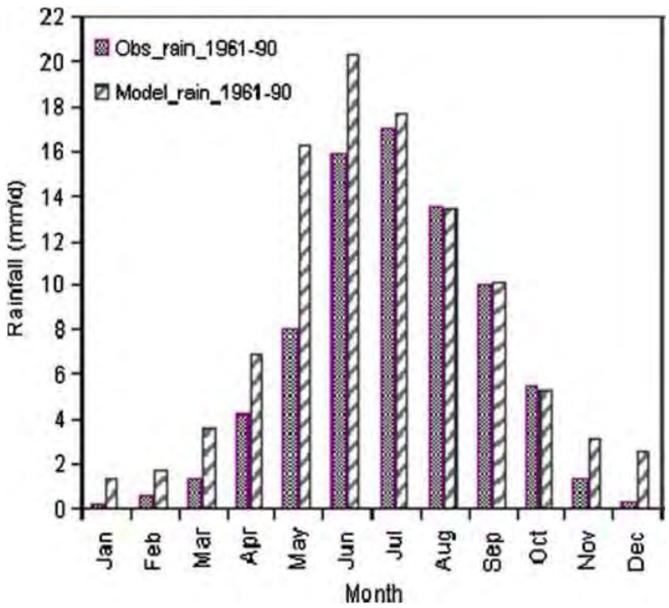


Figure 2: Comparison of simulated (GFC) monthly rainfall (mm/d) with the observed data in Bangladesh during the period 1961–1990.

In fact, the characteristics of precipitation systems, especially the vertical height and precipitation strength in this region are different in different rainy periods, whereas the use of same cloud parameterization cannot represent variable atmospheric conditions in different periods (Islam and Uyeda 2008).

2.1.3. Seasonal rainfall

It is seen that the model has overestimated rainfall in winter (DJF), pre-monsoon (MAM) and monsoon (JJAS) seasons. During the post-monsoon (ON) season, model simulated (GFC) values are almost the same as the observed values (figure 3).

The average monsoon rainfall (JJAS) for the baseline (1961–1990) simulated (GFC) by RegCM3 is 1877 mm with a standard deviation of 222 mm (table 1) whereas All-Bangladesh Summer Monsoon Rainfall (ABSMR) based on 28 stations averaged during the period of 1961–1990 is 1729 mm with a standard deviation of 228 mm. The model seems to have overestimated the ABSMR; its variability is almost the same as the observed values. During the winter, pre-monsoon and post-monsoon period model simulated rainfall is 166, 822 and 259 mm with standard deviation of 115, 218 and 126 mm, respectively. Similarly, observed rainfall is 33, 418 and 211 mm with a standard deviation of 20, 148 and 126 mm during the winter, pre-monsoon and post-monsoon period, respectively (table 1).

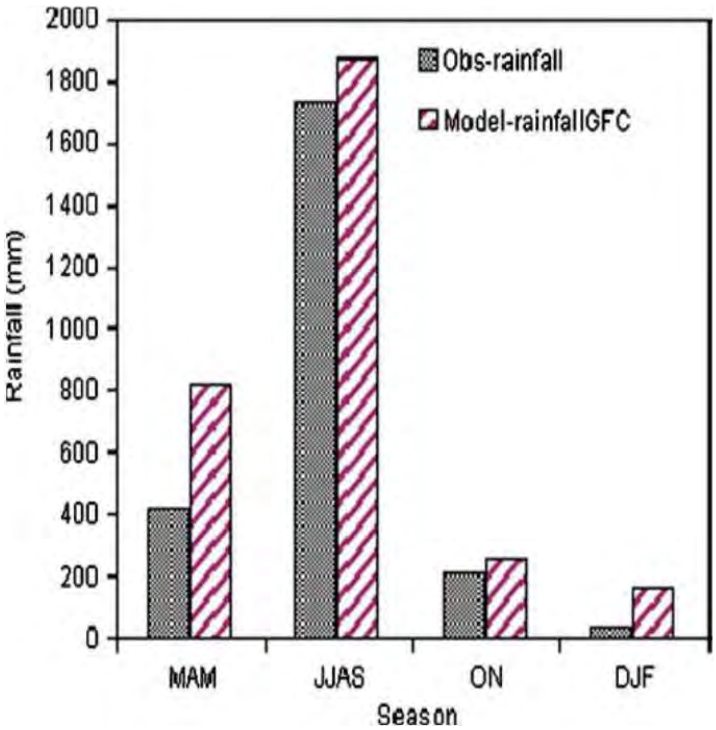


Figure 3: Comparison of simulated (GFC) seasonal rainfall (mm/d) with the observed data in Bangladesh during the period 1961–1990.

2.1.4. *Long term rainfall*

The simulated (GFC) area averaged rainfall over Bangladesh is compared with the CRU gridded (0.5◦×0.5◦) rainfall for the period 1961–1990 and is shown in figure 4(a, b). Spatial distribution of the simulated and the CRU rainfall over Bangladesh are found to be almost similar pattern except in the northeastern part of Bangladesh. The model does not capture rainfall well over northeastern part. But, southeastern and some areas of western parts rainfall is captured well by the model. The southeastern part is located in hilly region and western part is located in large landmass area over Bangladesh and India.

Spatial distribution of differences (CRU Model) in rainfall for the period of 1961–1990 is represented in figure 4(c). Highest rainfall is seen in the northwestern part and next, in some areas of the western part while less rainfall is found to be in the northeastern part extending up to southern part of Bangladesh.

A summary of correlation and RMSE between observed and model simulated seasonal average rainfall in Bangladesh is shown in table 1 in which a better correlation is seen for two seasons than the other seasons. During winter and pre-monsoon seasons, correlation between observed and model rainfall is found to be the same as 0.38 which is statistically significant at 5% level with RMSE of 170 and 454 mm, respectively while correlation between observed and model rainfall is found to be poor (less than 0.20) with RMSE of 325 and 152 mm, respectively during monsoon and post monsoon seasons. All these statistical calculations were carried out using software.

Table 1. *Characteristics of observed and RegCM simulated (GFC) seasonal and annual rainfall (mm) over Bangladesh during the period 1961–1990.*

Mean	MAM	JJAS	ON	DJF	Annual
Observed	418.9	1729.0	211.8	33.7	2393.4
Baseline (model)	822.7	1876.8	259.7	166.6	3125.8
Standard deviations					
Observed	148.5	228.1	97.3	20.4	312.5
Baseline (model)	218.3	222.1	126.7	115.09	373.8
Mean bias	403.8	147.8	47.9	132.9	732.4
Std. dev. bias	69.8	6.0	29.4	94.69	61.3
Correlations	0.38*	0.14	0.16	0.38*	0.09
RMSE	454.2	325.4	152.2	170.7	852.5

*: Correlation significant at 95% level.

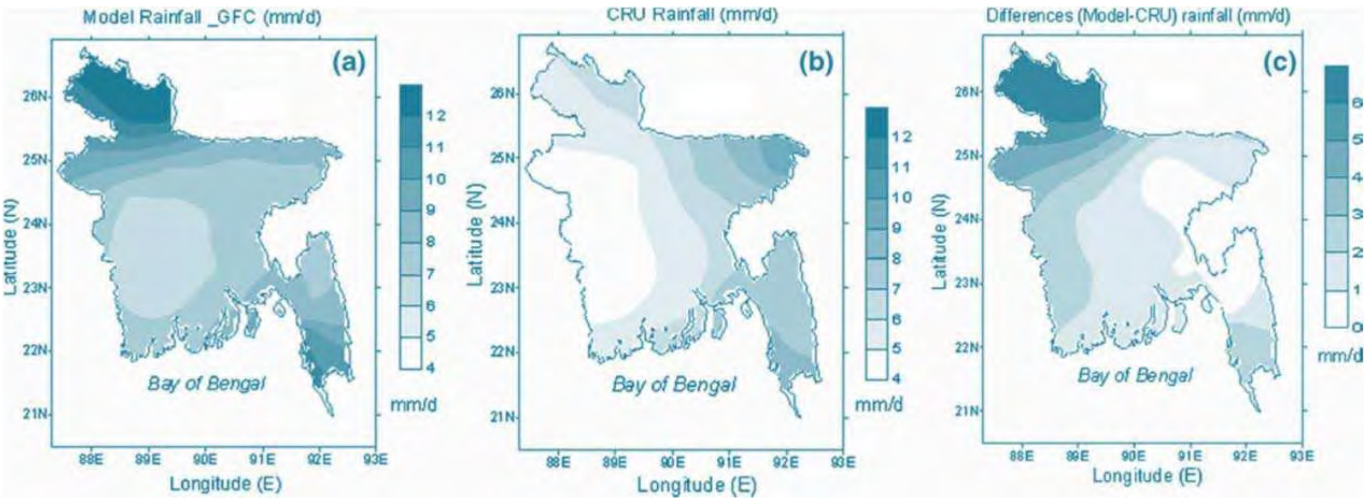


Figure 4: (**a–b**) Comparison of spatial distribution of model simulated (GFC) rainfall (mm/d) and CRU rainfall during the period 1961–1990. (**c**) Differences between model and CRU rainfall during the period 1961–1990.

2.1.5. *Simulation of temperature over Bangladesh*

In this section, the simulated (GFC) temperature is compared with the observed data.

2.1.6. Monthly mean temperature

The monthly mean annual cycles of the simulated (GFC) temperature are compared with the observed data as shown in figure 5.

The annual cycles in the surface air temperature having the highest temperature during the pre-monsoon months (April–May) followed by slight temperature decrease during the monsoon months are well represented by RegCM3. These appear to be some cold bias in the model throughout the year. The model-simulated monthly mean surface air temperature is almost the same for all months but magnitude is different from the observed data.

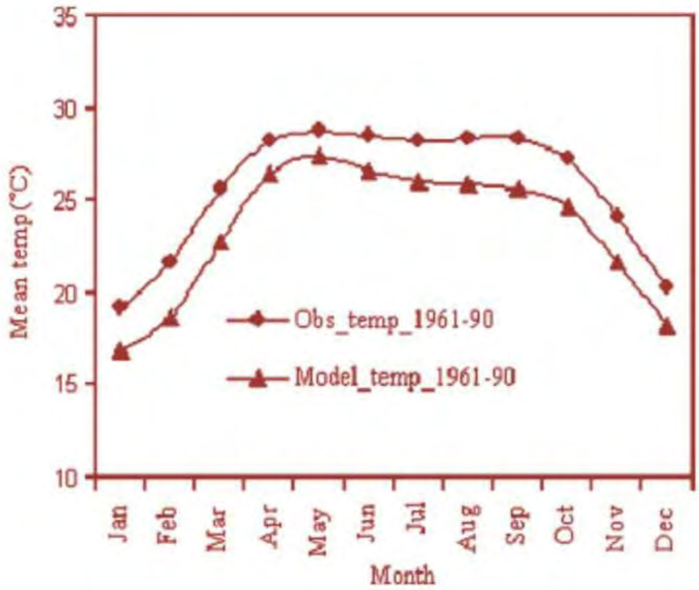


Figure 5. Comparison of simulated (GFC) monthly mean surface air temperature (°C) with the observed data during the period 1961–1990.

2.1.7. Seasonal mean temperature

The model simulated (GFC) average seasonal temperature is compared with the observed data for the four seasons over Bangladesh as shown in table 2. The simulated temperature is seen to underestimate the observation by 2.0◦, 2.3◦, 2.5◦ and 2.3◦C for pre-monsoon, monsoon, post-monsoon, and winter seasons, respectively. The simulated mean pre-monsoon temperature is 25.5◦C with a standard deviation of 0.4◦C (table 2).

Table 2. *Characteristics of observed and simulated (GFC) mean temperature (°C) over Bangladesh during the period 1961–1990.*

Mean	MAM	JJAS	ON	DJF	Mean temp.
Observed	27.5	28.3	25.6	20.2	25.6
Baseline (model)	25.5	26.0	23.1	17.9	23.4
Model bias	−2.0	−2.3	−2.5	−2.3	−2.2
Standard deviations					
Observed	0.5	0.2	0.5	0.4	0.2
Baseline (model)	0.4	0.4	0.7	0.7	0.4
Correlations	0.2	0.10	0.2	0.0	0.2
RMSE	2.1	2.4	2.6	2.5	2.3

The observed mean pre-monsoon temperature based on 28 stations over Bangladesh is 27.5◦C, with a standard deviation of 0.5◦C. The simulated mean surface air temperature is seen to underestimate the observed value (by 2.0◦C) but variability is almost the same for pre-monsoon season. Model shows systematic cold bias for all seasons. However, simulated surface air temperatures are well matched with the pattern as observed over all seasons but magnitude is different. The model simulated surface air temperature underestimates the observation by 2.3◦, 2.5◦ and 2.3◦C for monsoon, post-monsoon, and winter seasons, respectively. The variation in mean temperature (cold bias for all seasons) may be as seen in the global model.

2.1.8. Long term mean temperature

Figure 6 (a and b) shows the spatial distribution of mean surface air temperature simulated (GFC) by RegCM3 with the CRU data for the period 1961–1990. It is found that the patterns are almost similar but magnitude is different as discussed in earlier section. The CRU temperatures are used for understanding the model performance. This figure shows that the low temperature regions are in the northeastern and northern parts of Bangladesh, whereas high temperature regions are in the southeastern and southwestern parts. Overall, the model shows that a cold bias persists in simulation. The spatial distributions of differences (CRU Model) between CRU and mean surface air temperature for the period of 1991–1990 are shown in figure 6(c). From the figure, the highest mean surface air temperature is observed in the northeastern and northwestern parts and next to it is found the western part while less mean surface air temperature is found in the southeastern part of Bangladesh.

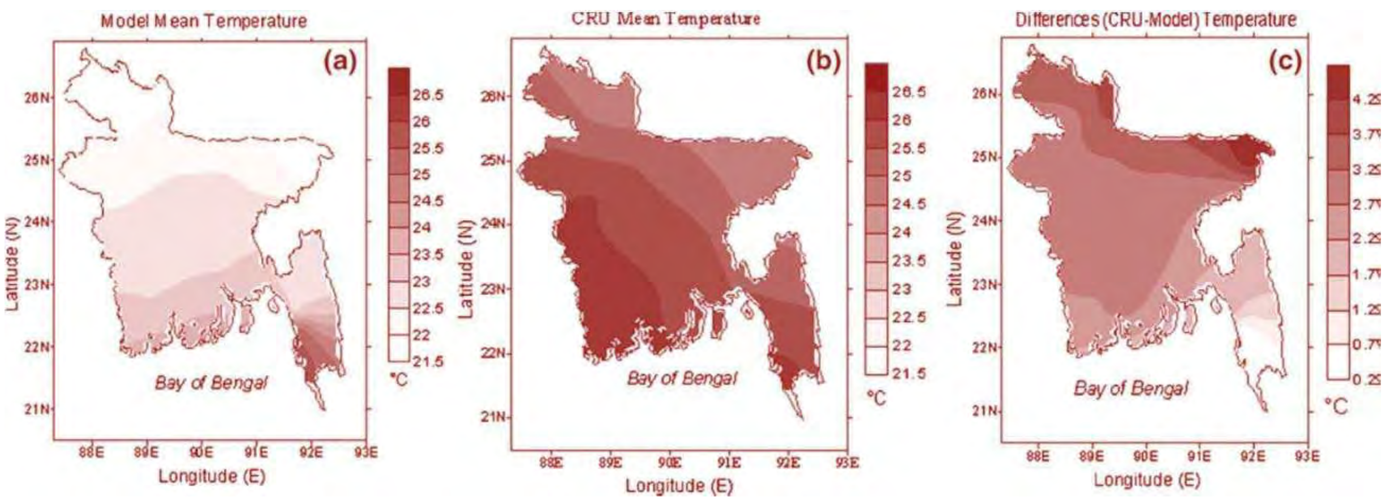


Figure 6: The spatial distribution of (**a**) model simulated (GFC) mean surface air temperature and (**b**) the CRU mean surface air temperature during the period 1961–1990. (**c**) Differences between CRU and model mean temperature during the period 1961–1990.

Figure 7 (a and b) shows the spatial distribution of long term mean surface air temperature obtained from (a) model simulation (left side) and (b) observation (right side) for the period of 1961–1990. Simulation shows that low temperature zones are in the northern and eastern parts of Bangladesh. A high temperature zone is observed in the southwestern parts of the country. The spatial distribution of long term observed temperature is obtained from the grid-to-grid method, which is almost similar to the simulated temperature distribution. Therefore, it may be concluded that model data is not directly applicable for any purpose due to model bias and after calibration, model bias may be reduced. Calibrated results may be applicable for various purposes especially in planning for the agriculture, water resources, health, biodiversity, etc., of the country.

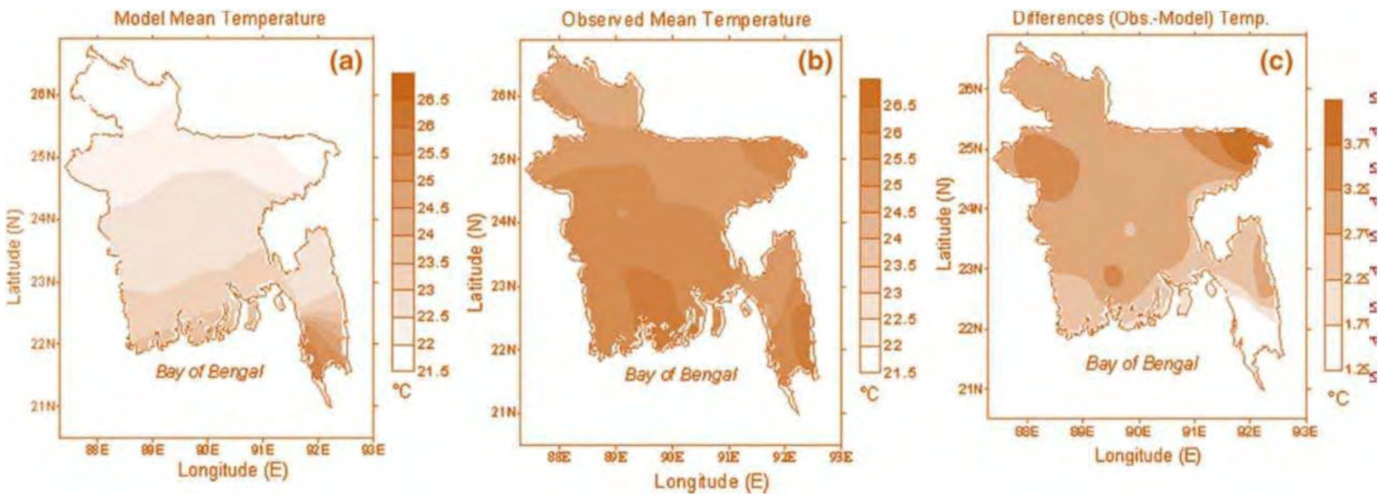


Figure 7: The spatial distribution of (**a**) model simulated (GFC) mean surface air temperature and (**b**) observed mean surface air temperature during the period 1961–1990. (**c**) Differences between observed and model mean temperature during the period 1961–1990.

The spatial distribution of differences between observed and model mean surface air temperature is found over Bangladesh for the period of 1991–1990 is shown in figure 7(c). High mean surface air temperature are seen in some areas of northeastern and western parts while low mean surface air temperature in some areas of southeastern and southwestern parts of Bangladesh. This figure shows almost the similar pattern as in figure 6(c).

2.2. Climate change projection

2.2.1. Projection of rainfall

To reduce model biases in the future precipitation scenario, the observed data and the differences between the future and present data were used to estimate climate scenarios in each season using the following expression:

$$P_{future} = P_{obs} + (P_{future} - P_{present}) \quad (1)$$

Where P_{obs} is the observed data, P_{future} is the model future data, and $P_{present}$ is the model present data. Rainfall projection is obtained using equation (1) for the year 2050 and 2060. The change of rainfall is found to be −67%, +35%, −12% and +107% for pre-monsoon, monsoon, post-

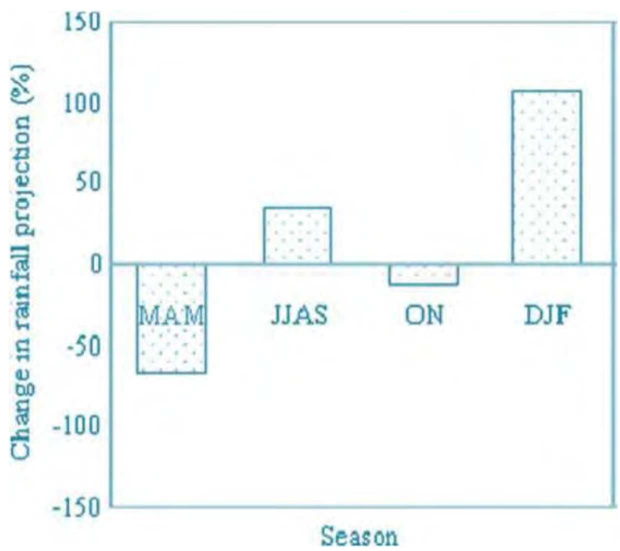


Figure 8: Percentage of change in rainfall projection with respect to baseline for four seasons in 2050.

monsoon and winter, respectively in 2050 (figure 8) and rainfall on an average may decrease more than 50% (not shown in seasonal values) in 2060.

2.2.2. Rainfall anomaly in 2050

Figure 9 shows the spatial distribution of model simulated (GFS) rainfall anomaly in 2050 with respect to the average rainfall for the period 1961– 1990. The average rainfall may increase in the eastern part and decrease in the western part of Bangladesh in 2050 with largest negative anomalies in the northwestern region.

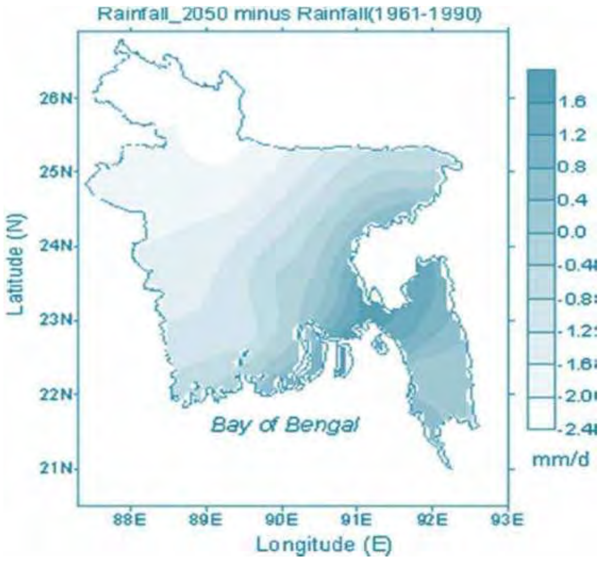


Figure 9: The spatial distribution of rainfall anomaly over Bangladesh in 2050.

2.2.3. Projection of temperature

Temperature projection is obtained using equation (1) as shown in figure 10 for the years 2050 and 2060, respectively. Mean surface air temperature may change in 2050 by 2.1◦, 1.3◦, 2.1◦, 1.6◦, 1.0◦, 0.0◦, 0.5◦, 1.1◦, 1.6◦, 0.2◦, 1.9◦, 1.2◦C for January, February, March, April, May, June, July, August, September, October, November and December, respectively. Similarly, temperature may change in 2060 by 3.5◦, 1.7◦, 3.3◦, 3.8◦, 1.2◦, 2.1◦, 1.7◦, 1.5◦, 1.9◦, 1.4◦, and 0.9◦C for January, February, April, May, June, July, August, September, October, November and December, respectively. Mean surface air temperature in various months at different places over Bangladesh may vary by 0.5◦– 2.1◦C and 0.9◦–3.5◦C for the year 2050 and 2060, respectively.

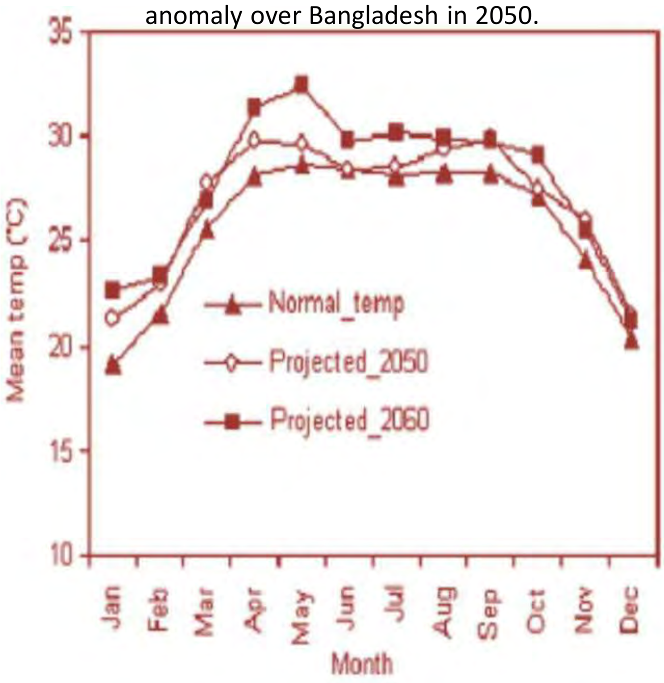


Figure 10: Annual cycle of projected temperature with normal over Bangladesh in 2050 and 2060.

2.2.4. *Temperature anomaly in 2050*

Figure 11 shows the differences of model simulated mean temperature of 2050 and the average temperature for the period 1961–1990. It is found that the mean temperature in and around Bangladesh may increase except in some areas of southeastern part of Bangladesh. Model-simulated mean temperature may decrease a little bit in southeastern part of Bangladesh in 2050. The rate of increase of mean temperature in the northern side is higher than that of the southern side of Bangladesh.

Rainfall and temperature scenarios presented in this chapter are very useful for impact assessments in various sectors in Bangladesh. Simulation results are obtained using various options of a regional climate model (RegCM3).

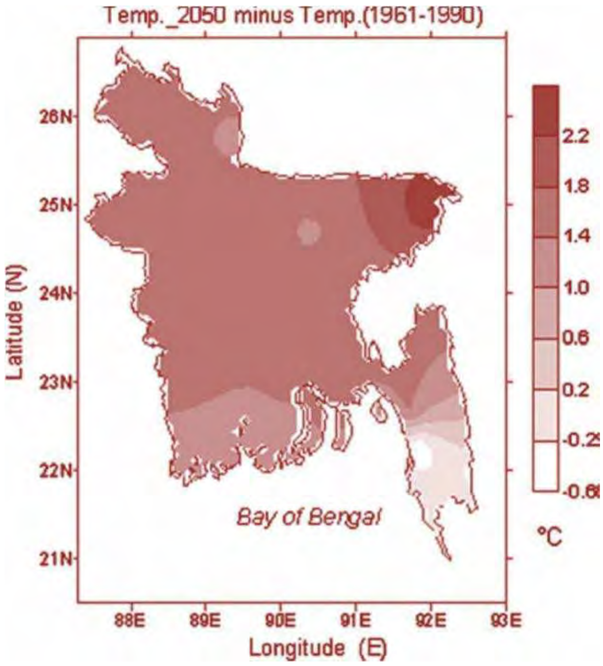


Figure 11: The spatial distribution of mean temperature anomaly over Bangladesh in 2050.

Surface air temperature and rainfall show similar patterns of projected changes under A2 scenario over India as found by Rupa Kumar et al (2006). Following are the major findings based on the results presented in this chapter:

• RegCM3 shows a systematic cold bias for temperature for all months for the period 1961– 1990. On an average, RegCM3 underestimates temperature by 2.3◦C. However, Figure 10 reflects Annual cycle of projected temperature with normal temperature over Bangladesh in 2050 and 2060. Month wise variability in the model resolved temperature which varies within a range of 1.4◦– 3.0◦C with respect to observed monthly average temperature.

• A major bias involving overestimation of rainfall over Bangladesh in the regional climate model may be carried down from its parent model (i.e., GCM).

• Model simulated scenarios of increasing greenhouse gas concentrations indicate marked increase in temperature towards the middle of the 21st century.

• RegCM3 projected temperature indicates that temperature in Bangladesh may increase throughout the country in 2050 and 2060. The rate of increase in temperature may vary from 0.5◦–2.1◦C and 0.9◦–3.5◦C for 2050 and 2060, respectively.

• RegCM3 projected rainfall indicates that rainfall over Bangladesh may change by −67%, +35%, −12% and +107% for MAM, JJAS, ON and DJF, respectively in 2050 and rainfall on an average may decrease by more than 50% in 2060.

2.3. Major Climate Change Vulnerabilities in Bangladesh

2.3.1 Sea level rise in Bangladesh

Bangladesh is highly vulnerable to sea level rise, as it is a densely populated coastal country of smooth relief comprising broad and narrow ridges and depressions (Brammer et al., 1993). World Bank (2000) showed 10 cm, 25cm and 1 m rise in sea level by 2020, 2050 and 2100; affecting 2%, 4% and 17.5% of total land mass respectively. Milliman et al. (1989; cited in Frihy, 2003) reported 1.0 cm per year sea level rise in Bangladesh.

UNEP (1989) showed 1.5 m sea level rise in Bangladesh coast by 2030 **(Figure-12)**, affecting 22,000 Sq. km (16% of total landmass) area with a population of 17 million (15% of total population) affected. Since this scenario was calculated in 1989, the expected rate of sea level rise has been modified because of uncertainty. At present expected rates, this situation will occur in about 150 years from now. However, number of potential population affected by the projection of World Bank by one metre sea level rise (17.5 million) and that of UNEP by 1.5 metre sea level rise (17 million) is similar.

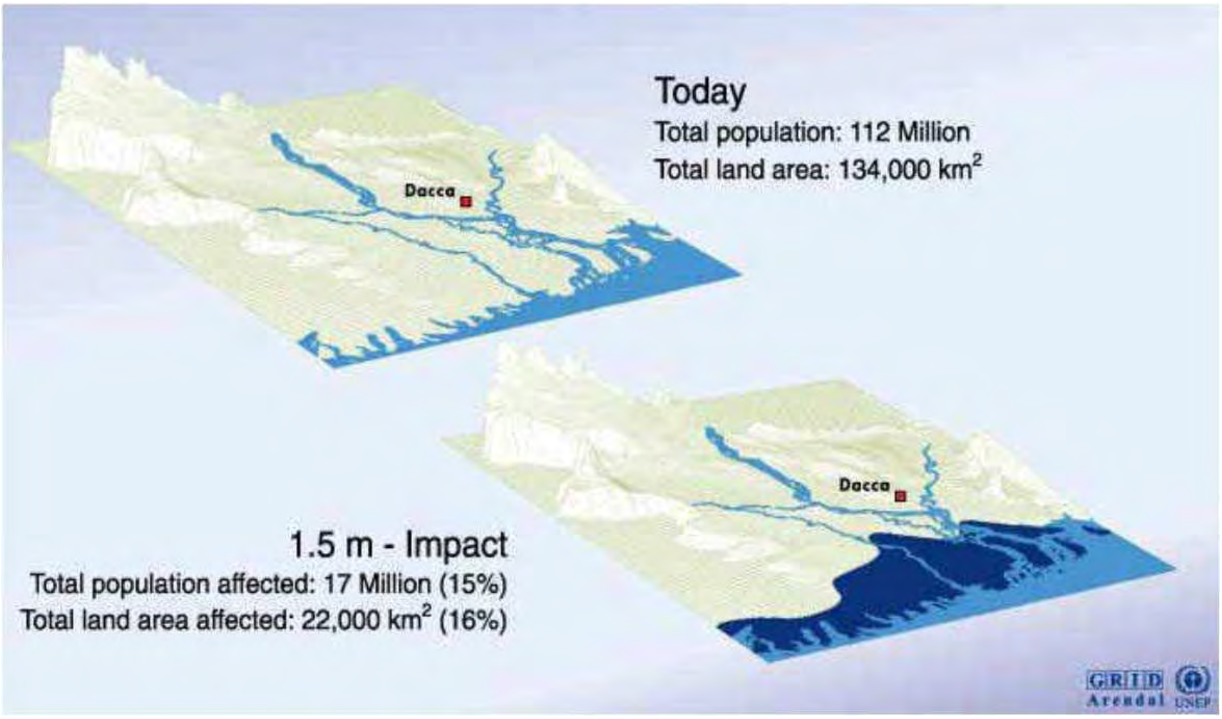


Figure-12: Impacts of 1.5 metre sea level rise on Bangladesh (Source: UNEP, 1989)

2.3.2. Salinity intrusion in Bangladesh

The main impacts of sea level rise on water resources are fresh water availability reduction by salinity intrusion. Both water and soil salinity along the coast will be increased with the rise in sea level, destroying normal characteristics of coastal soil and water. A water salinity map for the period of 1967 and 1997 (**Figure-13**) produced by Soil Resources Development Institute (SRDI, 1998a) shows that the problem is already on the way. A comparative study between Soil Salinity map of SRDI (1998b, 1998c) for the period of 1973 and 1997 shows salinity intrusion in soil is much higher than water salinity. The map shows that soil of Jessore, Magura, Narail, Faridpur, Gopalgonj and Jhalokati was newly salinized in 24 years of time expansion. A one meter sea level rise will expand the soil and water salinity area at a faster rate.

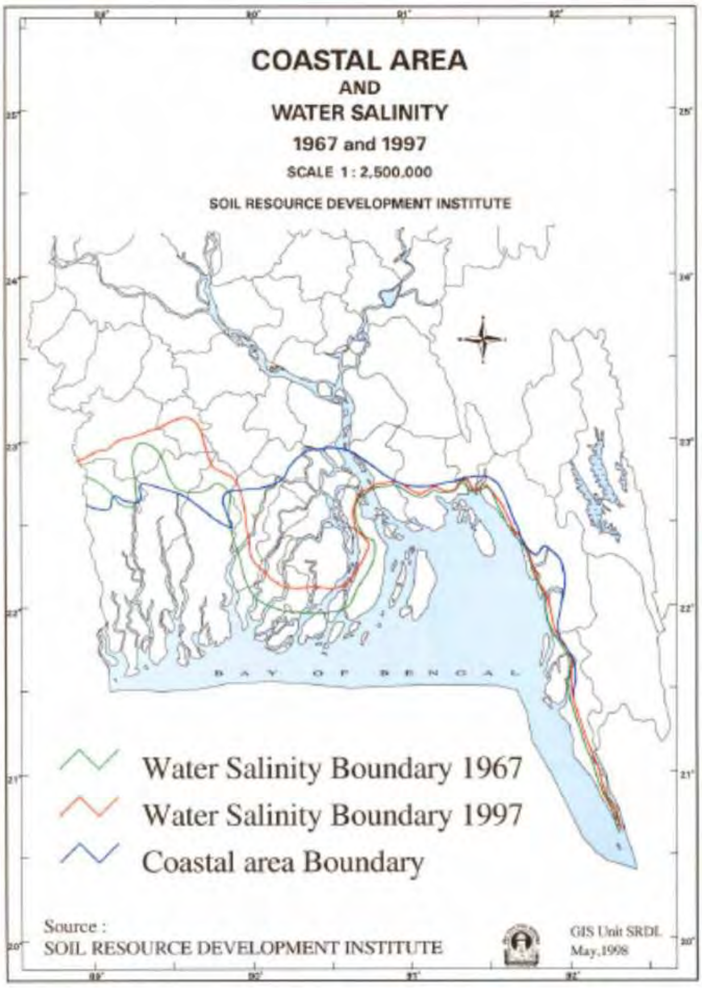


Figure 13: A water salinity map for the period of 1967 and 1997

2.3.3. Flash flood in Bangladesh

A flood, which is caused by heavy or excessive rainfall in a short period of time over a relatively small area, is referred to as flash flood. In flash flood, water level rises and falls quite rapidly with little or no advance weather forecast / warning. Typically, flash flood occurs in areas where the upstream basin topography is relatively steep and the concentration time of the basin is relatively short. In Bangladesh flash floods generally occurs in the north-east, south-east and Chittagong region. But devastating and extended flash flood is a recurrent phenomenon for the north-east region (Figure: 18) of Bangladesh. The extreme flashy character of the rivers and sudden excessive rainfall in the region causes frequent flash floods in the northeastern Haor areas. In the haor area, flash flood comes from the very steep uplands adjacent to the region in Assam and Meghalaya hills range in India causing immense damage to the standing Boro crops, lives and properties every year. One of the functions of flash floodwater is to carry sediments, which are eroded from the hilly catchments area. During heavy rainfall in the hilly region, massive erosion is taken place on the exposed surface of the hill. If the high intensity rainfall is continued for certain period then coarser sediment such as big sized stone, boulder etc starts to erode and move along the rivers. Finally these sediments are deposited on the river bed, canals and agricultural land. During flash flood, sediment transport rates increase significantly of the rivers and hence major flood events make a disproportionate distribution of sediment and changes in channel size, shape and even location. Flash flood has another impact on the plan form of the rivers and canals in the north east haor area. Due to high magnitude flash flood, sometime severe erosion is occurred along the river bank causes not only a huge amount of national loss but also creates immense sufferings to the local people. Sand carpeting is another problem induced from flash flood. This problem is normally found in haor very adjacent to the hill such as Matian haor, Angurali haor, Karchar haor and Kalner haor under Sunamganj district.

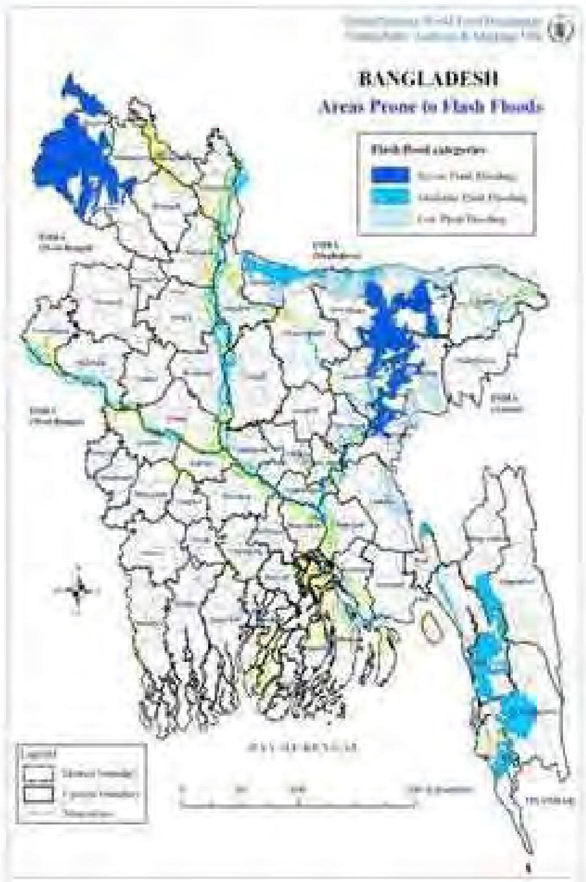


Figure 14: Flash Flood Prone areas of Bangladesh

2.3.4. River erosion in Bangladesh

The natural setting of Bangladesh is between the Himalayas and the Bay of Bengal together with the prevalence of tropical monsoon climate. The catchment area of the major rivers is about 1.65 million square km of which only 7.5 percent lies within the border of Bangladesh (Sarker et al., 2003) that generates 1200 km3 of run-off annually, only 10 percent of which is generated within Bangladesh. In addition to vast quantities of water, these rivers carry about 1.1 billion tons of sediment every year (EGIS, 2000; Sarker et al., 2003) and are responsible for the prevalence of flooding and riverbank erosion in Bangladesh (Elahi, 1991). The combination of the large discharges and heavy sediment loads with high water content from the annual wet monsoon, a low degree of compaction, and a large amount of runoff materials result in highly variable and dynamic channel morphologies (Coleman, 1969) to adjust their bed configurations. The river channel may shift laterally by more than 300 meters (Haque and Hossain, 1988) in any season. Riverbank erosion (RBE) has important implications for channel adjustment and long-term channel change, meander development, catchment sediment dynamics, riparian land loss and downstream sedimentation problems. (Lawler et al., 1997). Because of poor understanding of riverbank erosion processes, river dynamics and sediment transport models are weakly integrated into river management strategies (Wang et al., 1997). Furthermore, such knowledge gap complicated the relationship between flow energy and bank retreat rates (Lawler et al., 1997) as both the fluvial and non-fluvial erosion processes take place in bank erosion system and because of the duration of process and response along with the lack of information on erosion or accretion. Study findings by Center for Environment and Geographic Information Services (CEGIS) based upon analysis of 30-year time series of satellite images reveals that the Jamuna and Padma rivers have widened more than three kilometers and destroyed about 130000 ha of floodplain land. Goodbred and Kuehl (2000) showed that during the early Holocene period, the sediments yielded by the catchment of the main rivers of Bangladesh were several times higher than that of present time as monsoon was stronger and the rate of sea level rise was very high (i.e., 1 meter per 100 years). One of the most influential phenomenons is that climate change is expected to disturb the sediment balance. It is difficult to forecast whether there will be net accretion or erosion.

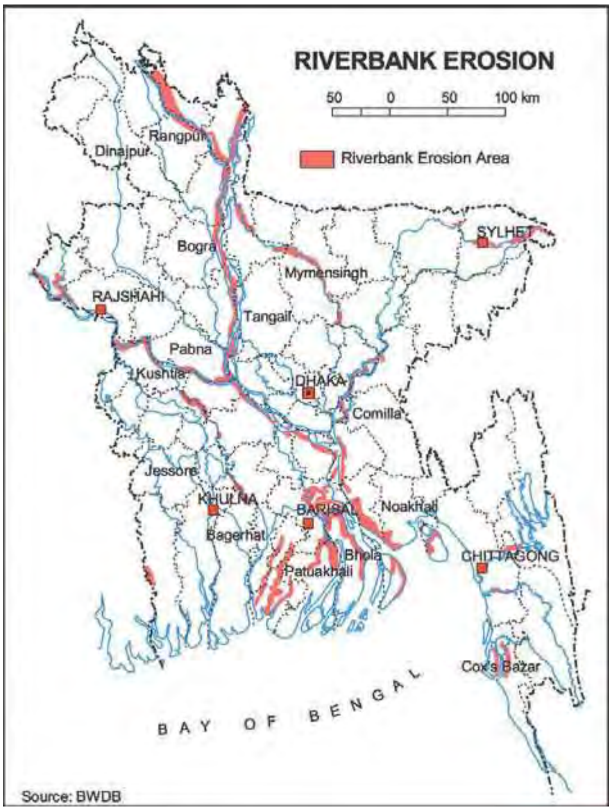


Figure 15: RBE Prone Areas of Bangladesh

2.3.5. Drought in Bangladesh

Drought is one of the main problems for many nations, and the severity of such issue goes big when it comes as obstacle to ensure an optimum agricultural production for a country like Bangladesh. Drought is being considered as the main cause which hampers the estimated agricultural production, here in Bangladesh over the last few decades. The direct cause of a shortage of rainfall may be because of one or more factors including large-scale downward air movement within the atmosphere or absence of available moisture in the atmosphere which suppresses rainfall. Variations in such factors involve variations in global, regional and local climate and weather. While it may be potential to indicate the direct cause of a drought event in a particular location, but it frequently is not possible to recognize an underlying cause. Rising levels of CO_2 and other GHGs have been recommended as causes of

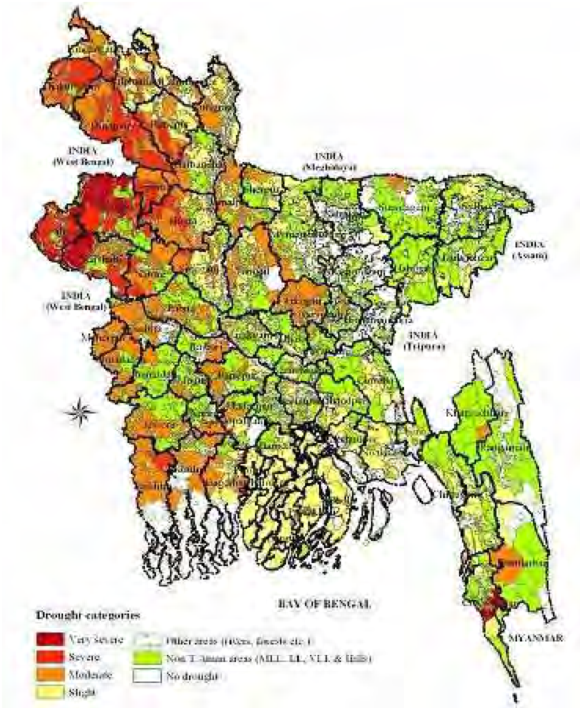


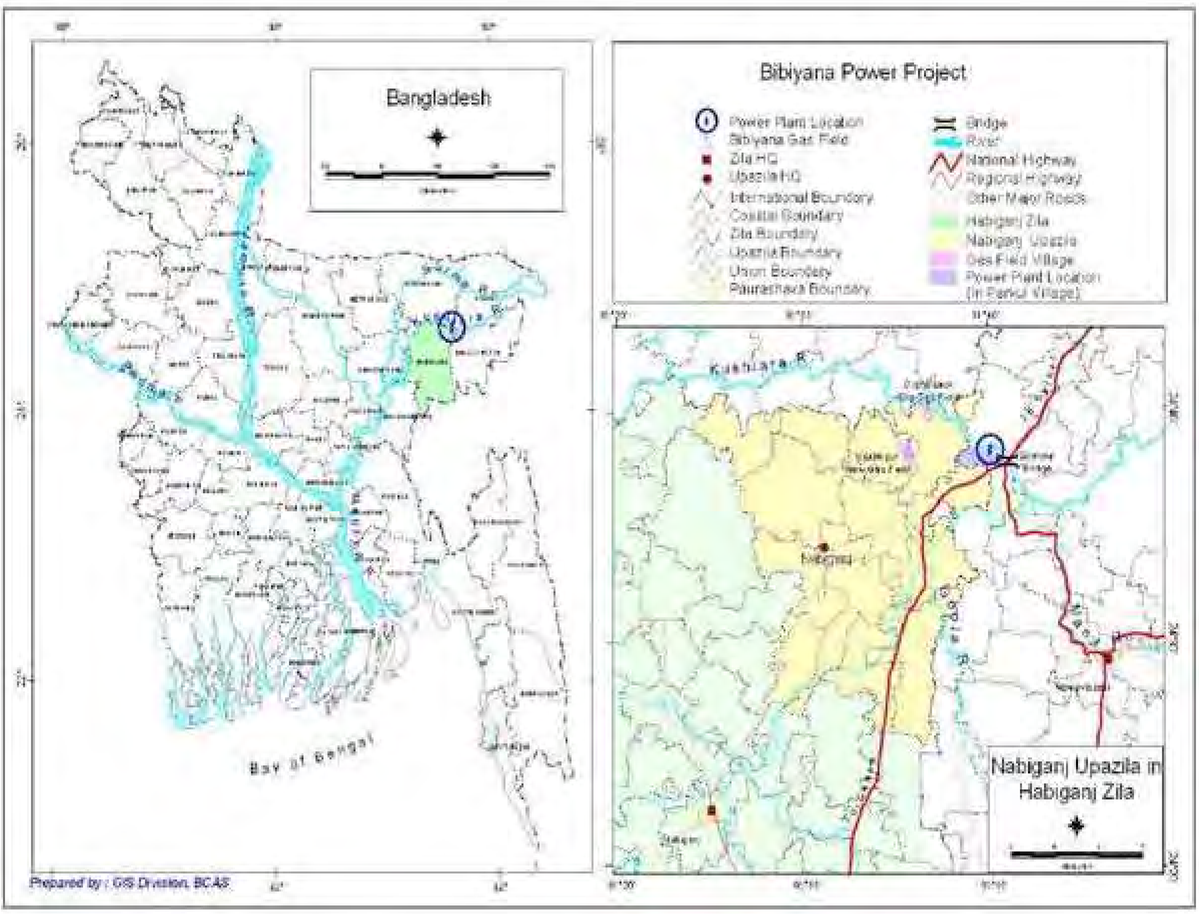
Figure 16: Drought Prone Areas of Bangladesh

variations of rainfall that are characterized as climate change. There are strong evidences that climate change will change the rainfall pattern and consequently more frequent droughts are happened. Among the local-level reasons are human-induced alterations resulting from vegetation loss because of deforestation and over exploitation of resources. Northwestern regions of Bangladesh are particularly exposed to droughts.

3. SBPCL II and Its Physical Environment

The proposed site of the SBPCL II Power Plant is located adjacent to the southern bank of the Kushiyara River, at 91°39′37″ E longitude and 24°38′18″ N latitude. The site is located approximately 3 km to the west of the Sherpur Bridge, approximately 45 km south-west of Sylhet (the district headquarters) and approximately 180 km north-west of Dhaka. Administratively, the site is located in the village of Parkul is Aushkandi Union under Nabiganj Upazila of Habiganj district (refer to Maps 1 to 2). The proposed power plant will be served by natural gas from the Bibiyana gas field, which is located c.6.5 km to the west of the SBPCL II Power Plant. This region has complex hydrodynamics, with tidal influences reversing the direction of flow in the river channel and shifting the river course. Monsoon floods and flash floods occur in the lower parts of the project area. The Bangladesh Water Development Board has constructed an embankment on the banks of the river adjacent to the Project Site, to protect agriculture from flood damage. This embankment, which is also used as village roads by local transport, is elevated to 9 meters above sea level (m asl) and acts as a barrier to normal floods against inundation of the project site.

Map 1: Location of the Project Site



The SBPCL II Power Plant will employ multi-shaft combined cycle technology based on two gas turbine generator units and one steam turbine generator unit, each having a separate power connection to the grid. The gas turbines will have a capacity of about 222 MW while the capacity of the steam turbines will be 119 MW with gross efficiency of 34%

The majority of the Project Site is situated at an elevation of 7.8 m above sea level (asl) and the elevation of the highest recorded flood is 10.15 m asl. Therefore, to protect the Project Site from floodwater, the proposed final elevation of the plant area is designed to be 11.2 m asl (i.e. municipalities above the highest recorded flood, as per the RFP issued by BPDB).

4. Assessment Methodology

In designing and building large infrastructure projects, investors and engineers utilize safety margins to factor an acceptable level of risk into project design— freeboards are included in flood protection works, ranges of variability are built into operating processes, and performance curves are developed for particular infrastructure components. This characterization of risk is fundamental to plant management as it aims to achieve an appropriate balance between ensuring a desired level of safety, optimizing performance, and minimizing the cost of investment. Generally, larger safety margins will entail larger cost. Methods such as hydro-economic analysis and composite risk analysis are used to optimize the capital cost and the risk of failure from extreme events, forecast the current and future demand on plant infrastructure, and defines plant capacity within the acceptable level of risk (Chow et al. 1988).

The characterization of risk for large infrastructure relies on detailed statistical analysis of historic time series data to understand relevant hydro-geophysical conditions and set key design parameters (such as ambient temperature, maximum water levels, and earthquake incidence). In the long term, some of these parameters may change in response to climate change—affecting the performance of the plant, the cost of maintenance, and the life of plant components.

The rapid assessment methodology utilized in this study adapts the International Centre for Environmental Management (ICEM 2011) climate change adaptation and mitigation methodology (CCAM) to characterize the threat, assess the plant's vulnerability, and recommend priority areas for adaptation response to climate change over the plant's design life. At the core of this approach are four key principles:

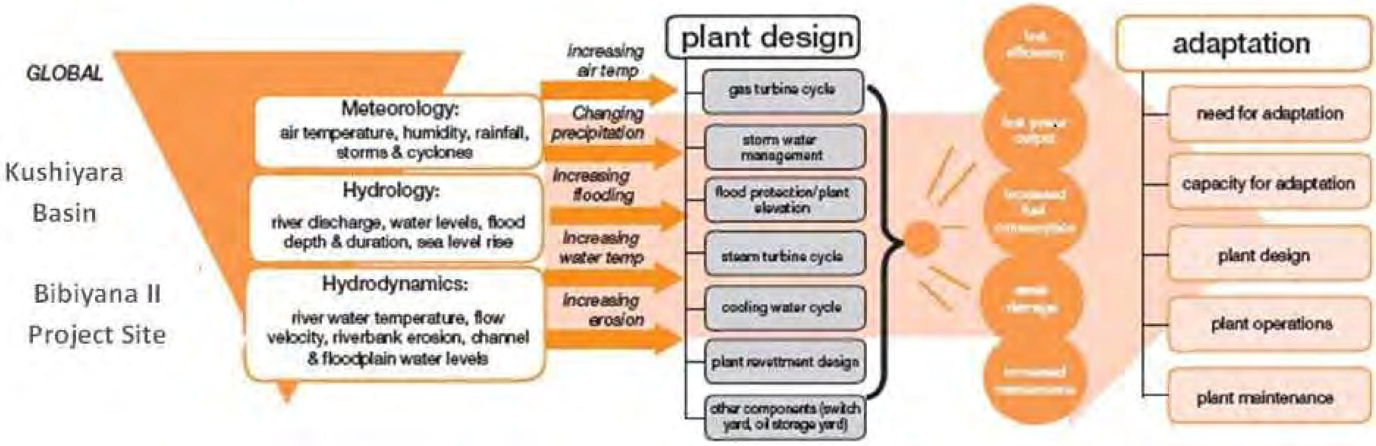
- Confidence in impact: Direct threats are those that inform a key design parameter of the plant and for which changes in trends for that parameter can be quantified with confidence.
- Identification of uncertainty: Acknowledging the uncertainty in projected climatic conditions can improve understanding of likely exposure and build confidence in assessment findings.
- Comparable methodology: Where possible, similar methodologies can be employed in the study as those used by design engineers to set the design parameters.
- Phasing response: The impacts of climate change on a power plant may extend over the entire plant life. Some adaptation measures may be required or are best implemented at the design phase. Other measures may be introduced at a later time. To this extent,

adapting to climate change involves not only selecting adaptation measures, but also identifying the timing of implementation of these measures.

Outlines the conceptual approach to this climate change assessment is:

- Approach to Threat Analysis: The main objective of the threat analysis is to define and quantify the changes in spatial–temporal dimensions of climate variability. This includes the changes in incidence, magnitude, and duration of hydro-meteorological events.

Figure: 17 Conceptual Framework of the Climate Change Rapid Threat and Vulnerability Assessment



- Approach to Vulnerability Analysis: The vulnerability assessment combined aspects of conventional engineering feasibility assessments with life cycle analysis. It relied on two assessment phases: (i) the sensitivity of the plant design to climate variability and (ii) the combination of the quantified direct threat and plant sensitivity to determine the impact over the design life.
- Approach to Adaptation Scoping: Once the magnitude of the impact and the need for adaptation were understood, a rapid assessment was made of the adaptive capacity of the plant's design, and priority areas of response were identified along with a number of corresponding potential adaptation options. These adaptation options are intended to establish the framework for comprehensive adaptation planning.

5. Assessing Vulnerability to Climate Change

Five potential threats (shown in figure below) can be identified as being of greatest significance. The nature of exposure and impact of these threats varies. Some, like air and river water temperature, threaten day-to-day performance of plant operations, while precipitation and flooding can affect maintenance schedules and downtime. Erosion and flooding were identified as the two potential threats that could damage planned infrastructure.

Figure 18: Potential Threats

Direct climate threat	Potential sensitivity of a power plant
Air temperature	Gas turbine cycle performance
River water temperature	Steam turbine cycle + coolant water cycle performance
Direct precipitation	Performance of gravity-driven stormwater management
Flood depth + Duration	Asset damage + plant downtime
Erosion	Asset damage

Following the CCAM methodology, direct threats were characterized and linked to associated plant components or processes. In this way, the vulnerability of the plant is specific to the prevailing hydro-physical environment of the site and the specific parameters and design specifications.

This section focuses on assessing the vulnerability of the proposed power plant to changes in air and river water temperature.

A. Changes in Air Temperature

1. Quantifying Future Air Temperature:

The historic average annual ambient air temperature is 25°C at Bibiyana and the designed temperature for SBPCL II Power Plant is 32°C. The data indicate that there is little monthly or seasonal variation in average daily temperatures, with a slight seasonal reduction in the order of 1 to 2 degrees during the wet season when cloud cover inhibits solar radiation, and a peak in temperature at the end of the dry season. The projection estimates that the increase in temperature will be 2.1°C in 2050.

Table 3: Key Features of the Climate Modeling Approach

General Circulation Model ID	GCM Source	Downscaling Methodology	Source of Downscaled Data	Baseline Time-Slice	Future Time-Slice	IPCC SRES Scenario
ccma_cgcm3_1	Canadian Centre for Climate Modeling and Analysis	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
cnrm_cm3	Meteo-France, Centre National de Recherches Meteorologiques	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
csiro_mk3_0		Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
csiro_mk3_5	Australian Commonwealth Scientific & Industrial Research Organisation	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
gfdl_cm2_0	NOAA Geophysical Fluid Dynamics Laboratory	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
giss_model_e_r	NASA Goddard Institute for Space Studies	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
ipsl_cm4	Institut Pierre Simon Laplace	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
mpi_echam5	Max Planck Institute of Meteorology (Germany)	Statistical/ empirical	CSAG	1961–2000	2045–2065 (Future A)	A2
		PRECIS (dynamic)	SEA START	1980–2000	2036–2045	A2, B2

CSAG = Climate Systems Analysis Group, GCM = general circulation model, IPCC = Intergovernmental Panel on Climate Change, NOAA = U.S. National Oceanic and Atmospheric Administration, SRES = Special Report on Emissions Scenarios, SEA START = Southeast Asia Global Change System for Analysis, Research & Training Centre

For the purpose of validation, GCM model outputs were compared with observed historical data that is available for Bibiyana (~20km from the Project Site).

However, the intra-daily variability in temperatures means that the design temperature is regularly exceeded for short periods of the day. The selection of the design temperature reflects an optimization of plant productivity and operational and capital costs based on historical conditions. A higher design temperature would require greater capital costs as components would need to be redesigned, while a lower design temperature would adversely impact plant production.

To explore the climate change impacts on the plant, the selected GCM outputs can be analyzed for minimum, maximum, and average daily temperature. The daily time-step can be chosen so that detailed temperature distribution profiles could be developed for typical years under baseline and climate change conditions.

2. Assessing the Potential Impacts of Increased Air Temperature for SBPCL II Power Plant

For combined cycle gas turbine plants, power output and energy efficiency decrease as air temperature increases. This is because an increase in air temperature reduces air density and the mass flow of air intake to the compressor, and creates a similar reduction in heat transfer efficiency of the air cooling system.

The historic average annual ambient air temperature is 25°C at Bibiyana and the designed temperature for SBPCL II Power Plant is 32°C. The data indicate that there is little monthly or seasonal variation in average daily temperatures, with a slight seasonal reduction in the order of 1 to 2 degrees during the wet season when cloud cover inhibits solar radiation, and a peak in temperature at the end of the dry season. The projection estimates that the increase in temperature will be 2.1°C in 2050.

For plant operations, the variability in daily temperatures together with the longer-term monthly averages defines the design air temperature. The SBPCL II project is designed for an ambient air temperature of 32°C. This design temperature is on average 4.9°C above the long-term average of 2050.

B. Changes in Water Temperature

1. Quantifying Future Water Temperature:

The direct impact of climate change to the intake water temperature for the once-through cooling system is to increase water temperature through greater heat exchange between a warming atmosphere and the river system.

The design water temperature for SBPCL II Power Plant is 28.5°C. Assuming, the temperature difference between ambient air and surface water is 4°C. So, by 25 years period in 2050, the water temperature is projected to be 32.5°C, which significantly higher than the design temperature.

It should be noted that the temperature variation is expected to be higher because of varying wind conditions and ambient water temperature. The main impacts of climate change on the river water temperature include:

- 3–6% increase in the range of intake water temperatures during average years;
- 5–10% decrease in the range and variability of intake water temperatures during extreme/wet years;
- increase in the average intake temperature of 3.5°C–4.0°C, with a higher projected temperature increase in the dry season, which can have significant consequences for plant efficiency and reliability;

6. Setting Priorities for Adaptation for SBPCL II Power Plant

Preliminary Scoping of Adaptation Options:

This section provides a scoping of potential technological and management solutions, providing comments on their suitability for SBPCL II Power Plant.

1. Rising Air Temperature

As the air temperature (27.1°C) is projected to be below by 4.9°C than the design air temperature (32°C) for 25 years period of 2050, it is expected that there will no significant consequences due climate change for SBPCL II Power Plant.

There are general options for adaptation for rising air temperature:

- **Customize turbine technology:** The fabrication of gas turbines is typically customizable to each project, as manufacturers are able to alter generic products to better suit design specifications. An effective adaptation response may be to redesign the gas turbines to accommodate the expected effects of climate change.
- **Install inlet air cooling:** This option attempts to reverse the climate change trend of increasing air temperature by adding a cooling process before use. The two most common options for inlet cooling in gas turbine applications are evaporative coolers and refrigeration chillers.
- **Upgrade the compressor:** A third adaptation option is to compensate for the reduced air density by increasing the flow rate, as this can maintain the design mass flux. This can be achieved by upgrading the compressor to a larger model.

2. Rising River Water Temperature

The rise in water temperature for SBPCL II is assumed as 4°C and by 25 years period in 2050, the water temperature is projected to be 32.5°C, which significantly higher than the design temperature. Increasing river water temperature has a significant influence on the efficiency of the steam turbine and power output. A number of adaptation options are available, including the following:

- **Use a free-cooling option:** Free-cooling systems are non-refrigerated cooling systems that rely on a nearby heat sink as a source of cooling.
- **Upgrade the heat exchanger:** Increasing the size of the heat exchanger would allow greater surface area contact between condensate and coolant, improving the performance of the cooling water process.

- **Increase flow rate:** Increasing flow rate at the cooling water pumps would pass a greater mass of fluid through the exchangers, increasing heat transfer capacity. This could be done through a number of different alterations to the cooling water pumping system.
- **Retain the existing pump design and open the throttle**
- **Add a backup pump unit**: An alternative option, offering greater flexibility while still adhering to the original design, is to add another smaller pump to the cooling water system.
- **Convert to hydro-coupling**
- **Revise management of coolant discharge:** Coolant feedback at the water intakes exacerbates the impact of increased river water temperature induced by climate change. Performance of the bottoming cycle could be improved by reducing the proportion of coolant waters entering at the water intake.
- **Redesign the intake**
- **Redesign the discharge structure:** Effective adaptation options for coolant management at discharge include those that (i) increase coolant temperature drop in the conveyance channel prior to intercepting the Kushiyara River, (ii) increase mixing of coolant into the Kushiyara River water column, or (iii) increase the distance between the discharge outlet and the intakes.
- **Improve the discharge channel:** Downstream of the discharge channel, the river channel widens considerably.
- **Increase retention time in the discharge channel**

3. Flash Flood

Potential adaptation measures for flash flood are described below:

- **Flood forecasting system:** Improvement of the existing flood forecasting and early warning systems by increasing lead times and strengthening dissemination mechanisms.
- **Flood management infrastructure:** Effective management and up gradation of existing flood management infrastructures such as polders, embankments, sluices, pump stations and construction of additional one.
- **Flood Evacuation shelters**: Establishment of multipurpose shelter more as well as there should be ensure proper management of this infrastructure

4. Riverbank Erosion

Potential adaptation options for River erosion:

- Proper construction of embankments with iron sheet and spurs
- Strengthen the banks other than using riprap
- Construction of polders with sacks, concrete blocks, articulated concrete mattresses and soil cement
- Construction of Windrows and Trenches
- Construction of Retaining Walls such as Gravity Walls, Cantilever Walls and Sheet-Piling Walls

5. Phasing in Adaptation Responses

Entry points for adaptation arise at different stages of the project time line. Ideally, adaptation planning should be initiated at the feasibility/design phase of a project because this allows for the greatest capacity for integration. However, adaptation entry points also exist at later stages in the project, including the construction and operations phases. The following potential adaptation entry points have been identified in the context of power plant projects:

- Investment in planning phase
- Gas turbine replacement
- Major equipment replacement
- Refurbishment and lifetime extension

Comprehensive adaptation responses for SBPCL II Power Plant could be phased to synchronize with these entry points. For example, adaptation to increasing river water temperatures could be phased using the above entry points. This would allow sufficient time for studies required for optimal selection of adaptation options.

7. Conclusions and Recommendations

Through an overall rapid estimate of potential costs, and the scoping of adaptation options, it is likely that some climate change impacts can be mitigated through the appropriate phasing of adaptation responses.

The magnitude of performance impacts on the bottoming cycle are half the magnitude of the topping cycle, but the variety and relative simplicity of adaptation options prove attractive for adaptation. There are three groups of adaptation options for improved performance of the bottoming cycle: (i) reducing the intake water temperature, (ii) increasing the performance of the cooling water system pumps and heat exchangers, and (iii) improving management of the coolant discharge plume.

The analysis reveals that in order not to violate existing environmental standards in Bangladesh and to avoid adverse impacts on power generation, retrofitting additional equipment (such as a cooling tower) may be required in the future (assuming that actual temperatures fall within the range of current projections). Such retrofitting will require that space be available in proximity to the power plant for the installation of the equipment. Hence, while such investment may be postponed, it is advisable to ensure that the needed space will be available if indeed such an investment proves necessary. Adaptation approaches of this nature have been referred as “climate readiness,” indicating that while climate proofing may not be recommended today, a cost-effective course of action may be to ensure that the investment (the project) is ready for adaptation in the future.

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