

Environmental Impact Assessment

October 2015

BAN: Power System Expansion and Efficiency Improvement Investment Program (Tranche 3) Ashuganj 400 MW Combined Cycle Power Plant (East)

Prepared by Ashuganj Power Station Company Limited (APSCL) for the Asian Development Bank. This is an updated version of the draft EIA posted in June 2015 available on <http://www.adb.org/projects/documents/ashuganj-400mw-ccpp-east-eia>

CURRENCY EQUIVALENTS

(as of 9 Sep 2015)

Currency unit	–	taka (Tk.)
Tk. 1.00	=	\$.01
\$1.00	=	Tk. 77.52

ABBREVIATIONS

ADB	–	Asian Development Bank
AECL	–	Adroit Environment Consultants Limited
APSC	–	Ashuganj Power Station Complex
APSCL	–	Ashuganj Power Station Company Limited
BBS	–	Bangladesh Bureau of Statistics
BMD	–	Bangladesh Meteorological Department
BPDB	–	Bangladesh Power Development Board
BWDB	–	Bangladesh Water Development Board
CCPP	–	Combined Cycle Power Plant
DOE	–	Department of Environment
ECR	–	Environment Conservation Rules 1997
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
GIS	–	Geographic Information System
GOB	–	Government of Bangladesh
GPS	–	Global Positioning System
GTG	–	Gas Turbine Generator
HRSG	–	Heat Recovery Steam Generator
IEC	–	Important Environmental Component
IEE	–	Initial Environmental Examination
LGED	–	Local Government Engineering Department
MMSCFD	–	Million Metric Standard Cubic Feet per Day
NEMAP	–	National Environment Management Action Plan
NGO	–	Non-Government Organization
NWMP	–	National Water Management Plan
PGCB	–	Power Grid Company of Bangladesh
REB	–	Rural electrification Board
SRDI	–	Soil Resource Development Institute
ST	–	Steam Turbine
TOR	–	Terms of Reference
UNDP	–	United Nations Development Programme

WEIGHTS AND MEASURES

°C	–	degree Celsius
dB(A)	–	decibel acoustic
GWh	–	giga watt hour
ha	–	hectare
km	–	kilometer
km/h	–	kilometer per hour

kWe	–	kilowatt-electric
KV	–	Kilo volt(s)
KVA	–	kilo Volt-Amps
m	–	meter
mm	–	millimeter
m ³	–	cubic meter
m ³ /hr	–	cubic meters per hour
mg/l	–	milligrams per liter
m/s	–	meters per second
MTPA	–	metric tons per annum
MW	–	megawatt
ppm	–	parts per million
ppt	–	parts per thousand
Rpm	–	revolutions per minute
µg/m ³	–	microgram per cubic meter

GLOSSARY

Adverse impact	–	An impact that is considered undesirable
Ambient air	–	Surrounding air
Aquatic	–	Growing or living in or near water
Bangla	–	Bengali language
Baseline (or existing) conditions	–	The ‘baseline’ essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the project, i.e. the ‘No-development Option’.
Bazar	–	Market
Beel	–	A ‘back swamp’ or depression can be either perennial or seasonal.
Beneficial impacts	–	Impacts, which are considered to be desirable and useful.
Biological diversity	–	The variety of life forms, the different plants, animals and micro organisms, genes they contain and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecological diversity.
Char	–	Newly accreted land: Land, sometimes islands, within main river channels and nearby mainland or in the estuary, subject to erosion and accretion
Ecosystem	–	A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit
Emission	–	The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source.
Endangered species	–	Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among those are species whose numbers have

	–	been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from immediate danger of extinction.
Environmental effects	–	The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity
Environmental Impact	–	An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors
Environment Management Plan (EMP)	–	A Plan to undertake an array of follow-up activities which provide for the sound environmental management of a project/ intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured.
Environmental Management	–	Managing the productive use of natural resources without reducing their productivity and quality
Erosion	–	Process in which wind and water removes materials from their original place; for instance, soil washed away from an agricultural field.
Evaluation	–	The process of looking back at what has been really done or accomplished.
Fauna	–	A collective term denoting the animals occurring in a particular region or period
Field Reconnaissance	–	A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal.
Flora	–	All of the plants found in a given area
Habitat	–	The natural home or environment for a plant or animal
Household	–	A household is identified as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit having separate cooking arrangements constitute separate household.
Important Environmental Component (IEC)	–	These are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment.
Khal	–	Small Channel, canal
Land use	–	Types include agriculture, horticulture, settlement, pisciculture and industries.
Mauza	–	A Bangla word for the smallest government administrative area corresponding to village revenue unit.
Mitigation	–	An action, which may prevent or minimize adverse impacts and enhance beneficial impacts.
Negative Impact	–	Negative change from the existing situation due to the project.
Public involvement/Public consultation	–	A range of techniques that can be used to inform, consult or interact with stakeholders' affected / to be affected by a proposal.
Reversible impact	–	An environmental impact that recovers either through natural process or with human assistance (e.g. cutting off fish migration by an embankment might be reversible at a later stage if a proper regulator is built).
Stakeholders	–	Those who may be potentially affected by a proposal, e.g.

		Local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the project or to take an interest in it.
Taka	–	Unit of Bangladeshi currency
Terrestrial	–	Living on land
Thana	–	Sub-district level of government administration, comprising several unions under district
Union	–	Smallest unit of local self government comprising several villages
Upazila	–	Sub-district name. Upozila introduced in 1982
Zila	–	Bengali word of district

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EXECUTIVE SUMMARY

1. Introduction

This report represents the results of Environmental Impact Assessment (EIA) of **Ashuganj 400 MW Combined Cycle Power Plant (East)** at Ashuganj, Brahmanbaria. To provide access to affordable and reliable electricity to all by 2021 as well as to comply with the policy of Government of Bangladesh (GOB) and to increase the efficiency on natural gas based power plants, APSCL intends to construct a new 400 MW Combined Cycle Power Plant beside its old plant premises. **Ashuganj 400 MW Combined Cycle Power Plant (East)** project is a natural gas fired power generation plant with rated capacity of 400 MW. The proposed area of the plant is located inside Ashuganj Power Plant Complex and the plant is going to replace an old inefficient plant, unit 3 (150 MW) with an energy efficient 400 MW Combined Cycle Power Plant at site of existing GT-1, ST, and GT-2 units (146 MW CCGT) which has already been retired. The authority has applied for the Environmental Site Clearance Certificate from Department of Environment (DoE) by submitting the IEE and other documents. The **Ashuganj 400 MW Combined Cycle Power Plant (East)** project shall be implemented by ADB & IDB Co-financing. The objective of this study is to provide an examination and assessment of the major environmental & social impacts to be created due to the project activity during its construction and operation phase. The study will also focus on the suggesting the possible mitigation measures for any adverse impacts and a management & monitoring plan to evaluate the affectivity of the mitigation measures.

This EIA report comprises 12 sections and the contents of these sections are summarized below.

2. The Project

Electricity generated in the power plant will be supplied to the 230 KV National Grids. The natural Gas supply system of Bakhrabad Gas Distribution Company Ltd. in the area will be used for the supply of natural gas to the proposed plant from the nearest District Regulating Station (DRS) at Ashuganj. The basic information of the project are given below:

1. Name of the Project	Ashuganj 400 MW Combined Cycle Power Plant (East)
2. Sponsoring Ministry/ Division	Ministry of Power, Energy and Mineral Resources (Power Division)
3. Executing Agency	Ashuganj Power station Company Limited (APSCL)
4. Project Location	Ashuganj, Brahmanbaria, Bangladesh.
5. Location of the Proposed Plant	Existing land inside APSCL Compound in place of existing unit GT-1, GT-2 & ST
6. Type of Project	Combined Cycle power plant

7. Raw Materials	The main raw material of the project is natural gas.
8. By-product, if any	None
9. Net Plant Capacity	400 MWh of Electric Power
9. Annual Production	2924.71 GWh at 85% Plant Factor
10. Project Cost	388.96 million USD (1 USD= 77.63 BDT)
11. External Finance	82% Foreign Currency by International lender
12. Internal Finance	18% GoB & APSCL
13. Total Area of Land	The power plant will be located inside Ashuganj Power plant complex and Ashuganj Power Station Company Ltd lease land.
14. Total Developed Land	4.30 acres
15. Employment	91 person(approximately), Admin – 5, Production – 85, Env. - 1
16. Fuel Requirement	Natural Gas Source: Petrobangla, Distributor: Bakhrabad Gas Distribution Company Ltd.
17. Water Requirement & Source of Water	28,500 m ³ /hr, Source: Meghna River.
18. Quantity of Discharge Water	28,500 m ³ /hr , water discharge
19. Term of the Project	25 years

The proposed power plant will be located inside Ashuganj Power plant complex and Ashuganj Power Station Company Ltd land at Ashuganj, Brahmanbaria, Bangladesh. The project site lies in the geospatial reference of 24°2'40.43"N & 91°1'1.55"E at the location of the existing GT-1, GT-2, ST and Fuel Tank. All these plant altogether covers total land of 4.30 acres. This land will be sufficient for the proposed 400 MW combined cycle power plant. The project comprise of one 289MW (ISO rated) gas turbine, a heat recovery boiler and a 135 MW steam turbo-generator along with some ancillary facilities, as water treatment plant, demineralized water treatment (reverse osmosis) etc. to support the main equipment of the project.

3. Policy and Legal Considerations

This EIA report has been prepared by following the methodology prescribed in the EIA guidelines for industries of DOE, ECA95 and ECR97, that are the main legislative documents relating to environment protection in Bangladesh. The report is also compliant with ADB's Environmental Safeguard Framework and WB group's operational policies and guidelines. Steps to consult potentially affected people by the project and to disclose the EIA report to the public have been taken for compliance with the Bank's policies of the EIA preparation, although these are non-mandatory as per national legislations. The environmental classifications for industrial projects in Bangladesh are based on "inclusion lists" given in the ECR97 with 'RED' being the

highest category. Power Plant is listed in the '**Red Category**' in ECR97 (i.e., serial no.6 in the ECR97 Red list in Schedule-1.). According to ADB environmental classification, the project falls under Category-A.

4. Baseline Environment

Baseline environment is concerned with existing physical, chemical and biological conditions of the area where the plant is going to be set up. The surface water, ground water, ambient air quality and noise level have been analyzed to evaluate the primary baseline of the area. The data from the monthly monitoring data of proposed APSCL 450 MW south have also been used to evaluate the monthly concentrations of PM_{2.5} and PM₁₀ in the project area.

In the vicinity of the plant, the main surface water body is the river Meghna at 440 m from the site. The quality of the river water has been analyzed and found satisfactory. Ground water level exists at a moderate (Generally below 8.0 m) depth in the area. Water from underground source, which is assumed to be available as because most of the period of the year the area remains under water and there is a canal passing by the side of the site. That means the recharge capacity of the ground water level seems to be adequate. In common with other peri-urban or rural areas; birds like Crow, Salik, Chorui, doel, ghughu, Kokil, etc are seen at times at the project site. There are no wildlife, natural forest and vegetation, endangered species of present in and around the plant site. There are a number of different types of trees like coconut, jack fruit, mango, mehogoni, krisnochura etc. around the plant site.

The climate of the region is of tropical monsoon type. According to Bangladesh Meteorological Department, the maximum temperature of 2013 at project site is 35.6° C in June & July and minimum temperature is 5.3 °C in January. Mean relative humidity for an average year (2013) is recorded as 79% and on a monthly basis; it ranges from 68% in February to 85% in August. At normal times, the maximum and minimum wind speeds at Brahmanbaria are 3.2 Knots/hr and 2.0 Knots/hr respectively in 2013. The rainfall is mostly confined in the monsoon season i.e., between May to October. Maximum rainfall in May 2013 is 467 mm and 0 mm from Nov-Feb respectively.

The data from the DOE CAMS (continuous air quality monitoring stations) is not available near the project area; So, to establish a realistic baseline air quality, AECL has undertaken a 24 hours air monitoring for one day and used AECL's previous air quality data for one year has been carried out for APSCL 450MW (south) which shows that the parameters are exceeding the NAAQS (National Ambient Air Quality Standards) for SPM due to the fact that huge construction work is going on for the new power plants in the Ashuganj Power Station Company Ltd complex. The baseline levels for other criteria pollutant i.e., CO, NO₂ and SO₂ are compliant with NAAQS. Baseline noise levels measured during the study period around the plant site were found to be above 70dBA in few places. The reason for the higher ambient noise level

is caused by the existing gas engine based power plants located adjacent to the project and the construction work of 225 MW combined cycle power plant. Since there is no homestead within the 100m radius of the proposed project, so, the noise emission from the project would not create any harm to the neighboring community.

5. Potential Impacts of the Proposed Project

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

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

6. Prediction and Evaluation of Impacts

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

As explained above, the main potential environmental impacts, which may arise as a result of construction of the power plant, can be grouped as follows: (i) Atmospheric emissions and Air quality, (ii) Noise generation, and (iii) Water pollution and waste

water disposal. These aspects have been examined and the findings are summarized below.

Atmospheric Emission and Air Quality: Emission of Nitrogen Oxides is the major concern of air pollution for the project. The Heat recovery Steam Generation (HRSG) system which produces steam by using the waste heat from the Gas turbine will reduce the exhaust heat temperature from 558⁰C to 90⁰C. To evaluate the ground concentration of the above emissions to the surrounding environment, an emission dispersion modeling (USEPA approved AERMOD 9.9.8 model) has been done and the result shows that all the criteria pollutants will be within the Bangladesh NAAQS and Bank group's (i.e. IFC).

Noise: The gas turbine and the steam turbine will have internal noise level of around 70 dBA which will be minimized by sophisticated acoustic power house building design so as to minimize the noise up to standard. The heat recovery steam generator stack will emit a noise level of 70 dBA after providing the silencer. To reduce the effect, most costlier and effective Critical Type Silencer will be used in the stack. In particular, significant noisy components such as the gas turbine sets are enclosed in buildings acoustically designed, providing Styrofoam filler of 50 mm width in between 300 mm thick brick walls around the power house building. Moreover, thick doors are provided and holes which may create sound pollution are sealed with sound proof materials. Vibration pad will also be used at the bed of all power generation units to prevent the vibration. The stack noise emission dispersion has been predicted by means of noise impact modeling. It is observed from the noise emission modeling that the max noise level within the 20m radius is 29.37 dBA.

The resultant noise calculation with the ambient noise level shows that the noise level after 100m from the power plant will not affect the ambient noise level of the area, so, there would not create any noise problem due to the power plant to the nearest settlement.

Liquid Discharge: It is estimated that 7.91 m³/sec of river water would be drawn from the intake of the proposed 400 MW CCPP project discharged at 7⁰C rise in temperature is at the condenser discharge point, while the water will be discharged back to the river with less than 3 degree rise in temperature may not have any significant impact on river water temperature. However, immediately after vicinity of the discharge point, due to instant mixing with equal/mass of water, the temperature will rise will be lower. At the long and down the river the temperature will reduce to almost initial river water temperature. The proposed power plant will have to share a new and modern water treatment plant with 225 MW Combined Cycle Power Plant unit under implementation with facilities to produce demineralized water, service water and potable water. The domestic liquid wastes would be disposed through a septic tank system. The surface drainage network would be connected with an interceptor prior to discharge to surface drainage system.

7. Environmental Management Plan (EMP)

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

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

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

8. Emergency Response and Occupational Health & Safety

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

The plant management will prepare an occupational health safety policy manual which

should be updated from time to time. The policy should be signed and dated by the Chief Safety Officer who may be the Plant Manager. The policy should be discussed with all the plant personnel. The Chief Safety Officer should periodically review the policy and re-issue the policy.

9. Alternative Analysis

The 'No Build' alternative in the present case would mean continued power deficiency, in the face increasing demand for industrial and economic growth which leads to poverty reduction. So, the 'No build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such a project far outweigh the adverse impacts, all of which can be controlled and minimized to an acceptable level.

The project site was owned by Ashugonj power Company Ltd, which was vacant thus involved no resettlement issues. After analysis various possible alternatives, this EIA finds the plant's environmental impacts at the selected site are acceptable if the management procedures delineated are properly implemented. Therefore, the site has been considered suitable for the plant.

10. Stakeholder Consultation and disclosure

Stakeholder consultations are very important and sensitive issues for setting up a new industry in any area of Bangladesh. The process was initiated with an open objective to ensure people's participation right from the planning stage of the project. More specially, this was aimed at improving the study taking into account opinions from the people of the impacted area. Meetings with stakeholders consisted of community consultation meetings, focus group discussions, and in-depth interviews with men and limited focus-group discussions with women. There was one stakeholder meeting organized at project office near the site on 30.04.2015 by verbal notice and paper advertisement. The advertisement was published in the two national daily newspapers in Bangla and English. Another in-depth interview with local fishermen were carried out on 1st July, 2015 at bazars and Meghna ghat. The consultation process was carried out in the Bangla languages. During these meetings a simple, non-technical, description of the project was given, with an overview of the project's likely human and environmental impact. The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were considered as a good gesture and appreciated, by the men and women. The stakeholders' consultation process will be continued in the operation phase of the plant, so that issues of public concern can be addressed.

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

11. Grievance Redress Mechanism

The Project Management has established a procedure to answer to project-related queries and address complaints and grievances about any irregularities in application of the guidelines adopted for assessment and mitigation of environmental safeguards impacts. The complaints related to plant operation that may create inconveniences to agency/individual should be addressed based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time-consuming legal actions. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRC will record the details of the complaints and the reasons that led to acceptance or rejection of the particular cases. The GRC will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by appropriate authority, WB and any organizations known to be working with urban development issues. However, it should be noted that the GRC process will not pre-empt and aggrieved person's right to seek redress in the courts of law.

12. Conclusion and Recommendations

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

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

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

Given the proponent's commitments, actions undertaken for further measures to be adopted in due course of time as required, the **Ashuganj 400 MW Combined Cycle Power Plant (East)** is going to be a nationally important and environmentally sustainable industrial venture.

Chapter-1

CHAPTER ONE: INTRODUCTION

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Power and energy are vital factors that determine the growth path of a developing country like Bangladesh whereas; electricity is the major source of power for country's most of the economic activities. Consistent supply of power and energy can ensure development of the economy. Bangladesh is still at a very low level of Electrification. The government of Bangladesh has declared its vision 2021 to provide electricity for all. Power Sector Master Plan 2010 (PSMP-2010) has been undertaken to accommodate the govt.'s vision 2021, According to PSMP study the electricity demand would be 34,000MW by the year 2030. The aggregated investments for the development of the generation, transmission and related facilities are found to be at Taka 4.8 trillion (US\$ 69.5 billion). The annual average of the investment amounts to Tk. 241 billion (US\$ 3.5 billion). The government fully recognizes the fact that public sector investment alone is not sufficient to achieve its target and has aimed at mobilizing resources from the private sector investments.

According to Bangladesh Power Development Board (BPDB) presently the installed generation capacity as on May 2015 in the power sector is 11,203.00 MW. According to a demand projection analysis, the peak electricity demand is 10,283 MW in 2015 and 11,405 MW in 2016. The per capital electricity consumption in Bangladesh remains one of the lowest in the Asian region, At present, only about 68% of the total population (including renewable energy) has access to electricity and per capita generation(is 348 kWh, which is very low compared to other developing countries. To alleviate poverty in the face of resource limitations and high population density, Bangladesh requires an economic growth rate of more than 7% p. a. In order to achieve this growth rate, electricity growth needs to be achieved by 10%. So, the generation of electricity should be increased for the following years to fulfill the upcoming increasing demands. PDB has undertaken studies to project the electricity demand over the next 20 years up to 2030 under the Power System Master Plan Study 2010. According to the study the total demand would reach 34,000 MW assuming a 7% GDP growth over the time period while according to plan, the generation capacity would be about 40,000 MW. Now the biggest challenge for Bangladesh's economic growth is to ensure uninterrupted electricity supply to reduce the demand- supply gap for the growing industrial, agricultural and household needs.

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

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

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

Responding to the need of the country, now the **Ashuganj Power Station Company Ltd. (APSCL)**, one of the largest power stations in Bangladesh is going to implement a project named “**Ashuganj 400 MW Combined Cycle Power Plant (East)**”. It is going to replace an old inefficient unit [Unit#3 (150 MW) plant] with an energy efficient 400 MW Combined Cycle Power Plant at the site of existing GT-1, ST, and GT-2 units (146 MW CCPP) which has already been retired.

The **Ashuganj 400 MW Combined Cycle Power Plant (East)** project shall be implemented by ADB & IDB Co-financing.

1.2 POWER GENERATION PLAN OF THE GOVERNMENT

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

Table 1.1 Plants Commissioned During 2009 – December 2013 in MW

YEAR	2009	2010	2011	2012	2013	TOTAL
Public		255	800	607	587	2249
Private	356	520	963	344	76	2259
Power Import					500	500
Total	356	775	1763	951	1163	5008

* From January to June 2014: Total 407 MW of capacity Power Plants commissioned

(Source: Ministry of Power, Energy and Mineral Resources, 2014)

Table 1.2 Calendar Year Wise Generation Addition program (From 2014 to 2018) In MW

YEAR	2014	2015	2016	2017	2018	TOTAL
Public	225	1293	1475	2131	1320	6444
Private	1024	1218	1014	640	630	4526
Total	1249	2511	2489	2771	1950	10,970

(Source: Ministry of Power, Energy and Mineral Resources, 2014)

Natural gas is the major source of fuel used for power generation (66.71%) with furnace oil being the next (17.75%). Although coal is available in Bangladesh, due to the huge cost of extraction and processing, use of coal in power generation has not yet been more widespread (Table 1.3).

Table 1.3 Power Generation Units (Fuel Type Wise)

Installed Capacity of BPDB Power Plants as on May 2015			
Unit Type	Capacity(Unit)		Total (%)
Coal	250.00	MW	2.17 %
Gas	7723.00	MW	67.01%
FO	0.00	MW	0.00%
HFO	2034.00	MW	17.65%
HSD	789.00	MW	6.85 %
Hydro	230.00	MW	2.00 %
Imported	500.00	MW	4.34 %
Total	11526.00	MW	100 %
Derated Capacity of BPDB Power Plants as on May 2015			
Unit Type	Capacity(Unit)		Total (%)
Coal	200.00	MW	1.90 %
Gas	6835.00	MW	64.91 %
FO	52.00	MW	0.49%
HFO	1993.00	MW	18.93 %
HSD	720.00	MW	6.84 %
Hydro	230.00	MW	2.18 %
Imported	500.00	MW	4.75 %
Total	10530.00	MW	100 %

(Source: BPDB, 2015)

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

There is no alternative than to add more power generating units to the existing power system of Bangladesh within the shortest possible time frame. The urgency is not only because of the ever-increasing demand for electricity but also due to the fact that many of our existing power generating units are nearing the end of their life cycle. It is necessary to add both base-load and peaking plants to the system, so that the whole system can run economically and efficiently. The proposed 400 MW combined cycle power plant at Ashuganj Power Station Complex would certainly help the cause.

1.3 OBJECTIVES OF EIA STUDY

This report presents the finding of an Environmental Impact Assessment (EIA) of the project namely **“Ashuganj 400 MW Combined Cycle Power Plant (East)”**. The proposed plant will be located at Ashuganj, Brahmanbaria inside the Ashuganj Power Station Complex at the site of existing GT-1, ST, and GT-2 units (146 MW CCPP). The objective of the study is to provide an examination and assessment of the principal environmental impacts of the proposed plant. The outline of an environmental management plan also suggested with an indication of the extent of work to be done to keep the development and environment compatible. In this context, it should be noted that the term “environment” and its derivatives have been used in a wide sense, which covers not only physical and chemical aspect, but also the human dimension. The specific objectives of this EIA are to:

- Present a brief discussion on the EIA process and its role in the planning and implementation of development projects;
- Present a general description of the project and the process;
- Present a description of the pre-project environment;
- Delineate the significant environmental issues found and believed to be involved;
- Identify the environmental impacts of the project and quantify them to the extent possible;
- Suggest the plan for management of the environment, during the implementation and operation of the plant.

1.4 STUDY METHODOLOGY

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

- Undertaking a field survey toward collection of primary Baseline Social and

Environmental information and data pertaining to the project area;

- Collection of Secondary data;
- Understanding the technical aspects of the proposed power plants
- Conducting modeling exercise to analyze environmental impact;
- Undertaking identification of potential environmental impacts (along with residual impacts and cumulative impacts, if any) and evaluation of socio-economic consequences of such impacts.

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

1.5 THE EIA TEAM

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

Professional	Name	Expected Expertise
EIA & Emission Modeling Expert	Dr. Nasir Uddin Khan	Highly experienced on conducting EIA of various nature in home and abroad. Have vast experience on identifying different environmental impacts and suggesting mitigation measures for any project. Experienced on emission and noise modeling of various projects. Experienced on Project stakeholder engagement - Public consultation and Disclosure Plans.
Environmental Engineer	Md Hasanul Islam BSc Engineering (Civil), MBA	Experienced on conducting EIA of various nature. Involved in baseline environmental study, identifying different environmental impacts, suggesting mitigation measures and environmental management plan for any project.
Power Plant Engineer	Md. Abdul Matin	Project stakeholder engagement - Public consultation and Disclosure Plans.
Socio-economist	Md. Humayun Kabir	Experienced on Social baseline studies, community needs assessment, Social and Community Health Impact Studies/Assessments etc.

Field Investigator/ co-coordinator	Engr. Mahrin Binte Islam	Make Liaison with all field staff and Consultants; allocate staff & resources to different places when necessary. Background of organizing site visits, surveys, liaison with community, public and govt. organizations, etc.
	Mr. Ratan Biswas	Base line data collection, secondary data collection, sample collection and site survey
	Syed Hosnee Jahab	Base line data collection, sample collection from site, sample preservation and laboratory analysis.
	Nigar Shultana	Base line data collection, sample collection from site, sample preservation and laboratory analysis.

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

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

1.6 ACKNOWLEDGEMENT

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

1.7 REPORT STRUCTURE

The EIA report has been structured to provide primarily the information content of ADB guideline and review requirement of TOR in a logical sequence. The issue and the Corresponding section of the report where it has been addressed is summarized in the following table (**Table 1.4**)

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

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

Chapter-2

CHAPTER TWO: THE PROJECT

2.0 DESCRIPTION OF THE PROJECT

2.1 PROJECT DESCRIPTION

Ashuganj 400 MW Combined Cycle Power Plant (East) project is a natural gas fired power generation plant with rated capacity of 400 MW. The plant is going to replace an old inefficient plant of Ashuganj Power Station Complex, unit 3 (150 MW) with an energy efficient 400 MW Combined Cycle Power Plant at site of existing GT-1, ST, and GT-2 units (146 MW CCPP) which has already been retired. Electricity generated will be supplied to the existing 230 KV National Grid network within the Ashuganj Power Station Complex. Gas will be provided by **Petrobangla** to the power plant from the nearest District Regulating Station (DRS) at Ashuganj.

Ashuganj Power Station Complex (APSC) is an area consisting of several power plants situated in the Ashuganj Upazila of the District of B.Barua. The Ashuganj Power Station complex (APSC), owned and operated by Ashuganj Power Station Company Ltd. (APSCL), a wholly state owned enterprise, currently has a total de-rated capacity of 671MW. The complex is situated by the River Meghna on approximately 311 acres of land located about 75km away from Dhaka. APSCL is a legacy which dates back to 1966 when the foundation of Ashuganj Thermal Power Plant was laid. With the financial assistance of the German Govt. two units of 128 MW capacity was established. In 1968 the erection of main equipment was started and by July 1970 the two units were commissioned. At that time to establish another three units in future some facility was preserved. After the post liberation period Ashuganj Power Plant has played an important role in the reconstruction and economic development of the war stricken country, Bangladesh. Three units (unit 3, 4 & 5) each having a capacity of 150 MW were commissioned on December, 1986 and May, 1987 successively. A combined cycle plant with three units (GT-1, ST, and GT-2) having a combined capacity of 146 MW were commissioned in 1982, 1984 and 1986 consecutively. APSCL has commissioned one 53MW Gas Engine power plant on 30 April 2011. As a part of the Power Sector Development and Reform Program of the Government of Bangladesh (GOB) Ashuganj Power Station Company Ltd. (APSCL) was incorporated under the Companies Act 1994 on 28 June 2000. Ashuganj Power Station (APS) Complex (with its Assets and Liabilities) had been transferred to the APSCL through a Provisional Vendor's Agreement signed between BPDB and APSCL on 22 May 2003. All the activities of the company started formally on 01 June 2003. The company is functioning as an independent entity and its source of revenue is sale of electricity to Bangladesh Power Development Board (BPDB) through a cost based provisional power purchase agreement (PPA). The annual income is about Bangladesh Taka 7,537.81 million and net profit is Taka 718.59 million for 2012-13. The total 620 number of employees are working headed by a four member management team

including Managing Director.

The space earmarked for the new power plant presently holds two open cycle gas turbines each of capacity 56 MW (GT-1, commissioned in 1982 and GT-2, commissioned in 1986), and one 34 MW steam turbine (ST, commissioned in 1984). GT-1, GT-2 and ST have been decommissioned. These three generating units will be demolished, to make way for the proposed 400 MW CCPP (East).

The proposed power plant would use an average of 50 million standard cubic feet per day (mmscfd) gas, of which 35 mmscfd would be sourced by decommissioning the existing 150 MW Unit #3 Steam Turbine power plant (ST 3). The remaining 15 million mmscfd would come through reduced dispatches of 150 MW Unit #4 Steam Turbine power plant, 150 MW Unit #5 Steam Turbine power plant, and 53 MW Gas Engine unit, by reducing their combined average output by an equivalent of 70MW. Thus, APSCL's overall gas allocation of 230 mmscfd from Petrobangla need not be increased.

To provide access to affordable and reliable electricity to all by 2021 as well as to comply with the policy of Government of Bangladesh (GOB) and to reduce the dependency on natural gas APSCL intend to construct a new 400 MW Combined Cycle Power Plant beside its old plant premises.

The **Ashuganj 400 MW Combined Cycle Power Plant (East)** project shall be implemented by ADB & IDB Co-financing.

2.2 PROJECT CATEGORY

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

Table-2.1: Basic data on Ashuganj 400 MW Combined Cycle Power Plant (East)

1. Name of the Project	Ashuganj 400 MW Combined Cycle Power Plant (East)
2. Sponsoring Ministry/ Division	Ministry of Power, Energy and Mineral Resources (Power Division)
3. Executing Agency	Ashuganj Power station Company Limited (APSCL)
4. Project Location	Ashuganj, Brahmanbaria, Bangladesh.
5. Location of the Proposed Plant	Existing land inside APSCL Compound in place of existing

	unit GT-1, GT-2 & ST
6. Type of Project	Combined Cycle power plant
7. Raw Materials	The main raw material of the project is natural gas.
8. By-product, if any	None
9. Net Plant Capacity	400 MW of Electric Power
9. Annual Production	2924.71 GWh at 85% Plant Factor
10. Project Cost	388.96 million USD (1 USD= 77.63 BDT)
11. External Finance	82% Foreign Currency by International lender
12. Internal Finance	18% GoB & APSCL
13. Total Developed Land	4.30 acres
14. Employment	91 person(approximately), Admin – 5, Production – 85, Env. - 1
15. Fuel Requirement	Natural Gas, no back up fuel will be used. Source: Petrobangla, Distributor: Bakhraabad Gas Distribution Company Ltd.
16. Water Requirement & Source of Water	28,500 m ³ /hr, Source: Meghna River
17. Quantity of Discharge Water	28,500 m ³ /hr , water discharge from open circuit cooling.
18. Term of the Project	25 years

2.3 SITE DESCRIPTION

2.3.1 Location

The proposed power plant will be located inside Ashuganj Power plant complex and Ashuganj Power Station Company Ltd land at Ashuganj, Brahmanbaria, Bangladesh. The project site lies in the geospatial reference of 24°2'41.33"N & 91°1'3.94"E. The project is located at Sonaram Mouza of Ashuganj Upazila. Bangladesh UK Friendship Bridge on the river Meghna (Meghna Bridge) connects both the banks of Bhairab and Ashuganj by the Dhaka Sylhet Highway which is around 2 km west to the project site. Ashuganj fertilizer factory is located within 1km of the project site.

If we consider 5 km radius from the project site bhairab bazar is located in the North West site of the project. Some small communities are seen within this area. The meghna river is a very common natural figure within this area. The Ashuganj Railway station is situated on the south west side and Bhairab Railway Station is on the North West side from the project. The Ashganj Fertilizer and govt. food storage are on south west side from the project.

The proposed 400 MW CCPP will be established at the location of the existing GT-1, GT-2, ST and Fuel Tank. All these plant altogether covers total land of 4.30 acres.

This land will be sufficient for the proposed 400 MW combined cycle power plant. The Meghna River is at the north side; APSCL 50 MW GE plant is located at the south side, 55 MW Precision Energy Ltd. at the east side of the proposed project. The APSCL office & Ashuganj 225 MW CCPP plant are located at the west side of the project.

The Brahmanbaria District map, Ashuganj Upazila map as well as the satellite map, has been shown in figure 2.1(a), 2.1(b), 2.1(c) & 2.1(d) respectively. The layout plan of the project is presented in **Annexure 1(a) & 1(b)**.

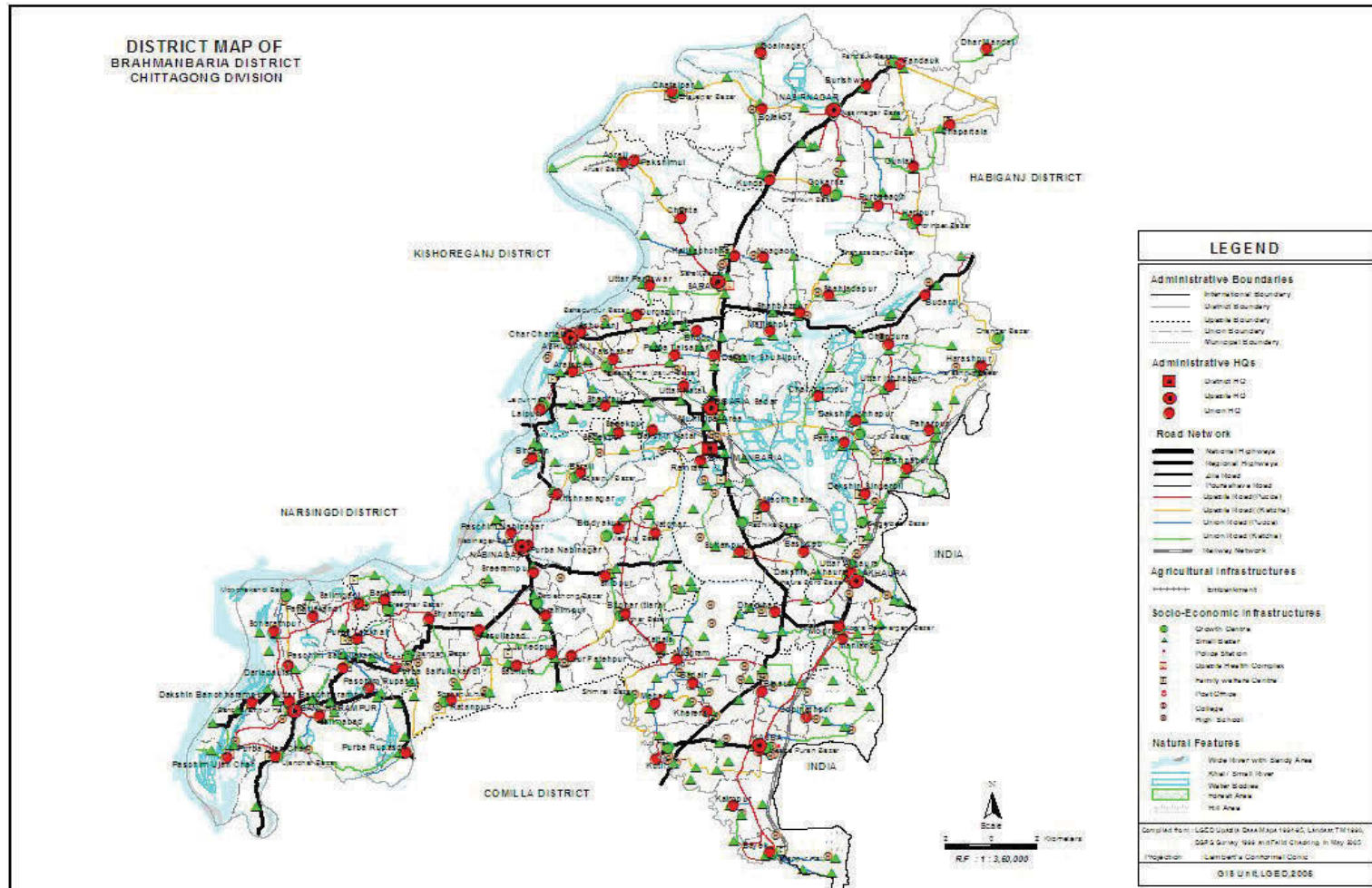


Figure: 2.1 (a) Brahmanbaria District Map

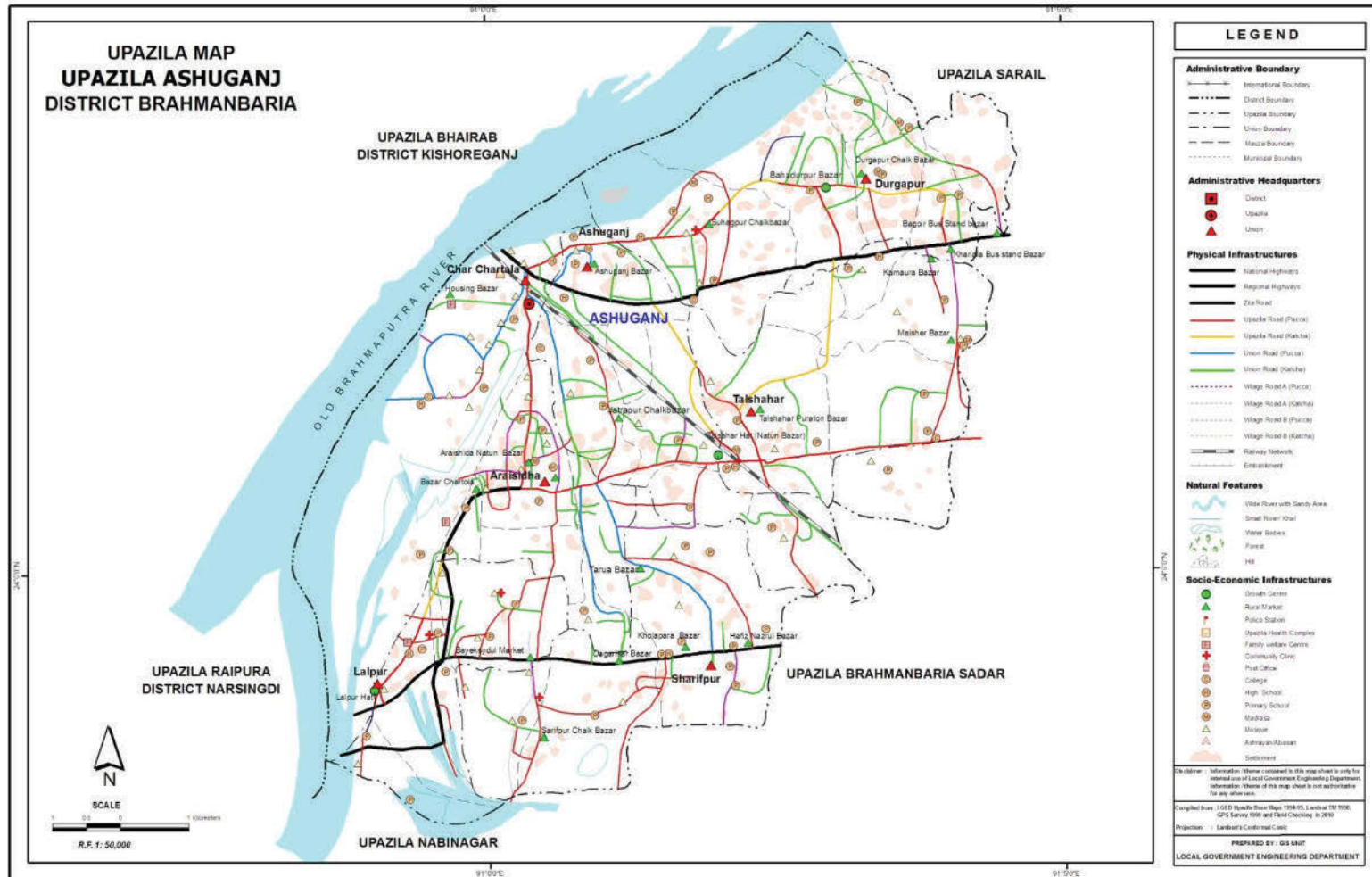


Figure: 2.1 (b) Ashuganj Upazila Map

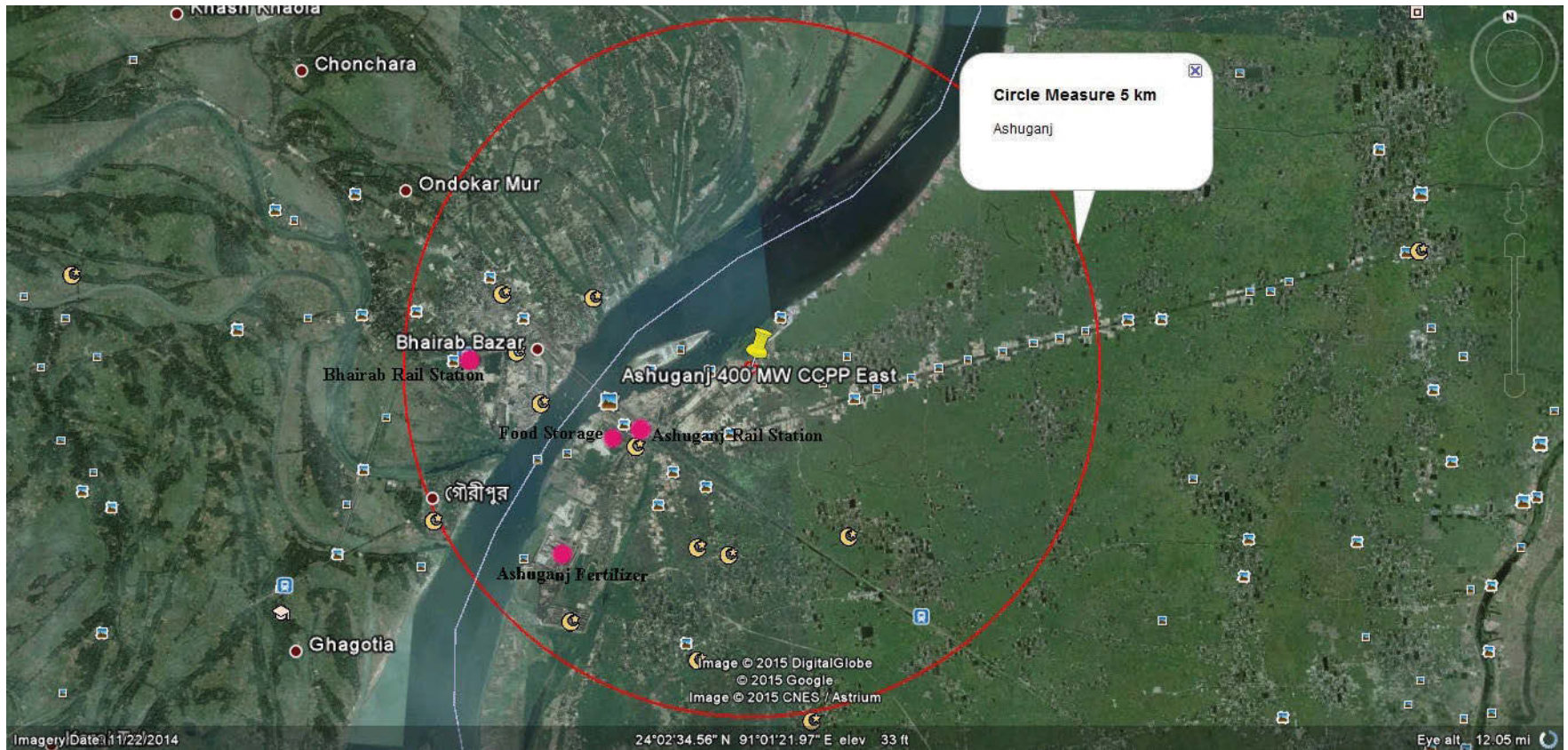


Figure: 2.1 (c) 5 km radius satellite map of the Proposed Project



Figure: 2.1 (d) Satellite image of the Proposed Project

2.3.2 Existing Power Plants at Ashuganj Power Station Complex (APSC)

The Ashuganj Power Station Complex (owned and operated by APSCL) currently has a total capacity of 671 MW. The APSCL power station complex at Ashuganj comprises steam power plants of 2x64MW units, 3x150MW units, a combined cycle power plant of 146MW (GT 1, GT 2 and ST). Recently, four more gas consuming power plants run by internal combustion engines with total capacity of 230MW have been built, of which 50MW by APSCL and 190MW by others as rental power plants. Three are within APSCL premises and one outside. The existing GT-1 and ST (1x56 GT+1x34 MW ST= 90 MW CCPP) has already been retired and the capacity of GT 2 has also decreased to 40 MW from 56 MW. Therefore the original power station of APSCL at present have total seven plants consisting of 5 Steam Turbine, 1 Gas Turbine & 1 Gas Engine.

The total capacity at Ashuganj is now 861MW (including the rental plants). All of these power plants use indigenous natural gas as fuel.

Table 2.2 illustrates the present status of the **Ashuganj Power Plant Complex**. **Table 2.3** illustrates the projects under construction.

Table-2.2: Current Status of the Ashuganj Power Complex

Name of Unit	Installed Capacity	Derated Capacity	Date of Commissioning
2x64 MW Steam Turbine (Unit 1 & 2)	128 MW	128 MW	July, 1970
Unit-3	150 MW	150 MW	1986
Unit-4	150 MW	150 MW	1987
Unit-5	150 MW	150 MW	1988
GT-2	56 MW	40 MW	1986
50 MW GE	53 MW	53 MW	2011
Total De-rated Capacity of APSCL		671 MW	
Rental Power Plants (within or not within APS Complex)			
Precision Energy Ltd. (within APSC)	55 MW	53 MW	-
AGGREKO (within APSC)	80 MW	83.74 MW	-
United Ashuganj Power Ltd. (outside APSC)	53 MW	53 MW	2011
Total De-rated Capacity at Ashuganj		860.74 MW	

Table-2.3: Projects under Construction in the Ashuganj Power Complex

Name of Unit	Projected Capacity	Expected Date of Commissioning
Ashuganj 450 MW CCPP (North)	450 MW	Feb, 2017
Ashuganj 200 MW Modular Power Plant (APSCL and UAEL joint venture)	200 MW	3 May, 2015
Ashuganj 450 MW CCPP (South)	450 MW	Jan, 2016
Ashuganj 225 MW CCCP	225 MW	30 Apr, 2015
Total	1325 MW	

2.3.2.1 Retirement Plan of Old Power Generating Units of Ashuganj Power Station Company Limited (APSCL)

To meet the extra demand of electricity of the country the Government of Bangladesh planned to establish more power generation units as early as possible, simultaneously retiring the old units with derated capacity & much lower efficiency. Atlanta Enterprises Ltd. in association with Prokousal Upadesta Ltd. and Institute of Water Modeling prepared a Master Plan for APSCL in 2012. The Master Plan shows the following units of APSCL have been considered for retirement in phases as their plant economic life is getting over:

Name of Unit	Installed Capacity	Derated Capacity	Efficiency	Date of Commissioning	Gas Consumption
Ashuganj 2x64 MW Steam Turbine (Unit 1 & 2)	110 MW	90 MW	29.79%	April/June 1970	30 MMSCFD
Ashuganj GT 1 (already retired)	35 MW	Retired	20.47%	1986	35 MMSCFD
Ashuganj ST	16 MW	Under maintenance Since 08/09/13	34.98% (65.57%)		
Ashuganj GT 2	40 MW	40 MW	22.74%		
Unit-3	150 MW	150 MW	35 %	1986	35 MMSCFD

From the above table it can be stated that the efficiency of the above plants are very poor. Due to continuous operation over the years the capacity of the above plants have been considerably derated, their efficiency has been reduced significantly rendering the plants commercially less economical to continue operation. Retiring the above plants will save about 100 MMSCFD of natural gas. The gas requirement for the 400 MW power plant will be about 50 MMSCFD, which is 1/2 of the gas required by the above-mentioned units. Therefore no extra amount of gas will be needed for

the proposed plant and the plant will run the single shaft configuration 400MW combined cycle power plant with 58% efficiency. So to ensure the efficient gas use APSCL intends to decommission unit 3 to fulfill the fuel requirement of the proposed plant.

To get the summary of all existing and proposed plans see **Annexure 1(c)**.

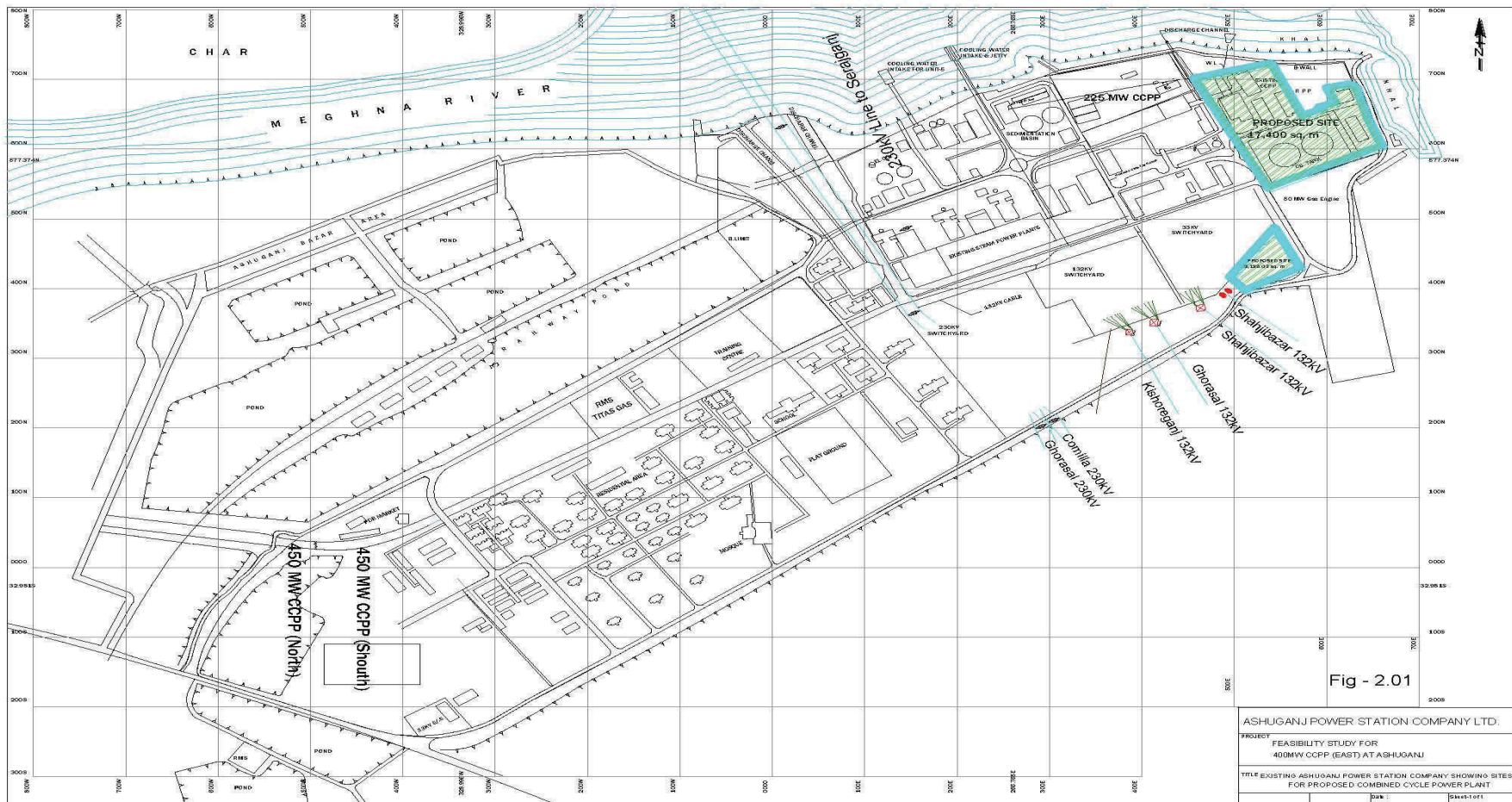


Figure 2.2(a): Existing Power plant beside the Proposed Project



Figure 2.2(b): Satellite image of the existing power plants beside the proposed project

2.3.3 Access to Site

Ashuganj is located on the east bank of the Meghna River about 91 km Northeast to Dhaka & is connected by railway & highway way with Dhaka. There also exists good waterway connection to the site with seaports of Chittagong and Mongla. The project is located in Sonaram Mouza of Ashuganj Upazila, Brahmanbaria District. Bangladesh UK Friendship Bridge across the river Meghna (Meghna Bridge) connects both the banks of Bhairab and Ashuganj which connects with Dhaka-Sylhet highway which passes at the south side of the project. Meghna River is in the north side of the project. A khal is situated in the east side of the project and the total APSCL complex including APSCL office is located on the west side of the project. A new 225 MM CCPP is under construction on the North West side of the project. The project is well communicated both roadway and railway. The proposed project will use the existing access road and no new access road will be constructed. The location map of the proposed project is shown in Fig 2.3.

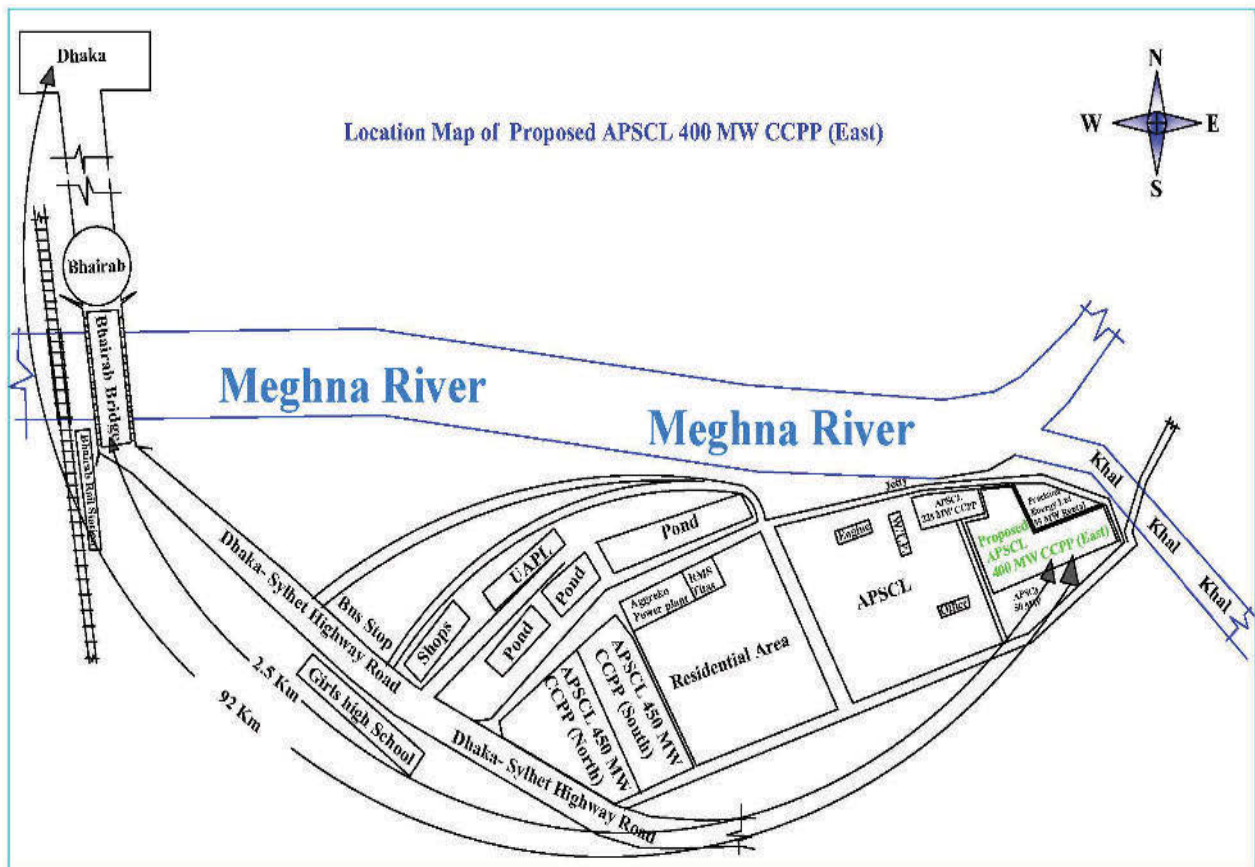


Figure 2.3: Location of the Proposed Project



Figure 2.4: Surrounding picture of the Proposed Project.

2.3.4 Gas Interconnections

The natural Gas supply system of Bakhrabad Gas Distribution Company Ltd. in the area will be used from the supply of natural gas to the proposed plant. The specification of natural gas is given in the **Annexure 2**. The existing valve Station at Ashuganj is located on the right side of the Dhaka-Sylhet Highway and to the west of the Ashuganj Power Station Complex boundary. This valve station has access to gas from Titas Gas Field, Habiganj Gas Field and from the GTCL RMS at Ashuganj. The receiving pressure of the station is 700-800 psi.



Fig. 2.5: Valve Station 3

From the Bakhrabad valve station no.3 the gas pressure is regulated and three different pipe lines are in use to supply gas to the power station complex. The 300MW (2×150) receives gas at a pressure of 500psi (present pressure 470psi) through a 10" dia pipe, the 128MW (2×64) receives gas at a pressure of 65psi through a 16" dia pipe and the proposed 400 MW CCPP (East) will receive gas at a pressure of 470psi through a 10" dia pipe.

Gas connection for Ashuganj 400 MW CCPP (East) shall be made from upstream of valve station-3 and Gas RMS shall be located at the Eastern side of Ashuganj 200 MW Moduler Power Plant with all metering and regulating facilities to supply gas to the new 400 MW CCPP (East). The details layout is given in the **Annexure 3**. The route for the gas connection has not been finalized yet but a proposed route from the existing RMS station is shown in the **Annexure 15** by yellow line. The estimated length of gas pipeline is about 2 km.

2.3.5 Evacuation of Power from the Proposed Ashuganj 400 MW CCPP East

There are three options for evacuation of power from the proposed power plant.

2.3.5.1 Option-1 (132KV bus):

There are two buses of 132kv each in APSCL'S sub-station. Unit 1, 2, GT1, GT2, ST, Precession Energy and 53MW Gas engine generators are connected to these buses. Outgoing 132KV feeders are Kishorganj (1,2), Ghorashal (1,2), Shajibazar (1,2) and Brahmanbaria (1,2).

GT1 and ST already retired. The bays of GT1 and ST have been used for power evacuation of 225 MW Combined Cycle Power Plant. GT of 225 MW Combined Cycle Power Plant will come in commercial operation very soon. By this time GT2 will go for retirement and hence its bay will be free. But at this condition the 132KV bus can not be used for power evacuation of proposed 400 MW Combined Cycle Power Plant due

to overload.

2.3.5.2 Option-2 (230KV bus):

The Proposed project is a single shaft combined cycle power plant. It comprises of one GT, one ST, one Generator and one HRSG. It is a replacement project of unit-3. The 230kV Grid S/S was installed in 1984. Due to aging and undersize bus conductor and also load concentration, 230kV bus cannot be used for power evacuation of proposed 400MW CCPP (East). Since it is the replacement project of unit-3. The 230kV bay of unit-3 will be free and this free bay can be used for auxiliary power supply.

2.3.5.3 Option-3 (400KV bus):

A project for construction of two double circuit 400 KV lines from Bhulta to Ashuganj has already been taken by PGCB (Power Grid Company of Bangladesh). An extension 400kV GIS bay can be constructed at the GIS of 450MW CCPP (North) and this GIS bay will be used for power evacuation of proposed 400 MW CCPP (East) by using underground cable from the power plant.

The option 3 has been selected for the proposed project. The length of the underground cable is approximately 1 km. The details power evacuation layout is given in the **Annexure 4**.

2.3.5.4 Associated Facility of Ashuganj 400 MW CCPP

Option 3 was selected for power evacuation from Ashuganj 400 MW CCPP, which is considered as an associated facility per ADB SPS 2009. Annexure 4 shows the power evacuation route. Under Option 3, a 70 km 400 kV double circuit transmission line from Ashuganj to Bhulta and a 400/230 kV, 3 X 520 MVA substation at Bhulta will be constructed to evacuate power from the proposed 400 MW CCPP, the 2X450 MW CCPP under construction and the planned 225 MW CCPP at Ashuganj Power Station Complex. PGCB is the EA of Option 3.

As per “Department of Environment’s Guidelines for EIA of Industries, Power Plant and Electricity Distribution”, this transmission line project falls under the Red Category, which requires an IEE for site clearance and an EIA (Annexure 16) for environmental clearance. IEE and EIA have been prepared by PGCB accordingly and submitted to GoB for site and environmental clearance.

The EIA study of Ashuganj-Bhulta 400 kV Transmission Line Project covers the description of the existing environmental and social baseline; identification of important environmental and social components which may be affected by the Project; assessment of the potential environmental impacts, including any residual impacts; identification of mitigation measures to mitigate the adverse impacts; and preparation of the EMP, including a monitoring program and proposed budget. Public consultation was conducted to share the information of the proposed interventions and the possible environmental impacts with the local stakeholders for obtaining their

perceptions, views and feedbacks on the probable changes likely to happen within the study area.

The route of transmission line and substation site avoided any sanctuary or protected areas and other environmentally-sensitive areas. Potential environmental impacts of the Project are mostly temporary, predictable, and reversible. The EMP is adequate to minimize and mitigate the adverse environmental impacts. A Resettlement Action Plan will be prepared to address the land acquisition issue.

However, the following gaps in the EIA report remain per ADB SPS 2009:

1) Grievance Redress Mechanism: a Grievance Redress Mechanism should be established and implemented during the construction and operation period of the Project to provide opportunity for project affected persons to settle their complaints and grievances. The established grievance redress procedures and mechanism ensures that project affected persons are provided with appropriate compensations and that all the administrative measures are in line with the relevant policies and regulations.

2) Hazardous and non-hazardous wastes: the potential impacts of construction waste at tower and substation sites and the proper handling of hazardous wastes, if any need to be considered. Hazardous and non-hazardous wastes disposal should be included in the EMP.

3) SF₆ gas handling: the use of SF₆ should be exercised with special caution considering that this is the greenhouse gas with the highest global warming potential (23,900 tons of CO₂ equivalent). The following provisions should be included in the environmental monitoring program:

- Regular monitoring of SF₆ through pressure gauges
- Use of handheld leak detectors to monitor leaks
- Prepare annual inventory checklist of SF₆ consumption, purchase, and losses to track emissions
- Provide training to staff on proper handling of SF₆

The EIA of of Ashuganj – Bhulta 400 kV Transmission Line is attached as annexure 16 to this EIA report.

2.4 PROJECT OBJECTIVES

In Bangladesh, there is acute shortage of electricity generation capacity. Addition of generation capacity is, urgently required to cope with the demand and to provide reliable and quality power supply in and around Ashuganj and in the national grid of Bangladesh as a whole. Considering the situation APSCL has already decided to replace the existing old outdated less efficient power plants with highbred energy efficient 400MW CCPP. It is to note that, the Combined Cycle Power Plant will be installed in APSCL's owned land in place of existing unit GT-1, GT-2 & ST; therefore, no new land acquisition is required and no alternative fuel will be required. The case is same with the Ashuganj 450MW CCPP (south) and Ashuganj 450MW CCPP (north). It is intended that all the unit(s) will be fired continuously on natural gas.

The main objectives to undertake this project are to:

- Meet the growing electricity demand of the country and to increase the stability and reliability of the power system.
- Narrow the ever increasing gap between demand and supply of electricity of the country.
- Increase the power generation through maximum utilization of country's natural gas resources available.
- Replace old inefficient 150 MW plant with an energy efficient 400 MW CCPP in place of existing 146 MW CCPP which has already been retired, thus utilizing presently unused land.
- Use natural gas in a more efficient and effective way by implementing Combined Cycle Power Plant.
- Accelerate the economic development of the country by adequate and reliable power generation.
- Support the planned target of power demand.

2.5 THE POWER PLANT DETAIL

2.5.1 Plant/Unit Sizes

The power plants in Bangladesh are interconnected and the total present power demand of Bangladesh is estimated to be more than 10283 MW. Such a system can accommodate a maximum unit size of 500MW. Considering the total output of the combined cycle power plant to be 400 MW under site conditions (35°C, 1.013 bar, 98%RH) and of 1:1:1 configuration of the plant is quite compatible.

2.5.2 Configuration

Although 2:2:1 is the preferred configuration for a CC Plant, but availability of gas, investment cost, specific gas consumption, operation & maintenance cost, life cycle cost and commercial aspect of APSCL dictated in favor of 1:1:1 configuration at the existing Ashuganj power station complex. The other option was also investigated. When maximum capacity is looked for, reliability and flexibility was to be compromised. The layout plan for the GTG, HRSG, STG, plus auxiliaries, balance of the plant (BOP); has been considered on the basis of available dimensions from the known range of standard sizes being produced by different internationally reputed manufacturers. Data were also collected from the existing power plants. As many as twenty different layouts were prepared.

After several options on capacities and configurations studied, it was found that a 400 MW power plant with 1:1:1 configuration was investigated with one 289MW (ISO rated) gas turbine, a heat recovery boiler and a 135 MW steam turbo-generator. The

plant machineries are listed in the Annexure 5, the engine catalogue is given in the Annexure 6 and the process flow diagram is shown in the Annexure 7.

2.5.3 Type of Gas Turbine

GT was selected after studying the data supplied by various manufactures. Size, physical dimensions, operating parameters were investigated and selection was made in consideration of site conditions and compatibility as regards to combined cycle operation. Exhaust temperature of 558⁰C is selected to maximize energy input to heat recovery steam generator. Dry low NOx Burners, Water injection and/or catalytic removal system is envisaged for limiting NOx. Dry low NOx burners will be adopted for the proposed project.

2.5.4 Type of Air Compressor

Compression ratio has been envisaged to be between 17 and 20 compatible with the required mass flow and pressure.

2.5.5 Type of Boiler

Considering ease of operation and maintenance, ease of handling during transportation, ease of erection and simplicity of construction, a vertical module triple pressure reheat forced circulation type heat-recovery boiler with water tube construction without supplementary firing is considered for this project. Exhaust gas temperature of gas turbine at site base rating being about 587⁰C, the maximum pressure and temperature of steam are considered to be 125 bar and 565⁰C respectively, with corresponding steam output of 275,000 kg / hour. Care has to be taken to keep the exhaust gas temperature sufficiently above 115⁰C to avoid condensation of vapor.

2.5.5.1 Estimate of Boiler Evaporation

There will be one gas turbine, 1 HRSG and one steam turbine. Based on the exhaust gas condition of the proposed gas turbine unit and the following related parameter, the boiler (HRSG) evaporation is estimated below at site condition of 35⁰C.

Gas turbine nominal output at 35 ⁰ C	:	250MW (ISO 288MW)
Exhaust gas temperature at base output	:	587 ⁰ C
Exhaust mass flow at base output	:	692kg/ sec
Steam pressure HP system	:	125 bar
Pinch point difference temperature	:	23 ⁰ C

Approach point difference temperature	:	16°C
Evaporation of boiler	:	275,000 kg/hr
HP system	:	275,000 kg/hr

2.5.6 Steam Cycle

In this size of the heat recovery boiler, forced circulation triple pressure steam cycle is usually adopted. From the viewpoint of thermal efficiency, the triple pressure steam cycle is considered preferable.

2.5.7 Type of Steam Turbine

The steam turbine is to be a double flow triple pressure turbine that can be operated at higher efficiency than single pressure type, but the construction of turbines and control system becomes more complicated.

Steam turbine shall be indoor type. The steam turbine will receive steam at 125bar and temp. 565°C while exhaust at 700mm Hg (vac) with corresponding temp. The steam duty of turbine is 275 ton/hr. Surface type condenser utilizing river water for once-through cooling system is selected.

Manufacturers of steam turbine have their own standard designed turbines to suit CC operation. Therefore, utilization of such standard designed turbine seems to be the most economical solution.

2.5.7.1 Turbine Output (At 35° C Ambient)

The maximum capability of the turbine is dependent upon the associated gas turbine exhaust gas temperature and hence the available mass flow, inlet steam conditions and of course, the condenser vacuum.

The steam turbine output at generator terminal is estimated to be 135MW the parameters of steam turbine is given below in Table 2.4

Table - 2.4: Steam Turbine Parameter

Steam Turbine output at Generator terminal	135MW (Field condition)
Steam Turbine output prior to Generation	135MW
Turbine inlet pressure	125 bar
Turbine inlet temp	565°C
Steam Turbine steam flow through	

(i) HP stage	275 ton /hr
(ii) LP stage	275 ton/hr
LP stage exhaust	
(i) Mass flow	275 ton/hr
(ii) Pressure	1 Psia (2" Hg)
(iii) Temp	45°C

2.5.8 Generator

Generators shall be indoor type rated to turbine output, air cooled and directly coupled to turbines for 3000rpm, 50Hz, 3-phase. Short circuit ratio should be high enough for stability. Generation voltage shall be 15.75kV to be stepped up to 400kV for connection to grid.

2.5.9 Condenser Cooling System

For this project the following three kinds of system may be considered.

- Open cycle cooling with river water
- Closed cycle with wet type cooling tower using makeup river water
- Closed cycle with dry type cooling tower using makeup from deep well

Closed loop cooling system is best in principle, but closed loop systems requires a minimum amount of land for cooling towers, and requires make-up water (i.e., closed loop systems have zero or near-zero discharge but present some potential impacts due to water consumption). The project cost and impact also need to be assessed. Because of the space constraints, closed loop cooling system is not feasible for this project.

Open cycle cooling being most economic should be adopted unless water availability is a problem. The water supply has been studied in detail and it was found that adequate water is available in the River Meghna, which support open cycle cooling for the proposed power station.

2.5.10 Water Supply

For the condensing turbine adequate supply of water must be ensured for cooling. Calculation shows that for sufficient vacuum, an amount of about 7.91 m³ of water is required per second to flow through the condenser so as to allow no more than 7°C rise of temperature of cooling water for once through cooling purpose at the condenser discharge point.

Once through cooling system is considered. The requirement of condenser cooling water is calculated on the basis of maximum 7°C rise of temperature at the

condenser discharge point, which is estimated to be 28,500 m³/hr. At condenser discharge point, there are three discharge channels (600m long, 700m long and 1.6 km long). The discharged water from open circuit cooling passes through these channels and immediately after vicinity of the discharge point, due to instant mixing with equal/mass of water, the temperature of surface water falls. At the long and down the river the temperature will reduce to almost river water temperature.

The total water withdrawal by the existing and new plants amount to 56.4 m³/sec the same volume (see **Annexure 1(C)** for the distribution of total water use by all existing and new plants) will be discharged back to the river with less than 3⁰C rise of temp. The minimum river discharge is 2050 m³/sec at plant location is quite adequate for this.

2.5.10.1 Intake, Circulating Water Pump House and Discharge

The required amount of cooling water for the proposed plant is 28,500 ton/hour. To supply this amount of cooling water an intake structure with intake channel and a pump house will be constructed on the bank of the river Meghna (West side of VIP Rest House). The capacity, head and number of circulating water pumps will be selected matching the water requirement and two full capacity CW pumps are envisaged. The cooling water pumps shall be of 2x100% capacity shall be installed in the pump house and the 2.5m dia cooling water pipe about 500m long shall be installed. A survey has been conducted and prepared a layout plan (**Annexure 8**). The measured area is (65mX27m). This pump house will easily be accommodated in this space.

On the matter of discharging the cooling water a sump shall be constructed near the ST Unit. From this sump an underground discharge pipeline of 2.4m dia and 700m long shall be installed to discharge the cooling water of the proposed plant to the existing discharge channel of unit 1&2. See Annexure 15 for better understanding the old and new structures. The green lines show the new pipelines to be constructed for intake and discharge.

All discharge channels then meet at the existing water holding pond (Dimension: Length:35 meter, Width:30 meter, Depth:2.965 meter) at the power plant complex, from the pond there are three discharge channels of 600m, 700m and 1.6km and then travelling through the discharge channels water is discharged on the river. For better understanding of the routes of the three discharge channels please see the **annexure 9 (a)**.

The inlet structure has not been designed yet but APSCL is committed to include all the standard measures and facilities to install an intake preventing the entrainment of fishes, wastes etc. The pump station is not affected by the outfall temperature since it is in the upstream side.

2.5.11 Demin Water System

As proposed, the 400MW CCPP will have a Steam Turbine Capacity of 135MW in a configuration of 289MW Gas Turbine and 135MW Steam Turbine. For this unit, 3.18 kg/sec (Maximum) demineralised water, service water and potable water will be needed. The facilities developed under the 225MW CCPP will be capable to supply this required quantity of water. The quality requirement of Boiler feed Water shall be defined when the Turbine Supplier specifies the required steam quality.

2.5.12 Water Treatment Plant

The proposed power plant will have to share a new and modern chemical water treatment plant with 225 MW Combined Cycle Power Plant under implementation with facilities to produce demineralized water, service water and potable water in accordance with SPS 2009 Bangladesh national standards. So no need to construct another new water treatment plant as the source of demineralized water will be from the 225 MW Combined Cycle Power Plant. The water treatment plant of 225 MW CCPP was designed for supplying of demi water for itself and also for unit 1 to 5. The capacity of water treatment plant of 225 MW CCPP is 95 to 115 T/H.

2.5.13 Oily Water Treatment

There will be an oily water separator which will trap waste oil from the oily water. The treated water will be drained properly.

The water use breakdown for the proposed plan is shown in the **Annexure 9(a)**, for current power generation at APSCL premises surface water temperature of Meghna river at cooling water discharge points have been measured and the measurements are shown in the **Annexure 9(b)** and the oily water separation treatment is given in **Annexure 9(c)**.

Chapter-3

CHAPTER THREE: POLICY AND LEGAL CONSIDERATION

3.0 POLICY AND LEGAL CONSIDERATION

3.1 BACKGROUND

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

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

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

3.2 POLICIES

3.2.1 Industrial Policy 1991

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

- To conserve ecological balance and prevent pollution during industrialization
- To take effective steps for pollution control and conservation of environment during industrialization

To ensure embodying of necessary pollution control and preventive measures by industrial investment project endangering environment.

3.2.2 National Environmental Policy 1992

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

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

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

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

3.2.3 National Conservation Strategy

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

industrial sector, the report offered various recommendations; some of those are as follows:

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

3.2.4 National Environmental Management Action Plan (NEMAP), 1995

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

NEMAP has the broad objectives of:

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

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

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

3.3 NATIONAL LEGISLATION

3.3.1 Environment Conservation Act 1995 (ECA 1995)

Formal concern at the national level, for the state of environment in Bangladesh can be traced back to at least Independence and passing of the Water Pollution Control Act in 1973. Under this a small unit was established in the Directorate of Public Health Engineering (DPHE) to monitor pollution of ground water and surface water. In order to expand the scope of environmental management and to strengthen the powers for achieving it, the Government issued the Environmental Pollution Control Ordinance in 1977. The ordinance provided for the establishment of an

Environmental Pollution Control Board, which was charged with formulating policies and proposing measures for their implementation. In 1982, the board was renamed as Department of Environmental Pollution Control (DEPC). Four divisional offices were established in Dhaka, Chittagong, Khulna and Bogra. A special presidential order again renamed the DEPC to the Department of Environment (DOE) and placed under newly formed ministry of Environment and Forest (MoEF) in 1989.

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

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

The main strategies of the act can be summarized as: down the ecologically critical areas.

- Regulation in respect of vehicles emitting smoke harmful for the environment.
- Environmental clearance.
- Regulation of the industries and other development activities - discharge permit.
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes.
- Promulgation of standard limit for discharging and emitting waste.
- Formulation and declaration of environmental guidelines.

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

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

- The national Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;

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

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

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

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

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

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

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

emission of various types of particulate, sulfur dioxide, and oxides of nitrogen and in some cases volatile organic compounds and other substances.

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

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

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

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

Source: ECR- Schedule 10

Table 3.2: Standards for Drinking Water

Parameters	Unit	DoE (Bangladesh) Standard for drinking water
pH		6.5-8.5
Hardness(as CaCO ₃)	mg/L	200-500
Iron	mg/L	0.3-1.0

Parameters	Unit	DoE (Bangladesh) Standard for drinking water
Chloride	mg/L	150-600
Arsenic	mg/L	0.05
Residual chlorine	mg/L	0.2
Total Coliform	n/mL	0
Fecal Coliform	n/mL	0
Ammonia	mg/L	0.5
Nitrate	mg/L	10
Phosphate	mg/L	6

Source: ECR- Schedule 3

Table 3.3: Ambient Air Quality Standards

AIR POLLUTANT	STANDARDS	AVERAGE TIME
1	2	3
Carbon Monoxide (CO)	10 mg/m ³ (Ka)	8-hour
	40 mg/m ³ (Ka) (35 ppm)	1-hour
Lead (Pb)	0.5 µg/m ³	Annual
Oxides of Nitrogen (NO _x)	100 µg/m ³ (0.053 ppm)	Annual
Suspended Particulate Matter (SPM)	200 µg/m ³	8-hour
PM ₁₀	50 µg/m ³ (Kha)	Annual
	150 µg/m ³ (Ga)	24-hour
PM _{2.5}	15 µg/m ³	Annual
	65 µg/m ³	24-hour
Ozone (O ₃)	235 µg/m ³ (0.12 ppm) (Gha)	1-hour
	157 µg/m ³ (0.08 ppm)	8-hour
Sulfur di Oxide (SO ₂)	80 µg/m ³ (0.03 ppm)	Annual
	365 µg/m ³ (0.14 ppm) (Ka)	24-hour

Source: ECR- Schedule 2 (Amended in 2005)

Abbreviation: ppm: Parts Per Million

Notes:

(Ka) Not to be exceeded more than once per year

(Kha) Annual average value will be less than or equal to 50 microgram/cubic meter

(Ga) Average value of 24 hours will be less or equal to 150 microgram/cubic meter for one day each year.

(Gha) Maximum average value for every one hour each year will be equal or less than 0.12 ppm.

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

Table 3.4: Standards for Gaseous Emission from Industries

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

Source: ECR- Schedule 11

Table 3.5: Ambient Noise Standards

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

Source: ECR- Schedule 1 (Amendment in 2006)

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

3.4 OTHER LEGISLATIONS

3.4.1 ENVIRONMENTAL REQUIREMENTS OF THE ASIAN DEVELOPMENT BANK (ADB)

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

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

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

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

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

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

Categorization based on the Most Environmentally Sensitive Component.

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

Basic Environmental Assessment Requirements

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

Category B. An IEE is required for Category B projects to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report. Public consultation must be undertaken during the IEE process. An IEE report is required to follow the recommended format. For Category B projects deemed environmentally sensitive, the SIEE should be submitted to the Board at least 120 days prior to the Board consideration. In addition to the SIEE, IEE will be made available to Board members upon request. The Bank may make the SIEE available to locally affected

groups and NGOs, upon request, through the Board Member of the DMC concerned, or through the Bank's Depository Library program, except where confidentiality rules would be violated.

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

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

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

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

- *Environmental Assessment (EA) (OP 4.01/BP/GP 4.01):* An Environmental Assessment is conducted to ensure that IFC-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any IFC-funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.
- *Natural Habitats (OP/BP 4.04):* Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under a sector investment or financial intermediary loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical

(either legally or proposed to be protected or high ecological value) and non-critical natural habitats. World Bank's interpretation of "significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.

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

- *Cultural Property (OPN 4.11)*: Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The Bank seeks to assist countries to manage their physical cultural resources and to avoid or mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

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

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

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

Table 3.6: WHO Ambient Air Quality Guidelines

	Averaging Period	Guideline value in $\mu\text{g}/\text{m}^3$
Sulfur dioxide (SO ₂)	24-hour	125 (Interim target1) 50 (Interim target2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO ₂)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM ₁₀	1-year	70 (Interim target1) 50 (Interim target2) 30 (Interim target3) 20 (guideline)
	24-hour	150 (Interim target1) 100 (Interim target2) 75 (Interim target3) 50 (guideline)
Particulate Matter PM _{2.5}	1-year	35 (Interim target1) 25 (Interim target2) 15 (Interim target3) 10 (guideline)
	24-hour	75 (Interim target1) 50 (Interim target2) 37.5 (Interim target3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target1) 100 (guideline)

Table 3.7: Noise Level Guidelines

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

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

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO ₂)		Nitrogen Oxides (NO _x)	Dry Gas, Excess O ₂ Content (%)
Combustion Turbine			NDA/DA		NDA/DA	
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%
Fuels other than Natural Gas (Unit > 50MWth)	50	30	Use of 1% or less S fuel	Use of 0.5% or less S fuel	152 (74 ppm)*	15%

3.5 ENVIRONMENTAL CLEARANCE

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

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

3.6 POWER SCENARIO AND MASTER PLAN IN BANGLADESH

Power and energy are vital factors that determine the growth path of a developing country like Bangladesh whereas; electricity is the major source of power for

country's most of the economic activities. Consistent supply of power and energy can ensure development of the economy. Nonetheless the huge demand supply gap prevailing in the power sector has turned out to be a hurdle for the economic expansion of the nation.

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

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

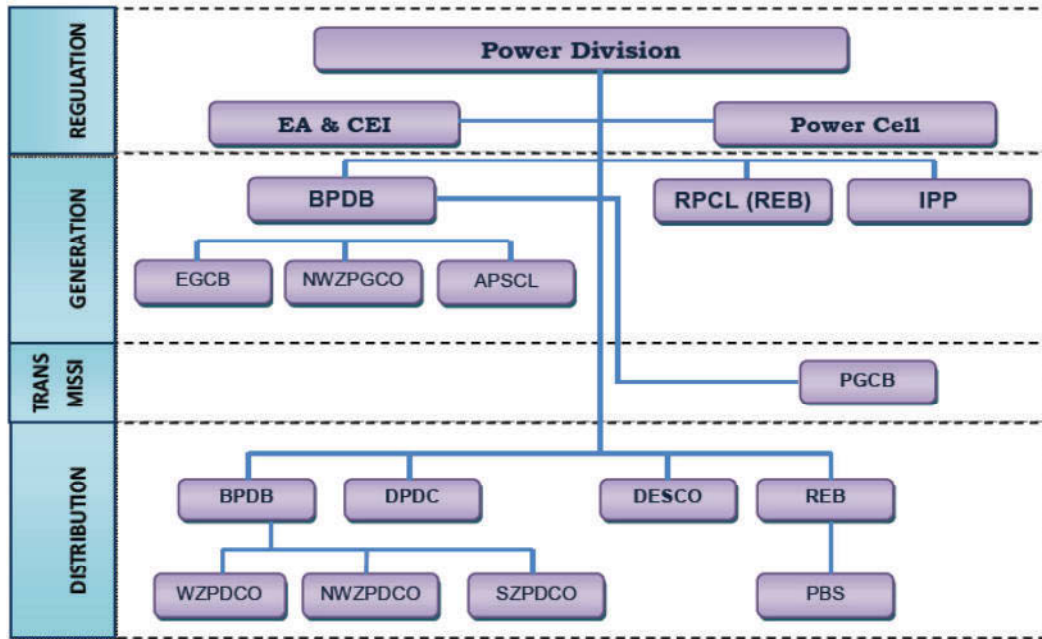
Because of the critical nature, the Government of Bangladesh has given highest priority to the power sector to enhance the generation capacity. BPDB has come up with a comprehensive plan to meet the surging demand in power. Accordingly, the government plans to eliminate the demand supply gap and achieve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

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

3.7 INSTITUTIONAL STRUCTURE OF POWER SECTOR IN BANGLADESH

Power Division is responsible for formulating policy relating to power and supervise, control and monitor the developmental activities in the power sector of the country.

To implement its mandate, the Power Division is supported by a number of organizations, related with generation, transmission and distribution. The overall organizational structure and linkage is shown below:



Chapter-4

CHAPTER FOUR: BASELINE EXISTING ENVIRONMENT

4.0 BASELINE ENVIRONMENTAL CONDITIONS

4.1 GENERAL CONSIDERATION

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

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

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

4.2 BOUNDING THE IMPACT AREA

The study area covers the APSCL and the immediate surrounding extended area of about 5 km radius, considered as “Area of Influence (AoI)”. The proposed power plant will be located inside Ashuganj Power plant complex and Ashuganj Power Station Company Ltd. Ashuganj located on the east bank of the Meghna River about 90 km Northeast to Dhaka and is connected by railway and highway with Dhaka. There also exists good waterways connection of the site with seaports of Chittagong and Mongla. The project locates in Sonaram Mouza of Ashuganj Upazila. Bangladesh UK Friendship Bridge across the river Meghna (Meghna Bridge) connects both the banks of Bhairab and Ashuganj. Primary and Secondary data has been generated and collected for conducting Baseline Study.

4.3 CLIMATE

The climate of this region is tropical, with monsoons, characterized by a change of four seasons: pre-monsoon (March to May), monsoon (June to September), post-

monsoon (October to November) and dry season (December to February). High air temperature is observed all throughout the year; daily air temperature variations are insignificant; air humidity is high with abounding rains. Typical parameters of the weather elements, as recorded for the period of last few years of observations (2007-2013) at Comilla Meteorological Station are presented in table 4.1 to 4.9 below.

4.3.1 Rainfall

Its annual rainfall is about 2551mm and approximately 80% of it occurs during the monsoon. Average monthly rainfall during monsoon period varies between 300mm to 450mm.

The rainfall follows the general climate pattern with the highest rainfall in the summer month of June to September and minimum rainfall in the cooler and drier months of November to March. It is evident that extreme rainfall events occurred during the monsoon (June-September). Average monthly rainfall values for Comilla area since 2001 are presented in Table -4.1.

Table - 4.1 Monthly Average Rainfall in the project area (2001- 2013)

Year	Rainfall in mm											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2013	0	3	30	28	467	214	276	243	255	124	0	3
2012	16	1	13	195	209	442	282	373	178	115	102	3
2011	0	0	28	76	351	346	273	501	233	76	0	0
2010	0	13	30	23	343	417	94	125	241	277	0	15
2009	0	0	3	48	295	235	573	427	145	98	0	0
2008	30	11	26	34	282	330	457	375	247	265	0	0
2007	0	20	21	179	153	548	665	221	339	280	82	0
2006	0	0	0	117	607	402	151	226	300	94	1	0
2005	6	2	249	157	193	259	403	410	395	349	0	1
2004	0	4	6	175	186	654	311	183	686	218	1	0
2003	2	50	128	132	141	673	290	131	97	129	3	49
2002	29	0	72	91	344	316	766	223	129	83	83	0
2001	0	13	6	54	300	590	184	312	258	161	72	0

Source: BMD

4.3.2 Relative Humidity

As would be expected, relative humidity during the wet season is significantly higher than those occurring at other period of the year. This is well depicted by the data as shown in the **Table - 4.2** for relative humidity of Brahmanbaria, Comilla during the

period 2007 – 2013.

Table -4.2 Average Monthly Relative Humidity of the Project Area in years 2007-2013 (source: BMD)

Humidity in %	Monthly Mean Humidity												
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
2007	77	76	71	81	82	86	88	84	85	82	81	79	81
2008	79	73	81	77	79	86	86	86	82	83	77	83	81
2009	78	73	75	78	80	83	86	86	83	82	76	79	79
2010	78	71	76	80	80	86	83	83	85	82	78	76	79
2011	75	68	74	78	82	85	84	85	84	80	76	81	79
2012	77	70	75	81	79	84	85	83	85	82	78	83	80
2013	74	68	75	78	85	81	83	85	84	85	78	81	79

Source: BMD

4.3.3 Wind Speed

According to Bangladesh Meteorological Department the average wind speed at Brahmanbaria within March to September is 2.05 knots in 2012.

Table - 4.3 - Monthly Prevailing Wind Speed and Direction in Knots of Brahmanbaria, Comilla for the period of 2007-2013

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2007	2.4N	2.8S	3.0NW	4.0S	3.7S	3.8S	3.2S	2.8S	2.7S	3.7S	2.3N	2.2N
2008	2.8N	2.5NW	3.2S	3.8S	3.7S	4.1S	4.5S	3.1S	2.9S	2.5N	2.2N	2.2NW
2009	2.1NW	2.9S	2.6S	3.4S	2.8S	2.5S	2.4S	2.1S	2.3S	1.7N	1.7N	1.7N
2010	1.8NW	2.0NW	3.6S	4.2S	2.7S	2.7S	2.1S	1.7S	1.8S	1.7N	1.5N	1.7N
2011	1.6NW	1.7NW	3.7S	1.8S	2.0S	2.0S	1.9S	2.0S	1.9S	2.3N	1.6N	1.8NW
2012	1.9NW	2.2NW	2.6 S	2.0 S	2.2 S	2.5S	2.3 S	1.9S	1.9 S	1.8S	1.5 N	1.8 N
2013	2.2NW	2.5NW	2.1S	2.4S	2.9S	2.5S	2.7S	2.4S	2.4S	3.2S	2.0N	2.3NW

Source: BMD

4.3.4 Ambient Air Temperature

The temperature of the country has the relationship with the period of rainfall. In general cool seasons coincide with the period of lowest rainfall. Table 4.4 - Table 4.10 respectively shows the monthly average maximum and minimum temperature at Comilla for the period 2007-2013. During this period maximum average temperature of 37.0 degree Celsius was observed in May, 2009 where average minimum temperature was 5.3 degree Celsius in January, 2013.

Table - 4.4 Monthly Ambient Temperature of the Project Area in 2007

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	17.2	27.7	8.3
Feb	21.1	30.0	12.5
March	24.0	34.5	13.5
April	26.8	34.5	16.6
May	28.7	36.4	21.5
June	28.3	35.6	22.7
July	27.8	34.6	23.0
Aug	28.8	35.6	24.0
Sep	28.2	34.8	24.0
Oct	26.9	35.4	19.4
Nov	24.1	31.5	17.5
Dec	19.4	28.2	10.8

Source: BMD

Table - 4.5 Monthly Ambient Temperature of the Project Area in 2008

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	18.5	28.0	10.5
Feb	19.7	30.4	8.5
March	25.4	32.4	15.6
April	27.8	36.6	18.2
May	28.4	36.7	20.7
June	27.9	35.5	22.6
July	27.9	34.4	24.0
Aug	28.2	36.2	24.5
Sep	28.5	35.4	22.6
Oct	26.6	34.4	18.8
Nov	23.6	32.5	14.5
Dec	20.5	30.3	12.2

Source: BMD

Table - 4.6 Monthly Ambient Temperature of the Project Area in 2009

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	19.2	28.2	9.8
Feb	21.9	31.0	11.2
March	25.5	34.0	15.6
April	28.5	36.8	19.0
May	28.4	37.0	19.8
June	29.0	36.3	23.2
July	28.2	35.5	23.8
Aug	28.5	35.0	23.7
Sep	28.8	36.4	23.0
Oct	26.9	36.5	19.8
Nov	24.0	34.0	13.2
Dec	19.0	29.5	8.7

Source: BMD

Table - 4.7 Monthly Ambient Temperature of the Project Area in 2010

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	16.9	30.2	8.6
Feb	21.2	32.3	10.0
March	26.7	35.6	17.2
April	28.7	35.2	20.8
May	28.3	36.6	21.3
June	28.4	34.2	22.9
July	29.0	35.2	24.4
Aug	29.2	35.6	25.4
Sep	28.4	36.0	23.0
Oct	27.8	36.2	20.8
Nov	24.4	33.0	16.2
Dec	19.4	30.3	10.3

Source: BMD

Table - 4.8 Monthly Ambient Temperature of the Project Area in 2011

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	16.9	28.2	7.7
Feb	21.6	30.0	12.0
March	24.6	33.1	13.5
April	26.9	34.0	19.4
May	27.7	35.8	21.0
June	28.3	35.7	23.4
July	28.5	35.0	23.4
Aug	28.2	35.4	23.8

Sep	28.3	35.8	24.5
Oct	27.6	34.4	20.4
Nov	23.3	32.1	15.8
Dec	19.0	31.2	10.3

Source: BMD

Table - 4.9 Monthly Ambient Temperature of the Project Area in 2012

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	18.1	28.0	9.0
Feb	21.0	31.0	9.8
March	26.0	34.0	16.2
April	26.7	35.5	17.6
May	28.9	35.5	20.5
June	28.7	35.8	22.2
July	28.3	34.1	24.8
Aug	28.6	34.5	24.0
Sep	28.5	35.5	24.5
Oct	26.9	34.5	19.2
Nov	23.1	31.8	12.9
Dec	17.9	28.2	8.8

Source: BMD

Table - 4.10 Monthly Ambient Temperature of the Project Area in 2013

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	17.1	28.6	5.3
Feb	21.9	31.4	12.9
March	25.7	34.0	15.2
April	27.5	34.8	19.2
May	26.9	34.8	19.2
June	29.5	35.6	23.8
July	28.6	35.6	24.8
Aug	28.2	35.0	24.6
Sep	28.5	35.4	24.0
Oct	26.8	34.6	20.7
Nov	23.1	33.2	15.1
Dec	19.4	30.8	10.2

Source: BMD

4.4 AMBIENT AIR QUALITY

Major atmospheric pollution is caused by man induced activities like - burning fossil fuels, industrial processors, construction works and agriculture, transportation

industry. In the rural areas however the ambient air quality is relatively good. It is assumed that accepting the small areas near the urban growth center air quality in the most of the area would be far below the Environmental Quality Standards of Bangladesh. Air monitoring has been conducted at three different locations (24 Hour Basis). The air quality data of the proposed plant site is given in Table 4.11. It shows that the ambient air quality in terms of major three ambient air quality indicators SPM, NO_x and SO₂, are of different ranges. The air quality of different parameters is within the national and international limits.

Table - 4.11 Ambient Air Quality Analysis

SN	Sample Description	Ambient Air Pollution Concentration in micro gram/cubic meter (µg/m³)					
		PM _{2.5}	PM ₁₀	SPM	SO ₂	NO _x	CO
01	Method of analysis	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator Tube
02	Test Duration (Hours)	24	24	8	24	24	8
03	Bangladesh (DoE) Standard for ambient Air	65	150	200	365	100	10000
04	International /World Bank Standard	75	150	NF	125	200 (1 hr)	NF
05	Test result in near project site N- 24°02'41.3" E- 091°01'06.2" (Location 1 in Fig 4.1) (Date :30/4/2015 & 12/10/2015 for 1 hr Nox)	38	73	157	22	26	110
						54 (1 hr)	
06	Test result in near APSCL Dormitory N- 24°02'47.6" E- 091°01'07.1" (Location 2 in Fig 4.1) (Date :1/7/2015 - 2/7/2015)	36	77	149	19	12	98
07	Test result in near Old Ferry Ghat, Meghna Bridge N- 24°02'28.1" E- 091°00'02.2" (Location 3 in Fig 4.1) (Date :1/7/2015 - 2/7/2015)	53	81	163	13	11	102
08	Test result in near East Dormitory. N- 24°04'57.17" E- 91°01'94.73" (Location 4 in Fig 4.1) (Date: 12/10/2015-13/10/2015)	32	68	161	16	20	105
						48 (1 hr)	
Remarks			Pollution source from normal activities				

(All units are microgram/cubic meter, NF – not found, DoE – Department of Environment.)

Source: AECL Lab (This monitoring report was accomplished by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550)

- Note:
1. Respirable Dust Content (PM₁₀).
 2. Suspended Particulate Matter (SPM).
 3. Oxides of Nitrogen (NO_x).
 4. Sulphur Di-Oxide (SO₂).
 5. Carbone Mono-Oxide (CO).
 6. Fine Particulate Matter (PM_{2.5})

A 450 MW Power plant named 'Ashuganj 450 MW Combined Cycle Power Plant (South)' has been under construction since 2014 which is situated in the **APSCL complex** (See Figure 4.1). Adroit has been monitoring the ambient air quality of the 450 MW project for the past year. Data of air quality monitoring for the last month of the 450 MW project is presented below:



Adroit Environment Consultants Ltd

A House of Complete Environmental Management Solution



Memo # AECL
Enterprise : Ashuganj 450MW CCPP Project by EPC Contractor TSK.
Project address : APSCL, B-Baria, Bangladesh.

Description of Sample : Ambient air quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 12-13 September, 2015.
Reporting date : 29th September, 2015.

AECL LABORATORY ANALYSIS REPORT
AMBIENT AIR QUALITY TEST REPORT

: 474


Description of analysis

SN	Description	Ambient Air Pollution Concentration in micro gram/cubic meter.		
		PM _{2.5}	PM ₁₀	SPM
01	Method of analysis	Gravimetric	Gravimetric	Gravimetric
02	Test Duration (Hours)	24	24	8
03	Bangladesh (DoE) Standard for ambient Air	65	150	200
04	International /World Bank Standard	75	150	NF
05	Test result in near TSK Office area. N- 24°02'19.3" E- 091°00'37.4"	28	58	111
06	Test result in near Project gate # 2 N-24°02'22.3" E-091°00'32.9"	35	93	183
07	Test result in near switch gate area. N- 24°02'21.6" E-091°00'29.1"	41	83	132
08	Test result in near SB project office area. N- 24°02'15.4" E-091°00'33.8"	33	80	130
Remarks		Maximum pollution source from project construction activities		

Note: This monitoring report was accomplished by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550).

1. Fine Particulate Matter (PM_{2.5}).
2. Respirable Dust Content (PM₁₀).
3. Suspended Particulate Matter (SPM).

Weather Condition: The weather was sunny.


 29/09/15
Md. Hasanul Islam
 Senior Manager (Engineer)


 29/09/15
Nigar Sultana
 Senior Chemist


 29.9.15
Syed Hosnee Jahab
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From the above analysis it has been observed that air quality surrounding the proposed project for the last few months was satisfactory under both domestic and international standards since the major construction of the plant is completed and therefore the dust emission is now minimum and the EPC Contractor is also following the mitigation measures to reduce the SPM.

4.5 NOISE

Sophisticated machineries will be installed in the project area during when the industries will be set up after allocation, which will produce little significant noise. It is suggested that the project authority will create necessary green belt around the project site, administrative building and other services buildings, which would reduce the noise level significantly. The ambient noise level data were collected from different sides of the project within 1-5 km radius area by noise level meter and has been given below in Table 4.12.

Table 4.12: Ambient Noise Quality Analysis

Concentration present (LA_{eq}) dBA.					
Site Description: Test result near Project area					
Location Coordinated : N- 24°02'41.3" E- 091°01'06.2" (Location 1 in Fig 4.1)					
SN	Time	Minimum	Maximum	Average	Remark
01	06.00 AM	61.3	75.7	68.5	Noise source from near power plant activities.
02	07.00 AM	62.1	75.4	68.75	Noise source from near power plant activities.
03	08.00 AM	61.5	75.5	68.0	Noise source from near power plant activities.
04	09.00 AM	62.6	76.3	69.45	Noise source from near power plant activities.
05	10.00 AM	65.8	77.5	71.65	Noise source from near power plant activities.
06	11.00 AM	63.7	77.4	70.55	Noise source from near power plant activities.
07	12.00 PM	66.2	78.9	72.55	Noise source from near power plant activities.
08	01.00 PM	63.3	77.3	70.3	Noise source from near power plant activities.
09	02.00 PM	61.1	76.8	68.95	Noise source from near power plant activities.
10	03.00 PM	66.8	78.0	72.4	Noise source from near power plant activities.
11	04.00 PM	68.7	79.4	74.05	Noise source from near power plant activities.
12	05.00 PM	66.6	76.8	71.7	Noise source from near power plant activities.
13	06.00 PM	62.7	76.5	69.6	Noise source from near power plant activities.
14	07.00 PM	61.4	75.5	68.45	Noise source from near power plant activities.
15	08.00 PM	60.9	75.3	68.1	Noise source from near power plant activities.

16	09.00 PM	61.5	75.9	68.7	Noise source from near power plant activities.
17	10.00 PM	59.4	74.0	66.9	Noise source from near power plant activities.
18	11.00 PM	58.7	74.2	66.5	Noise source from near power plant activities.
19	12.00 AM	58.9	74.6	66.75	Noise source from near power plant activities.
20	01.00 AM	58.5	74.9	66.7	Noise source from near power plant activities.
21	02.00 AM	57.8	74.7	66.25	Noise source from near power plant activities.
22	03.00 AM	57.6	75.2	66.4	Noise source from near power plant activities.
23	04.00 AM	59.2	75.8	67.5	Noise source from near power plant activities.
24	05.00 AM	59.7	75.5	67.6	Noise source from near power plant activities.

Source: AECL Lab (measured on 30.04.2015 by Sound Level Meter of AECL)

Concentration present (LA_{eq}) dBA.					
Site Description: Test result near APSCL Dormitory					
Location Coordinated : N- 24°02'47.6" E- 091°01'07.1" (Location 1 in Fig 4.1)					
SN	Time	Minimum	Maximum	Average	Remark
01	06.00 AM	75.8	78.5	77.15	Noise source from near power plant activities.
02	07.00 AM	74.3	79.3	76.8	Noise source from near power plant activities.
03	08.00 AM	74.5	80.1	77.3	Noise source from near power plant activities.
04	09.00 AM	71.2	80.5	75.85	Noise source from near power plant activities.
05	10.00 AM	76.9	82.4	79.65	Noise source from near power plant activities.
06	11.00 AM	79.9	83.6	81.75	Noise source from near power plant activities.
07	12.00 PM	80.1	83.9	82.0	Noise source from near power plant activities.
08	01.00 PM	78.1	84.1	81.1	Noise source from near power plant activities.
09	02.00 PM	78.5	85.0	81.75	Noise source from near power plant activities.
10	03.00 PM	76.6	86.2	81.4	Noise source from near power plant activities.
11	04.00 PM	77.4	85.7	81.55	Noise source from near power plant activities.
12	05.00 PM	79.8	84.6	82.2	Noise source from near power plant activities.
13	06.00 PM	80.3	84.5	82.4	Noise source from near power plant activities.
14	07.00 PM	76.4	81.8	79.4	Noise source from near power plant activities.
15	08.00 PM	74.1	79.7	76.9	Noise source from near power plant activities.
16	09.00 PM	74.3	77.5	75.9	Noise source from near power plant activities.

17	10.00 PM	74.3	77.8	75.9	Noise source from near power plant activities.
18	11.00 PM	75.1	76.3	75.7	Noise source from near power plant activities.
19	12.00 AM	74.5	76.2	75.35	Noise source from near power plant activities.
20	01.00 AM	74.6	77.9	76.25	Noise source from near power plant activities.
21	02.00 AM	74.5	77.4	75.95	Noise source from near power plant activities.
22	03.00 AM	73.8	76.5	75.15	Noise source from near power plant activities.
23	04.00 AM	74.8	78.9	76.85	Noise source from near power plant activities.
24	05.00 AM	75.7	77.4	76.55	Noise source from near power plant activities.

Source: AECL Lab (measured on 1-2 July, 2015 by Sound Level Meter of AECL)

Concentration present (LA_{eq}) dBA.					
Site Description: Test result near Old Ferry Ghat, Meghna Bridge Location Coordinated : N- 24°02'28.1" E- 091°01'02.2" (Location 1 in Fig 4.1)					
SN	Time	Minimum	Maximum	Average	Remark
01	06.00 AM	61.3	65.3	63.3	Noise source from nearby traffic activities
02	07.00 AM	62.4	65.7	64.05	Noise source from nearby traffic activities
03	08.00 AM	60.7	66.9	63.8	Noise source from nearby traffic activities
04	09.00 AM	62.7	67.1	64.9	Noise source from nearby traffic activities
05	10.00 AM	63.2	70.3	66.75	Noise source from nearby traffic activities
06	11.00 AM	63.8	72.4	68.1	Noise source from nearby traffic activities
07	12.00 PM	66.1	75.9	71	Noise source from nearby traffic activities
08	01.00 PM	62.7	77.8	70.25	Noise source from nearby traffic activities
09	02.00 PM	60.2	77.5	68.85	Noise source from nearby traffic activities
10	03.00 PM	64.5	77.1	70.8	Noise source from nearby traffic activities
11	04.00 PM	68.9	77.4	73.15	Noise source from nearby traffic activities
12	05.00 PM	67.7	75.4	71.55	Noise source from nearby traffic activities
13	06.00 PM	65.5	72.8	69.15	Noise source from nearby traffic activities
14	07.00 PM	61.2	69.1	65.15	Noise source from nearby traffic activities
15	08.00 PM	62.4	67.4	64.9	Noise source from nearby traffic activities
16	09.00 PM	61.8	67.1	64.45	Noise source from nearby traffic activities
17	10.00 PM	59.5	66.2	62.85	Noise source from nearby traffic activities

18	11.00 PM	58.8	66.3	62.55	Noise source from nearby traffic activities
19	12.00 AM	58.9	65.8	63.35	Noise source from nearby traffic activities
20	01.00 AM	57.1	61.2	59.15	Noise source from nearby traffic activities
21	02.00 AM	55.0	61.8	58.4	Noise source from nearby traffic activities
22	03.00 AM	56.1	60.2	58.15	Noise source from nearby traffic activities
23	04.00 AM	58.7	64.5	61.6	Noise source from nearby traffic activities
24	05.00 AM	59.7	64.9	62.3	Noise source from nearby traffic activities
Bangladesh (DoE) Standard					
				Day	Night
Industrial area				75	70
Commercial Area				70	60
Mixed Area				60	50
Residential Area				55	45
World Bank/IFC Standard					
Industrial				70	70
Residential; Intuitional; Educational				55	45

Source: AECL Lab (measured on 1-2 July, 2015 by Sound Level Meter of AECL)

For location 1, the night time monitoring was not done. But, it is obvious that, at night, the noise level will be less than the noise level at day time. From the table 4.14 for location 1, it can be seen that the noise is reducing after 4:00 pm and therefore to comment on the noise level, it is not compulsory to take the noise data even at night. But for better observation, later while monitoring at location 2 and 3, 24 hr data was observed. Since, there are many power plants are operating in that area, it is seen that the noise level is exceeding. To control the noise issue, noise protection measures are to be taken by APSCL.

In figure 4.1 the monitoring locations are shown. The farthest monitoring point (Location 3 in the figure 4.1) is aerially at 1.79 km distance from the project site. The green icon is the proposed project location, yellow icons are the other power plant projects of APSCL that are going under construction and the red icons are the monitoring locations. Air, noise and water quality monitoring reports are attached as Annexure 11.

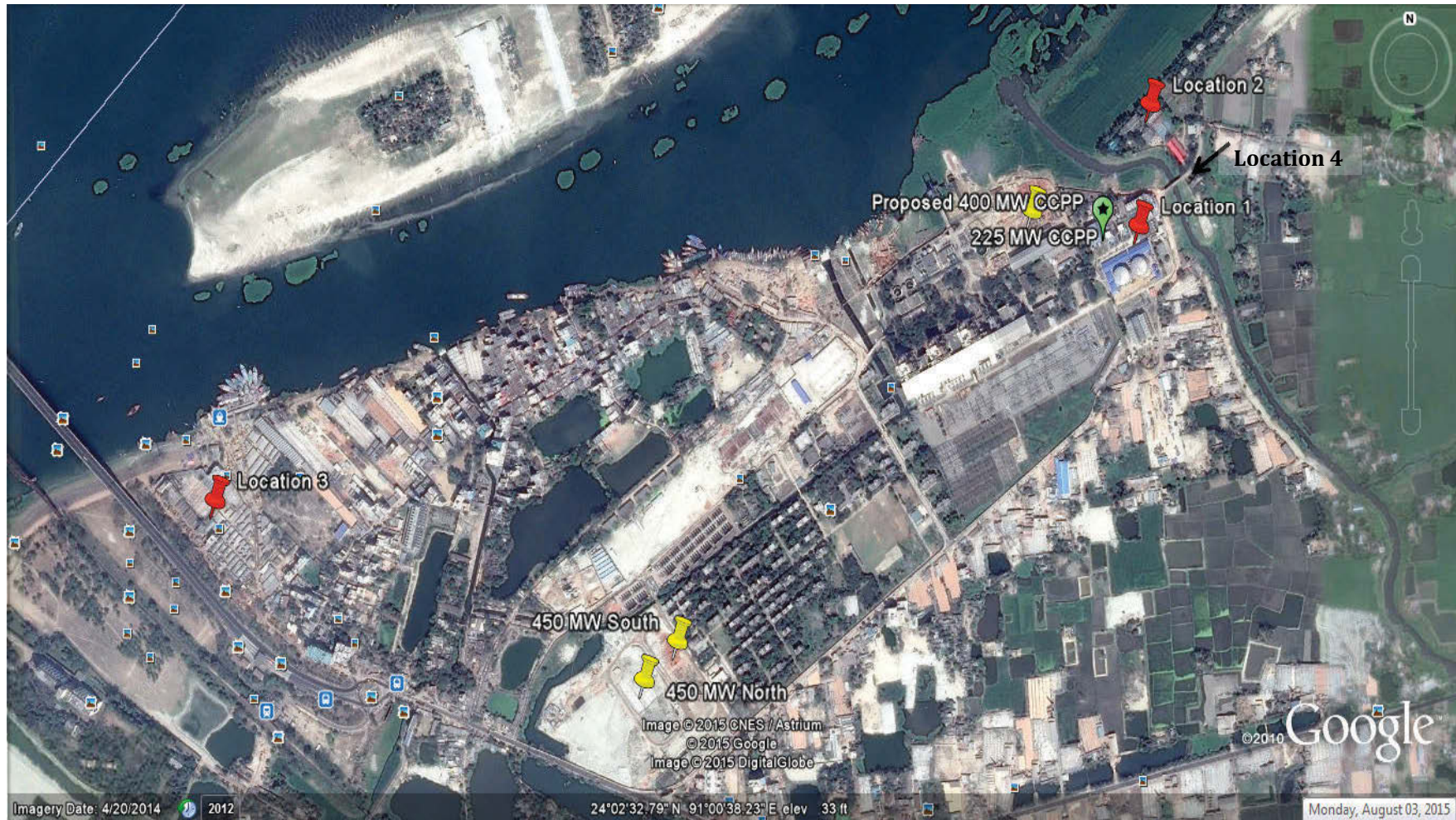


Figure 4.1: Air and Noise Monitoring Locations near the Project

4.6 GEOLOGY AND SOIL

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

Proposed project site belongs to the Middle Meghna River Floodplain area of the National Classification. Soils of the area are grey, loamy on the ridges and grey to dark grey clayey in the basins. Grey sands to loamy sands with compact silty topsoil, occupying areas of old Brahmaputra char. Dominant general type is Non calcareous Grey Floodplain soils. Top soils are strongly acidic and sub soils slightly acidic to slightly alkaline. General fertility level is medium. The physiographic map of Bangladesh is shown in **Figure 4.2**. Within this area, elevations are less than 3m above sea level, which is shown in **Figure 4.3**.

The elevation survey report of Ashuganj Power Station Company Ltd. (APSCL) is attached in the Annexure 10.

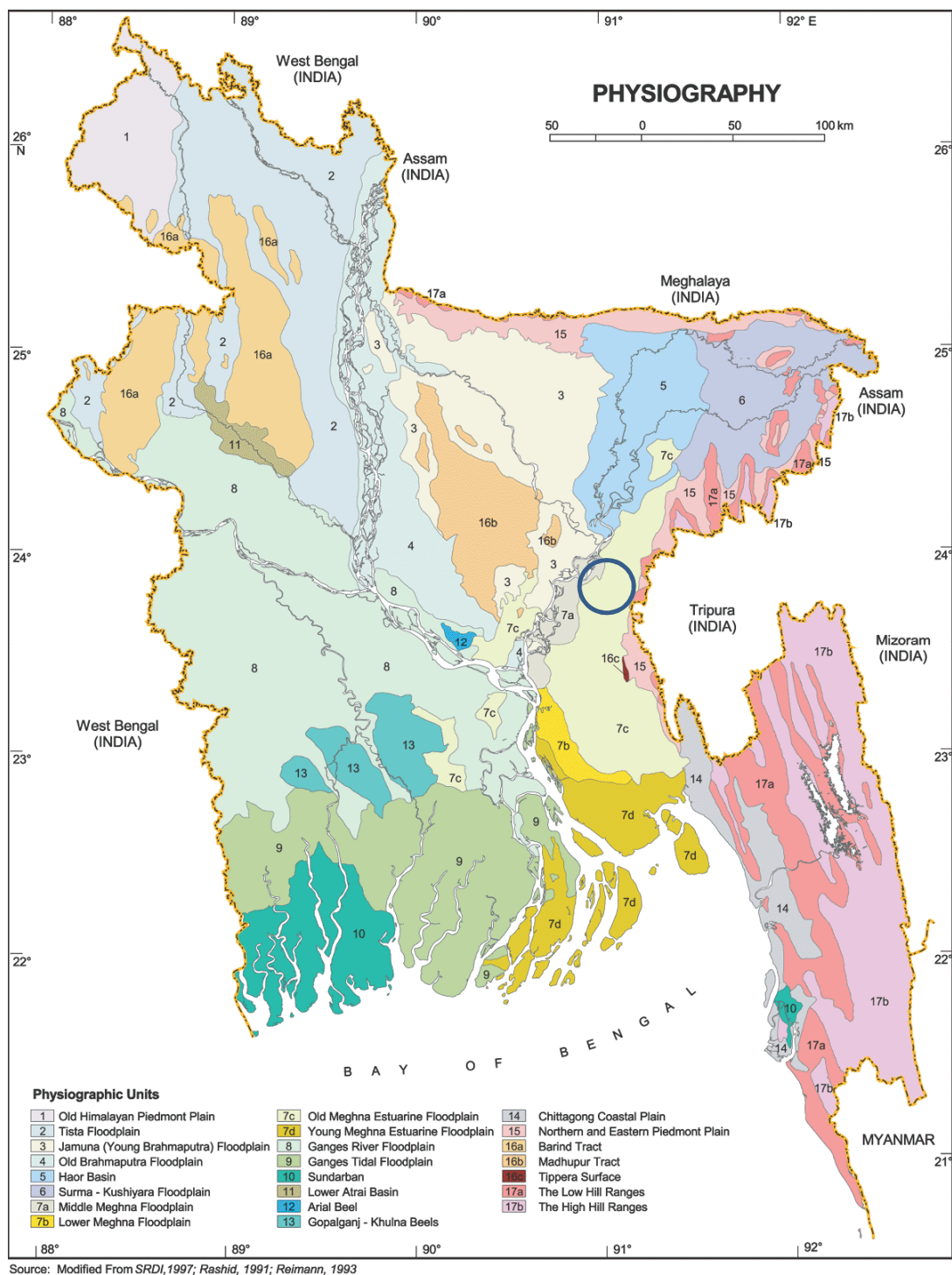


Fig. 4.2: Physiographic Map of Bangladesh

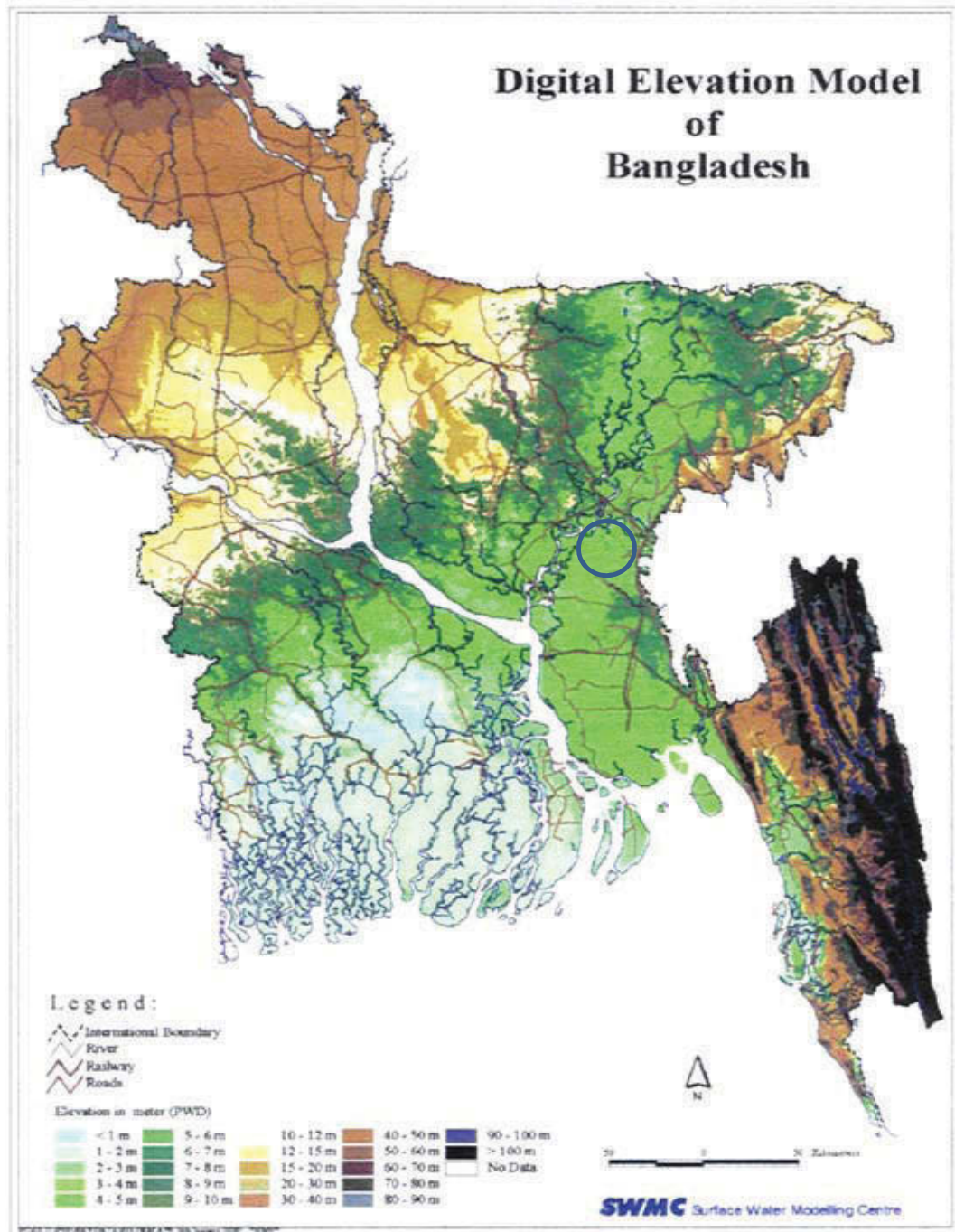


Fig. 4.3: Digital Elevation Model of Bangladesh

4.7 SEISMICITY

Bangladesh, a densely populated country in South Asia, is located in the north-eastern part of the Indian sub-continent at the head of the Bay of Bengal.

Tectonically, Bangladesh lies in the north-eastern Indian plate near the edge of the Indian craton and at the junction of three tectonic plates – the Indian plate, the Eurasian plate and the Burmese micro plate. These form two boundaries where plates converge– the India-Eurasia plate boundary to the north forming the Himalaya Arc and the India-Burma plate boundary to the east forming the Burma Arc (**Fig. 4.4**).

Active faults of regional scale capable of generating moderate to great earthquakes are present in and around Bangladesh. These include the Dauki fault, about 300 km long trending east-west and g north-south situated between Madhupur Tract and Jamuna flood plain, Assam-Sylhet faulocated along the southern edge of Shillong Plateau (Meghalaya- Bangladesh border), the 150 km long Madhupur fault trendinlt, about 300 km long trending north east southwest located in the southern Surma basin and the Chittagong-Myanmar plate boundary fault, about 800 km long runs parallel to Chittagong-Myanmar coast (**Fig. 4.5**).

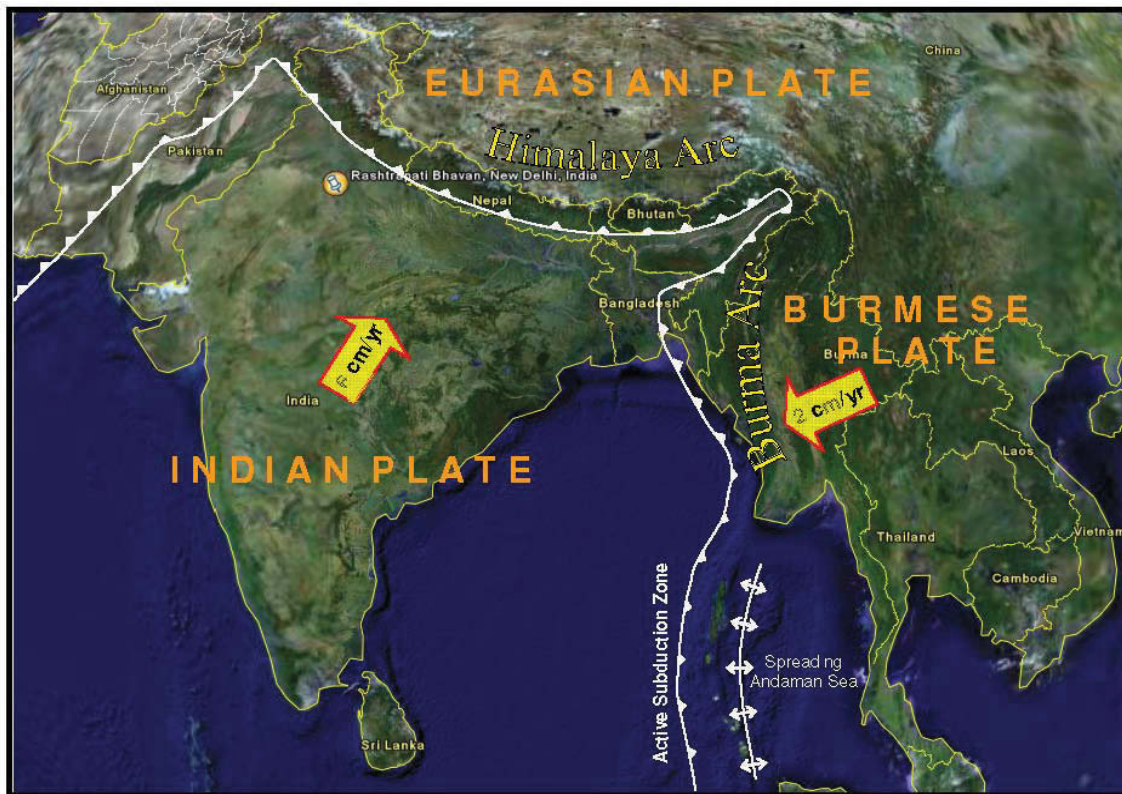


Fig. 4.4: Regional tectonic setup of Bangladesh with respect to plate configuration

The Chittagong- Myanmar plate boundary continues south to Sumatra where it ruptured in the disastrous 26 December 2004 Mw 9.3 earthquake (Steckler et al. 2008). These faults are the surface expression of fault systems that underlie the northern and eastern parts of Bangladesh. Another tectonic element, the 'Himalayan Arc' is characterized by three well defined fault systems (HFT, MBT and MCT) that are 2500 km long stretching from northwest syntaxial bend in Pakistan in the west to

northeast syntaxial bend in Assam in the east. It poses a great threat to Bangladesh as significant damaging historical earthquakes have occurred in this seismic belt (Bilham et al., 2001; Mukhopadhyay et al., 2004 and Mullick et al., 2009). The tectonic set-up and the plate motions together place Bangladesh potentially vulnerable to earthquake.

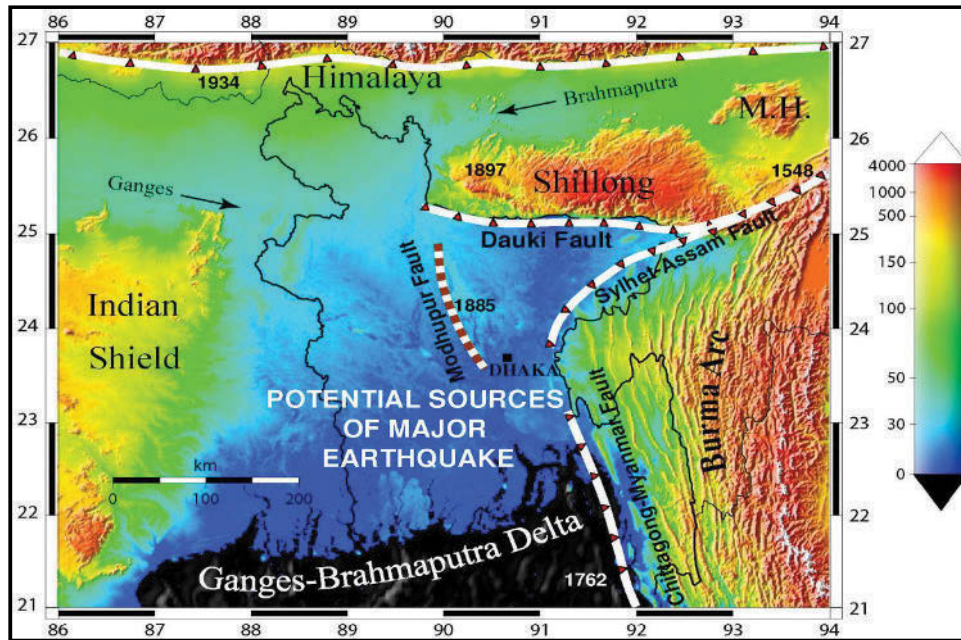


Fig. 4.5: Digital Elevation Model (DEM) of Bangladesh and surroundings showing geological faults – potential sources of major earthquakes in Bangladesh.

On the basis of distribution of earthquake epicenters and morphotectonic behaviour of different tectonic blocks Bangladesh has been divided into three generalized seismic zones (**fig 4.6**). Zone-II comprising the central part of Bangladesh represents the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. The zone II consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the Bask coefficient for this zone is 0.05. Ashuganj area within the vicinity of Brahmanbaria falls in seismic zone II of the seismic zoning map of Bangladesh.

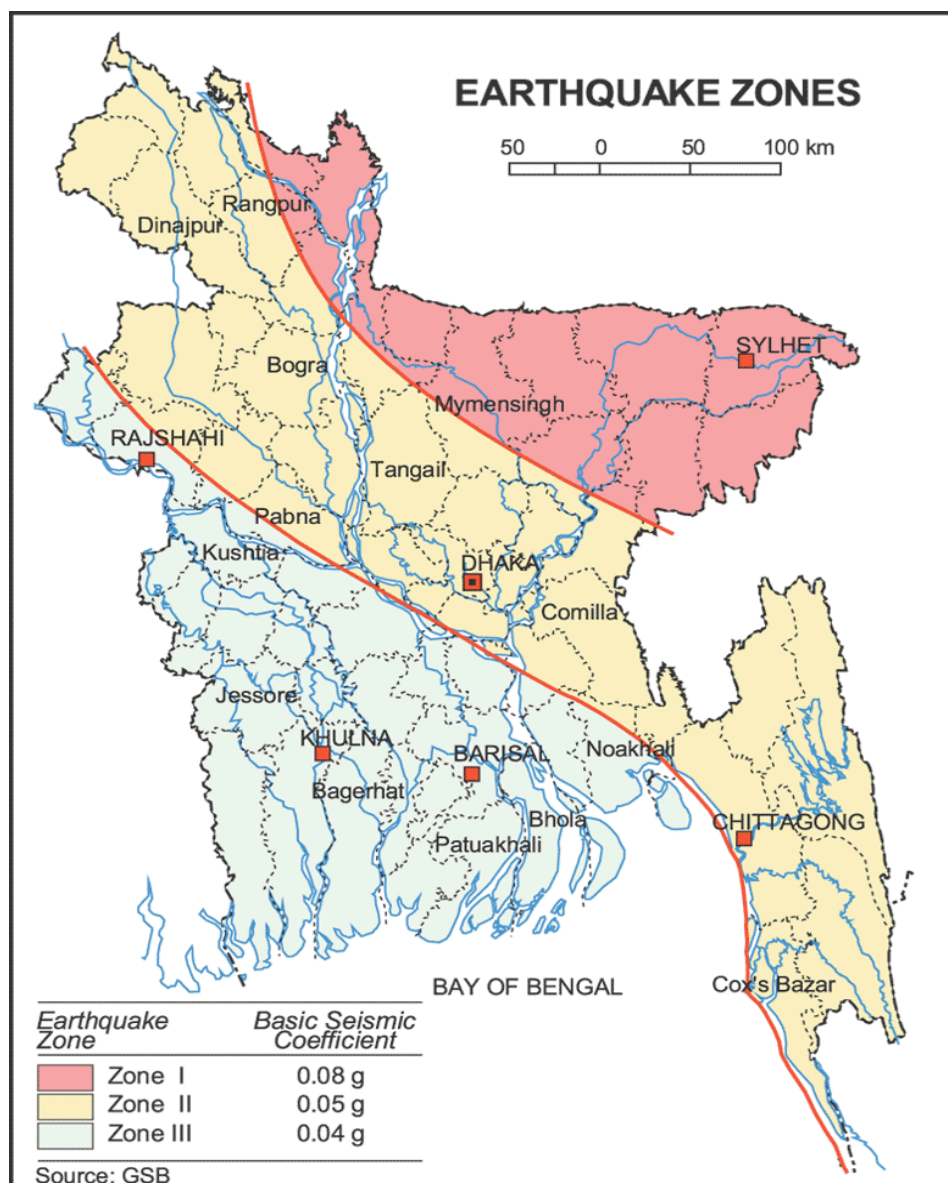


Fig 4.6: Earthquake Zoning Map of Bangladesh

Table 4.13: Seismic Zonation of Bangladesh

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

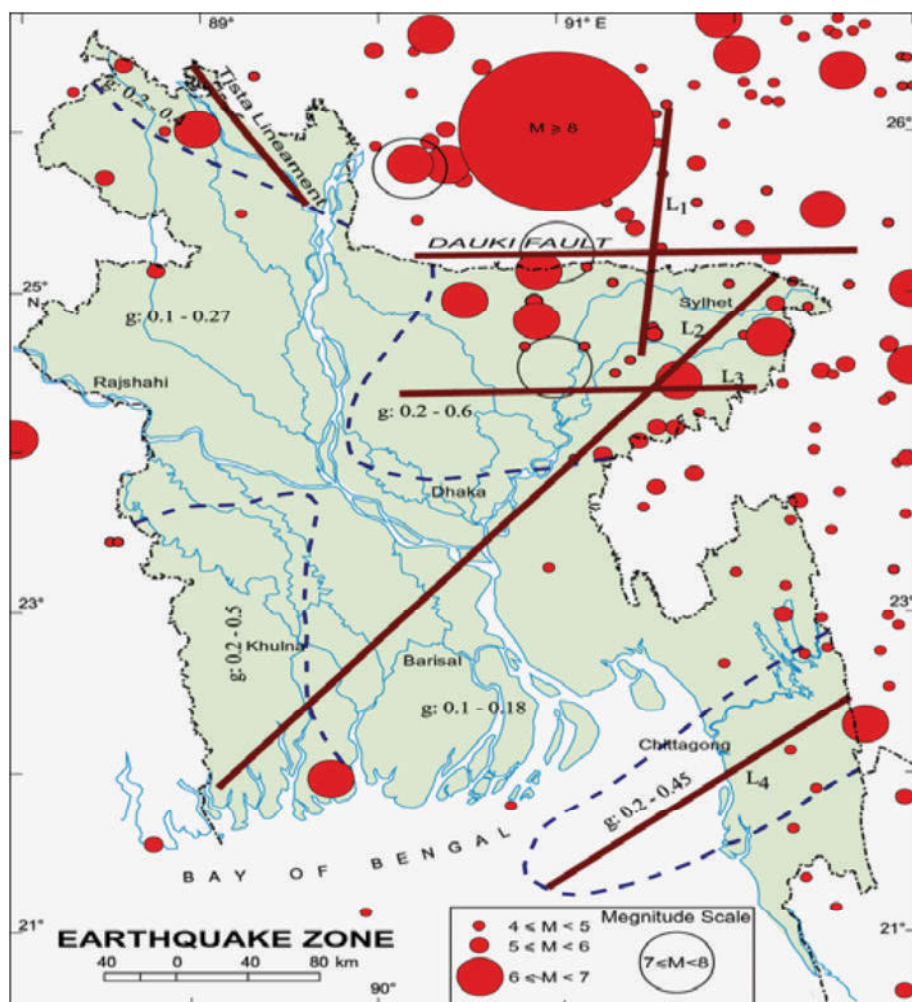


Fig. 4.7: Seismic Activity of Bangladesh

4.8 HYDROLOGY

4.8.1 River Water Flow

The flow of Meghna River at Ashuganj is less affected by tides. The maximum discharge of 16558m³/sec was measured on 9th September 2002; while the minimum discharge of 2050m³/sec was recorded on 10th June, 1998. The water data collected from BWDB for the period from 1998 to 2006 is attached in **Table – 4.14**.

Table 4.14: Flow at the Meghna River (m³/s)

Year	Maximum	Minimum
1998	14669	2050
2000	12109	3197
2001	11630	3135
2002	16558	4448
2003	13229	2938

2004	10571	3742
2005	10786	3658
2006	9463	4230

Source: BWDB

4.8.2 Surface Water Quality

The existing water quality of the Meghna river at the upstream is relatively good (**Table: 4.15**). Ashuganj Fertilizer Complex is situated about 2km downstream of Ashuganj Power Station. So, the Fertilizer Factory has no adverse environmental effect on Ashuganj Power Station.

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

The water quality parameters investigated are within the Bangladesh standards. It may be pointed out that the cooling water discharge shall be similar in composition to that of the water abstracted from the Meghna River. The surface water quality test of the nearby pond from the project site as well the surface water quality of the river Meghna is shown in table 4.15.

Table-4.15: Surface Water quality (limited parameters) of the River Meghna

Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	IFC/World Bank Standard	Method of analysis
Temperature	38°C	40°C	NF	Mercury filled thermometer
Dissolved Oxygen(DO)	7.3 mg/L	4.5-8 mg/l	NF	Azide modification
BOD ₅	7 mg/L	50 mg/l	50 mg/l	Dilution
COD	32 mg/L	200 mg/l	250 mg/l	COD Refluction
Total Dissolved Solids (TDS)	115.2 mg/L	2100 mg/l	NF	TDS Meter
Total Suspended Solids (TSS)	5.32 mg/L	150 mg/l	NF	Gravimetric method
pH	6.69	6-9	6-9	P ^H meter
Total Alkalinity	27 mg/L	NF	NF	Standard Titrimetric method
Hardness	96 mg/L	NF	NF	EDTA titrimetric method
Iron	1.5 mg/L	2 mg/l	NF	Colorimetric
Chloride	60 mg/L	600 mg/l	NF	Mercuric nitrate titration
Nitrate	3.75 mg/l	10.0 mg/l	NF	Specific Ion Electrode
Arsenic	0.003 mg/l	0.2 mg/l	NF	AAS(Atomic Absorption spectrometry)

Lead	<0.05 mg/l	0.1 mg/l	0.1 mg/l	AAS
Manganese	<0.1 mg/l	5 mg/l	NF	Colorimetric
Copper	0.01 mg/l	0.5 mg/l	NF	AAS
Calcium	1.9 mg/l	NF	NF	Titration
Oil & Grease	<5.5 mg/l	10.0 mg/l	10.0 mg/l	APHA 5520.B

Source: AECL Lab (water collected on 30.04.2015 and tested on 17.05.2015)

For Oil & Grease Test (water collected on 1.07.2015 and reported on 1.08.2015)

*Standard for inland surface water.

*NF-Not Found.

4.8.3 Groundwater Hydrology

Groundwater Level

Groundwater hydrological conditions are established by the availability of developed ground water horizon everywhere, adapted to dust foams and sand lenses. The waters are closely connected with the Meghna River and during flooding practically are occurred on surface.

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

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

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

4.8.4 Ground Water Quality

Ground water level exists at a moderate (Generally below 8.0 m) depth, which is

being recharged mainly by infiltration of rainwater. According to Bangladesh Water Development Board, the ground water level of Ashuganj Upazila is about 7.0 m. The ground water zoning map is shown in Figure 4.8. Ground water is the source of water for domestic use in this area. Water from underground source, which is assumed to be available as because most of the period of the year the area remains under water and there is a canal passing by the side of the site. That means the recharge capacity of the ground water level seems to be adequate. To determine quality of ground water, water sample was collected from the nearest tube well of the high school of Ashuganj and analyzed for different parameters(See Fig: 4.8). The tube well is almost 700m away from the proposed project. Inside the Ashuganj Power Station Complex, there is no tube well installed for water supply since they have their own water treatment plant which uses the Meghna river surface water and supplies drinking water, domestic water and demineralized water inside the Ashuganj Power Station Complex. The results of ground water quality test shows that all the parameters remain within the allowable limit of drinking water value as per as Environmental Quality Standards for Bangladesh. The parameters which have been analyzed during this study are presented below in Table 4.16.

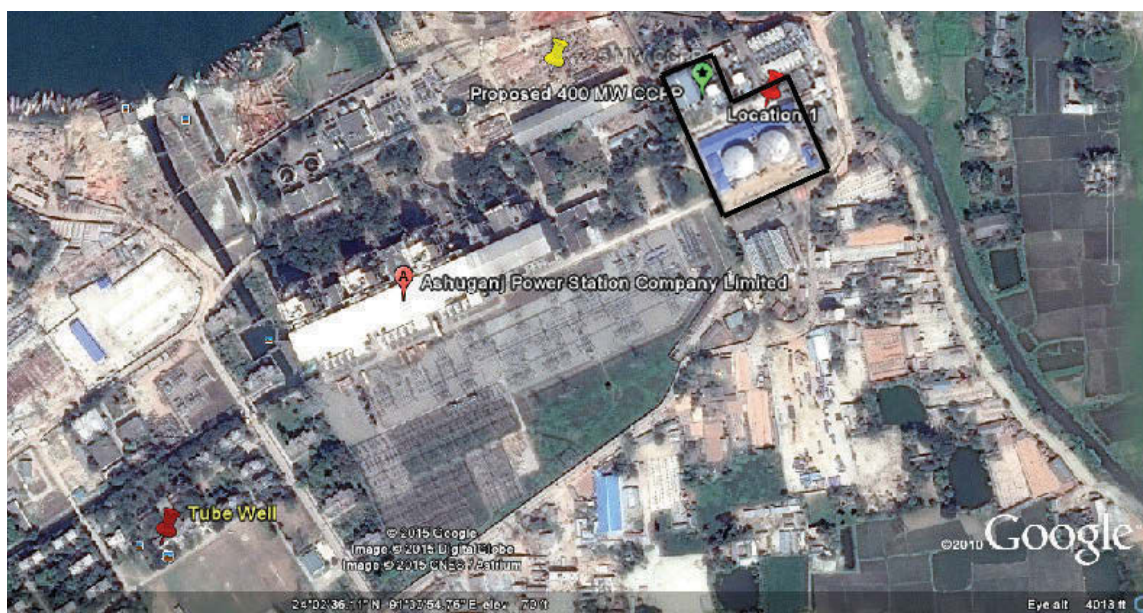


Fig. 4.8: Location of tube well (the nearest tube well from the plant)

Table-4.16: Ground Water quality (limited parameters) of the Project Site

Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	IFC/World Bank Standard	Method of analysis
pH	6.9	6.5-8.5	6.5-8.5	P ^H meter
Total Alkalinity(as	30 mg/L	NF	NF	Standard Titrimetric method

CaCO ₃)				
Hardness(as CaCO ₃)	132 mg/L	200-500 mg/l	NF	EDTA titrimetric method
Iron	0.4 mg/L	0.3-1.0 mg/l	0.3 mg/l	Colorimetric
Chloride	30 mg/L	150-600 mg/l	<250 mg/l	Mercuric nitrate titration
Arsenic	0.003 mg/L	0.05 mg/l	0.01 mg/l	Colorimetric
Residual chlorine	<0.2 mg/L	0.2 mg/l	NF	DPD Ferrous Titrimetric
Total Coliform	0 n/100 mL	0 n/mL	0 n/mL	Membrane Filtration
Fecal Coliform	0 n/100 mL	0 n/mL	0 n/mL	Membrane Filtration
Ammonia	0.35 mg/L	0.5 mg/L	NF	Nesslerization method
Nitrate	2.15 mg/L	10 mg/L	50 mg/L	Specific ion electrode
Phosphate	3.65 mg/L	6 mg/L	NF	Ascorbic acid

Source: AECL Lab (water collected on 30.04.2015 and tested on 17.05.2015)

*Standard for drinking water.

*NF-Not Found.

Although the groundwater quality has been assessed on the basis of drinking water standard for Bangladesh, the proposed plant will not use groundwater for their source of drinking water or other domestic purposes. The assessment has been done to show the ground water condition of the area. As stated earlier, the plant will use the water from the water treatment plant of Ashuganj Power Station Complex. APSCL has a plan to install a new water treatment plant as a drinking water plant in near future. When the plant will be installed, the whole complex will have drinking water supplied from that plant also. That means Ashuganj Power Station Complex will not cause ground water depletion in that area which is good because, the local people of Ashuganj are very much dependent on the ground water.

The breakdown of treated water from Water Treatment Plant is:

1. For drinking water (Drinking water treatment plant): 45 Ton/hr
2. Demi water for 225 MW CCPP: 120 Ton/hr
3. Demi water for Unit-1 to 5: 85 Ton/hr

When the proposed 400 MW CCPP will be in operation, it will use the water that is currently being used by Unit 3. Therefore additional water treatment will not be required. As per Annexure 9(b), it is seen that the proposed plant will require 2 ton/hr water from this existing drinking water plant. The recent water quality test result for the drinking water plant of APSCL is shown in the table 4.17.

Table-4.17: Water quality (limited parameters) of the APSCL Drinking Water Plant

Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	IFC/World Bank Standard	Method of analysis
pH	6.8	6.5-8.5	6.5-8.5	P ^H meter
Iron	0.13 mg/L	0.3-1.0 mg/l	0.3 mg/l	Phenanthroline
Residual chlorine	<0.2 mg/L	0.2 mg/l	NF	DPD Ferrous Titrimetric
Total Coliform	0 n/100 mL	0 n/mL	0 n/mL	Membrane Filtration

Fecal Coliform	0 n/100 mL	0 n/mL	0 n/mL	Membrane Filtration
Total Aerobic Bacteria	<10 n/ml	NF	NF	Drop Plate

Source: icddr,b

Sampling Date: 24.08.2015

Reporting Date: 26.08.2015

4.9 BIOLOGICAL RESOURCES

Biological monitoring is the study of biological organisms and their responses, is used to determine environmental condition of an ecosystem. The biosurvey involves collecting, processing, and analyzing aquatic organisms to determine the health of the biological community. In river, a look at higher plants, plankton, insects, worms, mollusks, crustaceans or fish give an idea about the health condition of that system. Macroinvertebrates that inhabit a river are a profile of the overall health of that ecosystem. Some of these creatures tolerate only pristine environments and die-off quickly if conditions decline; others tolerate limited pollution, particularly if it is temporary or intermittent; and some will survive even in much polluted environments. Macroinvertebrates present must tolerate whatever the conditions of their stream, so the species present do not change rapidly, and they are good indicators of river quality. Examples of aquatic macroinvertebrates include insects in their larval or nymph form, crayfish, clams, snails, and worms. Most live part or most of their life cycle attached to submerged rocks, logs, and vegetation.

Aquatic macroinvertebrates are good indicators of stream quality because:

- They are affected by the physical, chemical, and biological conditions of the river water.
- They can't escape pollution and show the effects of short-and long-term pollution events.
- They may show the cumulative impacts of pollution.
- They may show the impacts from habitat loss not detected by traditional water quality assessments.
- They are a critical part of the aquatic food web.

Ashuganj Power Plant uses water from river Meghna for steam preparation and the steam water is passed out to the river again after its uses. So, quality of river water of both intake point and out fall points is of great ecologically important.

Methodology

A comprehensive survey was conducted at the vicinity of Ashuganj 400MW CCPP (East) on the month of February, 2015 to get an idea about the status of the diversity of fauna and flora. Parts or whole bodies of the shrubs and lower plants available were collected and brought to the laboratory for identification. Photographs of the vegetation were also taken for reference. Aquatic vegetation floating on the water surface near the intake and outfall area were also observed and recorded. Water samples of the river Meghna were also collected from both the intake and outfall points of the power plant. Different physical parameters of the water samples were

checked and recorded. Phytoplankton and Zooplankton nets were used to collect different types of planktons available in each type of water sample. Different types of fishes, macro and micro invertebrates were collected from both the intake and outfall points. Several types of fishing nets were utilized for this purpose. To get an idea about the biodiversity of intake and outfall area, samples were collected within 40 meter radius of each area. Please see the Fig 4.9, the survey locations are at several points within location 1 to location 2. Each intake and outfall points were covered and upstream (at Location 1) and downstream (at location 2) were also surveyed. The main river was surveyed. The collected specimens were identified instantly or brought to the laboratory for further confirmation. Proper keys, Journals, books and encyclopedia were consulted for identification of the collected specimens. Fishermen were interviewed to get an idea about the present status and past records of the availability and abundance of fish population of the river. Fish sellers of the local fish market were also interviewed to collect their opinion about the present and past status of the abundance of fishes in the area.

For phytoplankton and Zooplankton survey 10 lit of water was collected from river and was sieved by plankton net. 50 ml of sieved water was collected in a 50 ml Falcon tube. In this way 5 samples from intake point and 5 samples from outfall point was collected. 1 ml of water from each 50 ml sample was studied in a “rafter cell counter” under microscope.



Fig 4.9: Biological Survey Locations

Observations

Water quality includes various physical and biological parameters which has direct influence on the aquatic organisms and vegetations. Abundance of fishes and their growth are dependent on the quality of water and availability of food. Few physical

parameters of water samples of intake and outfall points of Ashuganj Power Plant were examined and presented in Table 4.18.

Table 4.18. Water quality parameters of the river Meghna near the intake and outfall area of the Ashuganj 400MW CCPP (East)

Parameters	Intake point	Outfall point
Temperature (°C)	22.3	23.4
DO (mg/L)	7.64	7.62
Transparency (cm)	69.33	67.66

Note: Each data represent average of five samples

Data Collected on the month of February, 2015.

The insect fauna recorded from the intake and outfall area are presented in table 4.19. Actually, there were no marked differences between the insect population of the two areas. Immature stages of dragonfly and damsel fly was collected. These are being reared in the laboratory for the adults to come out.



Plate. A-B: Sampling of microinvertebrates by using plankton net

Plate. C-F : Sampling of fish and other organisms by using different type of nets



Plate. G - Sampling inside aquatic vegetation, H-J Floating aquatic vegetation

Table 4.19. Insect fauna recorded from the intake and outfall area of the Ashuganj 400 MW CCPP

English name	Order	Status	
		Intake area	Outfall area
Damselfly nymph	Odonata	+	+
Water strider	Hemiptera	+	-
Midge	Diptera	+	++
Flies	Diptera	+	+
Ant	Hymenoptera	+	+
Caddisfly	Trichoptera	-	+

Status: ++Common, +Few, - Absent,

Note: Samples could not be identified up to species level as some of these samples were collected at immature stage.

Mollusk fauna of the intake and outfall areas are presented in table 20. Significantly higher number of mollusk species was recorded from intake area. This may be due to the soil and ecological condition of the intake area. The shore of the intake area was sloppy and sandy. On the other hand the shore of the outfall area was full of bricks and stones

Table 4.20. List of fresh water mollusks from the river Meghna near the intake and outfall area of the Ashuganj 400MW CCPP(East)

Common Name	Scientific Name	Class	Order	Family	Abundance		IUCN Status
					Intake area	Outfall area	
Common Apple - Snail	<i>Pila globosa</i>	Gastropoda	Mesogastropoda	Pilidae	++	+	LC
Brotia snail	<i>Brotia costula</i>	Gastropoda	Mesogastropoda	Pilidae	+++	++	LC
Banded river snail	<i>Bellamya bengalensis</i>	Gastropoda	Prosobranchia	Viviparidae	++	+	LC
Fresh water mussel	<i>Parreysia corrugata</i>	Bivalvia	Unionoida	Unionidae	+	+	LC
Fresh water mussel	<i>Parreysia caerulea</i>	Bivalvia	Unionoida	Unionidae	++	+	LC
Fresh water mussel	<i>Lamellidense marginalis</i>	Bivalvia	Unionoida	Unionoidae	+++	++	NE

Common Name	Scientific Name	Class	Order	Family	Abundance		IUCN Status
Fresh water mussel	<i>Lamellidense jenkinsianus</i>	Bivalvia	Unionoida	Unionoidae	+++	+	NE

Status: +++Very common, ++Common, +Few, - Absent

Least concern (LC) – Lowest risk.

Not evaluated (NE) – Has not yet been evaluated against the criteria.

Several types of small fishes were captured and have been presented in table 4.21. We were not able to capture any single big fish. Names of fishes available at other seasons of the year are presented in table 4.22. According to fisherman, the rivers becomes devoid of fishes in the dry season. However, in the rainy season, few types of fishes become available. It was learnt from interviews with the fisherman and fish sellers that in the recent past the river had abundant fishes. Several types of big fishes like Rui, Catla, Ayre, Mrigel, Boal along with different types of small fishes were very common. But at present number of all types of fishes has declined greatly.

Table 4.21. List of small fishes captured during survey period by different types of fishing nets from the river Meghna near the intake and outfall area of Ashuganj 400MW CCPP (East)

Local Name	Scientific Name	Abundance	IUCN Status
Pabda	<i>Ompoc pabda</i>	+	NE
Golsha	<i>Mystus cavasius</i>	+	LC
Bele	<i>Glossogobius giuris</i>	+	LC
Tengra	<i>Mystus vittatus</i>	++	LC
Puti	<i>Puntius conchoniis</i>	++	LC
Fali	<i>Notopterus notopterus</i>	+	LC
Kachki	<i>Corica suborna</i>	+	NE
Mola	<i>Amblypharyngodon mola</i>	+	LC
Kakila	<i>Xenentodon cancila</i>	+	LC
Chapila	<i>Gudusia chapra</i>	++	LC
Kholisha	<i>Colisha fasciatus</i>	++	NE

Chingri	<i>Macrobrachium eqidense</i>	+	NE
Shol	<i>Channa striatas</i>	+	NE
Taki	<i>Channa punctatus</i>	++	NE
Shing	<i>Heteropneustes fossilis</i>	+	LC
Koi	<i>Anabas testudineus</i>	+	DD
Mola	<i>Amblypharyngodon mola</i>	+	LC

Status: ++Common, +Few

Least concern (LC) – Lowest risk.

Data deficient (DD) – Not enough data to make an assessment of its risk of extinction

Not evaluated (NE) – Has not yet been evaluated against the criteria

Table 4.22. List of fish fauna recorded during the survey as mentioned by the local fish sellers and fishermen

Local Name	Scientific Name	Abundance	IUCN Status
Rui	<i>Labeo rohita</i>	+	LC
Katla	<i>Catla catla</i>	+	NE
Kalibaush	<i>Labeo calbasu</i>	+	LC
Boal	<i>Wallago attu</i>	+	NT
Ayre	<i>Sperata aor</i>	+	LC
Bain	<i>Mastacembelus armatus</i>	+	LC
Chital	<i>Chitala chitala</i>	+	NT
Meni	<i>Badis badis</i>	+	LC
Batashi	<i>Neotropius atherinoides</i>	+	LC
Poa	<i>Otolithoides pama</i>	+	NE
Ilish	<i>Tenuialosa ilisha</i>	+	LC
Fasha	<i>Setipinna phasa</i>	+	LC
Shilon	<i>Silonia silondia</i>	+	LC
Bacha	<i>Eutropiichthys murius</i>	+	LC
Bata	<i>Liza Persia</i>	+	NE
Chela	<i>Chela cachius</i>	+	LC
Gozar	<i>Channa marulius</i>	+	LC
Magur	<i>Clarius batrachus</i>	+	NE

Dari	<i>Scistura scaturigina</i>	+	NE
Kanpona	<i>Aplocheilus panchanx)</i>	+	NE

Status: +Few

Near threatened (NT) – Likely to become endangered in the near future

Least concern (LC) – Lowest risk

Not evaluated (NE) – Has not yet been evaluated against the criteria

Phytoplanktons are the producer of the river ecosystem and thus their status are of prime importance. List of Phytoplanktons and Zooplankton found in the water samples of intake and outfall points of Ashuganj Power Plant are presented respectively in Table 4.23 and 4.24. Slightly higher number of phytoplanktons were recorded from the outlet water samples (Table 4.23). This may be due to slight raise of water temperature which stimulate their growth in this area. Higher number of zooplanktons were also recorded from the outfall water samples. This also may be due to the slight raise in temperature of the outfall water samples.

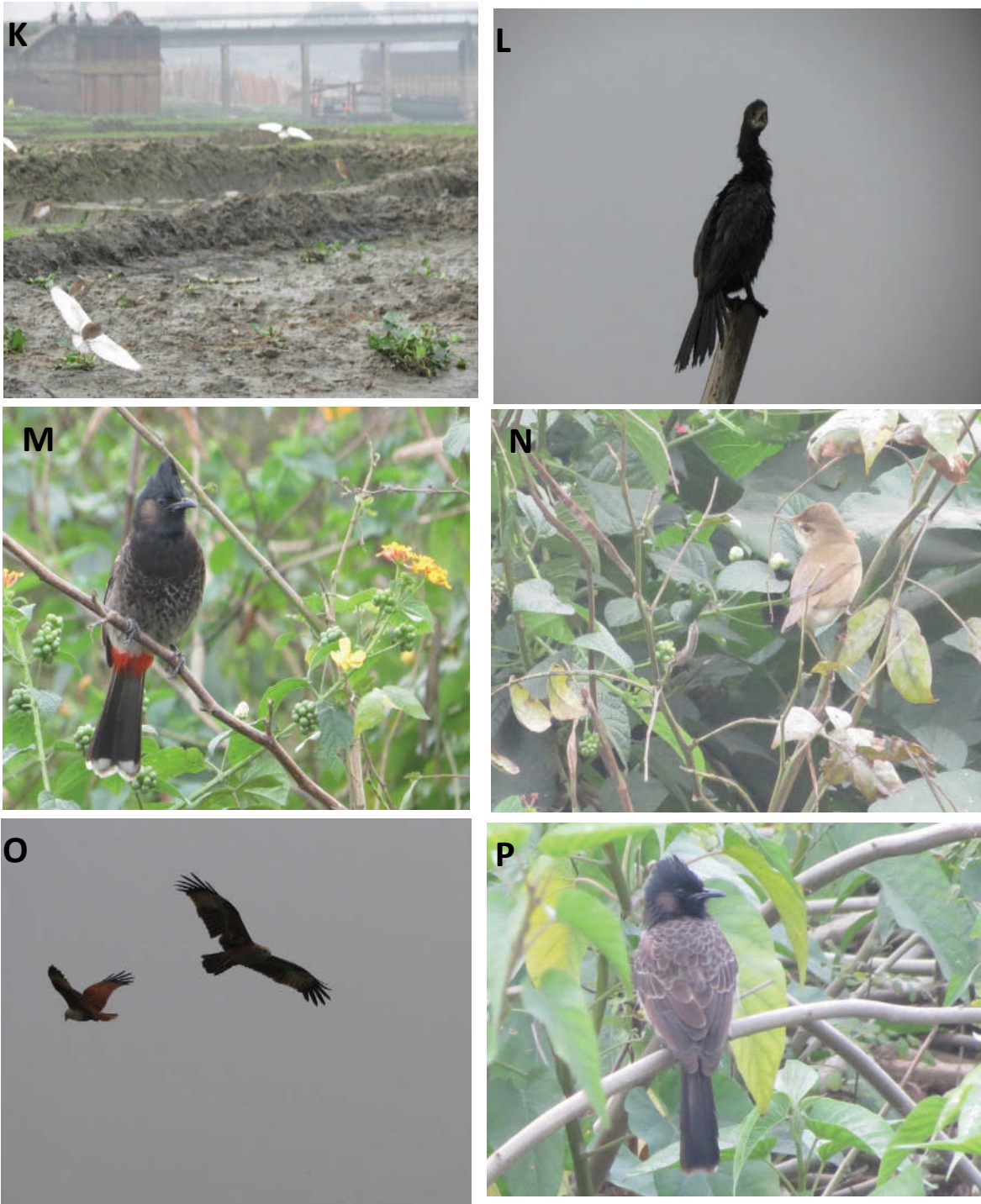


Plate. K-P: Different bird species of birds observed in the river area and vicinity: Pond Heron, Little Cormorant, Red Vented Bulbul, Tailor Bird, Brahminy Kite and Red Vented Bulbul.



Plate. Q - T: Fish caught from the sample river

Plate. U: Interviewing local market fish sellers

Table 4.23. Phytoplanktons recorded from the water samples (average of per liter) of the river Meghna near the intake and outfall area of Ashuganj 400MW CCPP

Name	Intake point	Outfall point
Spirogyra	11.25	2.5
Zygonema	2.5	2.5
Oedogonium	1.25	-
Nostoc	3.75	7.5
Pithophora	6.25	10
Anabena	2.5	2.5
Volvox	3.75	7.5
Oscillatoria	3.75	3.75
Chlamydomonas	-	1.25
Cladophora	-	1.25
Cosmarium	-	1.25
Navicula	3.75	5
Eremosphera	3.75	3.75
Staurastrum	2.5	3
Dinobryon	2.5	2.5
Melosira	4	5.5
Nitzschia	-	1.25
Glenodinium	1.25	-
Chroococcus	5	6.25
Gloeocapsa	2.75	-
Microcystis	4	7.5
Coelosphirum	1.25	1.25

Table 4.24 List of zooplanktons recorded from the water samples of the river Meghna near the intake and outfall area of Ashuganj 400MW CCPP

Name	Intake point	Outfall point	IUCN Status
Diflugia	16.25	16.25	NE
Phacus	1.25	3.75	NE
Nebalia	3.75	5	NE
Glaucoma	1.25	2.5	NE
Nauplius	3.75	0	NE
Brachionus	20	18.75	NE
Branchipus	0	1.25	NE
Keratella	7.5	20	NE
Lepadella	5	0	NE
Polyarthra	7.5	11.25	NE
Trichocera	0	2.5	NE
Hexarthra	3.75	0	NE
Rotaria	1.25	1.25	NE
Monostyta	0	2.5	NE
Cyclops	21.25	18.75	LC

Diaptomus	8.75	8.75	DD
Daphnia	13.75	15	VU
Diaphanosoma	0	2.5	NE
Cypris	10	25	NE
Heterocypris	1.25	0	NE

Status: Vulnerable (VU) – High risk of endangerment in the wild.

Least concern (LC) – Lowest risk.

Data deficient (DD) – Not enough data to make an assessment of its risk of extinction

Not evaluated (NE) – Has not yet been evaluated against the criteria.

Table 4.25 Avifauna observed near the surveyed river

English Name	Scientific Name	IUCN Status
Pond Heron	<i>Ardeola grayii</i>	LC
Little Cormorant	<i>Phalacrocorax niger</i>	LC
Black Kite	<i>Milvus migrans</i>	LC
Brahminy Kite	<i>Haliastur Indus</i>	LC
Red Vented Bulbul	<i>Picnonotus cafer</i>	NE
House Crow	<i>Corvus splendens</i>	LC
Tailor Bird	<i>Orthotomus sutorius</i>	LC

Status: Least concern (LC) – Lowest risk.

Not evaluated (NE) – Has not yet been evaluated against the criteria.

Some birds feed on the river fishes and thus take part in the consumer level of the river ecosystem.

Among the aquatic vegetation Helencha and Duckweed were not observed in the outfall area. In general aquatic vegetation was less in this area. This might be due to heavy current in the outfall area.

Table 4.26. List of aquatic vegetation seen in the visiting site

Common Name	Scientific Name	Intake point	Outfall point	IUCN Status
Water hyacinth	<i>Echhornia crassipes</i>	++	+	NE
Ipomea	<i>Ipomea aquatica</i>	+	+	NE
Helencha	<i>Alternanthera philoxeroides</i>	+	-	LC
Duckweed	<i>Spirodela</i> sp	+	-	LC

Status: ++Common, +Few

Least concern (LC) – Lowest risk.

Not evaluated (NE) – Has not yet been evaluated against the criteria.

Herbs and shrubs grown near the visiting area was observed and listed in table 27. These species should be conserved for ecological balance.

Table 4.27 List of vegetation (Herbs and Shrubs) grown near the visiting site

Local Name	Scientific Name	IUCN Status
Junka	<i>Sida cordata</i>	NE
Banmorich	<i>Croton bonplandianum</i>	NE
Fulkuri	<i>Ageratum conyzoides</i>	NE
Kanai	<i>Commelina erecta</i>	LC
Notey Shak	<i>Amaranthus viridis</i>	NE
Ban-palang	<i>Rumex dentatus</i>	NE
Durba	<i>Cynodon dactylon</i>	NE
Chanchi	<i>Alternanthera sessilis</i>	LC
Ghagra	<i>Xanthium indicum</i>	NE
Vat	<i>Clerodendrum viscosum</i>	NE
Kutus Kata	<i>Lantana camara</i>	NE
Verenda	<i>Ricinus communis</i>	NE
Kanta begun	<i>Solanum sisymbriifolium</i>	NE
Bish Katali	<i>Persicaria hydropiper</i>	LC
Nakful	<i>Synedrella nodiflora</i>	NE
Bara-Halkus	<i>Leucas cephalotes</i>	NE
Bondhoney	<i>Scoparia dulcis</i>	NE
Joshorilata	<i>Mikania cordata</i>	NE
Helencah	<i>Altenanthera philloxioides</i>	NE
Sitki	<i>Phyllanthus reticulatus</i>	NE
Pichas-Ban	<i>Lippia aka</i>	NE
Ban-Ghagra	<i>Urena lobata</i>	NE
Lalverenda	<i>Jatropha glandulifera</i>	NE
Dhekia	<i>Christella dentata</i>	NE
Dhanighas	<i>Brachiaria reptans</i>	LC
Tridhara	<i>Tridax procumbens</i>	NE

Status: Least concern (LC) – Lowest risk.

Not evaluated (NE) – Has not yet been evaluated against the criteria.

This bio survey data might not reflect the actual biodiversity of that area. One species found in the monsoon might not see in the winter. Extensive survey over the year might give an actual status of biodiversity. Present bio survey list is a snapshot prepared based on the species found during the survey time.

Possible impact due to thermal pollution and proposed bio-monitoring

A slight fluctuation of temperature may have profound effect on the breeding, fecundity and life cycle of aquatic organisms in general. Intake and Outfall water might have temperature difference that may result substantial change in ecological community in the area.

It is proposed to conduct a comprehensive bio-monitoring at inlet and out fall in every six months for first 5 years after start of operation of the power plant and once in a year from 5 year and onward. Appropriate mitigation should be taken into account based on the change in biological community observed during the survey. It has been surveyed that no endangered species declared by IUCN is found in this area.

4.10 SOCIOECONOMIC BASELINE DESCRIPTION

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

Other than the industrial site, remaining areas are low lying agricultural land. West part of the project site across the Meghna River is under Bhairab Upazila of Kisoreganj district and east part is under Ashuganj Upazila of Brahmanbaria district. The project is located in Sonaram Mouza of Ashuganj Upazila. Bangladesh UK Friendship Bridge across the river Meghna (Meghna Bridge) connects both the banks of Bhairab and Ashuganj. The Bridge lies on the Dhaka Sylhet Highway. The project site locates in the North West direction of the highway. Location of Bhairab Rail Bridge is in the south west direction of the Bhairab Bridge. Within 1km distance of project site, Ashuganj fertilizer factory is located. Beside the rail line on the east bank Ashuganj rail station is situated and a Silo is located in the eastern bank. In the western bank Bhairab rail station is located. On both banks there are residential areas. During monsoon low lying paddy field is submerged by the flood water. Boro crop is the main crop in the dry season.

The following figure 4.10 shows the sensitive and important locations within the 1 km radius of the project site.



Fig 4.10: Sensitive and Important Locations within 1 km Radius of the Project Site

4.10.1 Population and Demography

Population and demographic characteristics of the Zila, 4 Upazilas and 1 Paurashavas (Bhairab) in the study area have been presented in **Table 4.28 & 4.29**. The table shows that the population density per/sq. km. varies significantly among the different Pourashavas, Upazilas and Zila/districts. Population and demographic profiles of the concerned unions have been presented Union and Upazila wise in **Tables -4.28, Table 4.29 and Table 4.30 respectively**.

Table 4.28: Population and demographic characteristics surrounding the project area (Zila, Upazilas and Paurashavas)

SI	Population Characteristics	B.Baria District	B. baria Sadar Upazila	Sarail Upazila	Ashuganj Upazila	Kishoreganj District	Bhairab Upazila
1	Total Area (Sq.km.)	1927.11	440.55	227.22	67.59	2731.21	139.2
2	Total Household	429390	109369	48822	26,709	534770	46634
3	Total Population - Male - Female	2398254 1205552 1192702	625484 318579 306905	271101 136240 134861	145,828 74,191 71,637	2594954 1320117 1274837	247166 125621 121545
5	Household Size -Rural -Urban	5.58 5.59 5.52	5.7 5.7 5.7	5.5 5.6 5.3	5.5 5.5 5.3	4.9 4.8 5.0	5.3 5.3 5.3
6	Literacy Rate % (7 years+) -Male - Female	39.46 42.26 36.69	44.3 46.2 42.4	32.9 36.2 29.7	46.2 47.7 42.7	38.3 41.3 35.1	40.7 44.8 36.6
7	Sex Ratio	101	104	101	104	104	103
8	Total Mouza/ Mohallah	1024 97	320 34	76 -	30 -	953 147	32 26
9	Total Village	1331	375	140	38	1794	84
10	Total Union	98	21	9	7	105	6
11	Total Upazila	8	1	1	1	13	1
12	Pourashava Paura Ward	4 39	1 12	- -	- -	4 39	1 12

Source: Population Census 2011

Table 4.29: Population and demographic characteristics surrounding the project area unions of Ashuganj and Bhairab Upazila

Ashuganj Upazila								
SL	Population Characteristics	*Ashuganj	*Araisidha	Charchartala	*Dakshin Panisar (Durgapur)	Lalpur	Pacchim Talshahar	Sharifpur
1	Total Area (Acres)	2799	1469	1572	3038	1818	2813	3193
2	Total Household	5958	2701	4092	4550	2817	3155	3436
3	Total Population-Male	30282	15482	23555	26831	14201	17954	17523
	-Female	16054	7742	11055	13691	7069	8983	8166
4	Total Household	5548	2690	3990	4519	2803	3117	3423
5	Household Size	5.46	5.76	5.90	5.94	5.07	5.76	5.12
6	Literacy Rate % (7 years +)	50.06	47.18	56.35	45.64	35.45	38.25	41.99

Source: Population Census 2011

Table.4.30: Population and demographic characteristics surrounding the project area Pourashava Unions of Bhairab Upazilas

SI	Population Characteristics	Bhairab Upazila						
		*Bhairab Pourashava	Aganagar	Gazaria	Kalika prashad	Sadekpur	*Shimulkandi	Shibpur
1	Total Area (in acres.)	3784	6331	4737	3241	5903	2866	1669
2	Total Household	17692	4872	4510	5246	5594	4721	3999
3	Total Population-Male	93254	27306	23128	26906	29914	25567	21091
	- Female	48764	13964	11411	13435	14674	12973	10400
		44490	13342	11717	13471	15240	12594	10691
6	Literacy Rate % (7years +)	53.57	23.54	32.85	32.23	33.75	37.14	35.26

Source: Population Census 2011

4.10.2.1 Population

As per Population Census 2011, population and other relevant information are as follows (Table 4.31).

Table 4.31: Population of the Project Upazila

Upazila	Area (km ²)	Total Household (No)	Population (No)	Male (No)	Female (No)	Literacy7+ (%)	Population 18+ (No)
Ashuganj	67.59	26709	1,45,828	74,191	71,637	46.2	72,332
Bhairab	139.32	46,634	2,47,166	1,25,621	1,21,545	40.7	1,24,941

The above Table shows that there are (103.5) males compared to 100 females. Sex Ratio (2001, BBS) in the Dhaka district is 109.5. But the ratio is different in the urban area, namely, 121.9 and the same in the rural area it is 103.6. Family Size: average family size in district (Census, 2011) is, in the district of Kishoreganj size is 4.9 and in Brahmanbaria are 5.6. Family size of Ashuganj is 5.5 and Bhairab 5.3 in the urban area and 5.52 and 5.39 in the rural area respectively. Density of population of Brahmanbaria district is 1244 per square km.

4.10.3 Religion

Religious feature of the manpower are presented in Table 4.32. The community is predominantly Muslim.

Table 4.32: Type of Religion of the sample households Bhairab Upazila

Upazila	Total H.H	Muslim	Hindu	Buddhists	Christian	Trbal	Others
Ashugnj	26709	25,599	1088	11	1	1	10
Bhairab	46,634	44,448	2,173	4	1	1	8

Source: census 2011

From the above Upazilla records shows that in Ashuganj 95.84% are Muslim and rest are mainly Hindu communities. And 95.31% is Muslim in the Bhairab upazila. Project area's condition is also same. In the sample area mainly Muslims are residing. Hindu communities are very minor.

4.10.4 Land Ownership and Homestead Land

In the study area, it is found that more than 30% of the households do not possess any land. That means majority of the people in the area are involved in profession other than agriculture (Table 4.33).

Table 4.33 Land holdings and Ownership of Land at Ashuganj Upazila

	Ashuganj	Bhairab
Agricultural Land in decimal (100 decimal =1 Acre)	(%) of Total	(%) of Total
0	30	30
1-50	40	15
51-100	10	20

101-150	10	20
151-250	5	5
251-500	5	10
Total	100	100

Source: Upazila Statistical Department, Ashuganj and Field survey

About 15-40% has land size of 50 decimal and 10-20% has land size of 101-150 decimal and 5% have land size of 151 to 250 decimal respectively. The price of the land is increasing rapidly as proportionately with urbanization and development.

4.10.5 Housing Pattern and Ownership

In the project area maximum people live on their own houses but a few in rented houses. As more urbanization more households will reside in the rented house in future. The area is a semi urban area; moreover, it has also a rural character. Most people live in inherited land. Table-4.34 below shows the pattern of the ownership of residence.

Table 4.34 Main house of the dwelling household by type of structure

Upazla	Jhupri (thatched)	Kutcha	Semi Pucca	Pucca
Ashuganj	3.03	76.01	11.91	9.05
Bhairab	3.21	80.24	10.58	5.97

4.10.6 Access to Health Facilities

There are government Health complex in both the Upazila. Two government hospitals are giving services, one owned by Ashuganj power plant and another is owned by Zia Fertilizer factory in Ashuganj Upazila. Two Clinics are in Ashuganj union near the project area. Also one diabetic Centre is rendering services for diabetic patients. In Bhairab, there is a 50 beds government hospital and a private hospital in the Pourashava. People normally contacts medicine shop and quack doctor primarily. But solvents go to private Clinic. Normally the poor go to government hospital. Zia fertilizer and power plant hospital is mainly for staff treatment but in emergency case, limited service is provided for the common people.

In Ashuganj the following health facilities are available. These are Upazila Health Complex-01, Community Health Centre-06, Hospital (non-govt.)-02, Private Clinic-02, Diabetics Centre-01, and Veterinary Hospital-01.

In Bhairab available health facilities are Upazila Health Complex-01 (50 Bedded), Upazila Community Health Centre-02 (Shemulkandi, Bhairab), Community Clinic-07, Health and Family Welfare Centre-05, Hospital (non-govt.)-06, Private Clinic-02, EPI Vaccination Centre-170, X-Ray Machine-01.

Main diseases are waterborne diseases via diarrhea, dysentery, typhoid and sexually transmitted disease (STD). Also Acute Respiratory Infection (ARI) is predominantly seen in the area. The STD is of abundance due to migratory people and workers in the area and in the boiler based rice husking mills. In the area lot of women workers work in these husking mills locally known as 'Chatal'. Approximately there are 250 Chatal in the project area. These rice husking mills burn husk and the smoke causes respiration problems.

4.10.7 Source of Drinking Water and Sanitation

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

Sanitation practice is very important for a community. It is a part of social behavior to use soap after toilet use. Earlier it is mentioned that the area has both urban and rural character. Table-4.37 and 4.38 above shows the sanitation coverage in Ashuganj and Bhairab Upazila. Sanitary latrine coverage was 44.89% of the households in Ashuganj and 39.74 % holds in Bhairab Upazila. But present situation has been drastically improved. Ashuganj is at present under 100% and Bhairab is under 90% sanitation coverage.

Table- 4.35 Access of Drinking Water

Union	Household	Tap	TW	Well	Pond	Others
Ashuganj	5548	345	4978	24	24	177
Bhairab Pourashava	17155	852	15,789	88	24	402

Source: Census 2011

Table- 4.36 Access of sanitary Latrine as per households

Union	Hh. No	Sanitary	others	None
Ashuganj	5548	2829	2406	313
Bhairab	17155	11179	4957	1019

Table- 4.37 Access of sanitary Latrine in percentage

Upazila	Sanitary Latrine	Non Sanitary Latrine	No latrine
Ashuganj	44.89(Upazila) 42.36%(Rural) 54.33(urban)	51.37%(Rural) 41.76%(Urban)	5..77%

Bhairab	39.74%(Upazila) 65.16%(urban) 24.62%(rural)	45.51%(Upazila) 55.38%(Rural) 28.90%(Urban)	14.76%
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4.10.8 Fuel Source

In the study area, most of the households have natural gas connection (40%) for cooking purpose. Others depend on fuel wood.. Fuel wood is a costly item. Survey shows that households using natural gas for cooking as well as those using fuel woods are almost same (35% each) and 5% depend on leaves (Table 4.38).

Table 4.38: Cooking Fuel

	Ashuganj Upazila	Bhairab Upazila
Type of Cooking Fuel	(%) of Total	
Natural Gas connection	40%	50%
Leaves	5%	5%
Cow dung	20%	15%
Wood / Straw	35%	30%
Total	100%	100%

Source: Field Survey and FGD meeting

4.10.9 Literacy

Education rate is rapidly increasing in the project area. According to the Upazila education office, about 90% enrollments are in the Ashuganj Upazila. Current year, 20,000 students have been new enrollment in the primary schools excluding kindergarten School. The Number of household in the Upazila is 26,709(Census2011), that means almost from each family one student is enrolled in the primary classes except ultra-poor family of the Upazila.

According to BBS 2001 census in Ashuganj Upazila the literacy rate for both sexes is 46.2%, for male is 47.7% and for female is 42.7%. According to BBS 2001 literacy rate of 7+ populations is 50.06% in Ashuganj and is 49.05 % in Arashida. So it is assumed that near plant site education rate is high to some extent, roughly 65%. From FGD meeting at Dakshin Panishar it is found that the education rate is now 60% approximately. Education rate is also increasing among the female.

Table: 4.39 Rate of literacy for male and Female

Upazila	Both	Male	Female
Ashuganj	46.2	47.7	42.7%
Bhairab	40.7	44.8	36.6%

Source: BBS,Census 2011

The above Table shows that, literacy rate is 46.2% in the project area for 7+ populations in Ashuganj Upazila whereas it is 40.7% in Bhairab Upazila.

4.10.10 Electricity Facility

Currently in the project area about 70% to 80% households have electricity connection. At Ashuganj union it is about 80%. Dakshin Panishar and Simulkandi unions of Bhaiab Upazila have 80% & 70% electricity coverage respectively.

In the project area nearly 99% the households have electricity connection. The area may be considered as largely dependent on electricity due to growing business in the area .Table 4.40 verifies this statement.

Table 4.40 Electricity Facility

Area (Upazila Basis)	Electricity Facility Available in Household (No)
Ashuganj	57.75%
Bhairab	51.31%

Source: BBS, 2011 census

4.10.11 Occupational Pattern

Tables 4.41 & 4.42 below give present and previous situation of the occupational pattern of the people living in the study area. In Table 4.42 it reveals that in Ashuganj and Bhairab, farming is decreasing as occupation. At present farming as occupation is 20% at Ashuganj and 10% at Bhairab of total households respectively. At Dakshin Panisar it is 40%. Bhairab pourashava and Ashuganj Union have urban character and remaining area is predominantly rural. Agriculture activities and business are the main occupation of the area.

Table 4.41 Present Occupational Patterns of the Households

	Ashuganj	Ararishida	Dakshin Panishar	Bhairab	SimulKandi
Occupation	(%) of Total	(%) of Total	(%) of Total	(%) of Total	(%) of Total
Farmers	20	78	40	10	20
Fishermen	2	1	1	3	5
Agricultural labor	15	5	10	-	40
Non -Agricultural	30	3	18	30	5
Service	15	2	15	5	10
Business	10	4	10	20	10
Overseas Work	5	2	5	6	6
Others	3	5	1	6	4

Total	100	100	100	100	100
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Table 4.42: Previous Occupational Pattern of the Households

Name of Upazila	Agriculture (%)	Business	Agricultural Labourer (%)	Wage labourer (%)	Industry (%)	Service (%)	Transport (%)	Others (%)	construction	Remittance
Ashuganj Upazila	27.88	23.55	8.46	6.56	1.79	14.10	2.24	18.19	2.02	3.57
Bhairab Upazila	30.08	23.54	8.93	10.17	1.33	8.86	3.87	17.94	18.32	2.14

Source: BBS, Census, 2011

4.10.11.1 Fishing

There are 42 Jalmahal (open water fishing zone) below 20 acres each in Ashuganj Upazila. No of pond is 764 and 10% ponds are under fish culture. The river Meghna is flowing beside the project area. Production of cultured fish is 250kg/Acre (0.25 metric ton) and open water fish production is 500 kg/Acre (0.5 ton.). 288 households live on fishing and fish culture (Source: Upazila fishery office Ashuganj). Major fish varieties are Ruhi, Katla, Taki, Kai, Magur, Singhi and Boal etc. Dependent population on fishery is 2% in the Upazila. Kai and Singhi are nearly extinct varieties. And rare fishes like River Pangas, Rani, Raia, Mahashail and Lacho fish are totally extinct varieties.

On the other hand Telapia, Grass carp, Pangas are exotic fish in the Upazila According to Upazila Fishery officer, in Bhairab there are 731 persons are professional fishermen who are about 2% of total households. Fish culture is being conducted in 213 ponds.

At the present point of time, there is some professional fishing (2%) community or fisherman at the project site. During monsoon season, some people catch fishes in the Upper Meghna River Fish is an important resource of the area. There are two large 'arats, fish sales Centre, one in Bhairab and another in Kuliarchar near the project area from which fishes are exported to the Dhaka city mainly.

4.10.11.2 Agriculture

The area is low- lying especially Ashuganj portion. In the Upazila, cropping pattern and cropped area are Aus 90 hectares, Aman-6750 hectares and boro 5200 hectares. Of Rabi crops Mustard is 820 hectares, Jute is 107 hectares, Sweet potatoes is 95 hectares, Mashkalai is 90 hectares, wheat- is 1 hectares, Potatoes is 50 hectares, Til is 40hactates, ground nut is 40 hectares. Water logging area is 5%.

Cropping intensity is 199%, Irrigation coverage is 80%. About 21,671 hh are found dependent on agriculture in the Upazila.

Production of paddy is Aus local-1.75 ton/hectare, Aus HYV 2 ton/hectare, Aman local 1.78 ton/hectare, Aman HYV 2.30 ton/hectare, Boro- HYV 3.70ton/hectre, Potato 15.20 ton/hectare, Sweet potato 15 ton/hectare, Jute 1.04 ton/hectare, Mashkaai ton/hectare, Mustard 1.20 ton/ hectare(Source:: Upazila Agriculture office, Ashuganj)

In Bhairab cropping pattern and cropped area are Aus 40 hectares, Aman 2010 hectares, Boro 6900 hectares. Mustard-75 hectares, Chili and vegetables 157 hectares, Cropping intensity-152%, irrigated land is 95 %(5200 hectares). Single crop land is 3618 hectares, double crop land- is 2779 and triple crop land is 372 hectares (Source: Upazila Agriculture office, Bhairab).

Main crops grown in the study area are Aus, Aman and Boro. The paddy is grown in the main three seasons of the year. Besides these, potatoes, sweet potatoes, oil seeds, vegetables, arum, til (sesame), wheat, sugarcane, mustard, bottle gourd etc. are cultivated in the study area. Fruits like, jackfruit, lemon, watermelon are also produced. About 9 cropping patterns are practiced in the area and these are identified through discussion with the Upazila Agriculture Officer and local farmer, which are presented in the Table 4.43.

Table4.43 Cropping Patterns Practiced in the Study

Crop	
Boro	Fallow
Fallow	Transplanted Aus
Boro	Transplanted Aus
Pulses	Transplanted Aus
Oil seeds	Transplanted Aus
Spices	Broadcast Aus
Watermelon	Broadcast Aus
Sweet Potato	Broadcast Aus
Sugarcane	Annual crop

4.10.12 Archeological, Cultural Heritage and Religious Site

No known remarkable archeological or historically important structure or sites are reported in the survey area. But at about six to seven kilometer distance three kilometer west of Belabo Upazila in the Narshigdhi district historically important place of ancient time of 450 BC named Wari Bateshwar exists. However, there will not be any impact on this historic archeological site due to the project. The probability of

finding significant cultural resources in the designated areas is low. Any impacts that may occur as a result of the project would be in future and the overall severity of impact will be low.

Araishidha union of Ashuganj is the birthplace of renowned poet Abdul Kadir. But the place will not be affected anyway. The place is about three km south of the proposed plant. Of historic place Bhairab rail bridge of British period can be mentioned and located within one km of the plant side and have not any impact on the structure.

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

4.10.13 Industry

Now Bhairab and Ashuganj is industrial zone. Zia Fertilizer factory is an industrial infrastructure in Ashuganj. 250 chatal are found in the east bank of the Meghna River. About 10,000 workers are getting employment in the chatal for husking rice. And most of them are female workers. In Bhairab different medium industries are found. Jute based factory making gunny bag employed about 1000 people. Two Soap factories, steel galvanizing plant for producing C.I sheet, steel re-rolling industry for producing MS rod, nail industry for making Peg. Ice factory, dry food industry, flat rice industry, cold storage (2) for preservation of potatoes, sanitation products are found in the survey area. Shoe factory(2000 no) employing 8000 workers , aluminum factory producing utensils, mosquito coil, ground nut crushing mill, spice processing factory, poultry farm, candle factory, plastic factory, bidi factory(04), etc. are important industrial units in the project area.

The proposed project will bring positive impact on them.

4.10.14 NGO Activities

Different NGOs are working in the area. Name of the major NGOs are ASA, BRAC, Grameen Bank, Proshika Manabik Unnayan Kendra, etc.

Chapter-5

CHAPTER FIVE: IDENTIFICATION OF POTENTIAL IMPACTS

5.1 GENERAL CONSIDERATIONS

In case for most industrial projects, potential negative impacts sometime could be far more numerous than beneficial impacts. The regional and national economic benefits associated with the implementation of any development project are considered to fall outside the scope of an EIA, and therefore not considered here. However, it is generally expected that these long-term benefits will ultimately trickle down to the local population and will make a contribution to an improvement in the quality of life.

Likewise, the indirect benefits of strengthening of technical capabilities of local persons through association with foreign experts and other training elements that may form part of a project have been considered to fall outside the scope of EIA.

5.2 SCOPING OF IMPACTS

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

5.2.1 Checklist

Checklist is comprehensive lists of environmental effects and impacts indicator designed to stimulate the analysts to think broadly about possible consequences of contemplated actions (Munn, 1979). **Table 5.1** represents the checklists developed for the present plant. In this checklist, actions, which may affect at the various stages of the project activities, are listed and the degrees of Significant Environmental Impacts (SEIs) are shown. The terms none, minor, moderate and major are used in the checklists to evaluate the magnitude of SEIs. In the checklist, both the construction and operational phases of the proposed development are considered separately in order to distinguish the short term and long-term impacts. As can be observed from the checklists, major environmental components, which will be adversely affected by activities of the project, are water quality and socio-economic environment. All these impacts will arise in operation phase of the project. It should be noted that identification indicated in the Checklist relates to the significant level of impact.

Table 5.1 Impact Identification Checklist for Proposed Power Project

Project Phase	Action Affecting Environmental Resources & Values	SEIs without Mitigation Measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
Plant Location/ Pre-Construction Stage	Land value depreciation	x						No land value changes anticipated
	Loss of and displacement from homestead land	x						No loss of and displacement from homesteads land; no impact
	Loss of and displacement from agricultural land	x						No loss of and displacement from agricultural land
	Damage to nearby operation	x						No impact anticipated
	Disruption to drainage pattern		X			X		Land development may create problem in local drainage pattern
	Inadequacy of buffer zone			x		X		Buffer strip is inadequate, medium impact
	Encroachment into precious ecological	x						No precious ecological issues; no impact
Construction Stage	Run off erosion		X			X		Land Filling may create runoff erosion during rainy season
	Worker accident		X			X		Irregularly may occur during construction period
	Water quality Degradation			x		x		Improper drainage may create river water pollution, medium impact
	Air Quality		x			x		Dust emission may occur during construction activity, minor impact
	Solid Waste		x			x		Solid waste may generate during construction, minor impact
	Sanitation diseases hazard		X			X		Concentration of labor force may create un-hygienic condition
	Noise/vibration hazard		X			x		Piling/equipment installations may generate noise
	Traffic congestion		X			X		Carrying of construction materials will create traffic congestion
	Blockage of wildlife passage	x						No wildlife in the area; no impact
	Employment			X			X	Major employment opportunity during construction
Post Construction and Operation Stage	Pollution from liquid discharge			x		x		Process water will be discharged from condenser cooling unit, medium impact
	Pollution from solid waste		X			X		No significant solid waste; minor impact
	Air quality				X	X		NOx emission may occur, major impact if no mitigation measures are taken,
	Occupational health hazard			X		X		Inherently will occur

Odor hazard	X						No obnoxious odor will be generated; no impact
Traffic congestion	X						No traffic congestion may occur: no impact
Noise hazard				X	X		Heavy noise may be generated, major impact;
Employment			X			X	Medium Employment opportunity during operation
GHG emissions		x			x		CO ₂ Emission will be within the IFC/WB guidelimes.
Water consumption			x	x			The plant will use water for domestic purpose, open loop cooling and closed loop cooling. Huge amount of water will be required for the operation of the plant.
Use of hazardous materials		x		x			Some hazardous wastes may generate which needs careful handling.

Chapter-6

CHAPTER SIX: PREDICTION AND EVALUATION OF IMPACTS

6.0 EVALUATION OF IMPACTS

6.1 GENERAL CONSIDERATIONS

The Impacts, which are likely to be occurred in the different phases of the project, are identified in section 5.0. In this section, evaluation of these impacts will be done mentioning their origin and characteristics along with their possible mitigation/enhancing measures. At the end of each sub section, status of residual impact will also be mentioned.

6.2. ADVERSE IMPACTS AND MITIGATION

6.2.1 Impact due to project location

6.2.1.1 Land Acquisition

Impact Origin

As discussed earlier the APSCL authority has allocated 4.30 acres of developed land for the 400MW gas turbine CCPP east. In general, land acquisition may affect the environment and peoples by the following ways

- i. Loss of Homestead land
- ii. Loss of Agricultural Land
- iii. Cultural, historical and Aesthetic Loss
- iv. Loss of sensible places
- v. Corruption and partiality during acquisition and Reacquisition process, etc.

Mitigation Measures

The proposed project didn't require any relocation of homestead since the project has been planned on the APSCL's own land inside their boundary. The proposed 400 MW CCPP will be established at the location of the existing GT-1, GT-2, ST and Fuel Tank which will be flat and vacant after demolition of existing structure. There is no homestead land falls inside the proposed project site. There was no cultural, historical and Aesthetic interest in the project land and no loss of sensible place. So the above mentioned impacts are absent. The environment clearance certificates for the existing plants of APSCL by DOE, GOB has been attached in the Annexure 13(a). The proposed site for the project has already achieved it's site clearance form DOE. The site clearance notice has been attached as Annexure 13(b).

6.2.1.2 Loss and Displacement from Agricultural Land

Impact Origin

The proposed project land will be a vacant and recovered land from the demolition of existing power plant of APSCL. There is no agricultural land in the project area. So, there was no loss of agricultural land hence agricultural product in the country.

Mitigation Measures

Since there is no agricultural land falls inside the project area, no mitigation measures suggested in this regard.

6.2.1.3 Disruption of Earth Surface

Impact Origin

As mentioned earlier that the land is flat and developed earlier before planning for this project. So, there is no land filling required for this project.

Mitigation Measure

Since there is no land development or earth filling required, no mitigation measures required in his regard.

6.2.1.4 Change in Landscape

Impact Origin

A landscape is a subjective concept that cannot be precisely quantified. However, in general, any project when not designed considering the local landscape, then it creates visual intrusion to the people. The proposed project may change the local landscape to some extent.

Mitigation Measure

Any built up part of the plant should be designed considering key criteria of landscape like coherence, readability, hierarchy and stability. It is understood that **400 MW CCPP (East) of APSCL** will have a modern architectural view, which does not provide any significant visual intrusion. One simple way by which the altered green area can be turned into its original visual quality is the plantation of trees around the project area.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.2 Impacts during Construction

All construction impacts mitigation measures per the World Bank EHS guidelines on Construction will be followed.

6.2.2.1 Disruption of Earth surface-Site preparation and Clearing and Earthworks

Impact Origin

Each development project more or less requires site preparation. The preparation works generally done during construction stages includes

- Biomass Removal
- Biomass Disposal
- Property removal
- Construction of access road
- Cut and fill operation
- Soil Export and Import
- Drainage works etc.

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

- Noise
- Fugitive dust
- Runoff and flooding
- Soil erosion: Land erosion along the uncovered space due to soil removal and excavation.
- Water Pollution through runoff and sedimentation
- Social concerns
- Infrastructure disruption
- Safety Concerns

However the proposed site is of the nature that it will cause negligible impacts in the pre-construction stages. The site will not require some land filling. The proposed site has no homestead land so impact from property removal activities.

Mitigation Measures

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

6.2.2.2 Impacts on Air Environment

Impact Origin

The air quality in the project area may slightly deteriorate for the time being during the construction. The major construction activities from which air emission mostly dust emission may occur are;

- Poorly paved service lane;
- Ground excavation;
- Delivery of building materials to site;
- Handling and mixing of cement

Poorly Paved Service

The access road to the proposed project should be perfectly paved. Dust nuisance from unpaved or partly paved road is of concern because:-

- There will be increased traffic driving in and out of the proposed site to deliver construction material;
- If soil moisture content becomes very low; it could create increasing quantity of loose particulate matter on road surface;
- There could be no or little vegetation cover to act as dust trap.

Ground Excavation

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

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

Delivery of Building Materials to Site

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

- Handling of cement which is dusty by nature of the way it is;
- Handling of ballast which could contain loose dust particles;
- Site clearing of area of holding ballast, building blocks and sand will expose the site to wind action;
- Handling of building blocks especially coral limestone blocks can be a source of dust.

Handling and Mixing of Cement

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

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

6.2.2.2.1 Potential Environmental Impacts of Dust

Dust produced will potentially negatively affect the following:

- 1) Employees generally construction workers;
- 2) Immediate neighbors and general public; and
- 3) Vegetation.

1. Effects of Dust to Employees

Cement dust can affect plant employers in the following way:

- ✓ Eye irritation;
- ✓ Skin irritation;
- ✓ Impairment of normal sweating of the skin as it blocks pores on the skin;
- ✓ chocking of the throat;
- ✓ Respiratory difficulties;
- ✓ Difficulty in breathing;
- ✓ Potential course of chest complication and ailment.

2. Dust Impacts to Immediate Neighbors and General Public

- ✓ Reduced visibility; emission of high particulate matter to the environment will reduce local visibility;
- ✓ Continuous exposure of people to dust will likely affect ones eye sight that can potentially
- ✓ result in an outbreak of eye infection;
- ✓ Chest related ailment; continuous exposure of people to dust will likely result in chest complications and respiratory disorders.

3. Dust Impacts to Vegetation

- ✓ Dust settling on plant leaf surface will block leaves stoma hence interfering with normal respiration of the plants;
- ✓ Dust settling on plants will reduce the evapo-transpiration of plants; and;
- ✓ Animals such as butterflies, caterpillars, grasshoppers who feed of foliage will be affected as the dust settled on foliage will render the foliage unpalatable;
- ✓ Heavy dust settling on plant matter will impair on normal growth of the plant; and

- ✓ Heavy dust settled on plants will choke and kill plants.

6.2.2.2.2 Proposed Mitigation Measures

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

- ✓ The Project authority should ensure complete the paving of the service road
- ✓ Regular sprinkling of water to be done on open surface and dust grounds until paving is done;
- ✓ Transport of materials in tarpaulin- covered trucks
- ✓ The sand and other such dispersible material will be stored at site for minimum working period.
- ✓ Removal of soil/mud from trucks and other appliances prior to leaving the project area.
- ✓ Storage of top-soil in a safe space and creation of top-soil on filled land utilizing this preserved soil
- ✓ Only trees which on exact proposed position of the building should be cleared any other vegetation outside proposed building position should be maintained;
- ✓ Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses) ;
- ✓ Project management and contractor to enforce strict use of personal protective clothing;
- ✓ Complains of dust related ailments among employees and neighbours to be given access to medical attention.
- ✓ The equipment design will be chosen for least suspension of dust/sand into atmosphere.
- ✓ The construction activity will be carried out during day time only.

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

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.2.3 Impacts on Acoustic Environment

Noise is likely to be generated from the following activities/areas:

- ❖ During ground preparation;
- ❖ During assembly of building materials on site;
- ❖ During construction of the various components of the proposed power plant.

A brief elaboration of each of the potential source/cause of noise is as follows:-

Ground Preparation

Ground preparation is another activity that will potentially result in noise nuisance. Activities of ground preparation that are likely to result in noise nuisance include:-

- ✓ Use of heavy machinery such as excavators, caterpillars in ground excavation will be a source of noise nuisance; and
- ✓ Transportation of excavated earth material from site by use of dump trucks will result in noise nuisance. The noise will be mainly from the trucks.

Assembly of Building Materials

Building materials to be used in construct site will first be gathered and assembled on site. These include building blocks, timber, steel bars, sand, gravel cement. Possible courses of noise nuisance when assembling construction material on site include:-

- Offloading of building materials on site especially steel bars, gravel and building blocks can result in noise;
- Trucks ferrying in building materials can be a source of noise;
- Employees involved in offloading of building material can be a source of noise.

Construction of the Various Components of the Proposed Power Plant

Construction of the civil work structures for the proposed power plant will be labour intensive. This will involve engaging a large workforce, also during construction some machines and equipment will be in use. Possible sources of noise during construction work may include the following:-

- Loud talking, shouting and conversation among employees;
- Noise from equipment such as cement mixers;
- Noise from machines such as welding machines and wood working machines;
- Increased machine and equipment activity on site.

6.2.2.3.1 Potential Environmental Impacts of Noise

Impacts of noise will potentially affect the following:-

- a. Immediate neighbors; and
- b. Employees.

a. Impacts of Noise to Immediate Neighbors

- ✓ Continuous exposure of neighbors to noise nuisance may result in noise induced hearing lose;
- ✓ Noise nuisance may reduce concentration of neighbors in their private matters.

b. Noise Impacts to Employees

- ✓ High noise level will force employees to shout loud when communicating to one another;
- ✓ Exposure of employees to high noise level (above 85dB) continuous for 8hours per day may result in noise induced haring lose;

- ✓ Exposure of ear to peak sound level instantaneously may result to deafness.

6.2.2.3.2 Proposed Mitigation Measures for Noise Nuisance Management

- ✓ Noisy construction works to be limited to daytime hours
- ✓ Immediate neighbours to be notified in writing on the date of commencement of construction work at least one month in advance;
- ✓ All employees likely to be exposed to ear noise to be provide with ear protectors;
- ✓ The project Proponent and contractors to ensure strict enforcement on user of ear protectors;
- ✓ Where applicable and possible exceptionally noisy machines to be fitted with noise reduction devices;
- ✓ Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor or project proponent;
- ✓ Fitting noise machines with noise reduction devices;
- ✓ Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A);

The noise impacts will be local; limited to the premises and very short – term.

6.2.2.4 Sanitation Hazard & drinking water

Impact Origin

The health of the project personnel, construction workers could be impacted if arrangement of sanitation and drinking water is not ensured adequately and properly. During construction stage, lot of local labors will work and hence they would generate considerable amount of human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also.

Mitigation Measures

Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured. Contractors and workers should obey appropriate means of waste removal and sanitation measures (Health consultation, HIV talks, etc are recommended). Adequate number of toilets and bathrooms should be made for the workers, and proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities. The minimum numbers of facilities for the workers are shown in the following:

Toilets used by for mixed use (or women only):

Number of people at work	Number of toilets	Number of washbasins
1-5	1	1
6-25	2	2
26-50	3	3

51-75	4	4
76-100	5	5

Toilets used by men only:

Number of men at work	Number of toilets	Number of urinals
1-15	1	1
16-30	2	1
31-45	2	2
46-60	3	2
61-75	3	3
76-90	4	3
91-100	4	4

It is recommended to use separate toilets for men and women.

For drinking purpose, the workers and employees of the plant will use treated water supplied from the treatment water plant owned by APSCL. The plant uses surface water from Meghna river and treats the water ensuring the quality for drinking water. The treated water is periodically tested for ensuring the quality. APSCL has a plan to install a new Drinking Water Plant as an upcoming project. Therefore the plant water consumption do not impact the community.

Solid waste disposal arrangement, pest and vector control, all measures of waste and wastewater must be consistent with the standards and measures in the EHS guidelines.

Residual Impact

If, the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.2.5 Overland Drainage and Impact on surface water

The potential impacts on local hydrology are principally those of altered patterns as a result of onside construction and earthwork activities. The proposed project will affect natural drainage, surface and ground water quality if not managed the construction works properly. There could be Siltation of water system or drainage from uncovered piles of soil

Proposed Mitigation Measures

- Surface drainage shall be controlled to divert surface runoff away from the construction area, and designed to include allowance for climate change;
- Laying barrier net
- At least 100 m safe distance for stockpiles to waterbody
- Undertaking construction work during dry seasons:
- Completed areas should be restored/re-vegetated as soon as practicable;
- 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
- Regular testing conducted of discharge water
- Strict supervision should be maintained to avoid blockage of natural creeks during the construction period, and
- Containment of sanitary waste should be adequately disposed off to avoid surface and ground water contamination.
- Making provision for temporary disposal of wastes inside construction yard and disposal of solid wastes in an appropriate manner:
- Adequate provision has to be retained for the treatment and disposal of cuttings, drilling fluids and other chemicals and lube oil wastes generated during drilling, testing and commissioning stage. Inlet structure construction in river shouldn't be done in the breeding season of fishes.
- A cofferdam shall be used to restrict downstream release of sedimentation while constructing inlet structures.
- During the period of in-river works, daily water quality testing is recommended to ensure no increase in suspended solids.

6.2.2.6 Social acceptability of Construction workers to the host communities

The differences in the cultures of workers (in case hiring is required) and local community may create some problems. In the rural area, the local people especially the religiously conservative section of the community will not accept the foreign workers in general. However the proposed project site is situated inside the APSCL complex where there is entry restriction for the local people.

Mitigation measures

APSCL has practice of working with the workers of different cultures. It is recommended to aware the foreign workers (if any) about the social & religious actability in the area so that they could maintain those when they will have touch with local community. The construction workers will be mainly local people. In cases if there are some non-local workers, they will reside outside the power plant complex in nearby residential areas by their own. There will be no construction camp inside the plant area. Legality of employees should be ensured.

6.2.2.7 Accidents or Occupational Health Hazard

Impact Origin

Under controlled situation, accident is not expected. However, occasionally it occurs during construction works. Accident may occur during earth cutting, casting, construction works and installation of heavy machinery. The protection of head, eye, ear, and hand, foot of the workers, laborers and project personnel could be affected if proper and adequate arrangement is not ensured.

Mitigation Measures

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

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

6.2.2.8 Increase in Vehicular Traffic in the Area

Increase in vehicular traffic in the area is likely to be experience during construction phase of the power plant. During the construction phase, increase in vehicular traffic in the area is likely to be because of-

- ✚ Trucks ferrying construction material to site;
- ✚ Trucks ferrying waste material from site; and
- ✚ Ferrying in of construction tools and equipment.

6.2.2.8.1 Potential Negative Environmental Impacts Likely to Result From Increased Vehicular Traffic in the Area

- ✓ Possible traffic congestion of local roads and lanes;
- ✓ Possible of occasional experience of delays on the said local roads;
- ✓ Increased number of vehicles on local roads will result in increased wear and tear of local roads thus reducing lifespan of affected roads;
- ✓ Cost of maintaining local roads will increase;
- ✓ Pedestrians and cyclists using local roads will have to exercise more care with increase of vehicular traffic on the said roads; and
- ✓ There will be an increase of exhaust emission from vehicles, which will pollute local atmospheric air.

6.2.2.8.2 Proposed Mitigation Measures to Mitigate Increase in Vehicular Traffic in the Area

The following measures can be put in place to mitigate possible negative impacts likely to result from increase in vehicular traffic in the area:

- ✓ Management to provide for adequate internal parking, for all vehicles coming to the plant premises;
- ✓ Management to pave the dilapidated service road with tarmac or more durable material;
- ✓ All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road; and
- ✓ Marking of the roads to be clearly done.

- ✓ The traffic route should be selected such that passing through residential areas is avoided as much as possible.
- ✓ The traffic management plan should minimize inconvenience to community by choosing the best alternative routes with least community disturbance, by restricting the unnecessary use of horns while passing any sensitive areas (hospitals, schools, residential areas etc.)

6.2.2.9 Impact due to Hazardous material in the site

Impact Origin

Hazardous waste that may be generated during the construction phase of the proposed project includes small amounts of contaminated soil or other solids and small volumes of waste oil, cleaning fluids, solvents, paints, batteries, lighting lamps, and welding materials. Most of the hazardous waste generated during construction will consist of liquid waste, such as flushing and cleaning fluids, passivating fluid (to prepare pipes for use), and solvents. Some hazardous solid waste, such as welding materials and dried paint, may also be generated. Flushing and cleaning waste liquid will be generated when pipes and boilers are cleaned and flushed. Passivating fluid waste is generated when high temperature pipes are treated with either a phosphate or nitrate solution. The volume of flushing, cleaning and passivating liquid waste generated is estimated to be one to two times the internal volume of the pipes cleaned. The quantity of welding, solvent, and paint waste is expected to be minimal.

Mitigation Measures

World Bank EHS guidelines on Hazardous Materials Management and Waste Management will be followed. Many of these wastes would be recycled. The construction contractor should have adequate knowledge about the generation of hazardous waste at construction site, and will be responsible for proper handling of hazardous waste in compliance with all applicable law. The contractor will provide personnel training to the construction workers to handle the hazardous waste, accumulation limits and times, and reporting and recordkeeping. The wastes that require disposal would be characterized based on generator knowledge or analytical testing to determine the appropriate management and handling procedures. Once properly characterized, the wastes would be temporarily stored at the site in appropriate containers and impermeable storage areas according to all applicable hazardous waste storage law. Impermeable surface should be used for refueling whilst there will be training of workers in spill response and provision of spill equipment on site. Oily waste and chemicals should be stored in a tank have sufficient secondary containment (110% more than it's capacity).

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

1. Name & type of waste
2. Quantity of waste
3. Date of waste generation (period of waste generation)
4. Waste generation site

5. Disposal site
6. Responsible authority who handles this waste.

The waste will be removed from the site with a regular interval for safe disposal at designated permitted facility.

6.2.3 Impact during Operation Stage

6.2.3.1 Impact on Air quality

Impact Origin

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

Sulfur dioxide (SO₂) emission: The emissions of sulphur dioxide are dependent on the sulphur content of the gas. Since there is no sulphur content in the natural gas to be used as may be seen from the analysis of natural gas. Therefore, there would be no sulphur dioxide emission from the plant.

Nitrogen Oxides (NO_x) emissions: Burning of fossil fuels at high temperature (above 1600°C) generally produces two forms of nitrogen oxides-nitric oxide (NO) and nitrogen dioxides (NO₂); commonly referred to as nitrogen oxides (NO_x). Since the gas turbine intakes excess air to the tune of 127% more than required for combustion, and if a fully premixed burner (dry low NO_x burner DLN) is used there will be no NO_x since the combustion temp is much less (2402°F ≈ 1317°C) in the case of such a turbines. The proportion of NO_x and NO₂ varies depending on the combustion technology, and in the case of gas turbines approximately 90 percent of the nitrogen oxides is present as NO with the remaining being NO₂. Once the NO enters the atmosphere, it reacts with oxygen in the air and oxidises to NO₂ with passage of time.

Carbon monoxide (CO) emission: Carbon monoxide (CO) is generated when incomplete combustion takes place. As per design, the emission of CO from the gas turbine would be minimal. So the impact due to emission of CO would not be significant for the proposed power plant.

Carbon dioxides (CO₂) emission: Emission of CO₂ is associated with global warming. CO₂ gas emission depends on the fuel burned and the carbon content of the fuel. The natural gas contains a significant portion of carbon, which reacts with

oxygen to produce CO₂ and heat; At full capacity CO₂ emission due to the project operation, with its present quantum will not have much impact on global warming.

The following table shows the comparison of IFC CO₂ Emission rate for Combine Cycle Gas Turbine Plants and the specification of 400 MW CCPP:

	Performance of Machine as per Engine Catalogue	IFC/WB Typical Values for CO ₂ Emissions in a CCGT Plant (Natural Gas)		
		Efficiency, (% Net, HHV)		Efficiency, (% Net, LHV)
		(w/o CCS*)	(with CCS*)	
Efficiency, (% Net)	58.4	50.8	43.7	54-58
CO₂ Emission, (t CO₂/ GWh)	342.1	355	39	348-374

*CCS-Carbon capture and storage

The CO₂ emission factor for Ashuganj 400 MW CCPP 342.1 tCO₂/GWh. Assuming 85% plant load factor, the total annual CO₂ emissions of Ashuganj 400 MW CCPP is estimated to be 1,018,910.64 tCO₂/year:

$$0.40 \text{ GW} \times 8760 \text{ hours/year} \times 0.85 = 2978.4 \text{ GWh/year}$$

$$2978.4 \text{ GWh/year} \times 342.1 \text{ tCO}_2/\text{GWh} = 1,018,910.64 \text{ tCO}_2/\text{year}$$

Mitigation Measures

It has been discussed earlier that the proposed power plant would be constructed with a modern design and sophisticated machinery setting. The power plant would be operated by natural gas, so CO, Particulate Matter and SO₂ would not be a concern in terms of emission. The NO_x emission from the power plant would be kept minimum with optimum designed cycle efficiency in order to maximize the MW output. Mitigation and monitoring measures in the World Bank EHS guidelines on Air Quality and Ambient Air Quality and Thermal Power will be followed.

Stack Emission

It has been discussed earlier that the proposed power plant would be constructed with a modern design and sophisticated machinery setting. The proposed APSCL 400 MW CCPP east power plant is of advanced design with dry low NO_x (DLN) burner with premix burning system which restricts the combustion temperature to 1316⁰C which is much below the NO_x forming temperature (1600⁰C). The proposed power plant will produce 25 ppm NO_x emission from the 289 MW turbine which will be within the IFC/WB emission limit of 51 mg/Nm³ (25ppm) with 15% O₂, for gas turbine power plants more than 50 MWth located in the degraded or non-degraded air shed. As per

Bangladesh ECR 1997, the NO_x emission standard of gas turbine power plant within 200-500 MW is 40ppm irrespective of O₂ content which is also higher than 25ppm.

For the emission standard, please check table 3.4 and table 3.8.

Ambient Air Quality

An effect on ambient air quality has been assessed based on preliminary air quality modeling results. An advanced air emission dispersion modeling has been conducted for determining the ground concentration of pollutants from the stack and turbine emission. In the study, the NO₂ emissions for the gas turbine stack exhaust system were modeled to obtain maximum possible downward ground concentration. USEPA AERMOD view version 8.8.9 model was used to estimate emission concentration from the plant.

The proposed power project will have a 289 MW gas turbine fitted with 135 MW steam turbine and the model calculates the values in different configurations by considering individual stack emissions with 65m stack height of NO₂ emissions. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO₂ concentration contour has been analyzed with 500 m interval with a radius of 5000m from the point source. The NO₂ concentration contour of 1 hour, 24 hour and annual average of maximum concentration have been analyzed.

The parameters and corresponding values are summarized in Table 6.1

Table 6.1: The exhaust specifications and stack parameters

Parameters	Values
Stack height (m) =	65m
Stack inside diameter (m) =	6.25m
Stack gas exit velocity (m/s) =	9 m/s
Exhaust temperature (K) =	(90+293) = 383
Exhaust flow rate (m ³ /sec) =	276.11
NO ₂ emission rate as NO ₂ (g/s) =	15.38
Ambient temperature (K) =	293
Receptor height above ground=	0.000

Dispersion Model results:

A. Stack emission results:

The NO₂ concentration contour of 1 hour and annual average of maximum concentration have been analyzed. The maximum of 1 hour concentration of NO₂ (10-18 µg/m³) has been predicted at a radius of 1000m east, west & south to the power projects. The concentrations will be expected to reduce from 10 µg/m³ to 3 µg/m³ uniformly surrounding the project within 4000m from the stack. The

concentrations will be further below to $3 \mu\text{g}/\text{m}^3$ beyond 4000m around the project. The maximum annual concentration of NO_2 has been detected as $0.50\text{-}0.60 \mu\text{g}/\text{m}^3$ at 1000m to 5000m west to the project, whereas the concentration are below $0.50\text{-}0.10 \mu\text{g}/\text{m}^3$ at the either sides further down to the project site up to 5000m.

Review of modeling results:

The modelling result shows the 1 hour concentration of NO_2 ($10\text{-}18 \mu\text{g}/\text{m}^3$) has been predicted at a radius of 1000m east, west & south to the power projects site which is within the IFC standard ($200 \mu\text{g}/\text{m}^3$) for 1 hour concentration. The maximum annual concentration of NO_2 has been found $0.50\text{-}0.60 \mu\text{g}/\text{m}^3$ at 1000m to 5000m west to the project which are also less than the Bangladesh, WHO/IFC and USEPA standard. These indicate that the expected power plant does not have major significant adverse impact on the prevailing air quality of that area.

Table 6.2: Ambient air quality guideline for NO_2

Pollutants	Average period	Standard in $\mu\text{g}/\text{m}^3$		
		BNAAQS***	WHO/IFC 2007*	US EPA
NO_2	1 hr		200**	188
	Annual	100	40**	100

* IFC Environmental Health & Safety Guidelines 2007

** Ambient air quality standard for small combustion facility using gas fuel and spark engine

***Bangladesh National Ambient Air Quality Standard

Table 6.3: Predicted NO_x Concentrations ($\mu\text{g}/\text{m}^3$)

Distance Downwind	
1-hour ($\mu\text{g}/\text{m}^3$)	
0-1500 meters all sides	10-18
1500-4000 meters all sides	3-10
Beyond 4000m all sides	<3
GOB Allowable limit ($\mu\text{g}/\text{m}^3$)	- - -
WB/IFC/WHO guideline for NO_2 ($\mu\text{g}/\text{m}^3$)	200
Ambient Monitoring at APSCL (various locations including project site)	48-54
Annual ($\mu\text{g}/\text{m}^3$)	
1000-5000m west	0.50-0.60
1000-5000 meters north-west & south-west	0.40-0.05
1000-5000 meters North, South & east	<0.05
GOB Allowable limit ($\mu\text{g}/\text{m}^3$)	100
WB/IFC/WHO guideline for NO_2 ($\mu\text{g}/\text{m}^3$)	40
Ambient Monitoring at APSCL (various locations including project site)	11-26

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

The following are the emission contour maps of the proposed project at 1 hour and annual average of NO_2 concentration at 65m stack height:

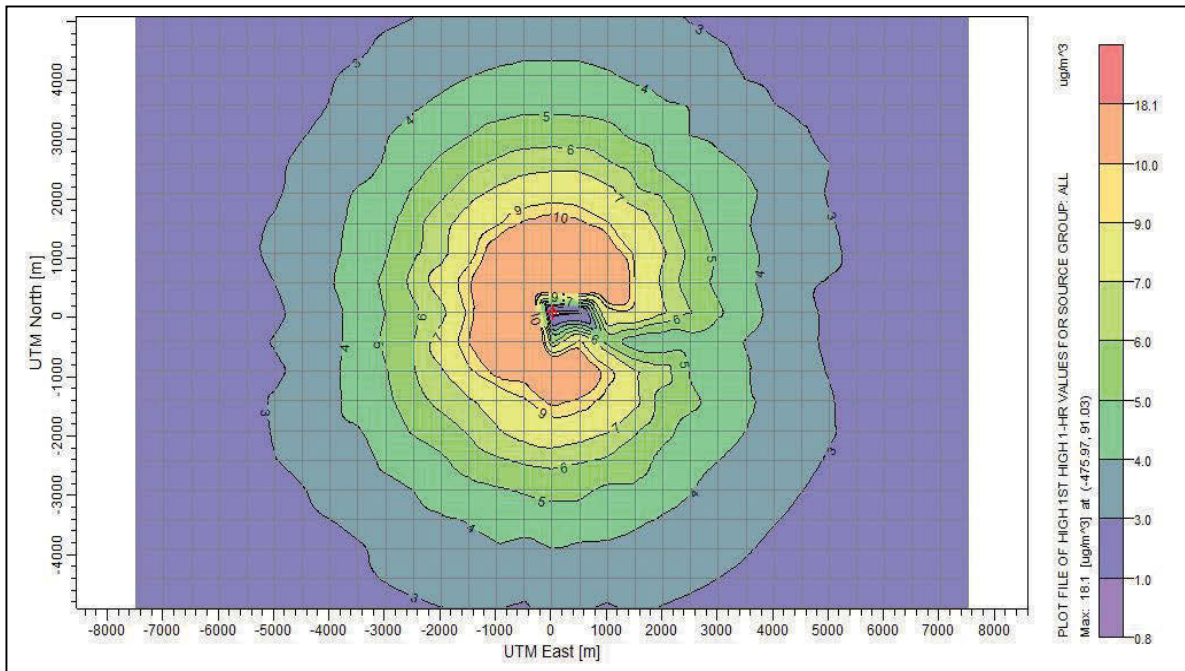


Figure 6.1: Emission contour map showing the NO₂ concentration (1 hour average)

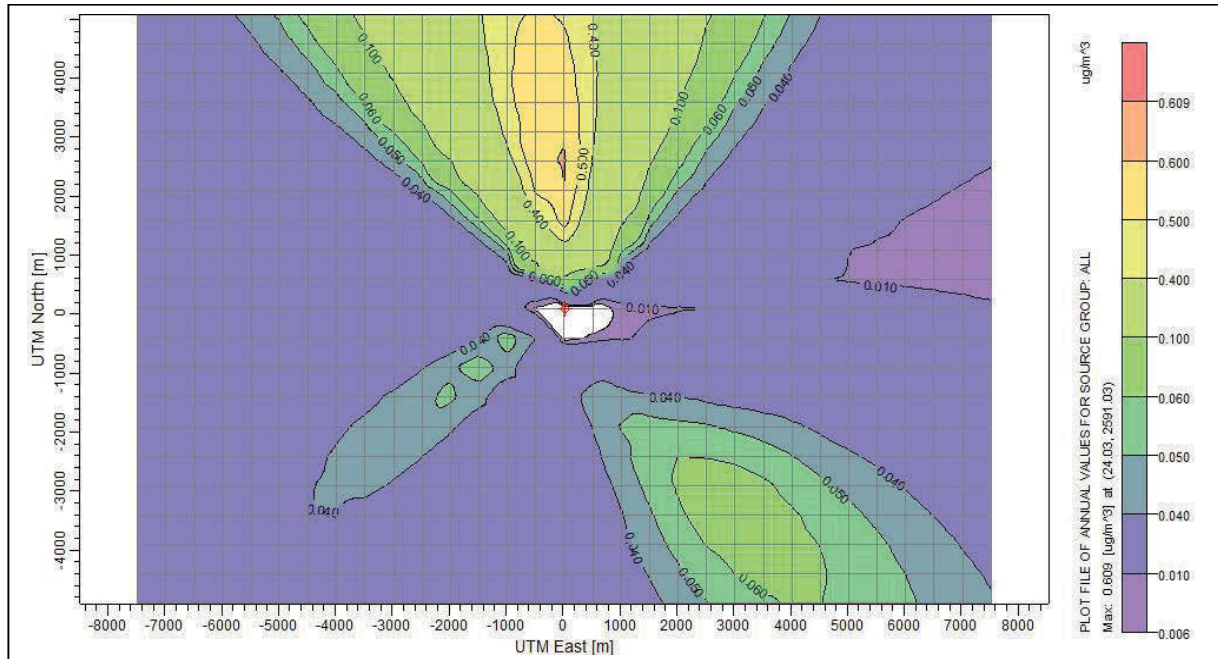


Figure 6.2: Emission contour map showing the NO₂ concentration (annual average)

B. Ambient Air Quality by considering the cumulative concentration from other proposed projects of APSCL.

An effect on ambient air quality has been assessed based on the cumulative ground concentration of NO₂ emissions together with other proposed power project of APSCL at the same complex. In addition to the 400 MW CCPP east, APSCL is now

constructing two 450 MW CCPP north & south, one 225 MW CCPP and one 200 MW reciprocating gas engine power project (by UAEL). USEPA AERMOD view version 8.8.9 model was used to estimate emission concentration from all the plant.

In this calculation, we have considered 20 reciprocating gas generators and 3 combined cycle power plant stack together as point source. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO₂ concentration contour has been analyzed with 500 m interval with a radius of 5000m from the point source. The NO₂ concentration contour of 1 hour, 24 hour and annual average of maximum concentration have been analyzed.

The parameters and corresponding values are summarized in Table 6.4 & 6.5

Table 6.4: The exhaust specifications and stack parameters (for 20 stacks)

Parameters	Values
Stack height (m) =	40m
Stack inside diameter (m) =	1.20
Exhaust temperature (K) =	(170+293) = 463
Exhaust flow rate (m ³ /sec) =	4.94
NO ₂ emission rate as NO ₂ (g/s) =	0.988
Ambient temperature (K) =	293
Receptor height above ground=	0.000

Table 6.5: The exhaust specifications and stack parameters (for 450 MW north & south)

Parameters	Values
Stack height (m) =	50
Stack inside diameter (m) =	6.09
Exhaust flow rate (m ³ /sec) =	472.12
Exhaust temperature (K) =	384
NO ₂ emission rate as NO ₂ (g/s) =	24.078
Ambient temperature (K) =	293
Receptor height above ground=	0.000

Table 6.6: The exhaust specifications and stack parameters (for 225 MW)

Parameters	Values
Stack height (m) =	50
Stack inside diameter (m) =	6.09
Exhaust flow rate (m ³ /sec) =	472.12
Exhaust temperature (K) =	384
NO ₂ emission rate as NO ₂ (g/s) =	24.078

Ambient temperature (K) = 293
Receptor height above ground = 0.000

Dispersion Model results:

The NO₂ concentration contour of 1 hour and annual average of maximum concentration have been analyzed. The maximum of 1 hour concentration of NO₂ has been predicted below 100-153 µg/m³ at a radius of 0-1000m around the project, whereas the concentrations are within 50-100 µg/m³ from 1000-3000m around the project site and the concentrations are below 50 µg/m³ has been predicted at further down beyond 400m radius. The maximum annual concentration of NO₂ has been detected as 10-20 µg/m³ at a radius up to of 3000m west to the project forming a pocket whereas the concentration are within 5-0.30 µg/m³ at the either sides further down to the project site up to 5000m.

Review of modelling results:

The modelling result shows the maximum 1 hour ground level concentration of the NO₂ is 100-153 µg/m³ at a radius of 0-1000m around the project which is within the IFC standard (200 µg/m³) for 1 hour concentration. Since this is not an individual contribution to air shed and no other major NO_x polluting sources exists within the air shed, the calculated concentration may be compared with the standard.

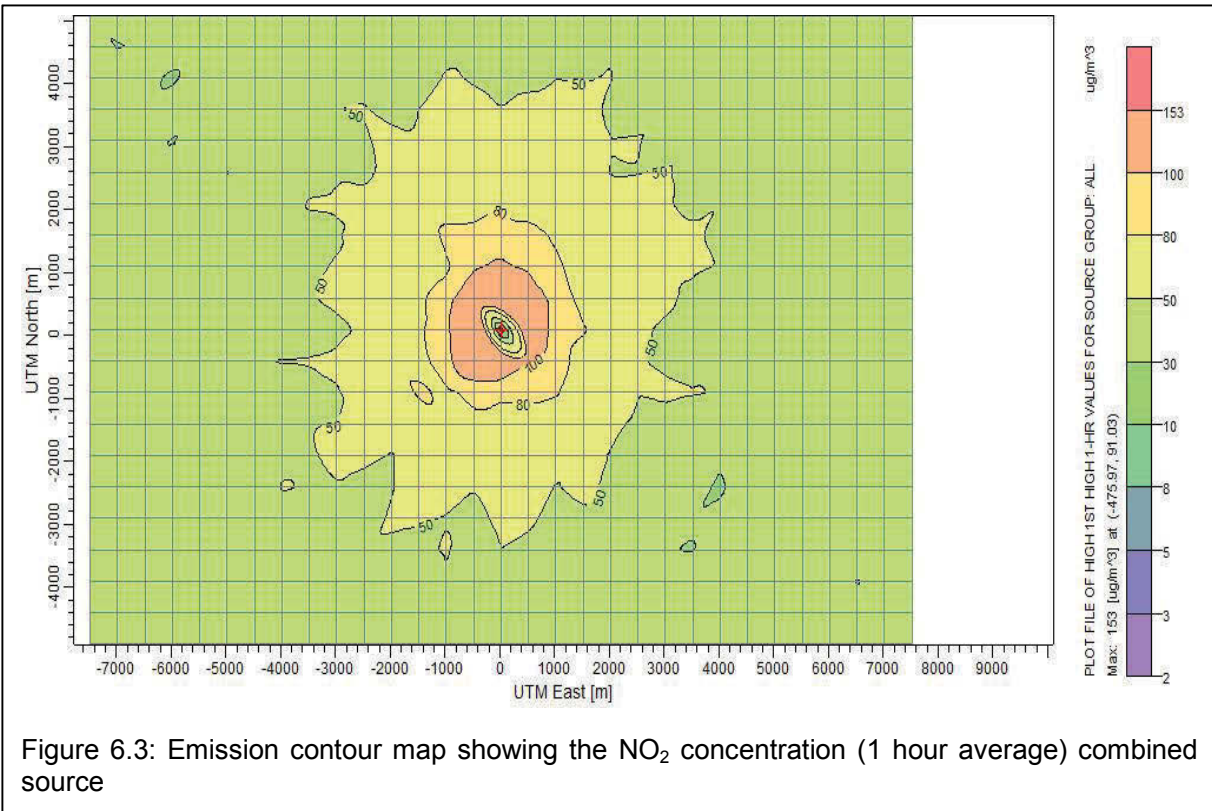
The maximum annual concentration of NO₂ has been found 10-20 µg/m³ at a radius up to of 3000m west around the site is also less than the Bangladesh, WHO/IFC and USEPA standard as mentioned in the table 3.1. These indicate that the expected power plant does not have major significant adverse impact on the prevailing air quality of that area.

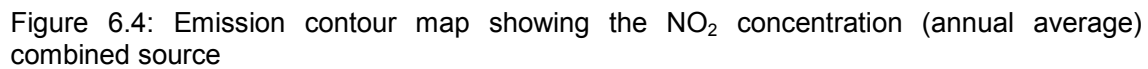
Table 6.7: Predicted NO_x Concentrations (ug/m³)

Distance Downwind	
1-hour (ug/m ³)	
0-1000 meters all sides	100-153
1000-3000 meters all sides	50-100
Beyond 3000 all sides	<50
GOB Allowable limit (ug/m ³)	---
WB/IFC/WHO guideline for NO ₂ (ug/m ³)	200
Ambient Monitoring at APSCL (various locations including project site)	48-54
Annual (ug/m ³)	
0-3000m west	10-20
0-1500 north & south	1-5
1000-5000 meters Northwest & southwest	1-0.5
GOB Allowable limit (ug/m ³)	100
WB/IFC/WHO guideline for NO ₂ (ug/m ³)	40
Ambient Monitoring at APSCL (various locations including project site)	11-26

ug/m³ = micrograms per cubic meter

The following are the emission contour maps of the proposed project at 1 hour and annual average of NO₂ concentration:





Residual Impact

It is clear from above study that the project proponent will adopt necessary options suitable to their needs meeting the national standards. Adoption of measures set out above is not expected to provide total mitigation, because no machine works at 100% efficiency. After adopting proper mitigation measures to maintain national/international standards, **APSCL** power projects will emit some residual pollutants, which can affect the environment in the long run. On the other hand, if other industries & power projects located in the area, emit the air, meeting the national requirement as **APSCL** 400 MW CCPP (east), the cumulative residual pollutants will create an adverse situation in the ambient air quality. So, this situation can be overcome by determining the exact level of treatment and maintaining it by following the management plan properly, which is required to maintain the normal ambient air quality of the area.

6.2.3.2 Impact due to Liquid Discharge

6.2.3.2.1 Non Hazardous Wastewater

The water balance diagram for this project is given as the Annexure-9(b). The wastewater collection system will collect sanitary wastewater from sinks, toilets, and other sanitary facilities, and will be managed by the septic tank. The waste water generated from the above sources will be disposed to underground septic tank and soak well system. Proposed septic tank and soak well details are shown in figure. $0.5\text{m}^3/\text{hr}$ wastewater flows from the building sewer line to the septic tank where both heavy and light solids separate from the wastewater. Solids that are heavier than water settle out forming a sludge layer on the bottom of the septic tank. Solids lighter than water float to the top of the wastewater forming a scum layer. A liquid layer of water with suspended solids, nutrients, microorganisms and other pollutants separates the sludge and scum. Anaerobic bacteria — those that can live without oxygen — begin to break down waste in the septic tank. As wastewater flows into the septic tank, an equal volume of the liquid layer, called effluent, flows out of the septic tank into the effluent treatment system. In a properly designed, functioning and maintained septic tank, scum and sludge will not flow out with the effluent.

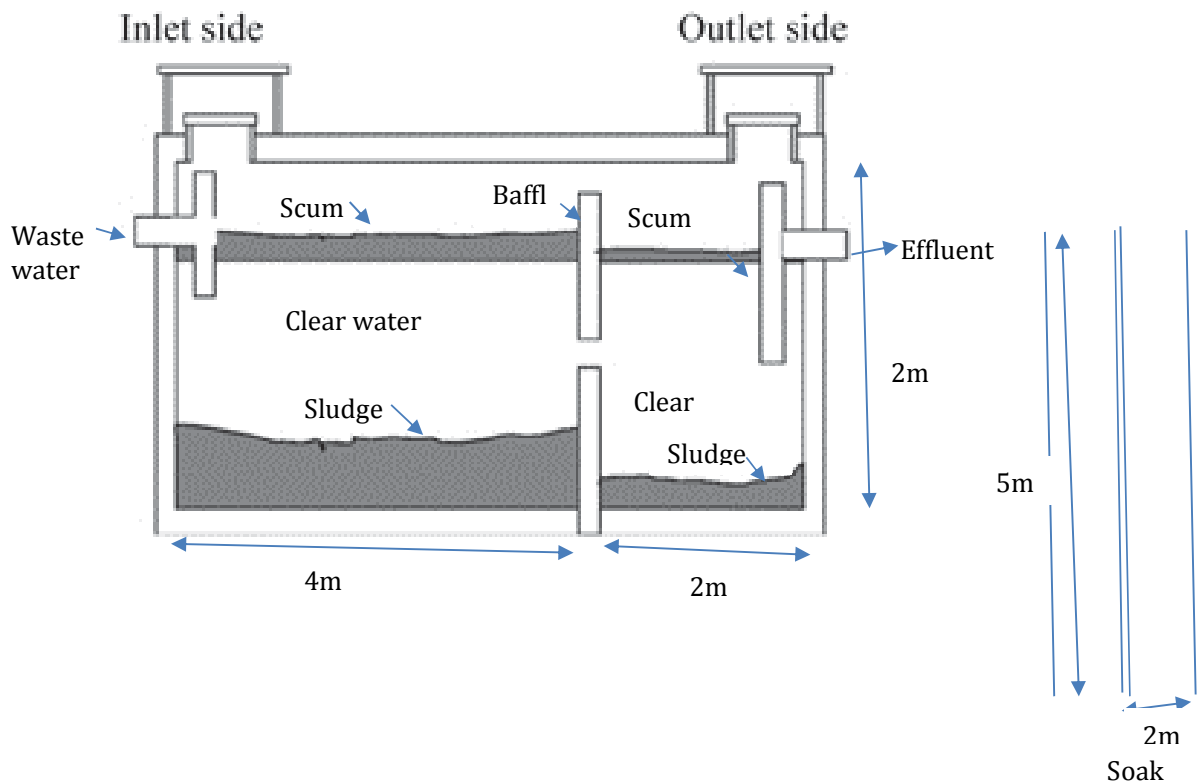


Fig. 6.7: Septic tank details

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

Solid waste is removed from septic tank every five years interval. This anaerobically digested septic tanks solid waste/sludge is used as a soil conditioner or fertilizer. There is no deep tube well within the 100 m radius of the project site, therefore no chance of groundwater pollution. The nearest deep tube well from the site is almost 700m away.

6.2.3.2.2 Wastewater from Plant Drains–Oil/Water Separator

General facility drainage will consist of area wash down, sample drains, equipment leakage, and drainage from facility equipment areas. Water from these areas will be collected in a system of floor drains, hub drains, sumps, and piping, and routed to the facility wastewater collection system. Drains that could contain oil or grease will first be routed through an oil/water separator and then directed to the wastewater treatment plant. If you see the annexures 9b and 9c it will be clear that after being intercepted through the oil water separator, the water will go to the waste water treatment plant. Wastewater from other sources like cooling tower back wash, water treatment plant or filtration back wash, HRSG & condensate receiver sump pit etc. will be discharged after treating in the wastewater treatment plant. The amount of wastewater generated from this system is anticipated to be minimal. For the detailed diagram of wastewater treatment plant and oily water separator see Annexure 9(b), (c) & (d).

6.2.3.2.3 Wastewater from Close circuit cooling system:

The proposed combined cycle power plant will have close circuit cooling water system 1200 m³/hour in the lubricating engine oil cooling system and other small water cooling part. This cooling water will not be discharged but will be recycled after cooling in the cooling tower, small amount of make-up water will be required in the system to be running effectively.

6.2.3.2.4 Wastewater from Open circuit water circulation unit:

The proposed Combined Cycle power project will use river water in the steam condensing unit at rate of 28,500 m³/hour or 7.91 m³/sec flow for the cooling process assuming a maximum rise of water temperature by 7°C during discharge at the condenser discharge point which will further reduce by travelling through the open channels. The cooling water will not contain any pollutants other than elevated temperature. From the section 2.5.10.1, the cooling water after discharging from the condenser outlet, will travel through the underground discharge pipeline of 2.4m dia and 700m long to the existing discharge channel of unit 1&2. See Annexure 15 for better understanding the old and new structures. The green lines show the new pipelines to be constructed for intake and discharge.

All discharge channels then meet at the existing water holding pond (Dimension as:

Length:35 meter, Width:30 meter, Depth:2.965 meter) at the power plant complex, from the pond there are three discharge channels of 600m, 700m and 1.6km and then travelling through the discharge channels water is discharged on the river. For better understanding of the routes of the three discharge channels please see the annexure 9 (a).

The total water withdrawal by the existing and new plants of APSCL amount to $56.4\text{m}^3/\text{sec}$. The same volume will be discharged back to the river. The minimum river discharge is $2050\text{m}^3/\text{sec}$ at plant location is quite adequate for this. The average river temperature was recorded during the study period was 32.2°C (On 29th July, 2015 during the field study of surface water temperature at inlets). There is a discharge pond (35mx30x3.0m) and an internal canal of APSCL of around 3 discharge canals among which the shortest is 600 m long receive all the cooling water discharge from the power plants (The shortest channel is chosen for the modelling because, water will travel the minimum distance through this channel before falling at the river, for the other channels the travel time of discharge water will be higher and therefore the temperature will reduce more compared to this shortest channel. Therefore if the rise of the river temperature is acceptable in this channel, then the rise will be satisfactory in other channels, too; which is also evident from the field temperature values shown in the Annexure 9a) and finally discharge to the meghna river at the south east boundary of APSCL. The temperature of discharge water in different point of the discharge canal and outfalls have been measured during the study period and has been attached as annexure 9(a). It is observed that the discharge water temperature drops significantly immediately after discharging to mixing pond (35°C) which discharges at 35°C at the shortest discharge point D and 34.44°C at the longest discharge point I.

It is estimated that over $56.4\text{m}^3/\text{sec}$ of river water would be drawn from the intake point by all the plants together including the proposed 400MW CCPP east and impact of $56.4\text{m}^3/\text{sec}$ water discharged at 34°C may not have any significant impact on river water temperature.

In order to predict the thermal plume dispersion properly, Cornell Mixing Zone Expert System (CORMIX3) software is used to predict the steady and un-steady state mixing behavior and plume geometry. The Objective of this study is to compliance the thermal plume dispersion with the regulatory mixing zone standard for new power generation unit (400MW CCPP East) after being operation of it's full capacity.

It is a USEPA-supported mixing zone model and decision support system for environmental impact assessment of regulatory mixing zones resulting from continuous point source discharge. Heated water will be discharged from the APSCL to the river after traveling through a 600m open channel (The shortest channel is considered assuming the full discharge flow from 400 MW CCPP, but in real, the discharge will be distributed from the pond into three different channels mixed with the discharges from the other plants. The reason for taking the shortest channel with maximum flow is to show the maximum possible impact on water due to the discharge from the proposed plant.). A number of input parameters are considered for this modeling process. Table-6.8 shows the input variables for thermal plume modeling.

Table 6.8: Input parameter for thermal plume modeling

	Unit	Data	Data Source
AMBIENT PARAMETERS:	Dry Period		
Cross-section		Bounded	Field observation
Width	M	200	Schematized of Cross section
Channel regularity		2	Field observation
Ambient flow rate	m ³ /s	200	20% of the Minimum Flow
Average depth	M	5	Schematized channel depth
Depth at discharge	M	4	Field survey
Ambient velocity	m/s	0.2	Field survey
Manning's Coff.		0.035	Field observation
Wind velocity	m/s	4.1	Literature review
Temperature	deg C	32.2	Field investigation
Water density	kg/ m ³	995.6	Calculated
DISCHARGE PARAMETERS:	Surface Discharge		
Discharge located on		left bank	
Discharge configuration		flush discharge	
Distance from bank to outlet	M	0	Field investigation
Discharge angle	Deg	90	Field investigation
Depth near discharge outlet	M	1.5	Field investigation
Bottom slope at discharge	deg	30	Field investigation
Discharge cross-section area	m ²	15	Field investigation
Discharge channel width	M	15	Field investigation
Discharge channel depth	M	1	Field investigation
Discharge aspect ratio		0.066667	Calculated
Discharge flow rate	m ³ /s	7.92	Design Condition
Discharge velocity	m/s	0.53	Calculated
Discharge temperature (freshwater)	degC	35	Design value
Corresponding density	kg/ m ³	993.6812	Calculated value
Density difference	kg/ m ³	1.9658	Calculated value
Buoyant acceleration	m/s ²	0.0194	Calculated value
Discharge concentration	degC	6	Design condition
Surface heat exchange coeff.	m/s	0.000018	Calculated value

After running the CORMX3 simulation for dry period, a continuous thermal plume path has been identified. Figure-6.7 shows the thermal plume dispersion with respect to the changing temperature and distance. Plume will be discharged from the left bank of the river and dispersed to the downstream. It will attach with the left bank downstream of the river. At this situation, the centerline temperature will reduce to 32.4 deg C at 100 m distance from the outfall.

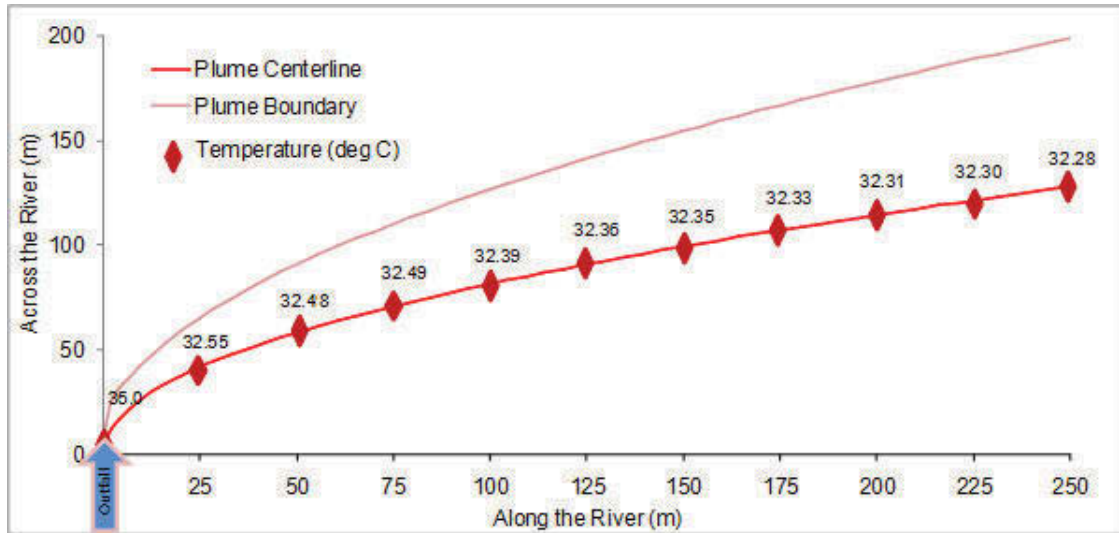


Figure-6.8: Thermal plume dispersion from upstream to downstream

This result is confirmed that the increase of river water temperature around the discharge point do not exceeds 3°C near the mixing zone boundary in the river. It will be reduced by 3°C near $(x=10\text{m}, y=27\text{m})$ to the discharge point. Moreover, all the thermal plume related issues are considerably confined inside the sub channel (i.e. left bank of Meghna river near APSL to the island/char). After certain distance when the channel water will join with the main river water, the effect of thermal plume becomes significantly minuscule. From field investigation and modelling output of thermal plume, it is evident that the thermal plume of this project will satisfy the international standards adequately. The modelling report is attached as Annexure 12(b).

It is to be noted that, the present rise of the water temperature will not be increased by the operation of 400 MW CCPP (East) project. Because, this is a replacement project of Unit 3 (150 MW, ST). The temperature rise in Unit 3 is definitely more than the proposed 400 MW CCPP. Because Unit 3 doesn't not have any HRSG or combined cycle power plant technology. Therefore the water temperature will certainly be less in case of 400 MW CCPP. Again, the discharge water from 400 MW CCPP will also be less than that of Unit 3. Since, the water temperature and quantity is less for 400 MW CCPP than the existing unit 3 and the distance of discharge point from 400 MW CCPP is more than that of the unit 3; the existing rise of water temperature found by considering unit 3 in the field investigation (Annexure 9a) will not increase when the 400 MW CCPP will operate.

However, proper care will be taken in the design of water circulation system for the Combined Cycle power plant that no contamination or waste is carried to the river. Thus, the river water will remain free from any sort of negative impact originated from the power plant. Rigorous temperature modelling will be required during detailed design stage to ascertain exact temperature dispersion of condenser outlet water mixing with the river water, so that other water users will not be affected.

It is recommended to continuously monitor the temperature on the discharge point for the power plant and on the three canal discharge points as it will be important to

be able to measure the impact of this project and the contribution of the other power plants to the overall temperature in case of grievance being raised.

6.2.3.3 Impact due to Solid Waste

Impact Origin

The operation of the plant itself would not generate any solid waste. Solid waste generated by the people working at the proposed site is paper, cartoons, bags, boxes, office wastes, pallets, empty drums etc. along with negligible quantity of domestic waste. There will have waste Air filters and waste rugs be generated occasionally which need to be properly disposed.

Mitigation Measures

All solid waste will be segregated properly. The World Bank EHS guidelines on Hazardous Materials Management, Waste Management and Thermal Power will be followed for all solid and hazardous waste management. Some solid Waste has tremendous secondary demand and sold to the secondary licensed dealers. Other solid wastes will be disposed to licensed landfill. Records of all waste transfer will be kept. The air filters and waste rugs should be collected in a safe place and should be disposed to the land fill.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.4 Impact due to Lubricating Oil

Impact Origin

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

Mitigation Measures

The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility of 110% bigger than the allowable maximum storage capacity. The waste lubricated oil thus collected will be supplied /sold to the venders or the Lube Oil Re-cycling plants approved by DoE at throwaway price. As there is no chance of mixing and disposal of oil onto land or water, so there is no mitigating measure to be suggested.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.5 Noise and Vibration Impacts

Impact Origin

The gas turbine and the steam turbine will have internal noise level of around 70 dBA which will be minimized by sophisticated acoustic power house building design so as to minimize the noise up to standard. The heat recovery steam generator stack will emit a noise level of 70 dBA after providing the silencer. This noise will be dispersed to the surrounding atmosphere to certain extent.

Mitigation Measures

Necessary noise abatement measures will be taken as required avoiding adverse noise & vibration impact on the neighborhood. To reduce the effect, most costlier and effective **Critical Type Silencer** will be used in the stack. In particular, significant noisy components such as the gas turbine sets are enclosed in buildings acoustically designed, providing **Styrofoam filler of 50 mm width in between 300 mm thick brick walls** around the power house building. Moreover, thick doors are provided and holes which may create sound pollution are sealed with sound proof materials. Vibration pad will also be used at the bed of all power generation units to prevent the vibration.

The following are the noise protection capacity of the material which would be used for sound insulation for the power house building:

Material	Thickness, mm	Surface density, kg/sq.m	Transmission loss, dBA
Styrofoam (Acrylic -Poly-Methyl-Meta-Acrylate (PMMA))	15	18	32
Brick with or without plaster	150	288	40

As per above calculation the Styrofoam filter and brick wall are capable to absorb more than 112 dBA noise from the engine room, but the approximated engine room noise is around 70 dBA near the turbines, which is lower enough to minimize the engine room noise by the acoustic measurement. Moreover, Vibration pad will also be used at the bed of all power generation units to prevent the vibration.

For the measurement of the dispersion of the stack noise to surrounding environment, a noise modeling simulation has been done by using CUSTIC-3.2 noise modeling software. The model has calculated the noise from the exhaust stack of 70 dBA and the result of the modeling has been given below

The distance of the following noise level have been calculated from the center of the stack row.

Radius, m	20	50	100	200	300	400
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Output Sound power level in dBA	29.37	24.48	19.58	14.69	9.79	04.79
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Fig 6.9: Plot of output noise power level in dBA vs Radius in meter

The modeling result shows that the power plant will produce max noise 29.37 dBA within the boundaries whereas the noise level is 19.58 within 100m radius and minimum 4.79 dBA within 400m radius of the project. There are few homesteads at the 100m south east side and south west side of the project where the noise contribution from the project is negligible.

The following are the World bank and Bangladesh standard for the ambient noise:

Standard	Zone	Day time dBA	Night time, Dba
World Bank	Residential, Institutional, educational	55	45
EHS Guideline 2007	Industrial, commercial	70	70
Bangladesh	Mixed area	60	50
	Commercial	70	60
ECR, 1997	Industrial	75	70

It is observed from the noise emission modeling that the max noise level within the 20m radius is 29.37 dBA. If we consider 12 am (night time) noise level (max 60 dBA) as the background noise (table 4.14), the combined effect can be found from the link -<http://www.sengpielaudio.com/calculator-spl.htm>

applying the formula of $(\Sigma L = 10 \cdot \log_{10} (10^{L1/10} + 10^{L2/10}))$ dBA. The calculated table is presented below:

The calculated table is presented below:

Radius, m	20	50	100	200	300	400
Output Sound power level in dBA	29.37	24.48	19.58	14.69	9.79	04.79
Ambient sound level in dBA	60	60	60	60	60	60
Summation of two sound level	60.004	60.001	60	60	60	60

The result clearly stipulates that the sound intensity level is within the WBG guideline (70 dBA at industrial zone) at all sides from the center of the stack row and gradually reduces at further distances. Interesting to note that, the reason for the higher ambient noise level causes for the existing container mounted 55 MW gas engine based power project and other power plants located at the APSCL site and the construction of 3 proposed power projects. Since there is no homestead within the 100m radius of the proposed project, so, the noise emission from the project would not create any harm to the neighboring community.

The exceeding noise levels at the nearest receptors were found while monitoring at dormitory. This noise level is temporary since massive construction work is going on and there are some gas engine based quick rental plants which emit noise. All these noise sources will not be continued after 1-2 years. Even though, it is suggested to investigate the actual noise source and take precautions at the residential areas such as: raising the height of the boundary walls, planting more trees, if possible thickening the boundary walls, raising grievances at the actual noise source. It is to be noted that the average noise levels at the project site is satisfactory but at times exceeding the standard. The plants operated by Ashuganj Power Station Company Ltd. are designed with sophisticated sound control measures that there are minimal noise inside the power station complex. The workers should use earplugs while working and if any grievances are received, it should be taken to solve immediately.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.6 Occupational Health

Impact Origin

The proposed project will employ around 91 people during its operational period. The workers who work inside the plant will face occupational health hazards due to different operational processes. Safe and good occupational health status of the employees and workers is important for only the persons working in the plant, but also for the better plant operation and maintenance.

Mitigation Measures

Protective clothing, earplug, helmets, shoes and accessories should be provided to the workers. Adverse impact on worker's safety would be minimized by implementing an occupational health program. Regular medical checkup would be done to ensure the soundness of health of employees and workers. Pollution control measures would duly adopt if necessary, including noise and air pollution.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.7 Socio-economic Impacts

The 400 MW CCPP (East) of **Ashuganj Power Station Co Ltd** will contribute to cover the increasing demand of electricity which is a beneficial operation factors, e.g. for producing industries. During the construction activities of the 400 MW CCPP (East) of **Ashuganj Power Station Co Ltd**, 1000 jobs and income opportunities will be created and as such per capita income will be enhanced in this area. During operation, around 91 long-term skilled and unskilled personnel will be required which will create employment opportunities for the local inhabitants also.

Since there was no habitation located inside the proposed site, resettlement would not be necessary for the project. But migration will be increased due to creating new job opportunities in the project area. People in the neighborhood are expected to get benefit from the employment that would be generated and from the increased business activities during the construction period. There is no religious, cultural or historic place near the project site, so the noise and air pollution during construction of the project would not create any potential impact. People of the surrounding area will be benefited by the development of local small businesses due to the increase of migration in the area.

6.3 Beneficial Impacts and Enhancement

6.3.1 During Construction

Impact Origin

During construction period, the plant will create job opportunities for approximately 1000 of skilled, semi skilled and unskilled labors. However, the impact will be a relatively short duration, being restricted locally to the construction period. In addition to this, all construction sites attract small traders, who supply food and other consumable to the work force. Although the numbers of people who benefited in this way are relatively small, the impacts on individuals can be disproportionately high compare to the other local people.

Benefit Enhancement Measure

Although labor recruitment is a matter of construction contractor who has the right to determine whom he shall not employ, but still the project proponent shall encourage him to hire local people wherever possible and to give preference to employment of the land less people.

6.3.2 During Operation Phase

Impact Origin

The most significant positive impact of the plant would be the generation of electricity, which will reduce the gap between supply and demand of electricity. The other important positive impact of the plant would be the employment of personnel for the operation of the plant. The project envisages employing 91 skilled and unskilled personnel during its operational phase, some of them will be newly hired and some will be shifted from the 150 MW Unit 3 suited to the job requirements. Apart from the positive impacts other beneficial impacts include benefit to local economy due to employment, community development, etc.

Benefit Enhancement Measure

Although labor recruitment is a matter of company who has the right to determine whom he shall and shall not employ, but still the project proponent should take initiative to employ local people wherever possible and to give preference to employment of the jobless people. Among the new employees, the skilled personnel will be allocated in the residential areas of the power plant complex on the basis of availability. The unskilled personnel and the other who will not be allocated inside the complex will arrange their accommodation by their own in the near locality.

6.4 Decommissioning of Old Power Plants

6.4.1 General principles for Environmental Management During Decommissioning

At this stage of the project planning & implementation process, the necessity for and timing of the decommissioning of the retired power projects situated at the proposed site of the APSCL 400 MW CCPP east is important. APSCL authority has plan to prepare a full scale decommissioning plan to dismantle and dispose the retired project to clean up the site as per project schedule. The World Bank EHS guidelines for Construction and Occupational H&S will be followed during decommissioning work.

They have two alternatives for dismantling their old plant:

- The EPC Contractor will be responsible for dismantling the old plant.
- APSCL will auction to licensed company for dismantling the old plant (Insulating Materials, Glass Wools, Fuel Tank).

It will be ensured by the contractor that no hazardous substance will be discharged to the atmosphere. General principles of decommissioning are detailed below. These principles must be required to be revisited and supplemented in the event of decommissioning of the power plant.

On decommissioning of the power project, APSCL will:

- Ensure that all sites not only vegetated are vegetated as soon as possible after operation ceases with species appropriate to the area.
- Soil investigation and survey on potential risks of asbestos and PCBs will be undertaken and an appropriate remediation strategy will be developed if needed prior to any decommissioning work taking place on site.
- All structures, foundations, concrete, and tarred areas are demolished, removed and waste material disposed of at an appropriately licensed waste disposal site.
- All disturbed areas are compacted, sloped and contoured to ensure drainage and runoff and to minimize the risk of erosion.
- All hazardous materials should be kept separate, documented and disposed to the safe recycling or disposal site.

A detail decommissioning and restoration of site plan should have to be developed prior to the decommissioning of the retired project by APSCL.

Summary of Environmental and Social Impact of the Construction Phase

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
Environmental Issues Construction Noise— Disturbance to surrounding communities of power plant due to operation of construction machinery at the plant site	Disturbance to communities in surrounding areas of the proposed plant site due to construction machinery operation	The BNEQS for noise require that the sound level in industrial area should not exceed 75 dBA at day time and 70 dBA at night time, IFC guidelines for noise also require that the sound level in commercial/industrial areas should not exceed 70 dB(A) during the day and 70 dB(A) during the night	<ul style="list-style-type: none"> ▶ Reduction of equipment noise at source ▶ Conduct pre operation noise survey ▶ Prepare noise control plan ▶ Pre-construction noise survey of the construction equipment ▶ Select low noise equipment for the power plant ▶ Minimization of vehicular noise ▶ Training of all staff members for the use of PPE (Personal Protection Equipment, including hearing protective devices) ▶ A temporary noise barrier around the site if necessary
Emissions— Particulate matter, NO _x and SO _x emitted during construction activities can result in deterioration of ambient air quality in the vicinity of the source, and be a nuisance to the community.	<p>Dust—nuisance to surrounding communities of the proposed plant due to emission of dust during construction on the plant site</p> <p>Vehicle and equipment exhaust—Combustion exhaust from vehicles and construction can affect the ambient air quality of the Study Area</p>	An increase in visible dust beyond the boundaries of the proposed power plant due to the activities undertaken at the plant site, or on the access road. Adverse impact on community assets, or There are persistent complaints from the community or the vehicles are not in compliance with the BNEQS for vehicles	<ul style="list-style-type: none"> ▶ Sprinkling of water on unsealed surfaces for dust suppression ▶ Wheel wash ▶ No open burning permitted ▶ Use of wind shield around aggregate and soil stockpiles ▶ Covering of material piles ▶ Restrictions on speed on unpaved roads ▶ Transportation of material in covered trucks and speed limits strictly observed ▶ Safe distance between the batching plant and the community ▶ Stockpiles will be placed at least 100 m from the community ▶ All vehicles and equipment will be properly tuned and

			maintained ► Medical attention will be free of charge
Vegetation Loss— Loss of vegetation as a result of land clearance for the power plant	Unnecessary or excessive removal of trees and shrubs	Preparation of a Reinstatement Plan; Minimization of the felling of trees and clearing of vegetation; and avoidance of the use of fuel Wood	► Try to avoid unnecessary cutting of trees. ► Plan a proper plantation and green belt plan for creating good landscape.
Soil and Water Contamination— Different types of effluents, solid waste and hazardous material may contaminate the water and soil resources of the Study Area	Untreated wastewater and other effluents from the construction activities may contaminate the water resources of the study Area. Hazardous materials and non hazardous waste if disposed of into the surroundings, may contaminate the soil and water resources of the study area	If the run off contains visible quantities of oil and grease and contains silt above BNEQS levels or if it flows towards the community. If any BNEQS and IFC non-compliant effluent is released to the environment. If any person is exposed to hazardous waste generated from project related activities. Disposal of waste outside designated areas	► Use of spill prevention trays and impermeable sheets to avoid soil contamination ► Storage of fuels, chemicals and lubricants in bounded areas with impervious flooring and secondary containment of 110% capacity. ► Emergency Response plan will be developed for hazardous substances ► Equipment and material containing asbestos, poly-chlorinated biphenyls (PCBs), and ozone depleting substances (ODSs) will not be used ► Material Safety Data Sheet (MSDS) will be maintained
Socioeconomic Issues ► Community Safety— Safety hazards associated with the construction activity, particularly the increase in traffic on the plant site access road	The proposed construction activity can potentially be a safety hazard for the community. In particular, the increase in construction related traffic on the proposed project access road.	A significant community hazard will also be considered, if a condition is created during the construction activity that would be considered a safety hazard in a standard occupational and safety health assessment	► A public safety plan will be developed ► A speed limit of 20 km/h will be maintained on the proposed access road ► Night time driving of Project vehicles will be limited where possible ► Community complaint register and other means will be adopted for the community to complain about non-adherence of Project traffic to speed limits, safe driving and other safety-related concerns ► Work areas outside the proposed plant site, especially where machinery is involved will

			be roped off and will be constantly monitored to ensure that local people, especially children stay away
Employment Conflicts— Conflicts may arise if the nearby communities feel that they are not given substantial share in project related job opportunities	The potential employment related issue includes dissatisfaction among local communities over the number of jobs offered to them, disagreement on definition of 'local' and also on distribution of jobs within the local community	A significant impact will be interpreted if the proportion of available unskilled jobs offered to the locals in the immediate area is less than around 50%	<ul style="list-style-type: none"> ► Maximum number of unskilled and semiskilled jobs will be provided to the local communities ► A local labor selection criterion will be developed in consultation with the community
Hazardous and Non-Hazardous Waste Management— Improper waste management may lead to health and aesthetic issues	Exposure to potentially hazardous waste; Generation of excessive waste; Recyclable waste and reusable waste is discarded; Littering; Improper disposal.	A significant impact will be considered, if the waste are not handled and disposed properly. The BNEQS is violated for the collection, storage and disposal of hazardous and non hazardous waste at site.	Development of a waste management plan; Separation at source of the recyclable material; Regular audits; Maintenance of a Waste Tracking Register; Separation of hazardous waste from non-hazardous waste; On-site storage facility for hazardous waste; Recyclable waste to be disposed via approved waste contractors; Dumping of non-hazardous, non-recyclable waste either to landfill or municipal disposal; Emergency response plan; Trainings; Labeling and avoidance use of asbestos, polychlorinated biphenyls (PCBs), and ozone depleting substances (ODSs)
Project and Community Interface— Inter-cultural differences between the project staff from other areas and the local community	community complaints	A community hazard may be created, if the migrated workers will have social, racial and religious conflict with the local community.	Training of the non-local project staff on local culture and norms; Avoidance of unnecessary interaction of local population with the non-local project staff; Prior notice to residents of the area before project activities

Summary of Environmental and Social Impact of the Operation Phase

Potential Impact	Description of Potential Impact	Criteria for Determining Significance	Mitigations
Environmental Issues Plant Noise	Unacceptable increase in noise levels in the communities	The BNEQS for noise require that the sound level in industrial area should not exceed 75 dBA at day time and 70 dBA at night time, IFC guidelines for noise also require that the sound level in commercial/industrial areas should not exceed 70 dB(A) during the day and 70 dB(A) during the night	<ul style="list-style-type: none"> ► Low noise equipment will be preferred ► Fans for cooling tower will be of low noise type ► Silencers will be used on vents and ventilators ► Proper stack height to be maintained with silencer fitted ► Proper acoustic design for the power house building. ► Noise levels will be monitored regularly within the communities in order to take timely corrective measures, if needed
Plant Effluents	The power plant is expected to generate liquid effluents in the form of oily water, plant cooling water, washing water, blow down water, treatment system effluent and sanitary wastewater	No discharge of untreated effluent to the environment or the canals	► The power plant water treatment system will be designed to ensure that the wastewater meets BNEQS before it is drained into the drainage channels or used for arboriculture
Emission	Emission from the plant can potentially affect air quality	BNAAQS and the IFC Thermal Power Plants Emission Limits	<ul style="list-style-type: none"> ► Low NO_x burner should be selected for turbine selection ► Proper stack height to be maintained.
Water Resources	An adverse impact on the water resources will be interpreted if it is established that the water consumed by the Project has directly affected the ability of the community to meet their water needs	The extraction of water for the power plant construction activities can affect the groundwater availability for the Study Area communities	<ul style="list-style-type: none"> ► Availability of ground water to be studied ► Use surface water where possible ► Initiation of a water conservation program
Hazardous and Non-Hazardous Waste	Various types of wastes such as packing waste, metal scrap, and excess materials, air	Material Safety Data Sheets (MSDS)	► Storage and handling of hazardous materials in accordance with international standards and appropriate to their

	filters, oily rags, will be generated during the operation phase. The waste can be a health hazard and pollute waterways, if disposed improperly		hazard characteristics. <ul style="list-style-type: none"> ▶ All hazardous waste will be separated from other wastes ▶ Storage of fuels, chemicals and lubricants in bounded areas with impervious flooring and secondary containment of 110% capacity ▶ Availability of supporting information such as the MSDS ▶ A Hazardous Materials Register to be in place
Waste Management	Waste generated during power plant operation can potentially damage the environment	Any person is exposed to potentially hazardous waste generated by the Project. Project generates waste that can be avoided through practicable means (waste minimization) Reusable waste generated by the Project is discarded. Recyclable waste instead of separation at the source is dumped at the trash bins. Non-recyclable and non-reusable waste ends up at any place other than the designated landfill site.	<ul style="list-style-type: none"> ▶ World Bank EHS Guidelines on Hazardous Materials Management, Waste Management and Thermal Power will be followed ▶ Separation of recyclable materials ▶ Regular audits of waste management system ▶ Maintenance of a Waste Tracking Register and all records will be kept ▶ Separation of hazardous waste from nonhazardous waste. ▶ On-site segregation and initial storage of hazardous waste ▶ Off-site disposal of hazardous waste in approved hazardous waste disposal facility. ▶ Recyclable waste to be disposed via licensed waste contractors ▶ Audits of the waste disposal contractors and waste disposal facilities ▶ Develop an emergency response plan for the hazardous substances ▶ Training of personnel in identification, segregation, and management of waste ▶ Appropriate labeling of all containers of hazardous waste

Occupational Health & Safety of workers	Non-ionizing radiation, Heat, Noise, Confined spaces, Electrical hazards, Fire and explosion hazards, Chemical hazards, Dust, sanitation, safe drinking water etc	Proper monitoring for work place environment, health & safety condition of the workers, PPE check, Fire drill and training of workers	<ul style="list-style-type: none"> • World Bank EHS guidelines on Occupational H&S, Community H&S and Thermal Power will be followed. • Regular health check up of workers • Proper PPE should be provided to protect from the heat, electric shock and noise protection, • Regular awareness and training should be provided for fire safety & chemical hazard, • Safe drinking water should be provided
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Chapter-7

CHAPTER SEVEN: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Background

In the context of a project, Environmental Management Plan is concerned with the implementation of the measures necessary to minimize or offset adverse impacts and to enhance beneficial impacts. All mitigation and monitoring measures will follow the World Bank EHS Guidelines and Bangladesh national. Unless the mitigation and benefit enhancement measures that identified in the ESIA, are fully implemented, the prime function of ESMP cannot be achieved. All the measures are said to be successful when they comply with the Environmental Quality Standard (EQS) of Bangladesh. Thus the objectives of ESMP for the present project would be

- Mitigation measures to reduce or eliminate negative impacts
- Enhancement measures to maximize positive impacts
- Monitoring requirement and
- Monitoring indicators

Feasible and economically expedient measures are planned to be implemented at EMP which can reduce to a reasonable level and/or exclude possible essential negative consequences of environmental impact.

At ESMP, in particular:

- expected adverse environmental impacts at construction stage and operation are identified and generalized;
- impact reduction measures are described;
- interrelation with existing impact reduction plans are established;
- parameters subject to measurement, monitoring methods to be applied, places of supervision, frequency of measurements are specified.

The environmental and social management plan includes the following elements facilitating it's timely and effective realization:

- management system - reflects implementation mechanism of ESMP;
- roles and responsibilities - identify persons responsible for realization of measures on impact reduction and monitoring;
- impact importance assessment - is intended for timely reveal of aspects invoking particular measures on impact reduction;
- environmental and social management plan includes the list of actions on impact decrease, monitoring, and also amount of expenses for their realization.

In case any non-compliance, change in scope, or unanticipated impact arises during project implementation, corrective action will be taken accordingly as per ADB SPS 2009 and national requirements.

Each of these elements is described below in details.

7.2 System of environmental and social management

For effective implementation of recommendations on impact reduction it is necessary to organize a system of environmental and social management.

The model of the management system consists of four basic components:

- planning includes development of particular actions and procedures on their realization;
- introduction and functioning - are direct realization of actions;
- checks and correcting actions include monitoring of environmental objects and control over execution of actions;
- analysis includes reporting and efficiency assessment of the introduced actions.

The system of environmental and social management assumes conformity to the Standard of environmental management system ISO 14001 according to which constant improvement of the developed model (periodic updating with entering necessary revisions) is necessary. It is important to note, that special attention during management is paid to interaction with stakeholders, including submission of reporting and processing notes and offers received.

7.3 Roles and responsibility

For realization of ESMP, it is necessary to identify persons responsible for performance of impact decrease/prevention actions, and also those responsible for control over the given actions and to define their role at all stages of the project implementation.

Table 7-1: Responsibilities for EMP Implementation

Organization	Responsibility
ASHUGANJ POWER STATION COMPANY LTD., (Project Implementation unit (PMU) and Operation & Maintenance unit)	<ul style="list-style-type: none"> ➤ Overall responsibility for environmental performance of 400 MW CCPP (East) ➤ Decision-maker on applicable policies to the 400 MW CCPP (East) ➤ Oversight supervisory role during the construction phase ➤ Overall responsibility for ESMP implementation during the operation phase ➤ Review reports of the Independent Environmental Monitoring Consultant ➤ Approves changes to the ESMP, as necessary, as part of an adaptive approach to environmental and social management of the 400 MW CCPP (East) ➤ Responsible for working with stakeholders in Different issues ➤ Develop an health, safety & environmental unit, headed by the Project Environmental Officer to implement ESMP responsibilities ➤ Management, implementation, monitoring and compliance of the ESMP, ESIA, and any approval conditions, including construction supervision and performance of all 400 MW CCPP (East) staff, contractors and subcontractors ➤ Review of ESMP performance and implementation of correction actions, or stop work procedures, in the event of breaches of ESMP conditions, that may lead to serious impacts on local communities, or affect the reputation of the project ➤ Ensure effective communication and dissemination of the content and requirements of the ESMP to contractors and subcontractors ➤ Assisting the contractor with implementation of ESMP sub-plans ➤ Monitoring of ESMP and ESIA performance ➤ Ensuring compliance to all project social commitments, including implementation of the social management and resettlement plans ➤ Report on environmental performance to DOE, the ADB, and other regulators as required ➤ Prepare environmental reports summarizing project activities, as required ➤ Representing the project at community meetings ➤ Ensuring effective community liaison and fulfilling commitments to facilitate public consultation throughout the project cycle ➤ Monitoring of downstream impacts of meghna river and any reports of downstream decreased fish yields
Supervising Engineer	<ul style="list-style-type: none"> ➤ Preparation and implementation of the Environmental Supervision Plan during construction ➤ Preparation and implementation of the Environmental Monitoring Plan during construction ➤ Supervision of contractor performance on implementation of the Construction and Work Camp Management Plan ➤ Reporting any incidents or non-compliance with the ESMP to the PMU ➤ Ensuring adequate training and education of all staff involved in environmental supervision

	<ul style="list-style-type: none"> ➤ Making recommendations to the APSCL (PMU) regarding ESMP performance as part of an overall commitment to continuous improvement
Construction Contractor	<ul style="list-style-type: none"> ➤ Preparation and implementation of the Construction and Worker Camp Management Plan ➤ Prepare and maintain records and all required reporting data as stipulated by the ESMP, for submission to the Supervising Engineer & Consultant ➤ Ensure that all construction personnel and subcontractors are informed of the intent of the ESMP and are made aware of the required measures for environmental and social compliance and performance ➤ During construction, maintain traffic safety along access roads, with special emphasis on high traffic areas
Independent Environmental Monitoring Consultant	<ul style="list-style-type: none"> ➤ Report to APSCL, DOE and the Asian Development Bank on project compliance with environmental and social commitments in the ESMP, ESIA and other applicable standards
Local Authorities	<ul style="list-style-type: none"> ➤ Local authorities, communities and individuals shall take part in the supervision of both the ESMP and ESIA, where applicable

7.3.1 Construction stage

General construction management and control over conducting technological process during construction works will be assigned to the contractor and APSCL project management. The contractor, in turn, concludes contracts with subcontract organizations performing works at the construction site. The APSCL authority bears responsibility under Project Implementation unit (PMU) for selection and assessment of subcontract organizations. Control functions over contract organizations activity in the field of labour safety, industrial safety and preservation of the environment are also assigned to the Consortium.

7.3.2. Operation phase

APSCL Management will be responsible to operate the power project under Operation & Maintenance unit (O&M) during the operation phase and will be responsible to maintain the environmental and social standard of the project.

7.4 MITIGATION/BENEFIT ENHANCEMENT MEASURES

For effective and environment friendly operation of a project, a set for guiding tools and suggestions are necessary which need to be followed at various stages of plant installation, operation and maintenance. This plan generally has various components of management depending on the type of project or plant activity and types of discharge and their pollution potential. This Environmental and Social Management Plan (ESMP) once prepared forms the basis of environmental management actions from the part of the project authority may need modification or up-gradation because of changes in the plant operation or accurate pollution load/environmental problems detected afterwards.

All beneficial and adverse impacts which may likely to occur at different phases of the project have been identified in section 6.0. Predictions, evaluation, aspect of mitigation and benefit enhancement measures have also been discussed concurrently with impacts prediction and evaluation. In view of the earlier discussion summary of recommended mitigation and benefit enhancement measures are presented in Table 7.2.

Table 7.2: Identification of Impacts, Mitigation measures, Monitoring and Management during Construction period

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
<i>Pre-Decommissioning and Construction</i>	<p>Develop a decommissioning plan for GT-1, ST and G2-Units as set out in the EIA including risk assessment and management plan for asbestos, PCBs and contaminated soil following the EHS contaminated land guidance.</p> <p>Undertake additional baseline studies for one year pre-construction to include:</p> <ul style="list-style-type: none"> Ambient air quality monitoring at sensitive receptors within the zone of maximum deposition. Notably the settlement and PDB high school and Hazzai Jolli high schools to the west, plus the APSCL dormitory to the east and the local settlement to the south of the project. Identified sensitive receptors within 2-5km west of the project site must also be monitored. Seasonal 24hr noise monitoring at nearest sensitive receptors (in absence of construction work)- Notably the settlement and PDB high school and Hazzai Jolli high schools to the west, plus the APSCL dormitory to the east and the local settlement to the south of the project. Daily monitoring of the existing discharge temperature at the point of discharge on all three outfall channels. Seasonal monitoring of river water temperature 500m upstream and downstream of the discharge point (away from the influence of the outfall channel). 	Before decommissioning and construction	<p>A continuous daily visual inspection by trained staff of the contractor is needed.</p> <p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during decommissioning.</p>	Implementation of Good Site management practices shall be the responsibility of all contractors on site under supervision of the APSCL nominated Project Manager.	APSCL Project Manager in collaboration with the Consultant's Site Manager & third party consultant	SPM, PM10, PM2.5, NO2, SO2 & CO.	Monthly reporting of summary results and submitted to the APSCL and any other concerned authorities. (e.g. DOE, ADB, etc.).	<p>APSCL responsible for the management of the safe decommissioning of old plants.</p> <p>Basic training of persons employed to operate and maintain the monitoring system.</p> <p>APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.</p>

<p>Detailed design for 440MW (East) power plant to incorporate mitigation measures set out in the EIA and the EHS General and Thermal Power Plant Guidance.</p> <p>Detailed design to demonstrate:</p> <p>(i) emission standard of 51mg/m³ (25ppm) NO_x will be met through adoption of dry low NO_x burner (catalytic removal will be retrofitted if necessary following review of annual ambient air quality data) with dust filters on air intake to ensure no particulate or SO₂ emission,</p> <p>(ii) noise level of 70dB can be achieved at the site boundary and that there will be no increase in background noise levels greater than 3dB at the nearest sensitive receptors,</p> <p>(iii) there will be no increase in the temperature of the thermal discharge above the existing discharge temperature, and no increase above 3 degrees C of the upstream background temperature at the edge of the mixing zone in both winter and summer,</p> <p>(v) structural engineering meets the applicable seismic design standards for location of the power plant, and</p> <p>(v) H&S measures per the EHS onshore oil and gas development guidelines are incorporated, undertake quantitative risk assessment of gas-related elements to demonstrate there will be no increase in risk level at the nearest sensitive receptors from gas leak, fire</p>							
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<p>or explosion.</p> <p>Detailed design of the inlet structure to incorporate mitigation measures set out in this EIA and the EHS General and Thermal Power Plant Guidance to minimize fish entrainment including reduction of maximum through-screen design intake velocity to 0.5 ft/s.</p> <p>Develop a decommissioning plan for Unit 3 (150MW) as set out in this EIA including risk assessment and management plan for asbestos, PCBs and contaminated soil following the EHS contaminated land guidance.</p> <p>Finalize IEE for associated facilities including grievance redress mechanism and to address hazardous materials including SF6 and waste management.</p> <p>Prepare Construction Environment Management Plan incorporating site waste management plan and emergency response procedures, Construction Health and Safety Plan incorporating emergency response procedures, and Construction Traffic Management Plan.</p>								
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<p><i>Air Quality:</i></p> <p>Dust emissions caused by construction activities, construction vehicle movements, and transport of construction materials.</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.</p> <p>Emissions must be within prescribed limits of National Ambient Air Quality Standards.</p> <p>Mitigation practices including:</p> <ul style="list-style-type: none"> • appropriate siting and maintenance of stockpiles of materials so as to minimize dust blow (seek to achieve a distance of at least 500m from nearest sensitive receptors); • minimizing drop heights for material transfer activities such as unloading of materials; • construction phase to begin with construction of access roads; • roads will be kept damp via a water browser; • provide wheel wash for all vehicles leaving the project site; • do not permit any open burning on the project site; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting construction materials and soil; • enforcement of vehicle speed limits on nonmetal roads to <20 km/h. 	<p>Before construction and during construction</p>	<p>A continuous daily visual inspection by trained staff of the contractor is needed.</p> <p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>Measurements and analysis of different pollutants to be made on a continuous basis (at least monthly) by a third party consultant and the report to be submitted to the APSCL authority. Monitoring to be carried out on site and at the settlement and PDB high school and Hazzi Jolli high schools to the west, plus the APSCL dormitory to the east and the local settlement to the south of the project.</p>	<p>Implementation of Good Site management practices shall be the responsibility of all contractors on site under supervision of the APSCL nominated Project Manager.</p>	<p>APSCL Project Manager in collaboration with the Consultant's Site Manager & third party consultant</p>	<p>SPM, PM10, PM2.5, NO2, SO2 & CO.</p>	<p>Monthly reporting of summary results and submitted to the APSCL and any other concerned authorities. (e.g. DOE, ADB, etc.).</p>	<p>APSCL responsible for the management of the air quality monitoring system. Submission of monthly summary reports to DOE and any concerned authorities.</p> <p>Basic training of persons employed to operate and maintain the monitoring system.</p> <p>APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.</p>
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<p>Aquatic Environment:</p> <p>Construction of the intake structure and water discharge structure.</p> <p>Increased suspended sediment and pollutant loads, permanent loss and disturbance to aquatic flora and fauna.</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.</p> <p>River water quality must be within prescribed limits of the national ambient water quality standards for classification as source of drinking water as it will be used to provide potable water for the construction workers (for standards see http://faolex.fao.org/docs/pdf/bgd19918.pdf).</p> <p>The following measures will be taken:</p> <ul style="list-style-type: none"> • Construction Method Statement to be produced by the Contractor; • coffer dam to be used during in-channel works to minimize downstream sediment release; • inlet structure construction in river should be undertaken outside the breeding season of fishes; • dredged areas limited to minimum area required; • disposal of dredged sediments to an agreed site; • all works will be made clearly visible using flags, beacons and/or signals; • bank area will be reinstated following construction. 	<p>During construction of intake and discharge structures</p>	<p>Continuous daily visual inspection by trained staff of the contractor.</p> <p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>During dredging and in-river works sediment discharge and surface water quality will be monitored (at least weekly) at three locations (upstream, adjacent to works and downstream) by a third party consultant. During other times river water sample should be collected monthly from three locations, 500m upstream and downstream of works and at the works site-outfall, if preliminary monitoring campaign shows strong variations in water quality additional locations may be required.</p>	<p>Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the APSCL the Project Manager.</p>	<p>APSCL Project Director in collaboration with the Consultant's Site Manager & third party consultant.</p>	<p>Temp., pH, COD, BOD, TSS, TDS, DO, oil & grease etc.</p>	<p>Monthly reporting of summary results and submitted to the APSCL and any other concerned authorities. (e.g. DOE, ADB, etc.).</p>	<p>APSCL to ensure that all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.</p> <p>These mitigation Measures must be a condition of any construction contracts.</p>
<p>Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils.</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.</p> <p>River water quality must be within prescribed limits of the national ambient water quality standards for classification as source of drinking water as it will be used to provide potable water for the construction workers (for standards see http://faolex.fao.org/docs/pdf/bgd19918.pdf).</p>	<p>During construction</p>	<p>Continuous daily visual inspection will be conducted by trained staff of the contractor.</p> <p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p>	<p>Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the APSCL Project management.</p>	<p>APSCL Project Director in collaboration with the Consultant's Site Manager & third party consultant..</p>	<p>Temp., PH, COD, BOD, TOC, DO, TSS, oil & grease etc.</p>	<p>Quarterly reporting of summary results and submitted to the APSCL and other concerned authority, e.g. DOE, ADB, etc., if required.</p>	<p>APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.</p>

	<p>8.pdf).</p> <p>Mitigation activities will include the following:</p> <ul style="list-style-type: none"> • no discharge of effluents into the river- all effluents shall be collected and removed off site for treatment by approved firms or disposed after proper treatment at site (records of effluent transfers to be maintained); • no discharge of surface water runoff direct into the river - development of a temporary site drainage plan which reduces flow velocity and sediment load by passing discharge through a sediment pond; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; • at least 100 m safe distance for stockpiles to waterbody to be achieved; • maintenance of well kept construction site. • all fuel, oil and chemicals should be stored in bunded area 110% volume. • impermeable surface should be used for refueling • regular training of all workers in spill response • provision of spill equipment at easily accessible locations around the site <p>Treatment of all wastewater must be consistent with the standards and measures in the EHS guidelines on wastewater and ambient water quality</p>		<p>River water sample should be collected monthly by a third party consultant from three locations, 500m upstream and downstream of works and at the works site-outfall, if preliminary monitoring campaign shows strong variations in water quality additional locations may be required</p>					
<p>Noise:</p> <p>Increased noise in the project area</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.</p>	<p>During construction</p>	<p>Continuous daily visual inspection will be conducted by trained staff of the contractor.</p>	<p>Implementation of Good Site Management practices shall be</p>	<p>APSCL Project Director in collaboration with the</p>	<p>Noise complaints register to identify</p>	<p>APSCL will produce a monthly log of valid complaints and actions taken.</p>	<p>APSCL to ensure all contractors and subcontractors working on site are aware of</p>

as a result of the use of noisy machinery and increased vehicle movements.	<p>No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. And no unprotected ear should be exposed to a peak sound pressure level of more than 140 dB(C). The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85dB(A).</p> <p>Emissions at the site boundary and nearest sensitive receptors must be within prescribed limits of the EHS Noise Guidelines.</p> <p>Implementation of good site practices including:</p> <ul style="list-style-type: none"> • provision of noise barrier around the project site to reduce off-site noise levels; • enforcement of vehicle speed limits; • strict controls of vehicle routing; • diesel engine construction equipment to be fitted with silencers; • limited noisy construction activities at night; • prohibition of light vehicle movements at night; • use of protective hearing equipment for workers. 		<p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>Monitoring of 24-hr noise levels to be made on a continuous basis (at least monthly) by a third party consultant at the site boundary and nearest sensitive receptors and the report to be submitted to the APSCL authority. Monitoring to be carried out on site and at the settlement and PDB high school and Hazzi Jolli high schools to the west, plus the APSCL dormitory to the east and the local settlement to the south of the project.</p>	the responsibility of all contractors on site under supervision of the APSCL project management .	Consultant's Site Manager & third party consultant.	<p>concerns.</p> <p>Check the noise level using noise measuring devices.</p>	<p>Monthly reporting of summary results and submitted to the APSCL and any other concerned authorities, e.g. DOE, ADB etc., if required.</p>	ESMP and all employees are given basic induction training on good construction and site management practices.
<p><i>Flora and Fauna</i></p> <p>Site Clearance- Vegetation removal and</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.</p> <ul style="list-style-type: none"> • Good site management 	During construction.	Continuous daily visual inspection will be conducted by trained staff of the contractor.	Implementation of Good Site Management practices shall be the responsibility of	APSCL Project Director in collaboration with the Consultant.	Good conservation of floral wealth.	<p>Quarterly reporting</p> <p>No. of floral species conserved or planted, if any.</p>	APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees

Habitat disturbance.	practices will be observed to ensure that disturbance of habitats off-site are minimized. • Specific mitigation measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads.		Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.	all contractors on site under supervision of the APSCL project management.				are given basic induction training on good construction and Site management practices.
<p><i>Soils and Hydrology:</i></p> <p>Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.</p> <p>The potential impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented:</p> <ul style="list-style-type: none"> • development of effective site drainage systems designed to include allowance for climate change; • restriction of access only to construction site areas; • disposal of waste materials unsuitable for reuse on-site, (e.g. for landfilling) at appropriately licensed sites; • provision of oil and suspended solid interceptors; • management of excavations during construction to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillages. <p>No septic tank will be installed within 500m of a deep or shallow tube well used by the community for drinking water. Septic tank will be installed in well drained and permeable soils well above high groundwater level and</p>	During construction.	<p>Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction.</p> <p>Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>Quarterly monitoring of drinking water in tube wells within 1km of a septic tank location by third party consultant to confirm that national drinking water standards are met.</p>	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the APSCL project management.	APSCL Project Director in collaboration with the Consultant.	<ul style="list-style-type: none"> • site drainage. • access only to construction site areas. • waste materials. • oily waters. • drainage pathways. • potential spillage in Operational areas. <p>Visual Inspection</p>	Quarterly reporting of summary results submitted to the APSCL and any other concerned authorities (e.g. DOE, ADB etc., if required).	APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.

	where sufficient soil percolation exists for design wastewater loading rate. It will be properly designed to prevent hazard to human health or contamination of land or water. Regular maintenance required. No overflow of septic tank permitted. If monitoring of tube wells identifies contamination (exceedance of national drinking water standards) provide community users with an alternate source of drinking water.							
<p><i>Socio-Economic Environment:</i></p> <p>Positive impacts identified.</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction and Community Health and Safety.</p> <p>Public access to the site must be restricted.</p> <p>All activities related to the construction of the new plant will take place within the area belonging to APSCL, i.e. there will be no off-site activities or associated land acquisition during construction.</p> <p>Transmission lines & gas line will connect the new power plant to the existing substations and RMS. Ensure H&S measures per the EHS electric power and distribution guidelines and EHS onshore oil and gas development guidelines are incorporated</p> <p>The entire labor force will be daily commuters, thus no worker housing or associated facilities will be erected</p>	During construction.	<p>Record local employment provided by the project.</p> <p>Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction.</p> <p>Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>Daily monitoring of drinking water provided to construction staff to confirm national drinking water standards are met.</p>	APSCL Project management	APSCL Project Director in collaboration with the Consultant.	<p>Workers satisfaction as measured by staff interviews and complaints reported.</p> <p>Visual Inspection</p>	Quarterly reporting	Responsibility of APSCL.

	<p>on site during construction. If any off-site accommodation for the labor force needs to be developed the EIA and EMP should be updated accordingly.</p> <p>No forced or child labor (under age 18) to be employed. All employees to be legal. Regular talks on communicable diseases including HIV to be held for all workers.</p> <p>The contractors will be responsible for relevant temporary water / toilet facilities during construction and the need to provide appropriate services will be specified in their contracts.</p> <p>Provide adequate supplies of drinking water that is compliant with the national drinking water quality standards to all workers.</p> <p>Provide adequate sanitation facilities as outlined in the EIA. Toilets and bathrooms must be properly equipped including hand washing facilities with hot water and with separate facilities for men and women.</p> <p>Regular talks on sanitation to be held for all workers to encourage cleanliness.</p>							
<p>Traffic and Transport:</p> <p>Disruption, noise and increased air pollution due to increased traffic, light loads and</p>	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction and Community Health and Safety.</p> <p>Standard good practice measures will be implemented as follows:</p>	During construction.	Daily monitoring of traffic entering the site during morning & evening peaks to ensure the implementation of good site management practices by trained staff of the contractor.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the	APSCL Project Director in collaboration with the Consultant.	<p>Increased congestion</p> <p>Travel time (compared to reasonable daily commute)</p>	Quarterly reporting of summary results submitted to the APSCL and any other concerned authorities (e.g. DOE, ADB etc.), if required.	APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and Site

abnormal loads. Traffic Management Plan of the project is given as the Annexure-14(a).	<ul style="list-style-type: none"> • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • construction shifts will be staggered; • scheduling of traffic to avoid peak hours on local roads; • routing of transport to avoid residential areas; • provision of adequate signage and flagmen along transport route and at site entrance; • transportation of construction workers by contract bus. <p>Ensure all roads and bridges used by construction traffic are maintained in at least their current state during construction with any damage immediately repaired.</p> <p>Condition survey of roads and bridges to be undertaken by third party consultant prior to start of works to provide a baseline for monitoring compliance.</p>		<p>Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>Quarterly monitoring of road and bridge condition by third party consultant to ensure maintenance being kept up.</p>	APSCL project management.		Visual Observation		management practices.
<p><i>Archaeology:</i></p> <p>Potential chance finds of archaeological remains during construction.</p>	<p>The project site does not lie on, or in the immediate vicinity of any known archaeological areas of interest. If remains are found APSCL is committed to:</p> <ul style="list-style-type: none"> • cease activities and consult archaeological department; • protection in situ if possible; • excavation of areas where protection not feasible following discussion and agreement of archaeological department; 	During construction.	<p>Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction.</p> <p>Weekly supervision of construction activities by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p>	APSCL project management will allocate responsibilities in accordance with the construction site plan.	APSCL Project Director in collaboration with the Consultant.	Visual observation	Quarterly reporting of summary results And submitted to the APSCL and any other concerned authorities (e.g. DOE, ADB etc.), if required	APSCL to ensure that all workers on site are aware of the importance of archaeological remains and must report any potential finds immediately.
<p><i>Natural Disasters</i></p> <p>Flash flooding.</p>	Good engineering design will incorporate the following mitigation measures:	During construction.	Continuous daily visual inspection will be conducted by trained staff of the contractor.	APSCL project management	APSCL Project Director in collaboration	Visual observation	Quarterly reporting of summary results submitted to the	APSCL to ensure that all workers on site receive training in emergency

	<ul style="list-style-type: none"> • drainage system designed to direct flood water from main plant areas into the river and direct potentially contaminated waters through the oil interceptor. 		<p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.</p> <p>River water sample should be collected monthly by a third party consultant from three locations, 500m upstream and downstream of works and at the works site-outfall, if preliminary monitoring campaign shows strong variations in water quality additional locations may be required</p>		with the Consultant.		APSCL and any other concerned authorities (e.g. DOE, ADB etc.), if required	preparedness and response procedures.
Solid Waste Management	<p>Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction and Waste Management.</p> <p>Good practice measures such as the following:</p> <p>(1) all waste taken off-site will be undertaken by a licensed contractor and APSCL will audit disposal procedure;</p> <p>(2) collection and segregation of wastes and safe storage;</p> <p>(3) recording of consignments for disposal;</p> <p>(4) prior agreement of standards for storage, management and disposal with relevant authorities.</p> <p>It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly</p>	During construction.	<p>Contractor to keep daily records of all waste transfers.</p> <p>Weekly monitoring by APSCL is required to ensure the implementation of good site management practices by all contractors during construction</p>	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the APSCL project management	APSCL Project Director in collaboration with the Consultant	Management contract in place	Quarterly reporting of summary results submitted to the APSCL and any other concerned authorities (e.g. DOE, ADB etc.), if required	APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site Management practices.

	disposal Contract. APSCL will plan a decommissioning plan for the disposal of old units.							
<i>Occupational Health & Safety</i>	<p>Good local and international construction practice (as per the EIA and EHS Construction and Occupational H&S Guidelines) in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes.</p> <p>Regular H&S training will be conducted for all construction staff, including training on good housekeeping, cleanup of debris and spills, and working in confined spaces and at height.</p> <p>Measures include:</p> <ul style="list-style-type: none"> • implementation of EHS procedures as a condition of contract all contractors and subcontractors; • clear definition of the EHS roles and responsibilities for all construction companies and staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; • appointment of site nurse and 	During construction.	<p>Daily inspection is required to ensure the implementation of EHS Policies, plans and practices during construction.</p> <p>Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction</p> <p>Record all fatalities, accidents and near misses that occur during construction work and implement corrective action to ensure such incidents are not repeated in future.</p>	Implementation of good site management practices and the EHS policies shall be the responsibility of all contractors on site under the supervision of the APSCL project management.	APSCL Project Director in collaboration with the Consultant.	<p>Management procedures in place.</p> <p>Workers health and safety as measured by number of incidents.</p>	<p>Daily inspection</p> <p>Quarterly reporting of summary results submitted to the APSCL and any other concerned authorities (e.g. DOE, ADB etc.), if required</p>	<p>APSCL to ensure all contractors and sub-contractors for workers on site include reference to the requirement of the ESMP and are aware of the EHS policies of the project. All employees will be given basic induction training on EHS policies and practices. Contractors are responsible for ensuring that a Fire Safety Plan, is prepared and implemented prior to commissioning of any part of the plant under supervision of APSCL project management.</p>

	provision of free on-site medical care for all construction staff; • pest and vector control; • maintenance of a high standard of housekeeping at all times. • provision of first aid equipment at easily accessible locations around the site							
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Table 7.3: Identification of Impacts, Mitigation measures, Monitoring and Management during Operational period

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training
				Implementation	Supervision			
Air Quality Emissions from stack are not expected to exceed standards.	Implement mitigation as set out in the EIA and EHS Guidelines on Air Emissions and Air Quality and Thermal Power. Emissions standards to be achieved during operation are 51 mg/m3 or 25ppm NOx with zero particulates and SO2. Ensure Unit 3 does not operate concurrently with the 440MW (East) power plant and reduced dispatches from Units 4 and 5 and the 53MW gas engine unit are implemented to achieve no net increase in pollution load (offsets).	Life time of plant operation.	Automatic monitoring of stack emissions for NOx, SO2, PM10 and PM2.5 to be installed in the stacks. Annual stack emissions testing of NOx, SO2, PM10 and PM2.5 by third party consultant. Monitor and record annual gas consumption to calculate annual emissions of CO2.	The analyzer stations will be owned and operated by APSCL	APSCL Top Management & EHS department	Stack emissions of NOx, SO2, PM10 and PM2.5 concentration. Annual CO2.	Continuous Hourly data acquisition. Quarterly reporting to APSCL. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	Records must be kept and summary data (including any deviations from DOE and World bank standards) will be submitted to the DOE and ADB as regular basis.
Ambient air quality affected by emissions		Life time of plant operation.		Third party monitoring	APSCL Top Management & EHS department		Quarterly reporting to APSCL.	Quarterly reporting by APSCL to Government and ADB etc. (or more frequently

from the power plant.	<p>APSCL will implement the mitigation measures suggested in the ESIA report. If ground level concentrations are found to be above the National Ambient Air Quality Standards, options for further mitigation will need to be implemented.</p> <p>Catalytic removal to achieve a tighter emission standard will need to be retrofitted if necessary following review of continuous annual ambient air quality data.</p>		<p>Conduct continuous ambient air quality monitoring for NO_x, SO₂, CO, PM₁₀ & PM_{2.5} at four different locations (sensitive receptors) located within the zone of maximum deposition (about 1km east, west and south and 2km to the west). At other locations carry out seasonal weekly ambient air quality monitoring. Monitoring to be carried out on site and at the settlement and PDB high school and Hazzi Jolli high schools to the west, plus the APSCL dormitory to the east and the local settlement to the south of the project. Identified sensitive receptors within 2-5km west of the project site must also be monitored.</p>		Third party inspection.	<p>Ambient air pollutants concentrations (at least PM₁₀, PM_{2.5}, NO_x, SO₂, and CO).</p>	<p>Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).</p>	<p>if required) highlighting key features and comparing results with air quality standards and prediction in ESIA report</p>
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<p>Aquatic Environment Discharge of process and cooling water.</p>	<p>Implement mitigation as set out in the EIA and EHS Guidelines on Wastewater and Ambient Water Quality and Thermal Power.</p> <p>Effluent discharge of process water to meet standards set out in Table 5 of the EHS Guidelines on Thermal Power. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.</p> <p>Sanitary discharges to meet national wastewater treatment standards.</p> <p>Good site management practices including the following will be implemented:</p> <ol style="list-style-type: none"> 1) proper treatment of contaminated water or cooling water before discharge to natural water body. 2) no disposal of solid wastes into the discharge structure; 3) regular maintenance of site drainage system to ensure efficient operation; 4) all discharges will comply with local and World Bank guidelines. <ul style="list-style-type: none"> • all fuel, oil and chemicals should be stored in bunded area 110% volume • regular training of all workers in 	<p>Life time of the Plant</p>	<p>Third party consultant to prepare and undertake a monthly water quality monitoring program of all discharges, 500m upstream & downstream of the project site and at the outfall location to the river including: temperature, pH, COD, BOD, TSS, oil & grease and residual chlorine.</p> <p>Install an automatic temperature gauge on the discharge point for the power plant and on the three canal discharge points to measure the daily impact of this project and the contribution of the other power plants to the overall temperature</p> <p>Third party consultant to conduct biomonitoring (fisheries, insects, mollusks, birds, vegetation, plankton, and zooplankton) at inlet and outlet once pre-construction and then every six months for five years following methods in the EIA.</p>	<p>APSCL Project management.</p> <p>Third party monitoring supervised by the APSCL Management</p>	<p>APSCL management & EHS department.</p>	<p>Basic parameters as per the ECR 1997</p> <p>pH, TSS, oil and grease, total residual chlorine, temperature</p>	<p>Monthly reports Prepared by APSCL or third party.</p> <p>Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).</p>	<p>Records will be kept and compared on regular basis against Bangladesh and World Bank standards and impacts predicted in ESMP.</p> <p>APSCL to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures.</p>
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	<p>spill response</p> <ul style="list-style-type: none"> • provision of spill equipment at easily accessible locations around the site <p>Specifically no increase above the existing discharge temperature and no increase above 3 degrees C of the upstream background temperature at the edge of the mixing zone is to be permitted.</p>		<p>Quarterly liaison with local fishermen regarding recent fishing catches and any concerns regarding thermal discharge.</p>					
Noise Quality	<p>Implement mitigation as set out in the EIA and EHS Guidelines on Noise and Thermal Power.</p> <p>No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. And no unprotected ear should be exposed to a peak sound pressure level of more than 140 dB(C). The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices</p>	Life time of the plant operation.	<p>When the plant is fully operational, quarterly noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at sensitive noise receptors around the plant.</p> <p>Monitoring to be carried out on site and at the settlement and PDB high school and Hazzi Jolli high schools to the west, plus the APSCL dormitory to the east and the local</p>	<p>APSCL Project management.</p> <p>Third party monitoring supervised by the APSCL Management</p>	APSCL management & EHS department.	Power plant to comply with ESMP suggestions.	<p>Monthly noise reports Prepared by APSCL or by third party.</p> <p>Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).</p>	<p>Should any complaints be received regarding noise, these will be logged and the APSCL EHS team will investigate the problem.</p> <p>APSCL to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and EHS procedures.</p>

	<p>provided should be capable of reducing sound levels at the ear to at least 85dB(A).</p> <p>Emissions at the site boundary and nearest sensitive receptors must be within prescribed limits of the EHS Noise Guidelines.</p> <p>Specific design mitigation measures to minimize noise impacts include:</p> <ul style="list-style-type: none"> • gas turbines, steam turbine generators; air compressors, pumps and emergency diesel engines are enclosed in the Buildings with proper acoustic design; • provision of a noise barrier around the project site to minimize off-site noise levels. 		settlement to the south of the project.					
Flora and Fauna: Disturbance to habitats as a result of noise, vehicle and personnel movements.	<p>The following mitigation measures will be implemented:</p> <ul style="list-style-type: none"> • restrict personnel and vehicle movements to access roads and within boundaries of site only; • control of noise during operation. 	Life time of the plant.	No monitoring is envisaged.	APSCL Project management	APSCL management & EHS department.	Good plantation	Yearly report prepared by APSCL or by third party.	APSCL to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and EHS procedures.
Visual Impact Visual image of Power plant from surrounding areas.	<p>The visual effect of the power plant will be improved through:</p> <ul style="list-style-type: none"> • creation of landscaped boundary along the fence of the power plant. 	Life time of the plant.	No monitoring is envisaged.	APSCL Project management	APSCL management & EHS department	Improved visual image		Management to consider the landscaped areas to maximize visual image and habitat creation.

	• Planting sufficient amount of trees around the project site							APSCL to manage and maintain proper landscaped areas.
Soil and Hydrology: Spillage of oils, chemicals or fuels on site.	<p>Follow mitigation measures in EIA and EHS Guidelines on Hazardous Materials Management and Waste Management.</p> <p>Good site management measures as described in the ESMP, under aquatic environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation.</p> <p>No septic tank will be installed within 500m of a deep or shallow tube well used by the community for drinking water. Septic tank will be installed in well drained and permeable soils well above high groundwater level and where sufficient soil percolation exists for design wastewater loading rate. It will be properly designed to prevent hazard to human health or contamination of land or water. Regular maintenance</p>	Life time of the Plant	<p>The APSCL authority will continuously monitor application of ESMP and good site management .</p> <p>Quarterly monitoring of drinking water in tube wells within 1km of a septic tank location by third party consultant to confirm that national drinking water standards are met. See also water quality monitoring program above.</p>	APSCL Project management	APSCL management & EHS department	<p>Quality of bunds and drainage systems.</p> <p>Efficiency of operation.</p>	<p>Yearly report prepared by APSCL EHS department</p> <p>Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).</p>	APSCL to ensure all employees will receive related training.

	<p>required. No overflow of septic tank permitted. If monitoring of tube wells identifies contamination (exceedance of national drinking water standards) provide community users with an alternate source of drinking water.</p> <p>Septic systems should only be used for treatment of sanitary sewage, and are unsuitable for process wastewater treatment.</p>							
Solid Waste	<p>Follow mitigation measures in EIA and EHS Waste Management Guidelines.</p> <p>Good practice measures undertaken during the construction phase will be continued into the operation phase.</p> <p>It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly disposal contract.</p> <p>Records of all waste transfers to be maintained.</p>	Lifetime of the plant	<p>Daily records of waste transfers to be kept.</p> <p>Continuous monitoring is required to ensure the implementation of good management practices during operation.</p>	APSCL Project management	APSCL management & EHS department	Efficient waste collection and disposal system should be done by either APSCL or Contractor in place.	<p>Quarterly reports from the EHS to APSCL management.</p> <p>Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).</p>	APSCL to ensure all employees are given basic induction training on good operation and site management practices.
Occupational Health and Safety, Risks and	Follow mitigation measures in EIA and EHS Occupational Health and Safety and Thermal	Lifetime of the Plant	<p>Regular on-site training.</p> <p>Regular staff checks, system checks and field</p>	APSCL Project management	APSCL management & EHS	Management procedures in place. Workers	Quarterly reports from the EHS to APSCL management.	APSCL to ensure that all employees are given basic induction training on EHS

Hazards	<p>Power Guidelines.</p> <p>Drinking Water provided to employees to meet drinking water standards.</p> <p>Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program.</p> <p>Use of warning signs near noisy environments and high temperature surfaces and provide personal protective equipment (PPE) as appropriate, including ear muffs and insulated gloves and shoes.</p> <p>The stand mitigation that has been suggested in the ESMP report will be implemented and followed on site.</p>		<p>tests of emergency procedures by on-site management.</p> <p>Record all fatalities, accidents, near misses and occupational diseases that occur during operation and implement corrective action to ensure such incidents are not repeated in future.</p> <p>Quarterly health check of employees with respect to EMF exposure and other occupational hazards.</p> <p>Daily monitoring of drinking water provided to employees to confirm national drinking water standards are met.</p>		department.	<p>health and safety status, incidents, injuries, slip, trip, falls and near misses are properly documented .</p>	<p>Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).</p>	<p>policies and procedures, Emergency Preparedness and Response Plan.</p>
Repair and maintenance schedules for the turbines and cooling system	<p>The gas turbine, steam turbine and cooling system require repair and maintenance schedules for the turbines and cooling system to maximize life cycle and operation efficiency.</p>	Lifetime of the Plant	<ul style="list-style-type: none"> As per the manufacturer's schedule the gas turbine set needs timely minor, hot gas path and major inspection at specific time interval. The repair and 	APSCL Project management	APSCL management & EHS department.		<p>Schedule for GT maintenance has been added as Annexure 14(b). The GT unit needs a major inspection after 100000 Equivalent Operating Hours and 8 minor inspections</p>	<p>APSCL to conduct the inspection with specialists as per schedule.</p>

			maintenance of steam turbine and cooling water system will be done according to the manufacturer's recommendation and as required.				within the time as per schedule. 3 times Hot Gas Path Inspection is also required as per schedule.	
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7.5 MONITORING PLANS AND SCHEDULES

7.5.1 During Construction Phase

The environmental monitoring program should be carried out as an integral part of the project planning and execution. It must not be seen merely as an activity limited to monitoring and regulating activities against a pre-determined checklist of required actions. Rather it must interact dynamically as project implementation proceeds, dealing flexibly with environmental impacts, both expected and unexpected. For this purpose, it is recommended that the Project Director (PD) for this specific project should take the overall responsibility of environmental management and monitoring. The PD will form a team with required manpower and expertise to ensure proper environmental monitoring, as specified in Table 7.7 below, and to take appropriate measures to mitigate any adverse impact and to enhance beneficial impacts, resulting from the project activities. The PD through its team will make sure that the Contractor undertake and implement appropriate measures as stipulated in the contract document, or as directed by the PD to ensure proper environmental management of the project activities. It should be emphasized that local communities should be involved in the management of activities that have potential impacts on them (e.g., traffic congestion in the surrounding areas). They should be properly consulted before taking any management decision that may affect them. Environmental management is likely to be most successful if such decisions are taken in consultation with the local community.

Table 7.4 summarizes the potentially significant environmental impacts during construction phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts.

Table 7.4 Potentially significant environmental impact during construction phase and mitigation measures

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Influx of Workers	• Generation of sewage and solid waste	• Construction of sanitary latrine and septic tank system (one latrine for 20 persons) • Erecting “no litter” sign, provision of waste bins/cans, where appropriate • Waste minimization, recycle and reuse • Proper disposal of solid waste (in designated waste bins)	Contractor (Monitoring By APSCL)
	• Possible spread of disease from workers	• Clean bill of health, a condition for employment • Regular medical check-up of workers	
Transportation of equipment, materials and personnel; storage of materials (See Annexure 14(a) for the Traffic	• Increased traffic/navigation • Generation of noise, especially affecting the nearby residential areas	• Scheduling of deliveries during after regular working hours • Protecting local community from traffic hazard during construction phase, with installation of proper traffic sign and warnings • Speed reduction to 10 km per hour within the APSCL complex	Contractor (Monitoring by APSCL)
	• Deterioration of air	• Keeping vehicles under good condition,	

Management Plan of this project)	quality from increased vehicular movement, affecting people in the surrounding areas	with regular checking of vehicle condition to ensure compliance with national standards	
	<ul style="list-style-type: none"> • Wind-blown dust from material (e.g., fine aggregate) storage areas 	<ul style="list-style-type: none"> • Watering unpaved/dusty roads (at least twice a day; cost estimate provided) • Sprinkling and covering stockpiles • Covering top of trucks carrying materials to the site and carrying construction debris away from the site 	
Construction activities, including operation of construction equipment	<ul style="list-style-type: none"> • Generation of noise from construction activities (general plant and access road construction), especially affecting the local resident 	<ul style="list-style-type: none"> • Use of noise suppressors and mufflers in heavy equipment • Avoiding, as much as possible, construction equipment producing excessive noise during at night • Avoiding prolonged exposure to noise (produced by equipment) by workers • Creating a buffer zone between the neighbouring community and construction site 	Contractor (Monitoring by APSCL);
	<ul style="list-style-type: none"> • Deterioration of air quality from wind-blown dust and possible use of equipment, such as stone (aggregate crushers) 	<ul style="list-style-type: none"> • Not using equipment such as stone crushers at site, which produce significant amount of particulate matter • Keeping construction equipment and generators in good operating condition • Using equipment, especially generators with high levels of emission control. • Immediate use of construction spoils as filling materials • Immediate disposal/sale of excavated materials • Continuous watering of bare areas 	
	<ul style="list-style-type: none"> • Generation of construction Waste 	<ul style="list-style-type: none"> • Hauling of construction debris away from the site and their appropriate disposal in a designated disposal site 	
	<ul style="list-style-type: none"> • Accidents 	<ul style="list-style-type: none"> • Regular inspection and maintenance of equipment • Environmental health and safety briefing • Provision of protective gear 	
	<ul style="list-style-type: none"> • Spills and leaks leading to soil and water contamination with hydrocarbon and PAHs 	<ul style="list-style-type: none"> • Good house keeping • Proper handling of lubricating oil and fuel • Collection, proper treatment, and disposal of spills 	
	<ul style="list-style-type: none"> • Employment of work/labour force 	<ul style="list-style-type: none"> • Local people should be employed in the project activities as much as possible. 	

7.5.2 Operation Phase

Most of the environmental parameters will experience beneficial effects during the operation phase of the power plant project. Efforts should be made to enhance these beneficial impacts, which may include incentives for proper growth of more projects in the area. The plant management authority of APSCL should be responsible for overall environmental monitoring during the operation phase of the project.

Table 7.5 summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts.

Table 7.5 Potentially significant environmental impact during operation phase and mitigation measures

Activity/ Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Power Generation	• Emission from the power plant	<ul style="list-style-type: none"> • Using stack as specified in the design • Using low nitrogen oxide burners, as specified in the design • Installation of stack emission monitoring equipment for major pollutants. An in-house Continuous Air Monitoring Station (CAMS) may be considered. • In stack design due consideration should be given to proper insulation • Planting of trees around the project site, specially along the south and south-east boundary of the project site 	APSCL
	• Generation of noise	<ul style="list-style-type: none"> • Provision of silencers for generators and turbines • Planting of trees around the project site • Regular plant maintenance • Regular noise monitoring, especially at the project boundary and residential quarters located nearby • Use of ear-muffs and ear-plugs by plant personnel working in the generator and turbine facilities of the plant 	
Water Consumption	• Depletion of groundwater resources	• Regular monitoring of groundwater level	APSCL
Surface Water Abstraction	• Increase of river water temperature	• Regular monitoring of surface water level and river water quality at the upstream and downstream of the discharge point	APSCL
Waste Generation	<ul style="list-style-type: none"> • Inappropriate disposal of sewage causing environmental pollution • Generation of solid waste including sludge from demineralizer. • Possible water pollution 	<ul style="list-style-type: none"> • Good housekeeping • Proper construction and maintenance of wastewater disposal system for the plant premises. • Ensuring proper storage, treatment, and disposal of all solid waste • Monitoring of effluent quality from treatment plant • Monitoring of river water quality and discharge water quality 	APSCL
Occupational Health & Safety of workers	Non-ionizing radiation, Heat, Noise, Confined spaces, Electrical hazards, Fire and explosion hazards, Chemical hazards, Dust, sanitation,	<ul style="list-style-type: none"> • Regular health check up of workers • Proper PPE should be provided to protect from the heat, electric shock and noise protection, • Regular awareness and training should be provided for fire safety & chemical hazard, • Safe drinking water should be provided 	APSCL

	safe drinking water etc		
Turbines and cooling system inspection	Machine performance may deteriorate with time.	<ul style="list-style-type: none"> As per the manufacturer's schedule the gas turbine set needs timely minor, hot gas path and major inspection at specific time interval. Schedule for GT maintenance has been added as Annexure 14(b). The repair and maintenance of steam turbine and cooling water system will be done according to the manufacturer's recommendation and as required. 	APSCL

7.6 Monitoring Parameters

7.6.1 Construction Period

There are two types of monitoring during construction, 1) Visual Monitoring and 2) Analytical Monitoring. The following are the visual monitoring, it's parameters and monitoring frequency for the APSCL 400 MW CCPP east:

1. Visual monitoring and observation

Table-7.6: Monitoring plan during construction phase of the project (Visual)

Issue	Key aspects	Monitoring Frequency	Responsibility
Traffic volume	Incoming & outgoing traffic, traffic movement records	Monthly	EPC Contractor/ Consultant
Site Security	Proper fencing, isolation of site from general access, marked passage for workers and visitors	"	"
Personal Protective Equipment	Ensure every single person involved in the construction activity wear proper PPE	"	"
Incident record & reporting	Documented record of all incident, accident, near misses etc. and its remedial process.	"	"
Solid waste	Quantity of solid waste, segregation and disposal process	"	"
Oily waste generation & disposal system	Quantity of oily waste, storage and disposal process	"	"
Worker's health	Monitoring process of worker's health	"	"
Complain from neighbours	Any significant complain from neighbours and it's remedial procedure	"	"
Safety orientation & training of workers	Frequency of training & orientation of workers for safety	"	"
Sanitation & drinking water facility to workers	Availability of safe drinking water and sanitation to the workers	"	"
Site Drainage	Maintaining proper drainage	"	"

2. Analytical Monitoring during construction

Table-7.7: Monitoring plan during construction phase of the project (Analytical)

Issue	Parameters	Monitoring Frequency	Responsibility
Ambient air Quality	PM ₁₀ and PM _{2.5}	Monthly	EPC Contractor/ Consultant
River water	Water temp., DO, BOD ₅ , COD, Oil and Grease and heavy metals (Cr, Cd, Pb)	Monthly	„
Groundwater	Groundwater level, p ^H , TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	Once in 3 months	„
Soil quality	Cr, Cd, Pb and Oil and Grease	Once in 12 months	„
Noise level	Noise at different locations	Monthly	„
Drinking water	p ^H , Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	Monthly	„

7.6.2 Operational Period

The following are the monitoring parameters and monitoring frequency for the APSCL 400 MW CCPP east during operation:

Table 7.8 Monitoring plan during operational phase of the project

Issue	Parameters	Monitoring Frequency
Stack emissions	NO _x , SO ₂ , PM ₁₀ , PM _{2.5} and temperature	Continuous and annual
Ambient air quality	CO, NO _x , PM ₁₀ , PM _{2.5} , SO ₂	Continuous at four locations, seasonal weekly monitoring at other sensitive receptors
River water	Water temperature and DO, PH, COD, BOD, TOC, DO, TSS, oil & grease etc	Continuous and monthly
Effluent quality	pH, DO, Sulfate, TSS, TDS, BOD, COD, Total N, Total P	Monthly
Groundwater	pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms; Groundwater level	Once in 3 months
Noise level	Noise at different locations	Once in 3 months
River morphology	River cross-section	Once a year during design life of the plant
Fisheries, Plankton, Zooplankton, Vegetation etc.	Number and Condition	Once in 6 months
Occupational health and safety	Health status and safety	Once in 3 months
Turbines and cooling system inspection	Machine condition and operation performance	Schedule for GT maintenance has been added as Annexure 14(b). The GT unit needs a major inspection after 100000 Equivalent Operating Hours and 8 minor inspections within the time as per schedule. 3 times Hot Gas Path Inspection is also required as per schedule.

7.6.3 Monitoring cost

The proposed monitoring parameters and the frequency to be monitored in accordance with the monitoring plan have been presented in Table 7.7 & Table 7.8 during the construction and the operation of the proposed project respectively. The estimated cost of EMP, environmental monitoring and training program during the construction phase and operation phase has been given in. Table 7.9, Table 7.10 & Table 7.11.

Table 7.9 Cost estimate for environmental monitoring and environmental management during construction

Item	Parameter	unit cost (Taka)	Unit per year	Total cost per year (Taka)
Visual	Visual monitoring	50000.00	12	600,000.00
Ambient air Quality	CO, NOx, PM10 and PM2.5	25000.00	12	300,000.00
River water	Water temp., DO, BOD5, COD, Oil and Grease and heavy metals (Cr, Cd, Pb)	30000.00	12	360,000.00
Groundwater	Groundwater level, pH, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	30000.00	12	360,000.00
Soil quality	Cr, Cd, Pb and Oil and Grease	50000.00	2	100,000.00
Noise level	Noise at different locations	10000.00	26	260,000.00
Process waste	Solid waste	5000.00	52	260,000.00
Health	Health status of the workers	20000.00	6	120,000.00
	Total Cost			23,60,000.00

Table 7.10 Cost estimate for environmental monitoring during operational phase

Item	Parameter	unit cost (Taka)	Unit per year	Total cost per year (Taka)
Stack emissions	CO, NOx, SPM, O2 and temperature	30000.00	04	120,000.00
Ambient air quality	CO, NOx, PM10, PM2.5,	30000.00	04	120,000.00
River water	Water temperature and DO	5000.00	12	60,000.00
Effluent quality	pH, DO, Sulfate, TSS, TDS, BOD, COD, Total N, Total P	30000.00	04	120,000.00
Groundwater	pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms; Groundwater level	30000.00	02	60,000.00
Noise level	Noise at different locations	10000.00	12	120,000.00
River morphology	River cross-section	20000.00	01	20,000.00
Vegetation	Number and Condition	25000.00	01	25000.00
Occupational health and safety	Health status and safety	25000.00	02	50,000.00
	Total cost			6,95,000.00

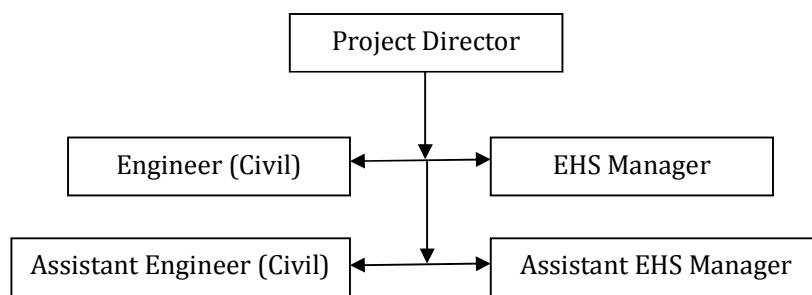
Table 7.11 Cost estimate for training during operational phase

Item	Number	unit cost (Taka)	Total cost per year
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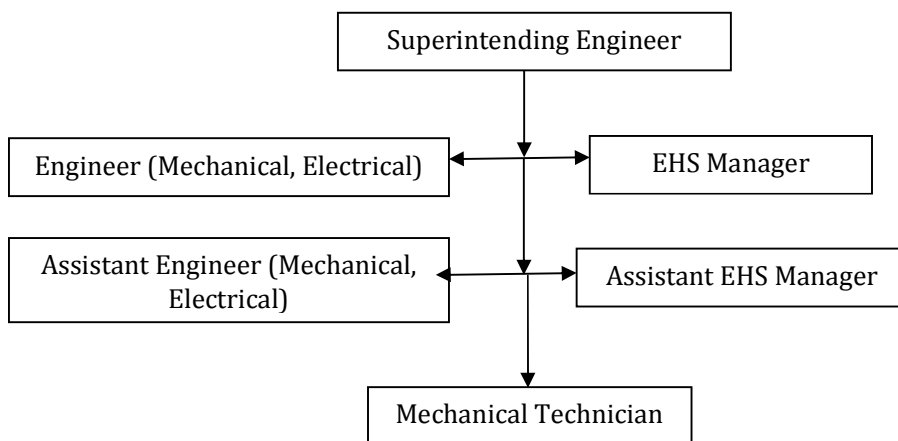
			(Taka)
Safety and occupational health	02	200,000.00	400,000.00
Environmental management system	02	300,000.00	600,000.00
Total cost during operational phase			10,00,000.00

7.6.4 Resources and Implementation

The environmental parameters to be monitored during the construction and operational phases along with the monitoring schedule have been presented in the previous sections. The responsibilities for the implementation of the proposed monitoring plan may be entrusted with the external contractor in association with the APSCL personnel and under the direct supervision of the APSCL management. It is very important to make sure that the potentially significant impact during both the construction and operation phases are properly addresses through adaptation of the proposed mitigation and enhancement measures. It is equally important to undertake environmental monitoring during both the construction and operation phases according to the proposed monitoring plan. These should therefore be made integral part of the proposed power plant project. The following are the management team of APSCL who will be responsible for the monitoring program of the proposed project during the construction and operation period; Team for Environment monitoring and ensuring compliance during construction



Team for Environment monitoring and ensuring compliance during operation



7.7 ESMP Monitoring and Review

The environmental unit of the APSCL shall periodically review, monitor and audit the effectiveness of the ESMP, including all sub-plans. The audit program should adequately cover the scope, audit frequency and methods that are typically required for large infrastructure projects. The frequency of audits should reflect the intensity of activities (typically more common during construction), severity of environmental and social impacts and non-compliances raised in prior audits.

7.7.1 Review of the ESMP

The environmental unit of the APSCL shall review the ESMP & ESIA to assess its effectiveness and relevance as follows:

- A full review shall be undertaken annually;
- Following a reportable incident, or a significant non-compliance; and
- Following an addition, up-date or change order to the ESMP, or a sub-plan.

The review of the ESMP should consider the following:

- Adequacy of data collection, analysis and review;
- Reporting;
- Non-compliances; and
- Corrective actions implemented.

The ESMP shall also be reviewed periodically to evaluate environmental controls and procedures to make sure they are still applicable to the activities being carried out. Reviews will be undertaken by the APSCL Environmental Unit as follows:

- The full ESMP shall be reviewed at least annually;
- Relevant parts of the ESMP shall be reviewed following a reportable incident;
- Relevant parts of the ESMP shall be reviewed following the receipt of an updated sub plan;
- Relevant parts of the ESMP shall be reviewed on request of stakeholders, Contractor, Supervising Engineer, World Bank/DOE or the host communities.

The review shall include analysis of the data collection and analysis of data, monitoring reports, incident reports, complaints/grievances and feedback from stakeholders, community reports, consultation meeting minutes and training records to evaluate the effectiveness of ESMP procedures. Site visits, interviews and other auditing methods may also be used.

Chapter-8

CHAPTER EIGHT: EMERGENCY RESPONSE AND DISASTER MANAGEMENT PLAN

8.1 EMERGENCY RESPONSE

The initial response to an incident is a critical step in the overall emergency response. Like all other Industries and installations, Power generation facilities must have adequate measures against accidents or incidents to meet the emergency. The purpose of having an Emergency Response Plan (ERP) is to:

- Assist personnel in determining the appropriate response to emergencies.
- Provide personnel with established procedures and guidelines.
- Notify the appropriate Company Emergency Response Team personnel and regulatory/ Govt. agencies.
- Manage public and media relations.
- Notify the next-to-kin of accident victims.
- Promote inter-departmental Communications to ensure a “Companywide” Co-ordinated emergency response.
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs.
- Respond to immediate requirements to safeguard the subtending environment and community.

Generally, the initial response is guided by three priorities Ranked in importance these priorities are:

1. People
2. Property
3. Environment

Emergency Response Procedures will identify who does what and when in the event of an emergency. Responsibility for who is in charge and their coordination of emergency actions shall be identified. Nature of Emergency & Hazardous Situations may be of any or all of the following categories:

I. Emergency

- ❖ Fire,

- ❖ Explosion,
- ❖ Electric shock
- ❖ Medical emergency,

II. Natural Disasters

- ❖ Flood,
- ❖ Earthquake/ cyclone,
- ❖ Storm/ typhoon/ tornados, and
- ❖ Cloud burst lightning.

III. External Factors

- ❖ Food poisoning/water poisoning,
- ❖ Sabotage, and
- ❖ War.

8.1.1 Six Steps in Emergency Response

Step-1)

- a) Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.
- b) Determine potential hazards stemming from local conditions such as inclement weather water bodies etc. and ensure that the initial response team is aware of these conditions.

Step-2)

Determine the source/ cause of the event resulting to the emergency and prevent further losses.

Step-3)

Conduct an assessment of the incident site for any further information on hazards or remedies.

Step-4)

Initiate redress procedures.

Step-5)

Report the incidence its nature cause impact applied redress procedures and any further assistance required etc. to the appropriate company, government and/or land owner.

Step-6)

Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment.

8.1.2 Reporting Incidents and Accidents

All accidents and near-miss incidents shall be investigated to determine what caused the problem and what action is required to prevent a recurrence. Employees required to perform investigations shall be trained in accident investigation techniques. The incident/accident investigation should be a fact-finding exercise rather than faultfinding. The investigations will focus on collection of evidence to find out the “root cause” of the incident. The recommendations of the investigation report are implemented in phases.

8.1.3 Approaches to Emergency Response

For this project, emergency response systems should be in place to deal with dangerous goods uncontrolled releases of dust and gaseous emission, natural calamities fires burns and injuries. There are to be trained emergency response teams, specific contingency plans and incidence specific equipment packages in place to cope with these types of emergencies. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts.

In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow a specific sequence of actions as stepped out in the preceding paragraphs.

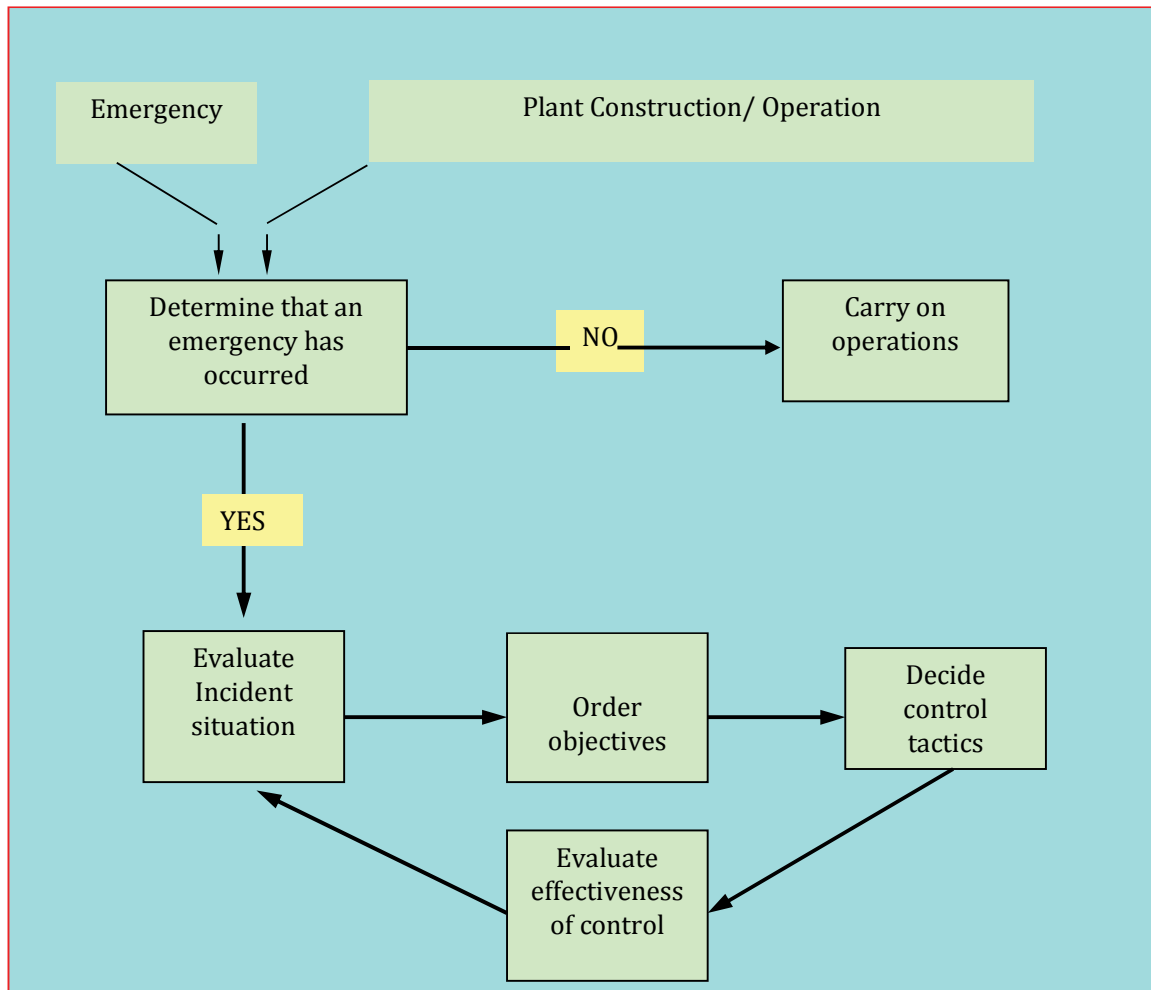


Figure-8.1: Illustrates an Example System Approach to Plant Construction & Operations.

8.2 DISASTER MANAGEMENT PLAN

In normal operation of the plant, when all environmental protection equipment works according to design specification, then there would be no environmental problems for the present plant.

Disaster (to certain degree) may occur if the environmental protection equipment fails to work at normal condition. This situation may arise for any of the following causes-

- When plant runs at abnormal situation e.g. if emission level increases than its normal level or if the engines give unwanted noise than normal level.
- If liquid waste over flows and pollutes the surroundings.

Therefore, appropriate management plan should have to be taken by the project proponent to prevent any unwanted disaster in the plant. In this regard, there should be a provision to stop the production immediately during any process failure as discussed above.

The disaster management plan should consist of preventive measures including, among others, the following.

- Formulation and strict implementation of safety codes and measures;
- Periodic inspection of safety relief valves provided with pressure vessels and equipment;
- Preventive maintenance;
- Aware the workers about electric shock
- Declaring the factory a “no smoking zone”
- Mock drills by the fire fighting cells/ groups
- Provision and inspection of firefighting equipment and fire hydrant system in all the sections;
- Proper training of the employees about the importance of codes;
- Training the employees and the residents of the surrounding villages about the actions to be taken during an accident, disaster etc.

In case of abnormal situation (Pressure rise/fall, high temperature, low fuel supply etc.) the plant will automatically trip giving alarm for the protection of machineries. This emergency shutdown shall manage all inputs and outputs relative to emergency shutdown functions.

It is imperative to develop entire facility environment policy and display necessary documentation for ease in accessing information. Some of these documents include:

- ✓ Emergency contacts;
- ✓ Emergency response procedures for fires

The facilities operations and monitoring are carried out under the management and help from both the employees and relevant government lead agencies. In order to take care of any hazards the following control should be adopted:

- ✚ All safety precautions and provisions covering the general cleanliness of the entire facility down to, ventilation, lighting, sanitary, waste collection, first aid box provision, adequate fire extinguishers and site security by fencing.

8.3 ENVIRONMENT, HEALTH AND SAFETY (EHS)

Health and safety aspects of the entire facility should be given due attention. Protective devices as provided should continuously be used within the unit's operations to ensure the safety of the natural resources and boat owners is guaranteed.

The maintenance of Material Safety Data Sheets (MSDS) will be followed to ensure safety all section of the facility that chemicals are utilized.

An Environment, Health and Safety register is essential for monitoring of performance of the entire facility community in relation to the environment. The management will use this as a self-auditing tool. This register should include:

- Fire extinguisher servicing records
- EHS meeting schedules and training records
- Electrical installations
- Generator inspection and maintenance records
- Waste disposal records
- Inventory records (fuels, paints, cleaning agent
- Emergency response procedure.
- Record off all incidents, accidents, near miss etc.

8.4 FIRE HAZARD & FIRE EVACUATION PLAN

Fire hazards such as large quantities of fuel, combustible/flammable liquids, electrical hazards, combustible dusts, and warehousing are common in electric power generating plants. Although fires are not a daily occurrence, they usually will cause severe property damage and business interruption. Sometimes the fire protection equipment systems have not received attention since they were installed. If these systems are needed, however, they are counted upon to perform reliably and protect vital plant equipment from fire. Fire protection systems are a combination of mechanical and electrical components and, like power generation equipment, need regular attention.

In addition, some people in charge of fire protection do not have an adequate knowledge of necessary inspection and testing frequencies, or they use the minimum frequencies prescribed by their authority having jurisdiction. For example, some jurisdictions only require annual water flow alarm tests on sprinkler systems, a frequency which is considered inadequate by most fire protection professionals.

The information contained in this part is based on the current standards established by the National Fire Protection Association (NFPA), the most widely used in North America, and generally accepted guidelines. Most fire protection systems are designed and installed according to these standards. Unfortunately, information on inspection, testing and maintenance is not contained in a single standard but is contained within the various system-specific standards, making it cumbersome and difficult to obtain an overview of the tasks which need to be accomplished.

Other codes and standards such as UBC, UFC, BOCA, OSHA and MSHA also address fire protection, but their contents are usually based on NFPA documents and may not address testing/maintenance requirements. Members on the NFPA technical committees comprise a wide range of fire protection expertise and include representatives from manufacturers, testing laboratories, users, authorities having

jurisdiction and insurance companies. Adherence to NFPA standards will satisfy most jurisdictions and insurance companies.

Suitable fire protection and detection systems shall be provided designed to the requirements of National Fire Protection Association (NFPA) standards. Gas detection systems and alarms shall also be included.

Fire protection shall consist of wet pipe, automatic deluge systems, hydrants, CO₂ gas flooding systems, and portable extinguishers of CO₂ and dry powder in sufficient quantities.

Areas to be covered by fixed protection installations shall be included but not be limited to:

- All oil filled transformers
- Gas engine
- Lub oil system
- Cable areas
- Storage areas.

The gas engines are to be protected against fire by a CO₂ total flood system within the enclosures. The only other significant fire risks are associated with the lube oil systems on the gas engines, cable areas, stores and with oil contained within transformers. Such systems will be protected from fires by water deluge sprays. All necessary systems are required to be fire 'protected' with suitable extinguishing agents. Additional protections are to be provided by a ring main and hydrant system with hose/equipment cabinets located at strategic points. This ring main shall be provided with suitable section valves located in valve pits.

The firefighting water will be taken from the fire tank and will be pumped by a dedicated electric pump with a diesel powered back-up pump available in case of electrical failure. Pressure in the firefighting mains is maintained using an electric jockey pump.

A site wide fire and gas detection system will be provided to initiate the fire protection and alarms. Manual "break glass" fire alarms shall also be situated at strategic locations around the site and inside the buildings.

A modern electronic fully addressable master fire alarm panel shall be located in the Central Control Room. All local fire panels shall be linked into the master fire alarm panel. This master panel should have a separate section for the gas detection system. A repeater panel should be provided in the site gatehouse to allow swift identification of the affected fire zone to incoming local fire-fighting appliances. This master fire panel shall be provided with its own dedicated battery system.

8.5 EMERGENCY AND DISASTER MANAGEMENT OF APSCL 400MW CCPP (EAST)

The following team will work in APSCL 400MW CCPP (East) in the event of any emergency or disaster:

1. Plant Manager
2. Environmental Health & Safety Manager
3. Plant Engineer (Electrical)
4. Plant Engineer (Mechanical)

The Emergency team will sit in a regular interval to discuss about their responsibilities in case of any emergency. The team will also be responsible for taking care of disaster and emergency handling devices enable them available in good working condition in case of emergency. The following are the major responsibilities of the disaster management team of APSCL 400MW CCPP (East):

1. Organize regular fire or emergency evacuation drill,
2. Check all emergency sign, emergency exit, alarm are in good working order.
3. Regular check of emergency evacuation alarm by blowing a test alarm for few seconds in a certain time of a day.
4. Sit with different emergency subcommittee to discuss various issues about the responsibilities of the subgroups in the event of emergency.

To prevent any unwanted Disaster or emergency, the following subcommittee will be in action during any emergency:

a. Fire prevention:

i) Fire Attacking team - to attack fire with prevention appliances within shortest possible time.

ii) Supporting team – This team will support the attacking team.

iii) Breathing apparatus team - will supply BA equipment.

iv) Containment team - for additional support.

v) First Aid support team: For providing first aid support to the victims, first aid boxes will be provided with sufficient first aid equipment.

vi) Emergency Casualties team: There will be plan to evacuate any injured or casualties to the hospital. These includes pick up, driver and stretcher.

b) Special event team: This team will be responsible for the following activities or other emergencies not mentioned in the list above:

1) Unrest management: Local police or law & force agencies will be contacted in case of any labor or political unrest will be beyond control.

2) Natural Calamity: The team will be trained to face any natural calamity like flood, earthquake, cyclone, tsunami, heavy rainfall etc.

3) Fear of unknown: Training will be given to the team to face any unwanted happening like aggrieved mob, sabotage etc.

Chapter-9

CHAPTER NINE: ALTERNATIVE SITE

9.0 THE 'NO BUILD' SCENARIO

From a purely physical environmental point of view, the 'do-nothing' is preferable to any project implementation, since it would avoid creation of any of the adverse impact associated with the project. However, the potential socio-economic benefits of the nation would be foregone and solving the problem of power generation and power demand disparity would be hampered. It is concluded that the 'No Build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimize to an allowable level.

9.1 SITE ALTERNATIVES

a. Hydroelectricity:

The country is flat having relatively limited potential for hydroelectricity.

b. Geothermal Plant:

No active geothermal site has been found.

c. Coal-Fired Plant:

The country has about 1700 million tons 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 carbon dioxide and leads to acid rain because of high sulphur content.

d. Fuel Consumption:

The supply of gas for continuous operation of highly efficient as well as low cost generation from the new 400MW unit with efficiency of about 58.4% can be ensured by reducing generation of the old and less efficient 2x150MW steam units (efficiency 32%). Daily operation of the old 2x150MW units at 60% capacity factor can save an additional amount of about 23 MMSCFD of gas. The future additional requirement of gas by APSCL can thus be met by reducing generation from old units.

e. Resettlement:

Site selection is ideal as it involves no resettlement issues.

f. Pollution Control:

As shown in subsequent sections, environmental pollution during the period of construction and also during the period of operation will be mostly insignificant.

g. Cooling System:

Closed loop cooling system is best in principle, but closed loop systems requires a minimum amount of land for cooling towers, and requires make-up water (i.e., closed loop systems have zero or near-zero discharge but present some potential impacts due to water consumption). The project cost and impact also need to be assessed. Because of the space constraints, closed loop cooling system is not feasible for this project.

The project aesthetic looks are modern and environment compatible, the site is environmentally acceptable. Currently, the existing power plants at the proposed site have been retired. Therefore, the project site is suitable for the proposed **Ashuganj 400 MW CCPP (East)**. So there is no logical need to look into alternative sites.

Chapter-10

CHAPTER TEN: STAKEHOLDER CONSULTATION

10.0 STAKEHOLDERS CONSULTATION

Stakeholder consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability.

Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision-making. Stakeholder consultation was therefore conducted in the project area not only to satisfy the legal requirements of the EIA process in Bangladesh but also to improve and enhance the social and environmental design of the project.

10.1 OBJECTIVES OF STAKEHOLDERS CONSULTATION

The process of public participation and consultation was endorsed in the United Nations Conference on the Environment and Development (UNCED) in 1992 through one of the key documents of the conference– Agenda 21. Agenda 21 is a comprehensive strategy for global action on sustainable development and deals with issues regarding human interaction with the environment. It emphasizes the role of public participation in environmental decision-making for the achievement of sustainable development.

For projects that have environmental and social impacts, consultation is not a single conversation but a series of opportunities to create understanding about the project among those it will likely affect or interest, and to learn how these external parties view the project and its attendant risks, impacts, opportunities, and mitigation measures. Listening to stakeholder concerns and feedback can be a valuable source of information that can improve project design and outcomes and help a company to identify and control external risks. It can also form the basis for future collaboration and partnerships. For stakeholders, a company's consultation process is an opportunity to get information, as well as to educate company staff about the local context in which a project will take place, to raise issues and concerns, ask questions, and potentially help shape the project by making suggestions for the company to consider and respond to.

Through the public consultation process, APSCL hopes to:

- Promote better understanding of the project, its objective, and its likely impact;
- Identify and address concerns of all interested and affected parties of project area;

- Provide a means to identify and resolve issues before plans are finalized and development commences, thus avoiding public anger and resentment and potentially costly delays;
- Encourage transparency and inculcate trust among various stakeholders to promote cooperation and partnership with the communities and local leadership;

10.2 CONSULTATION PROCESS

Primary stakeholders were consulted during informal and formal meetings held in the project area. The consultation process was carried out in the Bangla languages. During these meetings a simple, non-technical, description of the project was given, with an overview of the project's likely human and environmental impact. This was followed by an open discussion allowing participants to voice their concerns and opinions. In addition to providing communities with information on the proposed project, their feedback was documented during the primary stakeholder consultation. The issues and suggestions raised were recorded in field notes for analysis, and interpretation.

By reaching out to a wider segment of the population and using various communication tools—such as participatory needs assessment, community consultation meetings, focus group discussions, in-depth interviews, and participatory rural appraisal—EIA involved the community in active decision-making. This process will continue even after this EIA has been submitted, as well as during future EIAs in which similar tools will be used to create consensus among stakeholders on specific environmental and social issues in the context of a proposed project.

It was important not to raise community expectations unnecessarily or unrealistically during the stakeholder consultation meetings in order to avoid undue conflict with local leaders or local administrators. The issues recorded in the consultation process were examined, validated, and addressed in the EIA report.

10.3 STAKEHOLDER CONSULTATION TECHNIQUE

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

- Informal meetings with communities in surrounding areas. Men, women and local elders attended these meeting.

10.4 STAKEHOLDERS CONSULTED

In the consultation process for EIA, following key stakeholders were consulted:

- Local communities, Men, Women and local elders attended meetings.
- Local Government representatives
- Local Fishermen, their family members

Meetings with stakeholders consisted of community consultation meetings, focus group discussions, and in-depth interviews with men and limited focus-group discussions with women. There was one stakeholder meeting organized at project office near the site on 30.04.2015 by verbal notice and paper advertisement. The advertisement was published in the two national daily newspapers in Bangla and English. Another in-depth interview with local fishermen were carried out on 1st July, 2015 at bazars and Meghna ghat. On 14 July 2015, the second round consultation with fishermen in Char Sonarampur Village of Ashuganj Sadar Upazila under Brahman Baria District was conducted by ADB consultants and the Executing Agency. The participants were informed about the proposed power plant at the Ashuganj Power Station and the location of the meetings, the process followed, and the outcomes are discussed in this section.

On 12th October, 2015 another round of public consultation and fishermen consultation were carried out. The participants were informed verbally and through paper advertisement (Published on the Daily Ekushey Alo dated 10/10/2015). The participants were given the information flyers containing short description, impacts and mitigation measures written on Bangla. An open discussion was performed. Participants shared their views spontaneously and suggested improvement measures to make the project a success. They were also provided information on how to approach their grievances, if any.

The list of the participants who attended the public consultation is given in *Table 10.1* while the photographs of consultations are included as *Figure 10.1*.

10.5 STAKEHOLDER CONCERNS AND RECOMMENDATIONS

The findings of the Community consultations are given in *Table 10.2*. All these have been addressed in various sections of the EIA, and the mitigation plans have been incorporated into the EMP. The summary of the various stakeholder consultations is given below.

10.5.1 Community Concerns

Project Approval

The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were *considered* a good gesture and appreciated. The demand of electricity generation is such that communities are looking to any project proponent to improve the electricity demand-supply disparity to a great extent. APSCL recognizes that benefits from the project should be distributed judiciously and equitably especially among primary stakeholders in the project area, and will continue to ensure that this principle is followed in its projects and community development program. Local fishermen also welcomed the power generation project as they believe that uninterrupted power supply is essential for their business and also in their daily lives.

Resettlement/ Relocation

The proposed power plant site will be placed in the existing plant of 146 MW CCPP of Ashuganj Power Station Company Limited complex. There was no household inside the land. Therefore, resettlement issue is not applicable for the proposed project.

Local Employment

Communities in the project area emphasized that local people should be given priority when employing people for various project-related works and activities according to their skills.

Compensation

As the proposed power plant site will be established demolishing an existing plant and leased from APSCL. Compensation was not required in the proposed project activities.

Interaction with Local Community

Non-Local work force coming in the project area that will not be aware of the local customs and norms, may result in conflicts with the local community, keeping in mind the sensitive law and order situation and culture of the area.

Impact on Environment & Livelihood

The communities also expressed some fear that construction and operation process would disturb their regular life by creating air, noise and water pollution. The project proponent assured the community people that Ashuganj 400 MW Combined Cycle

Power Plant (East) project will use all the modern equipment and measures to control the adverse effects of the project. The discharge flow was also a major concern in the consultations considering the safety issues for navigation since the river is used as local port. But the project proponent assured them that the overall discharge flow and volume will not increase due to the proposed project since it's and replacement project and discharge water is less than the old project.

Impact on Fishing

As the proposed plan is designed such that, the temperature rise in the Meghna River will be kept minimum; therefore, the project will not hamper aquatic life rather power generation will solve the problems in refrigeration of fishes due to power failure.

10.5.2 Local Government & APSCL Representatives

During the consultation, Ashuganj Power Station Company Ltd. and Local Government representatives were present and consulted. They appreciated for the project, as it will create job opportunities for the local poor and will meet the crying need of electricity.

The consultations were considered a good gesture and appreciated. They also expressed the jobs and business opportunities for the local community will be increased due to project activities.

Table 10.1: Stakeholder Consultations Conducted During EIA Study

a) Local Community:

Date	Location	Name	Age	Occupation
30.04.2015	Nearby Ashuganj 400 MW CCPP Plant, at APSCL office	Robel Sikder	41	Businessman
		Md. Shamim Ahamed (Rana)	37	Businessman
		Aved	27	Businessman
		Md. Akhtaruzzaman Iqbal	46	Businessman
		Md. Taifor Rahman	30+	Businessman
		Md. Mohiul Islam Palash	49	Businessman
		Md. Rajaul Karim Shikdar	35	BADC
		Md. Abul Kalam	38	Teacher
		Md. Monim Mia	35	Businessman
		Md. Niyaj	50	BADC
		Md. Salauddin	37	Businessman
		Md. Zonaidul Islam	60	Businessman
		Ratan Kumar Pal	35	Service Holder

b) Local Government & APSCL:

Date	Location	Participants
30.04.2015	Nearby Ashuganj 400 MW CCPP Plant, at APSCL office	Hazi Md. Mobarok Shekh Chairman, Ashuganj Union Parishod Member
30.04.2015		A M M Sazzadur Rahman Ex. Director (Engg.), APSCL Md. Zainal Abedin Khan Ex. Director (P&P), APSCL Achinta Kumar Sarker Chief Engineer (O & M), APSCL Md. Sharafat Ali Ex. Director (Fin.), APSCL Md. Anwar Hossain Project Director (400 MW CCPP east), APSCL Md Atiqur Rahman Manager (HSE), APSCL Ratan Kumar Paul DGM (Fin. & Acc.), APSCL

c) 2nd Public Consultation

Date	Location	Name	Age	Occupation
12.10.2015	Auditorium, APSCL Complex	Md. Yasin Majumder	63	Consultant, ADB
		Md. Mahbubur Rahman Shahin	25	Assistant Engineer, APSCL
		Md. Atiqur Rahman	31	Manager (HS & E) APSCL
		Md. Zakir Hossain	55	Member, Bangladesh Awami league
		Md. Musha	70	Business
		M.H.Khandekar	60	APSCL
		Achinta Kumer Sarker	58	CE(O&M), APSCL
		Md. Anwar Hossain	48	PD, 400MW CCPP
		Faijor Rahman	31	Business
		Kawsar Ahmed	31	Business

		Polash Khan	33	Business
		Liton	30	Business
		Md. Ramjan	45	Business
		Md. Shahansha	43	Business
		Mohammad Rasel	30	Business
		Md. Ashraful	31	Business
		Alamgir Hossain Forhad	31	Business
		Ali Akter	20	Ansar Employee
		Rasel Mahmud	20	Ansar Employee
		Tofayel Hossain	27	Ansar Employee
		Md. Harun-or-Rashid	27	Ansar Employee
		Humayun Shikder	24	Driver
		Md. Milon Rahman	26	Ansar Employee
		Md. Shobuj Mia	33	Ansar Employee
		Md. Polash Babu	24	Service
		Md. Abu Baakr	30	Business
		Md. Dinar	40	Business
		Md. Rafiqul Islam	21	Business
		Md. Sagore Sarker	28	Business
		Md. Dinar Mia	32	Business
		Md. Samir Ali	30	MLSS
		Ishak Shumon	34	Journalist
		Haji Mahbubur Rahman	28	Business
		Abul Kalam	34	Service
		Md. Saidur Rahman	33	Business
		Md. Liakot	42	Contractor
		Md. IShak	45	Contractor
		Md. Junayedul Islam	28	Business
		Md. Mamun Mia	33	Business
		Md. Hossain	40	Service
		Aftaruzzaman Iqbal	43	Business
		AKM Taufiqur Rahman	35	Service
		Md. Golam Baki	25	Engineer
		Haji Mohammad Mosharrof Hossain	89	Business
		Zonaidul Islam	60	Business
		Hazera	42	Service
		Nurjahan Begum	33	Cleaner
		Nureda Begum	41	Cleaner
		Safia Begum	45	Cleaner
		Mala Begum	28	Worker
		Nurjahan Begum	30	Cleaner
		Jomela Begum	34	Cleaner
		Asma	27	Worker

		Maleha Begum	35	Worker
		Saleha Begum	39	Worker
		Peyara Begum	40	Worker
		Ambia Begum	35	House Wife
		Mumraj Begum	33	Worker
		Nurjahan Begum	36	House Wife
		Halema Begum	43	House Wife
		Monu Begum	28	House Wife
		Mala Begum	32	Worker
		Shaheda Begum	36	Cleaner

d) Local Fishermen:

Survey-1

Date	Location	Name	Age	Contact Number
1.07.2015	Ashuganj Bazar, Meghna Ghat, Ashuganj Rail Station, Bhairab Bridge	Biplab Das	39	01915443958
		Sujon	16	01953999530
		Mujibor	45	01738529576
		Md. Faruk Mia	50	01765016985
		Selim	42	01936193005
		Md. Shahed Mia	30	01926024222
		Dulal	50	-
		Abdul Kader	48	-
		Salam Mia	15	-
		Aziz	30	-
		Kalam	45	-
		Motaleb	40	-

Survey-2

On 14 July 2015, the second round consultation with fishermen in Char Sonarampur Village of Ashugonj Sadar Upazila under Bramman Baria District was conducted by ADB consultants and the Executing Agency. There were 20 participants, including 15 fishermen, 1 religious person, 4 women/house wife. Following is the participants list

The Asian Development Bank (ADB)
Consultation Attendance Sheet

Place: Chhar Sonamampur Date: 14/10/2015 Union: Chhar Sonamampur
Ward No. Upazila: District: B. Brahmanbaria
Name of the Project: Ashuganj CCPP

Sl. No.	Name	Age	Occupation	Education	Contact Number	Signature
1	মল্লিক চন্দ্র দাস	২০	সহকারী	-	০১২৩৭৮২৭১২	
2	ফারুক চন্দ্র দাস	৫৫	ডা	-	-	
3	মুন্সি চন্দ্র দাস	৭০	ডা	-	-	
4	জুয়েলি চন্দ্র দাস	৩০	জুয়েলি	-	-	
5	বাসুদেব চন্দ্র দাস	৫৫	জুয়েলি	-	-	
6	মামুন চন্দ্র দাস	৩৫	জুয়েলি	-	০১২৩৭৮২৭১২	
7	মিলন চন্দ্র দাস	৫০	জুয়েলি	-	০১২৩৭৮২৭১২	
8	জুবিন চন্দ্র দাস	৭০	জুয়েলি	-	-	
9	জুবিন চন্দ্র দাস	৪০	জুয়েলি	-	-	
10	মোহন চন্দ্র দাস	৫৫	জুয়েলি	-	০১২৩৭৮২৭১২	
11	জামাল চন্দ্র দাস	৩০	জুয়েলি	-	০১২৩৭৮২৭১২	
12	জামাল চন্দ্র দাস	৫৫	জুয়েলি	-	০১২৩৭৮২৭১২	
13	মমুন চন্দ্র দাস	২৫	ডা	-	০১২৩৭৮২৭১২	
14	মমুন চন্দ্র দাস	৪৫	ডা	-	-	
15	জুবিন চন্দ্র দাস	৫০	ডা	-	০১২৩৭৮২৭১২	
16	জুবিন চন্দ্র দাস	৫০	ডা	-	-	
17	জুবিন চন্দ্র দাস	৩৭	সহকারী	-	০১২৩৭৮২৭১২	
18	জুবিন চন্দ্র দাস	২৫	ডা	-	০১২৩৭৮২৭১২	
19	জুবিন চন্দ্র দাস	৪০	ডা	-	০১২৩৭৮২৭১২	
20	জুবিন চন্দ্র দাস	৪০	ডা	-	-	

Survey-3

Date	Location	Name	Age
12.10.2015	Shonarampur Char	Anwar Hossain	47
		Shamanda Sharnadas	45
		Nabakrishna Das	74
		Helal Mia	45
		Md. Nurul Islam	26
		Raicharan Das	45
		Amaresh Chandra Das	30
		Shabuj Das	17
		Shapan Chandra Das	34
		Shubash Chandra Das	34
		Promot Chandra Das	75
		Arjun Das	85
		Jounandan Das	41
		Komola Rani Das	40

	Shudeb Chandra Das	70
	Shonjoy Chokrobarti	42
	Minoti Rani	48
	Chondrona Rani	32
	Afia Khatun	34
	Jolekha Khatun	43
	Purni Rani	55
	Koruna Das	28
	Nurul Islam	22
	Namita Rani Das	26
	Jotara Rani	41
	Bina Rani Das	35
	Liton Chondro Das	28
	Ronjona Chokroborti	33
	Bonota Rani	46
	Asman tara Rani Das	33
	Tulshi Rani	29
	Musa Banu	40
	Shunita Rani Das	32
	Kajol Rani	38
	Shobita Rani Das	44
	Bashonti Rani Das	49
	Sheeta Rani	27
	Roshoboti Rani	22
	Bashonti Rani Das	37
	Geeta Rani Das	25
	Shebika Rani Das	30
	Kobita Rani Das	70
	Jamuna Rani Das	37
	Lakshi Rani Das	26
	Rekha Rani Das	26
	Shoroshoti Rani Das	75
	Noyontara Rani Das	30
	Anita Rani Das	30
	Chaya Rani Das	40
	Nayontara Rani Das	62
	Durpoti Rani Das	50
	Kanchon Rani Das	30

Table 10.2: Concerns Raised by the Communities during Stakeholder Consultations

Issues	Concern Raised by the Community	Communities' Remarks
Employment	Provision of semi-skilled and unskilled jobs for the local labor	Maximum unskilled jobs should be allocated to the locals.
Environment & Livelihood	Possibilities of air & noise pollution, discharge water flow & safe navigation and river transportation	APSCL assures the local community that the project will have modern facilities to control possible negative environmental impacts. The discharge will not increase since it's a replacement project.
Project Construction	May obstruct natural drainage or disturb local business	APSCL assures the local community that the project will neither hamper any natural drainage system nor disturb the local business.
Development of communication system	Local bridges and roads should be repaired or newly constructed	APSCL expresses their interest to develop the local communication system.
Fishing	Thermal pollution of river may hamper aquatic growth	APSCL ensures that the thermal increase of Meghna river will be within acceptable limit. The village is not electrified and only 50 households have access to solar PV systems. Lack of electricity obstructs the fishermen engaging in many income generating activities, hence it will be a great boom for the economy and power generation will help the local fishermen to carry out their

		business and daily lives in a better way.
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Table 10.3 Meeting Minutes of the Public Consultation

Name	Designation	Opinion
Md. Zainal Abedin Khan	Executive Director (P&P), APSCL	He delivered the introductory speech regarding the project and described the different components of the project.
A M M Sazzadur Rahman	Executive Director (Engg.), APSCL	He asked the participants to express their opinions and inquiries regarding the project.
Md. Mohiul Islam Palash	Local Businessman	He raised his concerns regarding the blockade of canal, proposed maintenance of the damaged bridge that will be used for transportation.
Md. Salauddin	Local Businessman	He raised his concerns regarding the heat and noise pollution due to power plant operation.
Ratan Kumar Pal	Service Holder	He thanked to the authority for their progress towards power generation of Bangladesh and expressed his concerns about the heat and noise pollution. He also demanded for more jobs for local people in the project.
Md. Shamim Ahamed (Rana)	Local Businessman	He welcomed the project and proposed to provide soundproof wall to reduce the noise pollution.
Hazi Md. Mobarok Shekh	Chairman, Ashuganj Union Parishod Member	He expressed his gratitude towards APSCL and supported the issues raised by the participants of the consultation. He expressed his concerns that the natural route of the canal should be unchanged and the bridge must be developed and the air and noise pollution should not be

		raised.
Md. Zainal Abedin Khan	Executive Director (P&P), APSCL	He explained that the noise and heat pollution occurs due to the small gas engine based rental power plants and ensured that the proposed project will not create such problems.
A M M Sazzadur Rahman	Executive Director (Engg.), APSCL	He said that the noise and heat problem will be solved when the small rental projects will be replaced by modern projects with more power generation capacity. He assured that the local bridge will be reconstructed for the project's own benefit as an annual maintenance project of APSCL in future. He also ensured the participants that the channel of river will not be hampered due to the construction/operation of the project. Finally he said that, the proposed power plant will be designed to solve heat, noise and air pollution. He thanked the participants.

On the 2nd round public consultation, the PD of 400 MW CCPP (East) welcomed everyone at the beginning and introduced the important participants to all. Then the ADB consultant, Md. Yasin Majumder then conducted the public consultation describing the project and its impact and mitigation measures at different stages of the project; pre construction, construction and operation. During the impact description several questions were raised from the participants and some useful suggestions were also given by the local people. Lowering the speed limit in the construction area was suggested for dealing with dust emission by the local people. The EHS manager, Atiqur Rahman then after Md. Yasin discussed the overall impact and measures adopted to mitigate the impacts for the proposed project on behalf of the project proponent. Finally the chief engineer, Achinta Kumar concluded the meeting thanking everyone and encouraging to stay with APSCL in future.

The overall response of the participants was welcoming the project and interested in the participation for the betterment of the project. The local people cordially accepted the project provided that all mitigation measures will be taken effectively.

Consultation with Fishermen:

The village, Char Sonarampur, has roughly 1500 families live there nearly for 20 years. Nearly 80% of the households depend on the fishing for their livelihood. On the aspect of livelihood currently their greatest needs are

- 1) lack of safe landing station for travellers, commodities and goods.
- 2) No protection measures to save the char from eroding.
- 3) lack of variety of fish nets.
- 4) lack of safe fishing opportunity due to influence and attack from local people and mastan particularly at night,
5. lack of electricity.

Nearly 80% people in the village are poor, 20% are low middle class and 20% middle class who earn nearly BDT 5000.00 per month, >5000.00-<8000.00) and >8000-12000 per month respectively as reported by the participants. The found the major reasons of poverty is

- 1) lack of education,
- 2) lack of capital,
- 3) and their involvement with fishing occupation as their forefather did it.

Fishermen in the village do fishing within 5-6 kilo meters around the char including 40-50 meters from the outfall. Some fishermen do fishing in other areas sometimes. Each fishermen consisting of two members can catch 2.5 -3 kg fish per day in rainy season and 1.5 - 2 kg per day in winter season. Per kg of fish is sold by BDT 500.00 to 700.00. They generally catch small fish like prawn and catalee.

To reduce the poverty and to address their current problem participants suggested to

- 1) provide them opportunity for safe fishing with the intervention from District and Local Administration,

- 2) construct a permanent landing station in both side of the river,
- 3) take protective measures to safe the char from eroding,
- 4) establish primary schools.
- 5) provide them capital with easy and low interest rate,
- 6) establish one cyclone shelter that can be used as primary schools during normal time,
- 7) arrange income generation activities for women along with training.
- 8) provide employment opportunity for the poor both men and women,

9. Provide electricity for the betterment of the people from all age

The participants including men and women were noticed from the local people about installation of 400MW CCPP at APSCL campus and they do not find any negative impact on their livelihood/fishing. Instead they welcome the power generation activities for the betterment of the country but they regret being deprived of electricity till days. They seek help from the APSCL to enlighten the village with electricity but APSCL representatives advised them to give a written application to the local government since the power supply and distribution is not in the department of APSCL.



Figure 10.1(a): Photographs of Public Consultation at APSCL Office (1st time)



Figure 10.1(b): Photographs of Public Consultation at APSCCL Auditorium (2nd time)

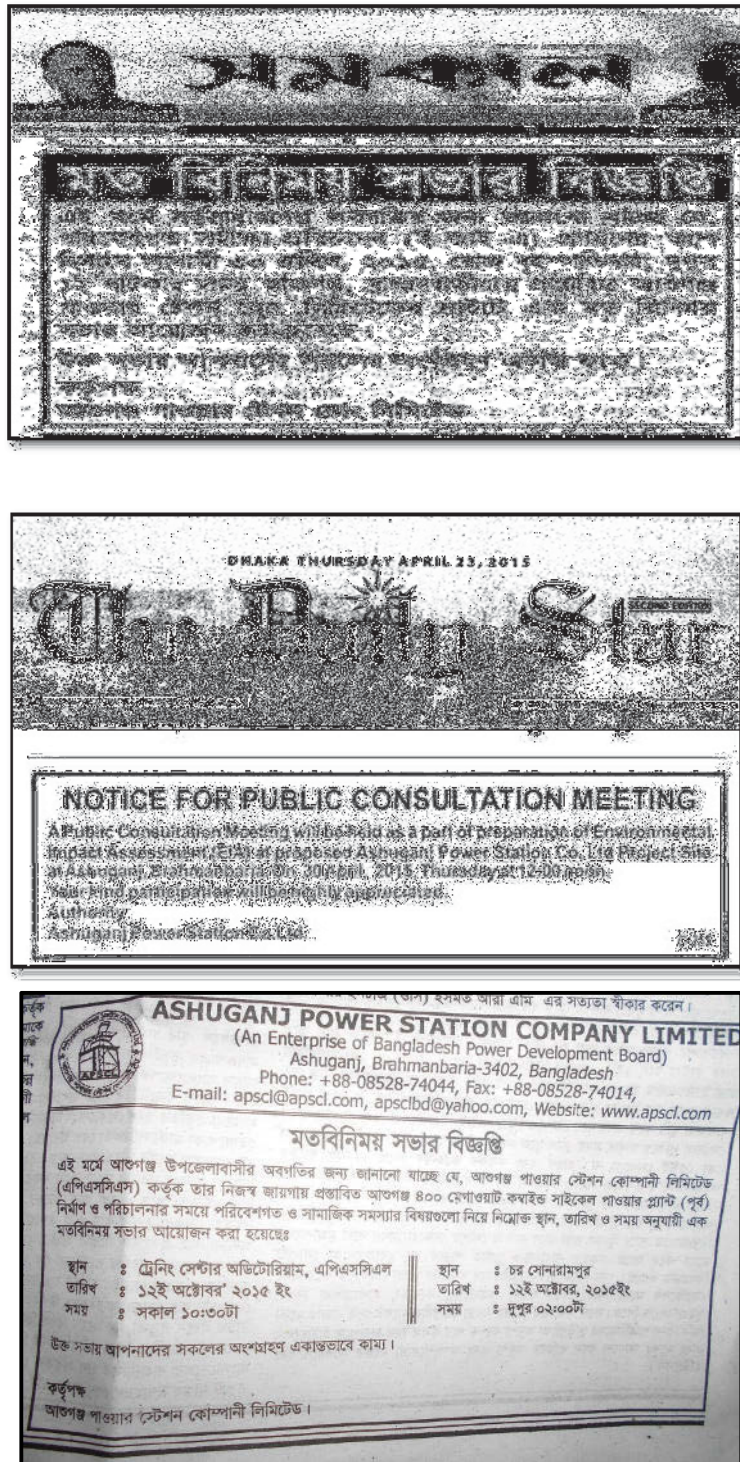


Figure 10.2: Circular in the Newspaper



Figure 10.3: Interview with Local Fishermen of Ashuganj

Chapter-11

CHAPTER ELEVEN: GRIEVANCE REDRESS MECHANISM

11.0 GRIEVANCE REDRESS MECHANISM AND DISCLOSURE

11.1 GRIEVANCE REDRESS MECHANISM

Public participation, consultation and information disclosure undertaken as part of the local EIA process have discussed and addressed major community environmental concerns. Continued public participation and consultation has been emphasized as a key component of successful project implementation. As a result of this public participation during the initial stages of the project, major issues of grievance are not expected. During the operational phase of the project, the complaints that may be anticipated are mostly related to noise & vibration of the engines. However, unforeseen issues may occur. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances will be established. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

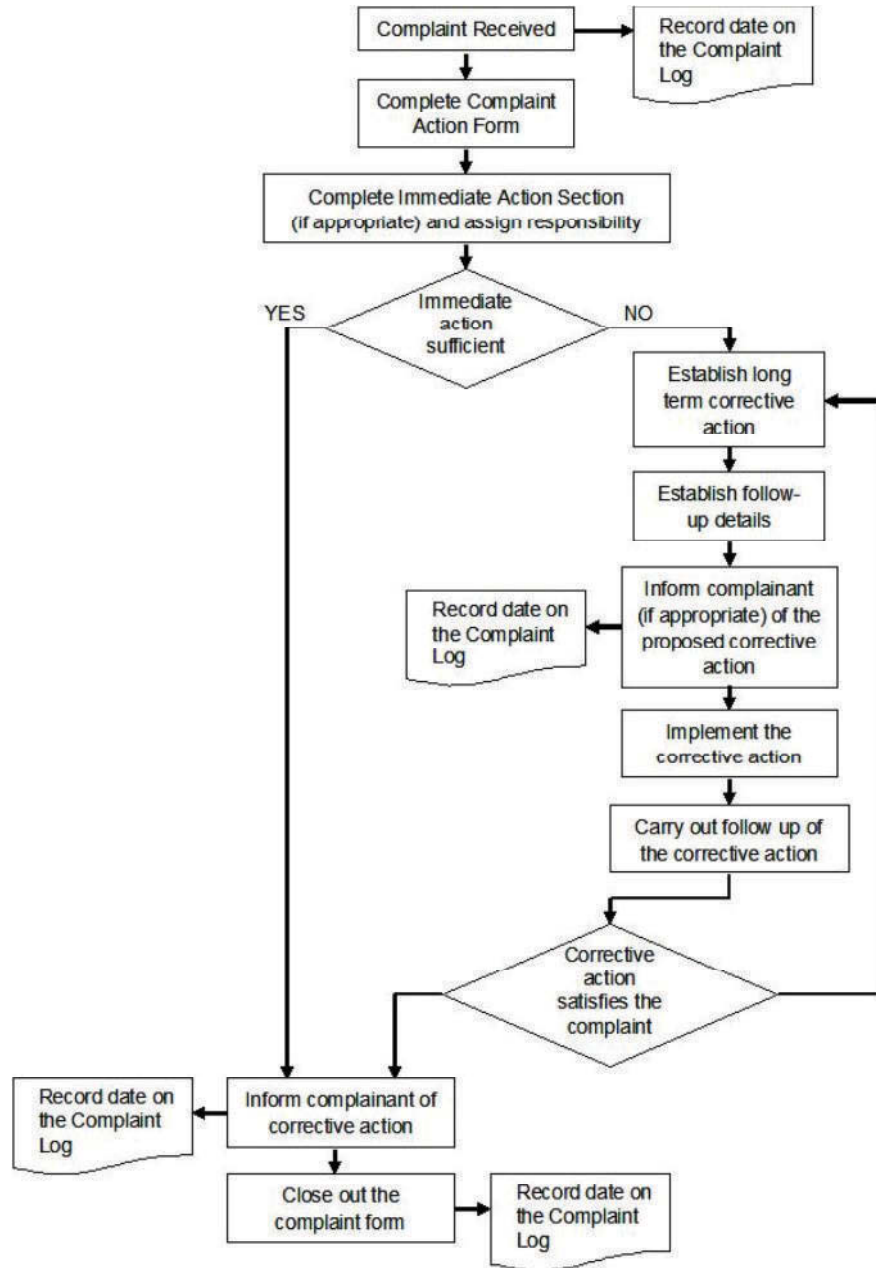
The Grievance Mechanism will be implemented during both the construction and operational period of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties.

The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations should be available. Confidentiality and privacy for complainants should be honored where this is seen as necessary or important.

A grievance redress mechanism and procedures is setup to provide opportunity for project affected persons to settle their complaints and grievances amicably. The established grievances redress procedures and mechanism ensures that project affected persons are provided with the appropriate compensations and that all administrative measures are in line with the law. It also allows project affected persons not to lose time and resources from going through lengthy administrative and legal procedures. Grievances are first preferred to be settled amicably.

APSCL shall set-up a grievance redress committee that will address any complaints during both the construction and operational period of the project.

Figure 11.1 - Flowchart of Complaints/Grievance Procedure:



The representation in the committee makes project affected persons to have trust and build confidence in the system. The grievance redress committee reports its plan and activities to the Implementation committee. The following list presents members of the committee.

Table 11.1: Members of the Committee of Grievance Redress (GRC)

No.	Name	Designation
1	Achinta Kumar Sarker	Chief Engineer (O&M), APSCL
2	Md. Anwar Hossain	Project Director, 400 MW (East) Project, APSCL
3	Mohammad Anamul Haque	Manager (HRM), APSCL
4	Md. Atiqur Rahman	Manager (HS&E), APSCL
5	A.K.M. Taufiqur Rahman	Deputy Manager (Security & Discipline), APSCL
6	Md. Rakib Hasan	Assistant Manager (Security & Discipline), APSCL
7	Hazi Md. Mobarok Shekh	Chairman, Ashuganj Union Parishod Member

GRC will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome.

The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand or uniform process for registering complaints provide project affected persons with free access to the procedures. The response time between activating the procedure and reaching a resolution should be as short as possible. An effective monitoring system will inform project management about the frequency and nature of grievances. GRC will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints Database are to be monitored and reviewed by third party consultant to ensure the required transparency. In addition to the above, if there are any grievances related to environmental management issues in the project area, the GRC will record these grievances and suggestions and pass it on to the relevant consultant for necessary action and follow-up.

GRC will be responsible to response for the grievances within a time limit. The initial movement to identify the causes should be taken within 48 hours. The GRC will not take more than two weeks to take the final initiative.

In case a dispute is not resolved by arbitral tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law. However, the preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties.

CHAPTER TWELVE: CONCLUSION

12.0 CONCLUSION

Ashuganj 400 MW Combined Cycle Power Plant (East), an upcoming project of Ashuganj Power Plant Station Company Ltd., intends to build and operate a 400 MW gas turbine combined cycle power plant at Ashuganj, Brahmanbaria inside Ashuganj Power Plant Complex. An EIA has been prepared for the project according to the requirement of DoE for necessary environmental clearances as it is made mandatory in ECA'95 for any new industrial set up. The EIA has been prepared through identifying the potential impacts, assessing them and recommendation possible mitigating and enhancing measures for negative and positive impacts, respectively.

The environmental analysis has revealed that the project can be set-up according to the proposed design and configuration in the proposed site and location. The environmental impacts are of limited nature, whereas the benefits of the project are many.

The primary reason why the environmental impact from the plant is minimal is that the project proponent is abide by Bangladesh/World Bank Standards and build a plant, which will meet the emission standards of Bangladesh and the World Bank. The excellent characteristics of the fuel used, equipment and machinery, which conform to international standard and good operation practices all combine to make the proposed power plant project acceptable one.

The main potential environmental problems, which may arise as a result of construction of power plant, can be grouped as follows-

- Atmospheric emissions and Air quality
- Water pollution and waste water disposal
- Noise

All these aspects have been examined and the findings are as follows:

Atmospheric Emission and Air Quality: The proposed power station will be fired on natural gas. Emission of sulfur dioxide and particulates would be insignificant as the Bangladeshi indigenous natural gas is almost free of Sulphur and particles. Emission of NO_x will also be very low as electricity will be produced using lean burn mixture of air and gas in the cylinder i.e. more air will be present in the cylinder than required for complete combustion. Based on the appropriate design of burner, dry low NO_x (DLN), water injection or Selective Catalytic Reduction (SCR) and the stack of nature 65 m height, as per the emission dispersion modeling, the NO_x emission from all the stacks would be within the Bangladesh and WB/IFC standard.

Liquid Discharge: It is estimated that 7.91 m³/sec of river water would be drawn from the intake of the proposed 400 MW CCPP project discharged at 7⁰C rise in temperature at the condenser discharge point, while the water will be discharged back to the river with less than 3⁰C (please refer to 2.5.10, page 20, Chapter 2) rise in river temperature may not have any significant impact on river water temperature considering the volume of water discharged by the other combined cycle power project at the APSCL premise. However, immediately after vicinity of the discharge point, due to instant mixing with equal/mass of water, the temperature will rise will be lower. At the long and down the river the temperature will reduce to almost initial river water temperature. The proposed power plant will have to share a new and modern chemical water treatment plant with 225 MW Combined Cycle Power Plant unit under implementation with facilities to produce demineralized water, service water and potable water. The domestic liquid wastes would be disposed through a septic tank system. The surface drainage network would be connected with an interceptor prior to discharge to surface drainage system.

Noise: The noise impact generated by operation of the plant has been predicted by means of noise impact modeling. The results will be used to specify noise abatement measurers. Appropriate noise controls will be installed to keep the neighborhood impact due to noise emissions within the limit of DoE and international standards.

Having reviewed all the potential environmental impacts, and following our proposed mitigation measures the project is expected to proceed without having unacceptable environment. Electricity supplies could be provided to the area without much of load shedding and it will also add a significant amount of electricity to the national grid. In this context, the proposed power station, Ashuganj 400 MW Combined Cycle Power Plant (East), would be a welcome relief for the people in that area as well as for the people of Bangladesh.

However no development can be expected without any adverse impact on the environment. The beneficial impacts on the nation as well as human beings would only be meaningful and sustainable development would only be possible if adverse impacts are minimized through strict maintenance and control measures as mentioned for this project. All this would need vigilant care and cost money, and the project authority should take these into consideration.

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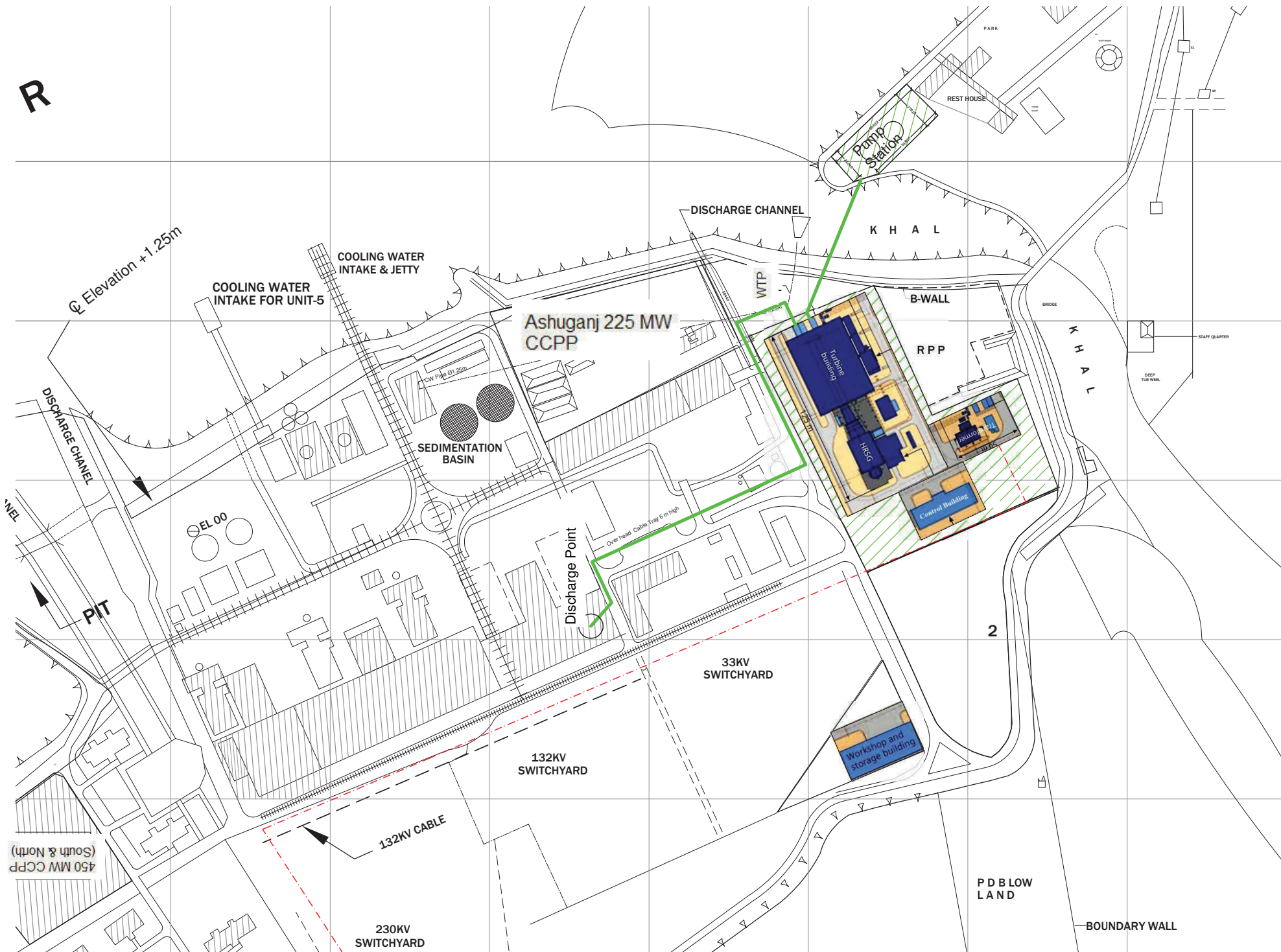
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Annexure-1

Project Layout of Ashuganj 400MW CCPP (East)

Annexure-1(a)
Layout Plan of Ashuganj
400MW CCPP (East)

R



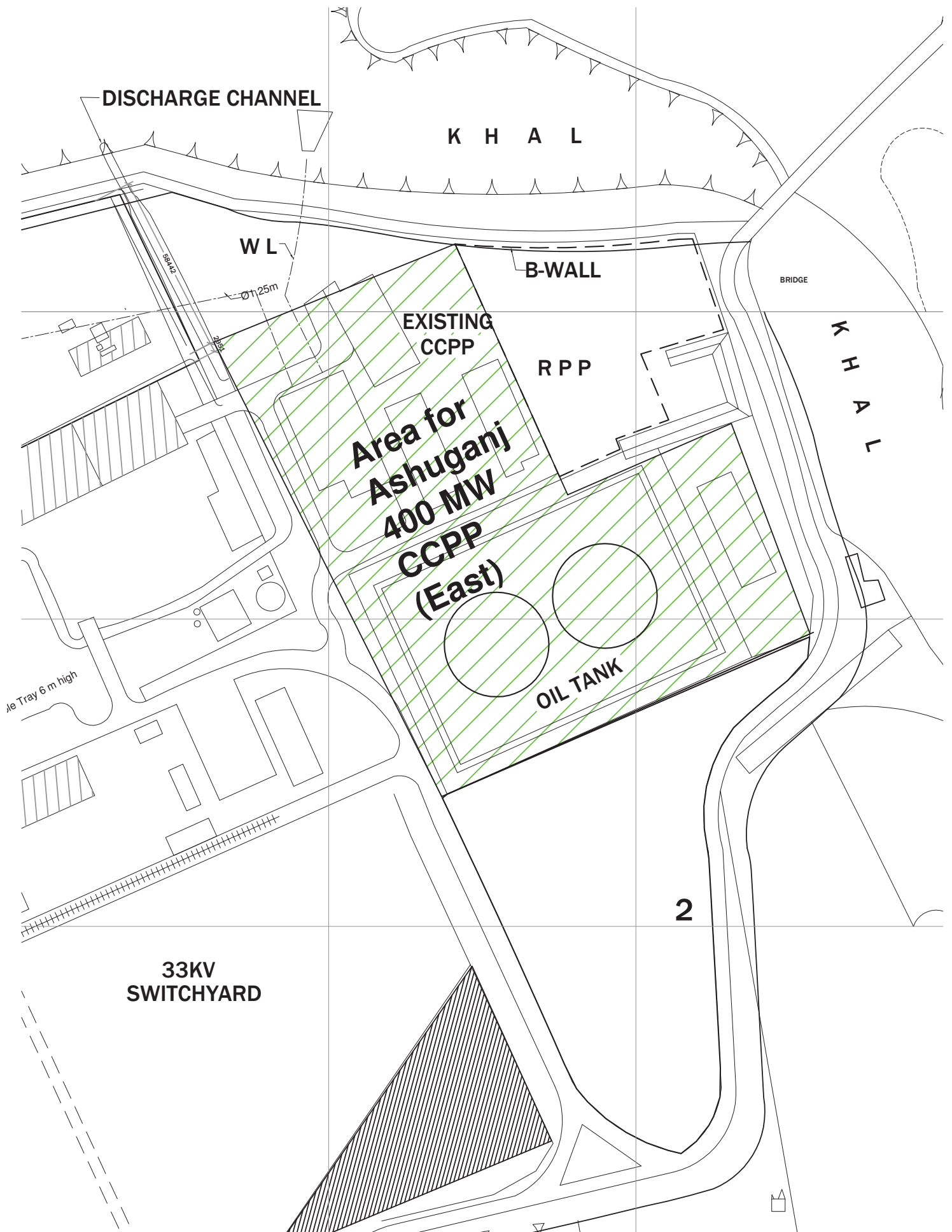
450 MW CCPP
(South & North)

PDB LOW
LAND

BOUNDARY WALL

Annexure-1(b)

Project Area with Existing Structures



Annexure-1(c)

Summary of Existing and Proposed Power plants at APSCL

Name of the Plants	Installed / Derated Capacity (MW)	Date in service	Status	Average Gas Use (m3/day)	Total Water use (m3/hr)	To be Replaced By	Average Gas Use (m3/day)	Water use (m3/hr)	COD of new Units	Cooling water for condenser (Raw river water)	Raw river water for cooling various equipments.i.e feed pump, lub oil cooler, compressor etc	Raw river water for Closed cooling water circuit	River water for water treatment plant to produce demi water	River water for General use (Office and residential area)	Total Water use (m3/hr)
ASHUGANJ POWER STATION COMPANY LTD															
ST 1 (Unit 1)	64/50	17.08.1970	In Operation	268,493	11,000	a) 225MW CCPP, b) 450MW CCPP (South) & c) 450MW CCPP (North)	a) 926,410 for 225MW CCPP, b) 13,98,860 for 450MW CCPP (South) & c) 13,94,601 for 450MW CCPP (North)	a) 22,000 for 225MW CCPP, b) 29,000 for 450MW CCPP (South) & c) 30,000 for 450MW CCPP (North)	Simple Cycle (225MW): April'15; Combined Cycle (225MW): November'15	10,200	650	-	-	150 ¹	11,000
ST 2 (Unit 2)	64/50	08.07.1970	In Operation	268,493	11,000				January'16 (450MW South)	10,200	650	-	-	150 ¹	11,000
GT 1	56/40	15.11.1982	Retired in Feb, 2014	263,014	-				February'17 (450MW North)	-	-	-	-	-	-
GT 2	56/40	23.03.1986	In Operation	263,014	-					-	-	-	-	-	-
ST - GT 1 (CCPP)	34/20	28.03.1984	Retired in Feb, 2014	-	5,200					5,000	200	-	-	-	5,200
ST 3 (Unit 3)	150/130	17.12.1986	In Operation	710,274	36,000	400MW CCPP (East)	13,94,600	31,000	2020	28,500	-	1,965	35	-	30,500
ST 4 (Unit 4)	150/150	05.04.1987	In Operation	838,134	36,000					34,000	-	1,965	35	-	36,000
ST 5 (Unit 5)	150/135	21.03.1988	In Operation	719,785	36,000					34,000	-	1,965	35	-	36,000
50 MW GE	50/50	30.04.2011	In Operation	203,889	-					-	-	-	-	-	-
225MW CCPP,										19,800	-	2,000	150 ²	50	22,000
450MW CCPP (South)										27,000	-	1,800	150 ³	50	29,000
450MW CCPP (North)										28,150	-	1,800	-	50	30,000
												Note 1: Used for Unit-1,2,3,4,5,Office and Residence Note 2: Used for Unit-1,2,3,4&5 Note 3: Used for 450MW(South) & 450MW(North)			

NON-ASHUNGONJ POWER PLANT					
Name of the Plants	Installed / Derated Capacity (MW)	Date in service	Status	Average Gas Use (m3/day)	Total Water use (m3/hr)
Aggreko Gas Engine	95/95	16-Mar-11	In Operation	563,958	-
Precision Gas Engine	55/55	29-Mar-09	In Operation	285,209	-
United Ashuganj Gas Engine	53/53	17-Jun-11	In Operation	259,106	-
United Modular Ashuganj Gas Engine	195/195	22-Apr-15	In Operation	984,309	-
Midland Gas Engine	50/50	7-Dec-13	In Operation	261,900	-
TOTAL					
GRAND TOTAL					
Daily Average					

Annexure-2
Gas Specification

BGDCL Gas Analysis

Gas Analysis for Bakhrabad Gas Distribution Co. Ltd.

Sample no: 1

Sampling date: 28/04/2014 Time: 6:00 PM

Analysis date: 29/04/2014

Sample Location: APSCL RMS, Ashuganj

Temperature: 80 °F

Pressure: 400 psig

Sampled by : Md. Salahuddin

	% Mole	% Wt
Nitrogen	0.536	0.895
CO ₂	0.090	0.237
Methane	96.603	92.312
Ethane	1.904	3.410
Propane	0.378	0.992
i-Butane	0.121	0.420
n-Butane	0.085	0.295
i-Pentane	0.053	0.227
n-Pentane	0.037	0.157
Hexanes	0.095	0.474
Heptanes	0.072	0.411
Octanes	0.027	0.171
Nonanes	0.000	0.000
Decanes+	0.000	0.000
Total	100	100

SG: 0.5797 Base condition: 60°F & 14.696 psia

Ideal Gas Density: 0.0442 lb/ft³

Mole Weight: 16.7886 gm/mol

Higher Heating Value: 1038.3875 BTU/SCF

Lower Heating Value: 936.2190 BTU/SCF

C5+: 0.1043 GPM (gallon per thousand cubic feet)

C6+: 0.0724 GPM (gallon per thousand cubic feet)

Higher Heating Value: 38.7536 MJ/sm³

Lower Heating Value: 34.9369 MJ/sm³

PMRE-100

8/11/14
20.8.78
Md. Mushahed Ullah
Principal Experimental Engineer
PMRE Department
Bangladesh University of Engineering and Technology (BUET)



Tel-Fax: 02-9613897
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Annexure-3
Gas Interconnection Layout

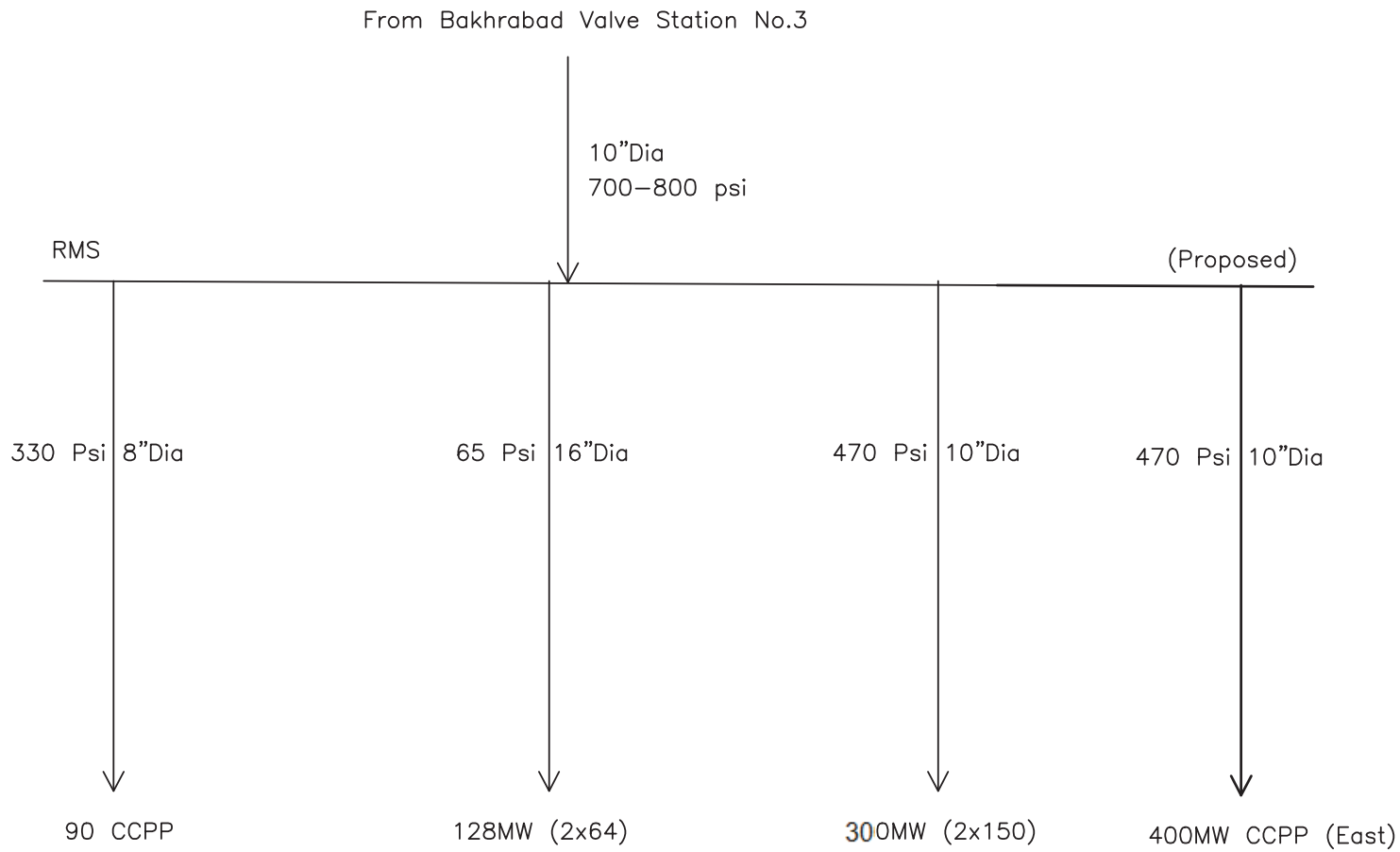


Fig - 2.03

ASHUGANJ POWER STATION COMPANY LTD.			
PROJECT FEASIBILITY STUDY FOR 400MW CCPP (East) AT ASHUGANJ			
TITLE EXISTING BAKHRABAD GAS RMS FOR ASHUGANJ POWER STATION COMPANY LTD. SHOWING FOR PROPOSED 400MW CCPP (EAST)			
		Date :	Sheet-1 of 1

Annexure-4

**Electrical Interconnection
Layout**

Annexure-5
Plant and Machinery

Plant and Machinery

Plant and machinery will include the following:

- a. 1 Unit of 289MW (ISO rated) Gas Turbine Generating Unit & ancillaries
- b. 1 Set of Heat Recovery Boiler
- c. 1 Unit of 135MW Steam Turbine Generating Unit
- d. One 3-phase, Step-up Transformers 15.75/230 kV, 525 MVA for GT Unit
- e. 15.75kV Isolated Phase Bus Duct for GT up to Transformer Terminal
- f. 230kV indoor type GIS Switchgear Equipment of 1-bays for GT generator transformers at power plant site
- g. 230kV single core XLPE underground cable.
- h. 15.75/6.6kV GT Unit Auxiliary transformer, 6.6kV switchgears and 6.6/0.4kV auxiliary transformers and LVAC Distribution system
- i. Battery Charger and Batteries with DC Distribution system
- j. Unit Control /DCS system
- k. CW Pumps and Pipe lines
- l. Gas RMS and Gas Pipe line
- m. Over head crane, mobile crane and workshop equipment

Annexure-6
Engine Catalogue

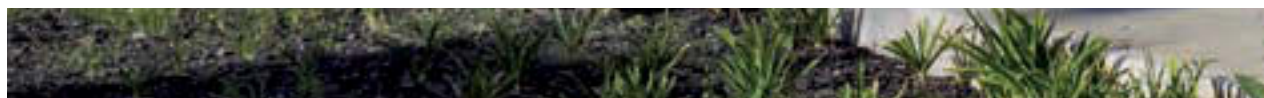


Siemens Combined Cycle Reference Power Plant SCC5-4000F 1S

400 MW-Class 50 Hz

Answers for energy.

SIEMENS





Siemens SCC5-4000F 1S – The next step in advanced single-shaft plant technology

The Siemens Combined Cycle (SCC™) single-shaft reference power plant has evolved over the years to be the plant of choice for combined cycle power plants in the 400 MW-class in the 50 Hz world. The first single-shaft plant with a Siemens F-class gas turbine was built in 1997. Currently, there are more than 40 Siemens single-shaft plants in service or under construction/commissioning throughout the world.

The primary focus of our Reference Power Plant (RPP) program is to develop plant designs that offer high customer benefit through low life-cycle costs. Furthermore, the modular concept used in the RPP program allows easy adaptation to specific customer needs and site requirements.

The combination of world-class gas and steam turbine and generator technologies with trend setting power plant system integration results in a highly efficient plant that provides reliable low-cost electricity.

The base design of the SCC5-4000F 1S RPP provides an optimum balance between capital cost, plant performance, as well as operational and maintenance considerations.

Pre-engineered modular options have been developed to further address individual needs. Plant exhaust emissions are minimized by the proven Siemens dry low NOx Hybrid Burner Ring (HBR) combustion system.

The SCC5-4000F 1S RPP is designed around advanced, well-proven and reliable Siemens equipment, including:

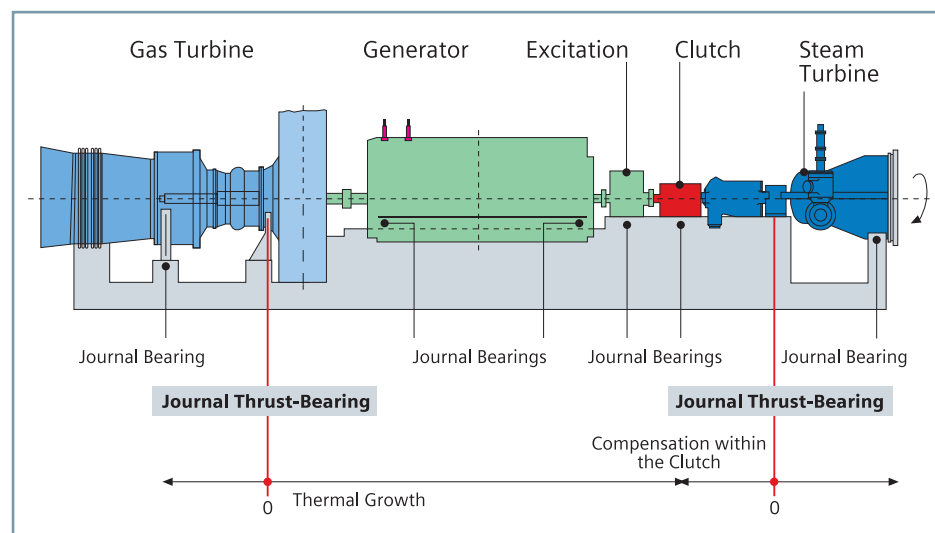
- One Siemens Gas Turbine (SGT™) SGT5-4000F

- One Siemens Steam Turbine (SST™) SST5-3000 or SST5-5000 (depending on ambient conditions)

- One Siemens hydrogen-cooled Generator (SGen™) SGen5-2000H

- The Siemens Power Plant Automation system (SPPA™)

All three main components are arranged on a single shaft. A Synchronous Self-Shifting (SSS) clutch is installed between the generator and steam turbine. This provides high operating flexibility and reliability.

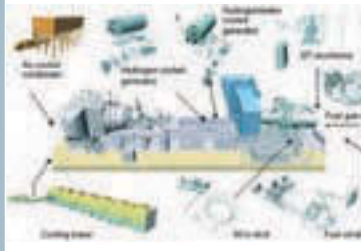


Project Specific based on "clean sheet"



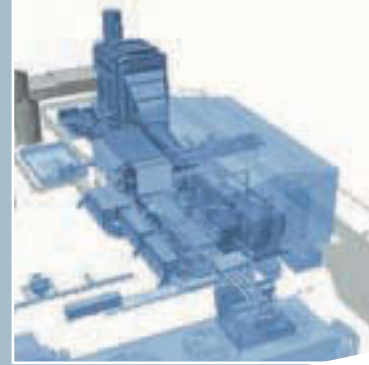
1980s
Customized solution

Reference Power Plant based on multiple modules



1990s
Reference Power Plant design

Standardized Power Block



2000s
Competitive solution in an open market

Logical evolution in RPP development

The requirements for power plants dramatically changed with the advent of deregulated and liberalized markets. Economic factors, such as life-cycle costs, net present value and internal rate of return became the customer's focus. In response, Siemens launched its Reference Power Plant development program in the 1990s with special emphasis on life-cycle cost optimization.

The main focus of the Siemens single-shaft RPP development is a core base design called the Power Block. This comprises the complete turbine building including all associated equipment therein, the complete water/steam cycle including the Heat Recovery Steam Generator (HRSG), and additional adjacent components and systems such as the electrical transformers and the Power Control Centers (PCCs).

The RPP development starts with customer requirements and includes feedback from project execution and operation and maintenance experiences.

During the development, modern design methods including Quality Function Deployment, FMEA and Six Sigma are used.

Site specific requirements, such as water supply systems mainly influence the scope outside the Power Block and can easily be adapted. Economic modeling of design variants inside the Power Block, such as redundancy of feedwater and condensate pumps result in a base design that is optimized from the customer's point of view.

By optimizing the core of the plant, i.e. the Power Block, only a limited number of variants and options are required. This results in a large number of plants with an identical design of the Power Block. This replication in turn allows Siemens to select the suppliers of all of the major components, thereby allowing the use of proven equipment and proven suppliers.

This Siemens RPP approach offers significant advantages for the customer, including:

- Low initial investment
- Reduced lead time
- Higher availability and reliability
- Increased quality and lower risk





Flexible solutions to match your needs

Two main variants are available for the SCC5-4000F 1S reference power plant. These are characterized by the implementation of two different steam turbines:

- The SST5-3000 incorporates a single-flow axial exhaust low-pressure steam turbine providing best economical benefit at medium to high condenser back pressure. The typical application for the SST5-3000 is in combination with a wet cooling tower at ambient temperatures above 12°C (54°F) or with an air-cooled condenser.
- The SST5-5000 incorporates a two-flow low-pressure steam turbine with increased exhaust area, which makes it the choice for low condenser back pressure. The typical application for the SST5-5000 is in combination with once-through cooling or a wet cell cooling tower at ambient temperatures below 12°C (54°F).

Application of either of the two depends not only on specific cooling conditions, but also on the economic evaluation of efficiency and power output.

Both designs incorporate a carefully selected number of pre-engineered options. This allows flexibility to adapt the SCC5-4000F 1S to specific customer requirements and site conditions.

Examples of options include fuel oil as a back-up fuel, different cold end variants (cooling tower, once-through cooling, or air-cooled condenser), a drum-type or BENSON® Once-Through HRSG, etc.

Our flexible scope of supply ranges from a Power Train, Power Island, Power Block to a complete Turnkey Plant.





Scope of supply

SCC Power Train	SCC Power Island	SCC Power Block	SCC Turnkey
SGT-PAC	SCC Power Train	SCC Power Island	SCC Power Block
<ul style="list-style-type: none"> • SST-PAC w/o condenser <ul style="list-style-type: none"> – Steam turbine incl. auxiliaries w/o piping – Generator incl. auxiliaries – SSS Clutch – ST electrical and I&C • Options 	<ul style="list-style-type: none"> • HRSG • Condenser incl. air removal system • Boiler feed pumps • Condensate pumps • Critical valves • Fuel pre-heater with filter, metering station etc. • Power Island controls • Options 	<ul style="list-style-type: none"> • Detailed design of turbine building, foundation and structures • HVAC inside Power Block area • Cranes inside turbine building • Water/steam cycle • Cooling water system with wet cooling tower and circulating water pumps • Service- and closed cooling water system • Electrical equipment • Power Block controls • Fire fighting inside Power Block • Options 	<ul style="list-style-type: none"> • Additional fuel supply systems and cooling systems • Water treatment • Raw water system • Waste water system • Tanks • Additional <ul style="list-style-type: none"> – Buildings/structures – Cranes/hoists – Fire protection/fighting – Plant piping/valves – Electrical plant • Erection/Commissioning • Further options
Power Train equipment Performance/Delivery	System integration/ Optimized operability	Replication of standardized components	Total EPC plant wrap



Plant layout

The main building is a compact structural-steel building of rectangular design and houses the gas turbine, generator and steam turbine along with their associated components.

The main gas turbine auxiliaries are arranged on a steel platform along side the gas turbine. The common lube oil system for gas turbine, generator and steam turbine is arranged at ground floor level.

All generator auxiliaries are directly arranged next to the generator either on the main steel platform or on the ground floor.

The auxiliary components for the water/steam cycle and the closed cooling water system are located in an annex to the turbine building. The air-intake filter house is located above the annex at the side of the main bay of the turbine building. The filtered air is led straight into the gas turbine compressor by way of an aerodynamically optimized oblique steel-fabricated duct, in which a silencer is installed.

Access to the building is provided via the entrance bay next to the turbine-generator set. Adequate access for inspection and maintenance is provided for all main and auxiliary equipment.

An overhead traveling crane runs the full length of the turbine building and is capable to lift all the heavy equipment in the building including the generator. Special attention has been given to provide short moving distances and adequate dismantling and laydown areas for major maintenance operations, as well as good accessibility to buildings and components for maintenance.

The HRSG as well as the annexed feed-water pumps are designed for outdoor installation.

The pre-fabricated and pre-tested Power Control Centers (PCCs) for electrical and I&C equipment are located outdoors close to the turbine buildings to ensure short connection runs.

The central control room and administration building are arranged close to the turbine building. Layout provisions are made in the plant for a workshop and storage building.

A forced-draft cooling tower is arranged behind the turbine building with the circulating water pump also in outdoor installation. In case of once-through cooling, the water intake and outfall structure is designed according to site requirements.

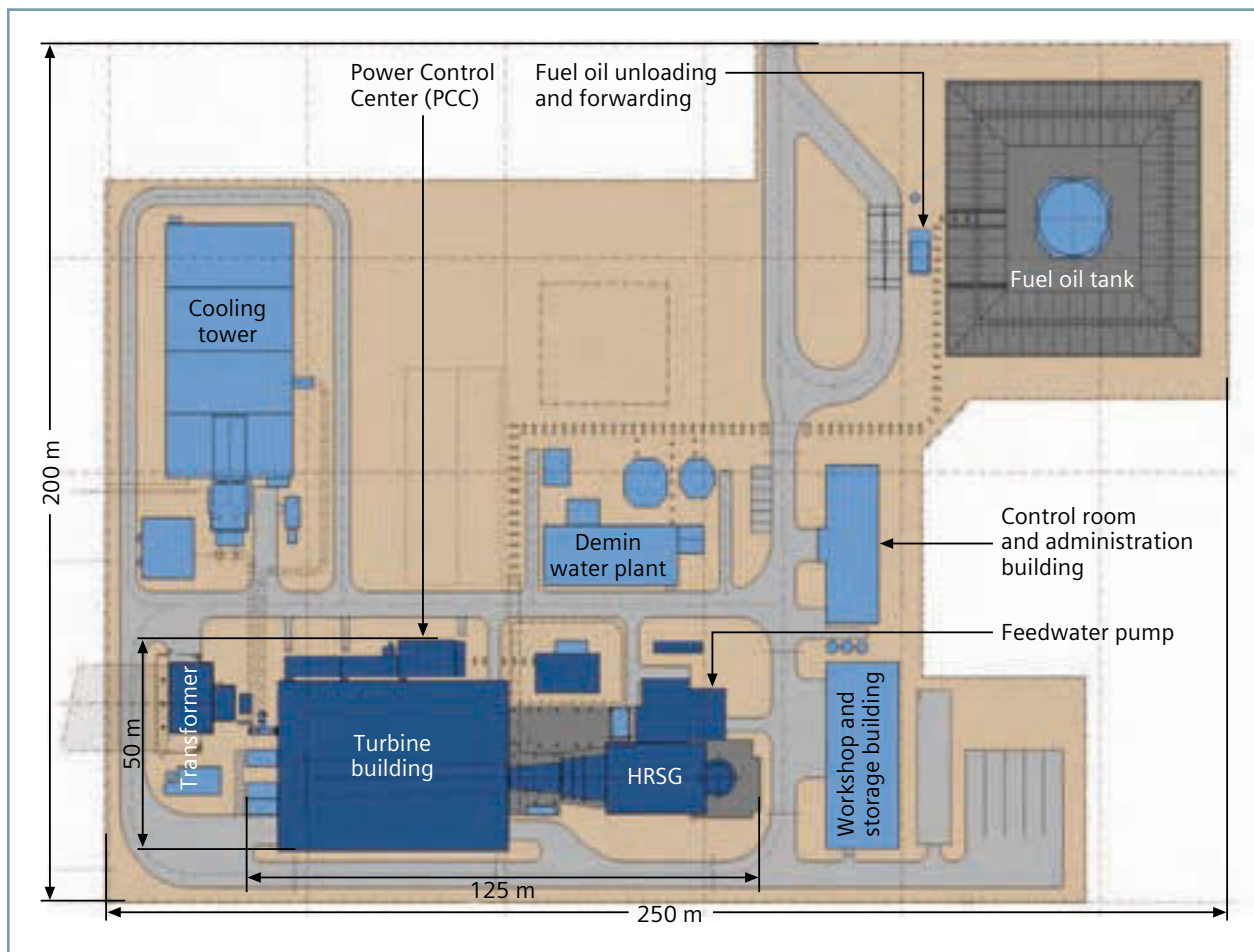
Site terminal points

The SCC5-4000F 1S base design incorporates the following terminal point assumptions:

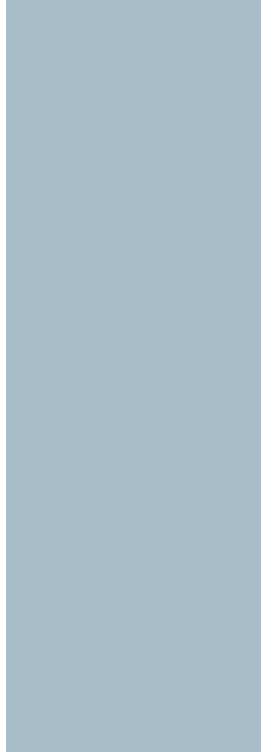
- Natural gas fuel supply at required conditions at the site boundary
- Raw, fire fighting and potable water from municipal supply at required conditions at site boundary
- Demineralized water tank hook up
- Effluent discharge to municipal connection at site boundary
- Electrical termination at high-voltage bushing of the generator step-up transformer



Plant arrangement



Plot plan SCC5-4000F single-shaft with oil tank and cooling tower



Advanced turbine-generator technology

Single-shaft power train

The gas turbine, generator and steam turbine are arranged on a single-shaft basis. The steam turbine is coupled with a SSS clutch to the generator. This design shows various advantages over 1x1 multi-shaft arrangements including:

- Smaller footprint due to a more compact arrangement
- Higher efficiency (one hydrogen-cooled generator instead of two air-cooled generators)
- Higher availability due to less components

SGT5-4000F gas turbine

Since its introduction in the mid-1990s, the SGT5-4000F has become the work horse of the 50 Hz fleet. Reliable and efficient, it is the most advanced proven gas turbine in its class today.

Features/benefits of the SGT5-4000F are as follows:

- Four-stage turbine for moderate stage loading
- Disk-type rotor with Hirth serrations and central tie bolt for rotor stability
- Low NOx Hybrid Burner Ring (HBR) combustion system for reduced environmental impacts
- Dual fuel capability (on-line transfer)
- Variable inlet guide vanes for improved part-load efficiency
- All blades removable with rotor in place for easy maintenance and shorter outages
- Unique design features for field serviceability





SST5-3000 steam turbine

The SST5-3000 steam turbine comprises a single-flow barrel-type high-pressure turbine and a combined intermediate- and low-pressure turbine element with single-flow axial exhaust. This turbine is mainly applied for wet cooling tower or air-cooled condenser operation.



SST5-5000 steam turbine

The SST5-5000 steam turbine comprises a combined high- and intermediate-pressure turbine element and a two-flow low-pressure turbine with a single-side exhaust. The larger exhaust area provided with this low pressure steam turbine enables better performance at sites with access to cold cooling water.



SSS clutch

A Synchronous Self-Shifting (SSS) clutch is located between the generator and the steam turbine. This allows individual gas turbine start-up without the need for cooling the steam turbine. Once the steam parameters match the requirements of the turbine, the steam turbine turns and synchronizes automatically with the generator. The SSS clutch has been used successfully since 1995 in numerous Siemens single shaft power plants.

SGen5-2000H generator

The SGen5-2000H is a hydrogen-cooled two-pole generator. This well-proven generator design provides high efficiency and low operation and maintenance costs. It is shipped to the site pre-assembled to facilitate ease of construction.





Plant design base and performance data

Water/steam cycle and cooling system

To provide high efficiency a triple-pressure reheat cycle is used. The plant design includes options for both a drum-type and a BENSON® Once-Through HRSG.

The BENSON® HRSG, designed and patented by Siemens, provides greatly improved operating flexibility with faster start-up and load change capability. Condensate and feedwater pumps are arranged in a booster set-up for low power consumption. Both main pumps are configured as 2x100% pumps for high availability.

The base design contains a wet cell cooling tower. Available options for cooling include an air-cooled condenser or once-through cooling.

Plant auxiliaries are directly cooled by means of a closed cooling water system using heat exchangers.

The SCC5-4000F 1S is designed with the following conditions:

Boundary	SCC5-4000F 1S RPP design base	
Grid frequency	50 Hz	
Ambient temperature	-20°C to 40°C (-5°F to 105°F) (15°C/59°F design for SST5-3000, 10°C/50°F design for SST5-5000)	
Site elevation	Design 0 m	
Fuel	Main fuel:	Natural gas, LHV: 50,012 kJ/kg (Methane at ISO conditions: 21,502 Btu/lbm)
	Back-up fuel:	Fuel oil Cat.II, LHV: 42,600 kJ/kg/18,315 Btu/lbm
Steam parameter	565°C/125 bar	(1,050°F/1,815 psi)
	565°C/30 bar	(1,050°F/435 psi)
	235°C/5 bar	(455°F/75 psi)



The advanced Siemens SCC5-4000F 1S

The Siemens SCC5-4000F 1S is a new milestone in the sector of 400 MW-class 50 Hz combined cycle plants. Not only is it one of the most powerful and efficient F-class plants on the market today, but even more important it is the most environmentally friendly with its significant reduction in emissions and water consumption. It builds on years of experience and includes feedback from executed projects. Additionally, it incorporates the feedback of customer interviews and QFD workshops to include the latest market developments. It is the answer to meet any 50 Hz combined cycle power plant needs in the future.

The use of our world-class gas turbine, steam turbine and generator technology combined with our expertise to design and build world-class combined cycle power plants helps to ensure that your plant will remain a sound investment for many years to come.

With the mentioned boundary conditions the following performance is achieved:

Performance	SCC5-4000F 1S (SST5-3000) *	SCC5-4000F 1S (SST5-5000) **
Net plant power output P_{net}	423 MW (ISO ambient conditions, reference design)	434 MW (10°C/50°F ambient temperature, once-through cooling)
Net plant power efficiency η_{net}	58.4% (ISO ambient conditions, reference design)	58.9% (10°C/50°F ambient temperature, once-through cooling)
Net plant heat rate	6,164 kJ/kWh (5,842 Btu/kWh)	6,112 kJ/kWh (5,793 Btu/kWh)
Plant NO_x emissions	Main fuel: ≤ 25 ppmvd (Base load)	Main fuel: ≤ 25 ppmvd (Base load)
Plant CO emissions	Main fuel: ≤ 10 ppmvd (Base load)	Main fuel: ≤ 10 ppmvd (Base load)
Plant CO₂ emissions	342.1 kg CO ₂ /MW _{el} (Natural gas)	339.2 kg CO ₂ /MW _{el} (Natural gas)

* Standard design; ISO ambient conditions

** 10°C/50°F ambient temperature, once-through cooling

Project and site-specific performance data for this and other Siemens combined cycle products can be obtained through SIPEP, the Siemens Plant Performance Estimation Program. For access to SIPEP please contact your Siemens sales representative.

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Fossil Power Generation Division
Order No. A96001-S90-B327-X-4A00
Printed in Germany
Dispo 05400, c4bs No. 1353, 799
108409M WS 05083.

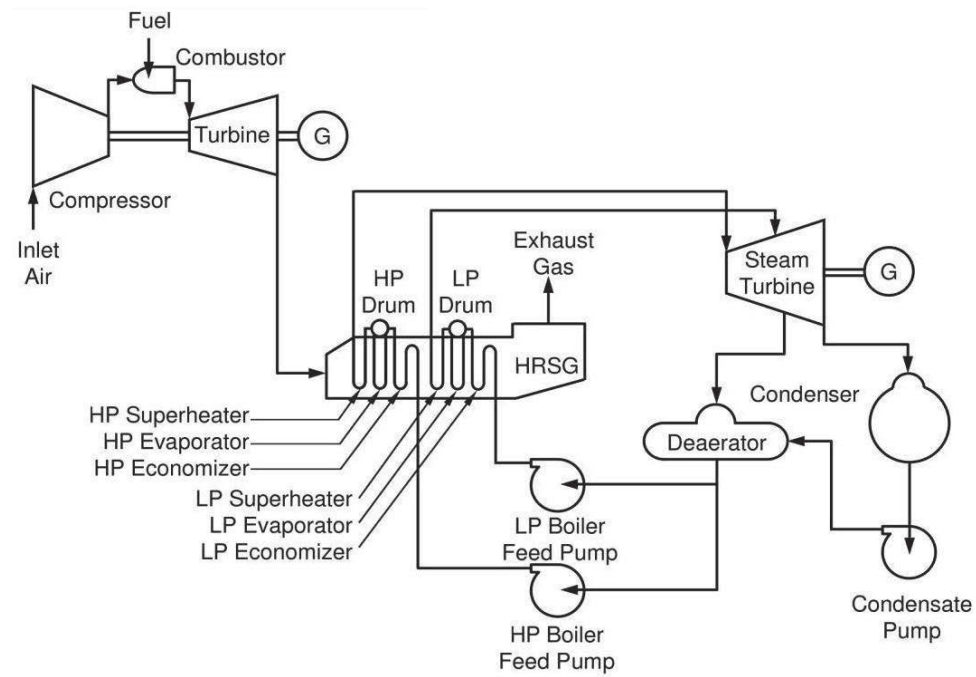
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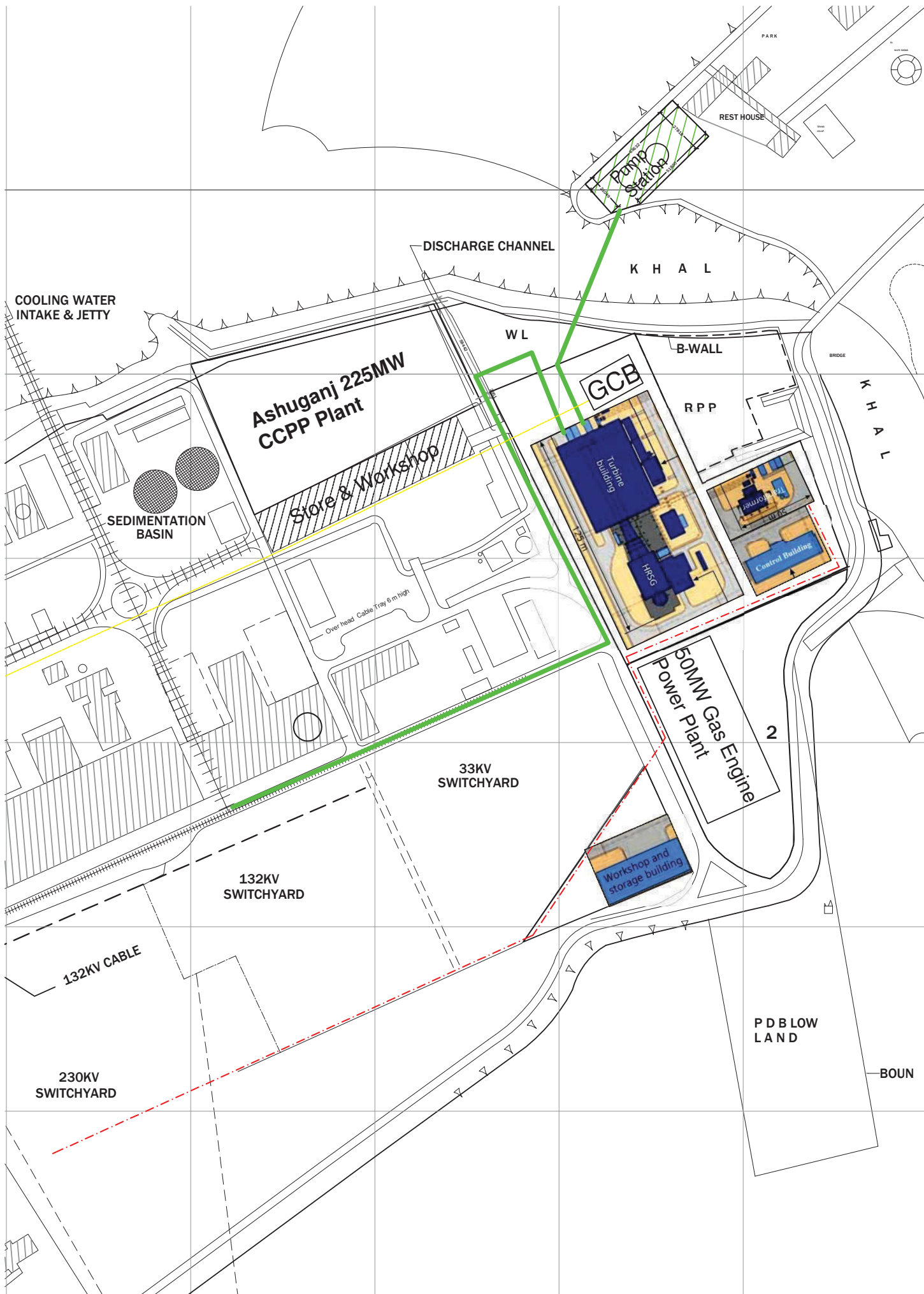
Subject to change without prior notice.
The information in this document contains general
descriptions of the technical options available, which
may not apply in all cases. The required technical
options should therefore be specified in the contract.

Annexure-7
Process Flow Diagram

Process Flow Diagram of Ashuganj 400MW Combined Cycle Power Plant (East) Project

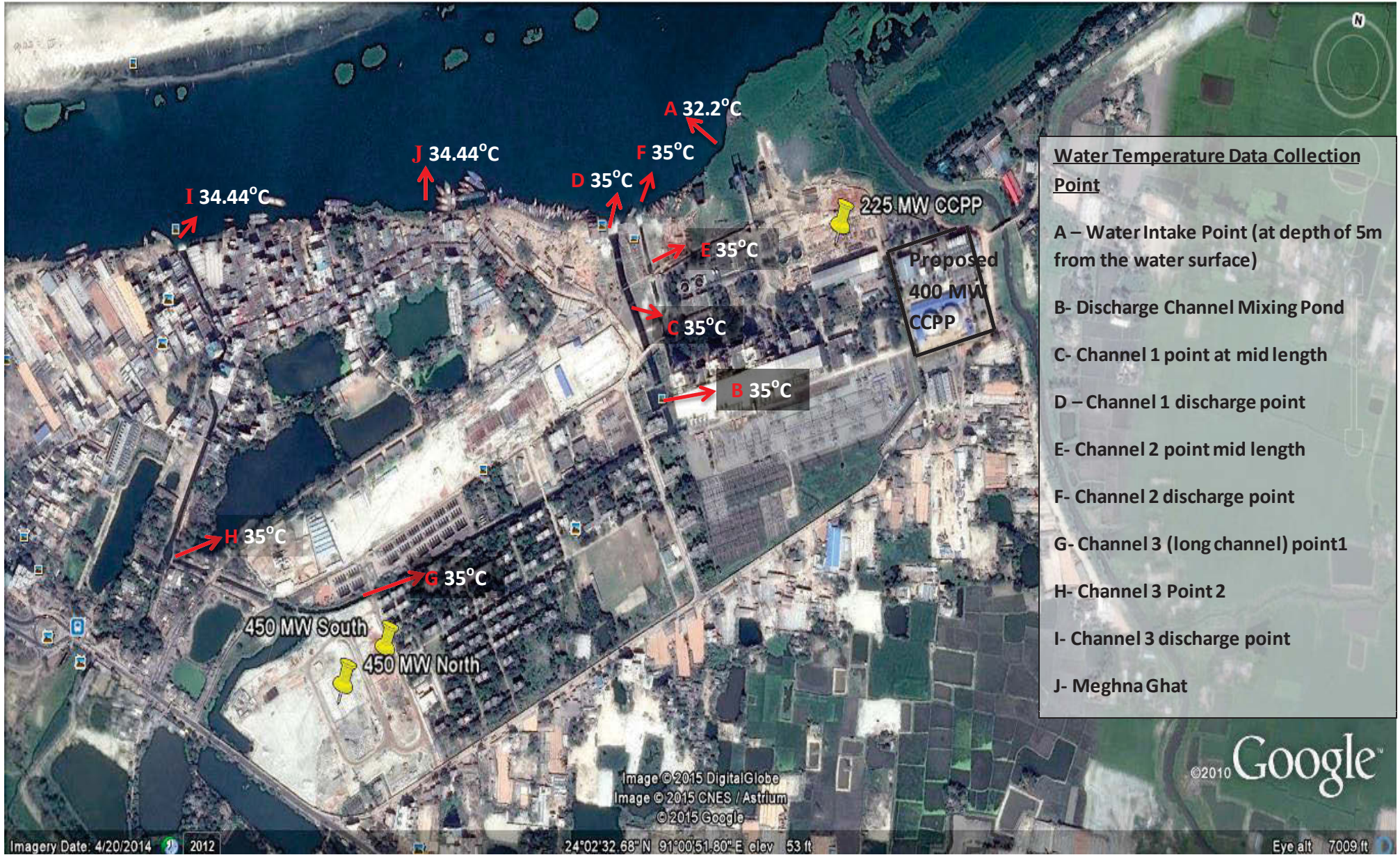


Annexure-8
Layout Plan for Cooling
Water Discharge



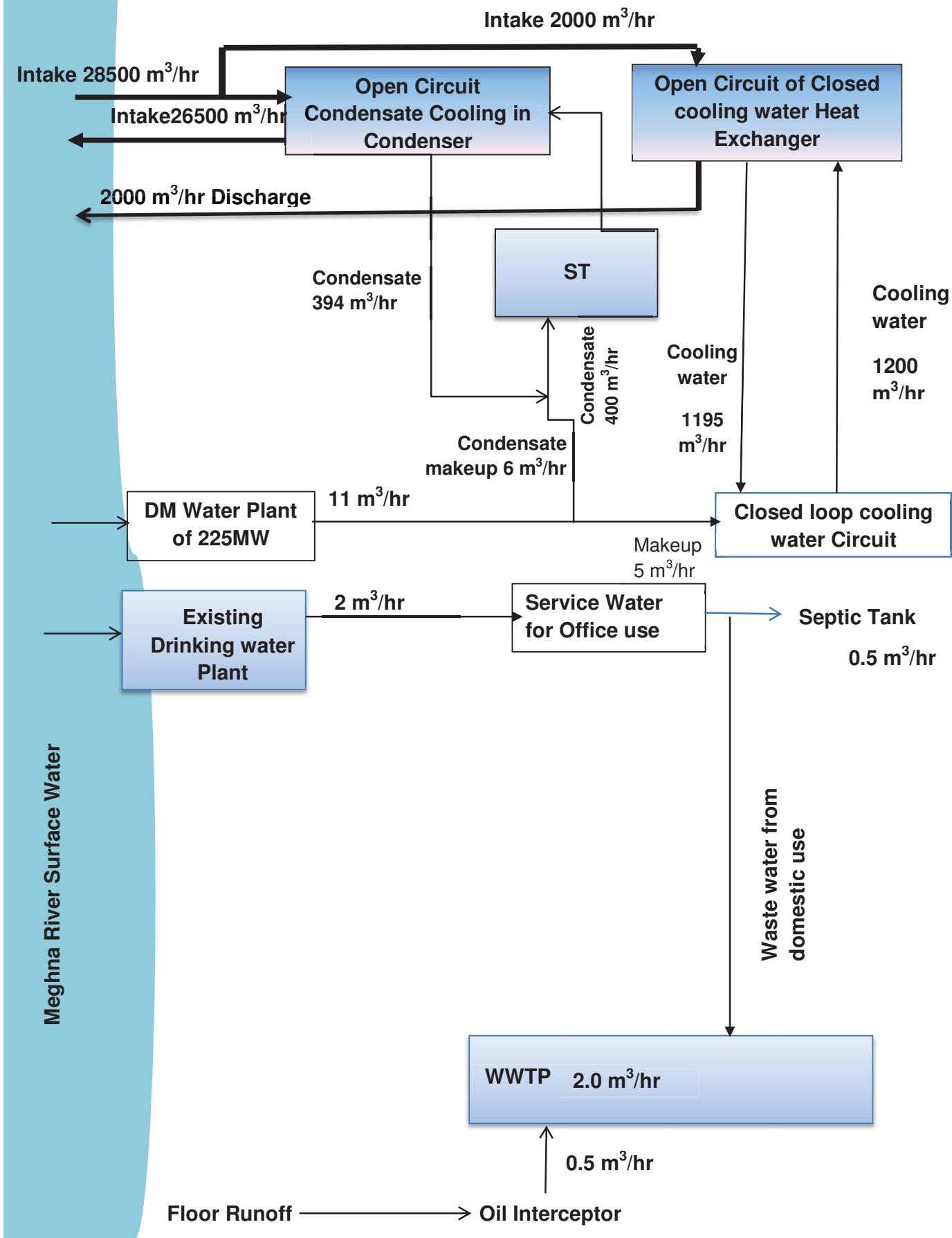
Annexure-9 (a)

Surface Water Temperature at Different Locations of Meghna River



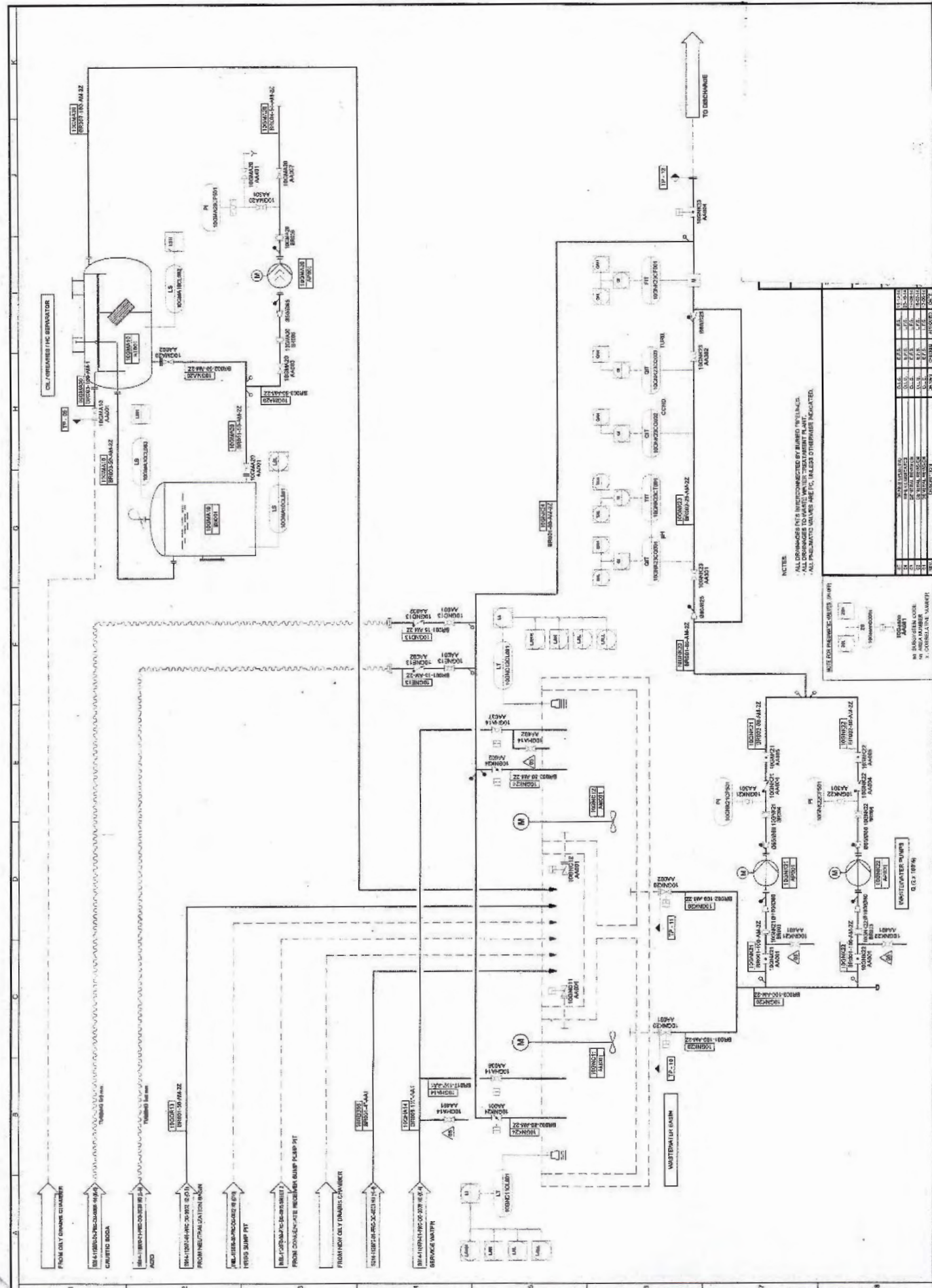
Surface Water Temperature at Various Locations of Meghna River (Measured on 29th July, 2015)

Annexure 9 (b)
Water Use Break Down



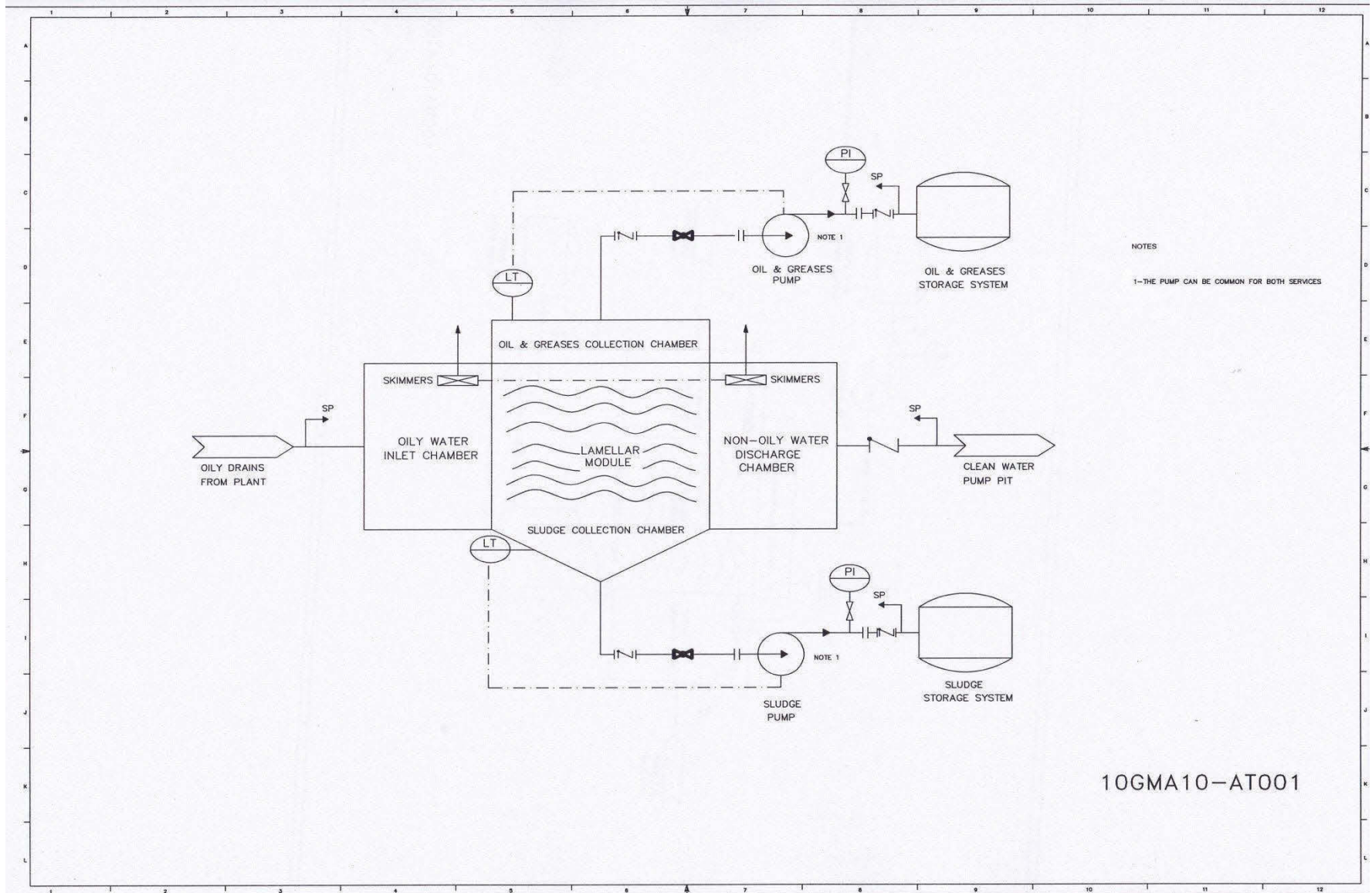
Annexure-9 (c)

**Waste Water Treatment
Plant**

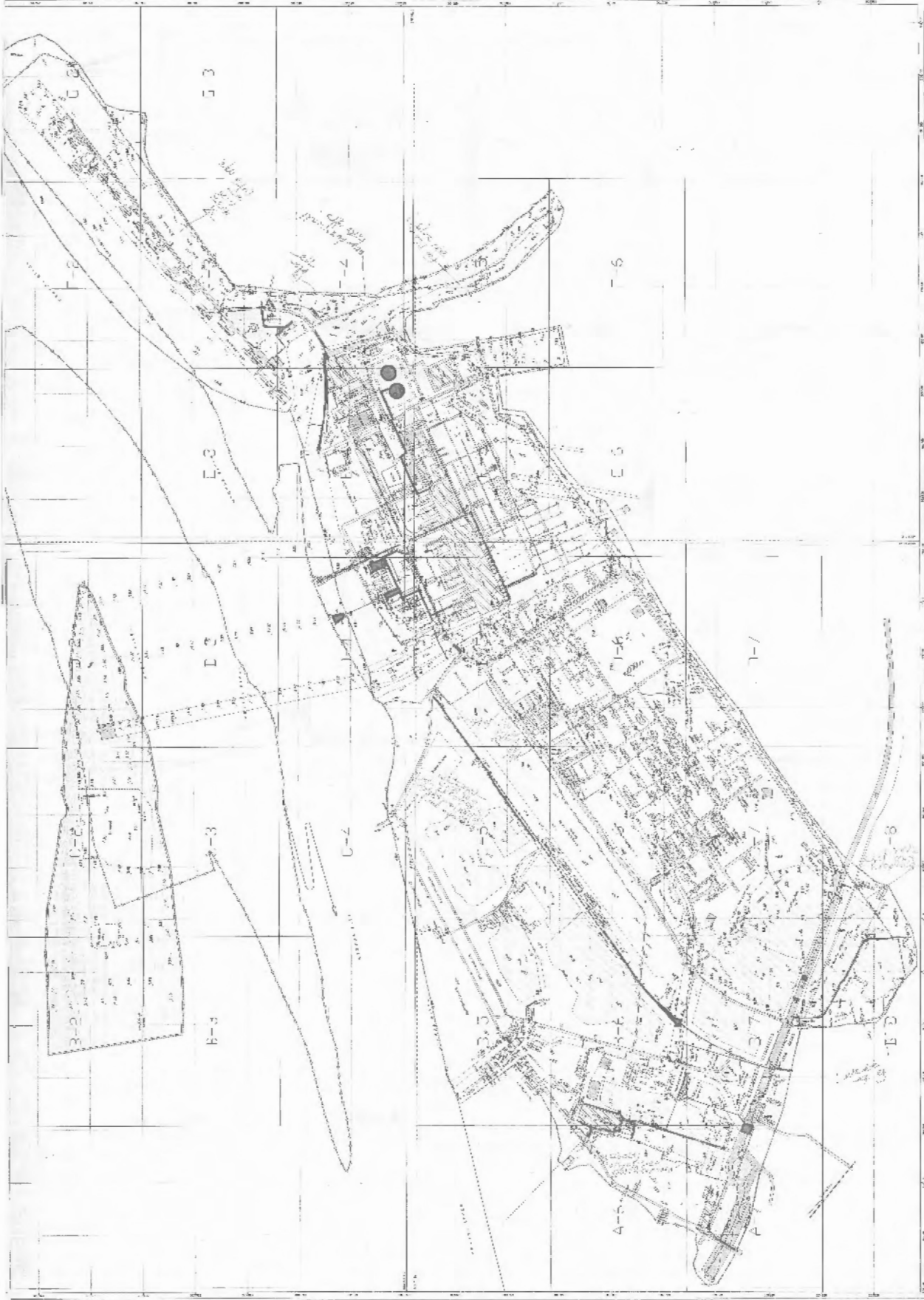


Annexure-9 (d)
Oily Water Separation
System

OILY WATER SEPARATION SYSTEM OF ASHUGANJ 400 MW CCPP (EAST) PROJECT



Annexure-10
Site Elevation Map



Legend

Symbol	Description
[Symbol]	Contour Lines
[Symbol]	Spot Elevation
[Symbol]	Water
[Symbol]	Settlements
[Symbol]	Transportation
[Symbol]	Vegetation
[Symbol]	Topography
[Symbol]	Infrastructure
[Symbol]	Boundaries
[Symbol]	Other Features

Legend

Symbol	Description
[Symbol]	Contour Lines
[Symbol]	Spot Elevation
[Symbol]	Water
[Symbol]	Settlements
[Symbol]	Transportation
[Symbol]	Vegetation
[Symbol]	Topography
[Symbol]	Infrastructure
[Symbol]	Boundaries
[Symbol]	Other Features

EXISTING PHYSICAL FEATURES & TOPOGRAPHIC MAP OF ATSCI

MASTER PLAN OF ASHGANI POWER STATION COMPANY LIMITED.

Legend

Symbol	Description
[Symbol]	Contour Lines
[Symbol]	Spot Elevation
[Symbol]	Water
[Symbol]	Settlements
[Symbol]	Transportation
[Symbol]	Vegetation
[Symbol]	Topography
[Symbol]	Infrastructure
[Symbol]	Boundaries
[Symbol]	Other Features

Annexure-11
Monitoring Test Report



Adroit Environment Consultants Ltd.

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AECL LABORATORY ANALYSIS REPORT AMBIENT AIR QUALITY TEST REPORT

Memo # AECL : 433
Enterprise : Ashuganj 400 MW CCCP (East) Project
Project address : Ashuganj, Brahmanbaria-3402, Dhaka.

Description of Sample : Ambient air quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 30th April, 2015.
Reporting date : 9th May, 2015.

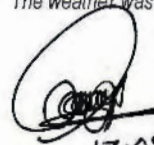
Description of analysis

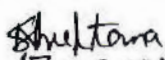
SN	Sample Description	Ambient Air Pollution Concentration in micro gram/cubic meter ($\mu\text{g}/\text{m}^3$)					
		PM _{2.5}	PM ₁₀	SPM	SO ₂	NO _x	CO
01	Method of analysis	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator Tube
02	Test Duration (Hours)	24	24	8	24	24	8
03	Bangladesh (DoE) Standard for ambient Air	65	150	200	365	100 annual	10000
04	International /World Bank Standard	75	150	NF	125	NF	NF
05	Test result in near Hyundai Office area. N- 24°02'41.3" E- 091°01'06.2" (Date :30/4/2015)	38	73	157	22	26	110
Remarks		Pollution source from normal activities					

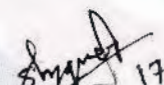
Note: This monitoring report was accomplished by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550)

1. Fine Particulate Matter (PM_{2.5}).
2. Respirable Dust Content (PM₁₀).
3. Suspended Particulate Matter (SPM).
4. Oxides of Nitrogen (NO_x).
5. Sulphur Di-Oxide (SO₂).
6. Carbone Mono-Oxide (CO).

The weather was sunny and the wind direction was from the south- west to north-east.


17.05.2015
Md. Hasanul Islam
Sr. Manager (Engineering)


17.05.2015
Nigar Sultana
Sr. Chemist


17.5.15
Syed Hosney Jahab
Sr. Environmental Engineer (Lab)



Adroit Environment Consultants Ltd.

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AECL LABORATORY ANALYSIS REPORT

AMBIENT NOISE QUALITY TEST REPORT

Memo # AECL : 483
Enterprise : Ashuganj 400MW CCPP (East) Project
Project address : APSCL, B-Baria, Bangladesh.

Description of Sample : Ambient noise quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 30th April, 2015.
Reporting date : 9th May, 2015.

Description of analysis

Concentration present (LA _{eq}) dBA.					
Site Description: Test result near Hyundai Office area					
Location Coordinated : N- 24°02'41.3" E- 091°01'06.2"					
SN	Time	Minimum	Maximum	Average	Remark
01	06.00 AM	61.3	75.7	68.5	Noise source from near power plant activities.
02	07.00 AM	62.1	75.4	68.75	Noise source from near power plant activities.
03	08.00 AM	61.5	75.5	68.0	Noise source from near power plant activities.
04	09.00 AM	62.6	76.3	69.45	Noise source from near power plant activities.
05	10.00 AM	65.8	77.5	71.65	Noise source from near power plant activities.
06	11.00 AM	63.7	77.4	70.55	Noise source from near power plant activities.
07	12.00 PM	66.2	78.9	72.55	Noise source from near power plant activities.
08	01.00 PM	63.3	77.3	70.3	Noise source from near power plant activities.
09	02.00 PM	61.1	76.8	68.95	Noise source from near power plant activities.
10	03.00 PM	66.8	78.0	72.4	Noise source from near power plant activities.
11	04.00 PM	68.7	79.4	74.05	Noise source from near power plant activities.
12	05.00 PM	66.6	76.8	71.7	Noise source from near power plant activities.
13	06.00 PM	62.7	76.5	69.6	Noise source from near power plant activities.
14	07.00 PM	61.4	75.5	68.45	Noise source from near power plant activities.
15	08.00 PM	60.9	75.3	68.1	Noise source from near power plant activities.



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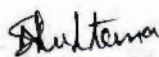
16	09.00 PM	61.5	75.9	68.7	Noise source from near power plant activities.
17	10.00 PM	59.4	74.0	66.85	Noise source from near power plant activities.
18	11.00 PM	58.7	74.2	66.45	Noise source from near power plant activities.
19	12.00 AM	58.9	74.6	66.75	Noise source from near power plant activities.
20	01.00 AM	58.5	74.9	66.7	Noise source from near power plant activities.
21	02.00 AM	57.8	74.7	66.25	Noise source from near power plant activities.
22	03.00 AM	57.6	75.2	66.4	Noise source from near power plant activities.
23	04.00 AM	59.2	75.8	67.5	Noise source from near power plant activities.
24	05.00 AM	59.7	75.5	67.6	Noise source from near power plant activities.
Bangladesh (DoE) Standard					
Industrial area				75	70
Commercial Area				70	60
Mixed Area				60	50
Residential Area				55	45
World Bank/IFC Standard					
Industrial				70	70
Residential, Institutional, Educational				55	45

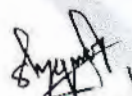
All units are in (LA_{eq}) dBA.

Note: This noise data was accomplished by – Lutron Sound Level Meter (Model – 4010)


17-05-2015

Md. Hasanul Islam
Sr. Manager (Engineering)


17.05.2015
Nigar Sultana
Sr. Chemist


17-5-15
Syed Hosney Jahab
Sr. Environmental Engineer (Lab)



Adroit Environment Consultants Ltd.

A House of Complete Environmental Management



AECL LABORATORY ANALYSIS REPORT

SURFACE WATER QUALITY TEST REPORT

Memo # AECL : **433**
 Subject : Ashuganj 400 MW Combined Cycle Power Plant (East) Project
 Project Location : Ashuganj, Brahmanbaria.

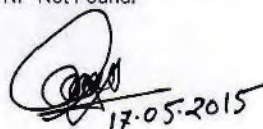
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
 Description of Sample : Surface water quality analysis report. (River water)
 Sample Location : Ashuganj, Brahmanbaria (Near project area).
 Sample Collection date : 30th April, 2015.
 Reporting date : 17th May, 2015.

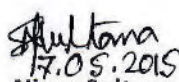
Description of analysis

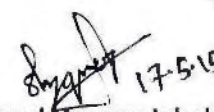
Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	IFC/World Bank Standard	Method of analysis
Temperature	38°C	40°C	NF	Mercury filled thermometer
Dissolved Oxygen(DO)	7.3 mg/L	4.5-8 mg/l	NF	Azide modification
BOD5	7 mg/L	50 mg/l	50 mg/l	Dilution
COD	32 mg/L	200 mg/l	250 mg/l	COD Refluction
Total Dissolved Solids (TDS)	115.2 mg/L	2100 mg/l	NF	TDS Meter
Total Suspended Solids (TSS)	5.32 mg/L	150 mg/l	NF	Gravimetric method
pH	6.69	6-9	6-9	P ^H meter
Total Alkalinity	27 mg/L	NF	NF	Standard Titrimetric method
Hardness	96 mg/L	NF	NF	EDTA titrimetric method
Iron	1.5 mg/L	2 mg/l	NF	Colorimetric
Chloride	60 mg/L	600 mg/l	NF	Mercuric nitrate titration
Nitrate	3.75 mg/l	10.0 mg/l	NF	Specific Ion Electrode
Arsenic	0.003 mg/l	0.2 mg/l	NF	AAS(Atomic Absorption spectrometry)
Lead	<0.05 mg/l	0.1 mg/l	0.1 mg/l	AAS
Manganese	<0.1 mg/l	5 mg/l	NF	Colorimetric
Copper	0.01 mg/l	0.5 mg/l	NF	AAS
Calcium	1.9 mg/l	NF	NF	Titration

* Inland Surface Water Body

*NF-Not Found.


 17.05.2015
 Md. Hasanul Islam
 Sr. Manager (Engineering)


 17.05.2015
 Nigar Sultana
 Sr. Chemist


 17.5.15
 Syed Hosney Jahab
 Sr. Environmental Engineer(Lab)



Adroit Environment Consultants Ltd.

A House of Complete Environmental Management



AECL LABORATORY ANALYSIS REPORT

GROUND WATER QUALITY TEST REPORT

Memo # AECL : **433**
 Subject : Ashuganj 400 MW Combined Cycle Power Plant (East) Project
 Project Location : Ashuganj, Brahmanbaria.

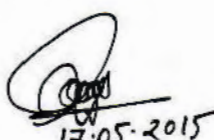
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
 Description of Sample : Ground water quality analysis report.
 Sample Location : Ashuganj, Brahmanbaria (Near project area).
 Sample Collection date : 30th April, 2015.
 Reporting date : 17th May, 2015.

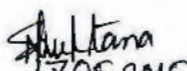
Description of analysis

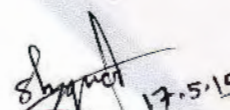
Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	IFC/World Bank Standard	Method of analysis
pH	6.9	6.5-8.5	6.5-8.5	pH meter
Total Alkalinity(as CaCO ₃)	30 mg/L	NF	NF	Standard Titrimetric method
Hardness(as CaCO ₃)	132 mg/L	200-500 mg/l	NF	EDTA titrimetric method
Iron	0.4 mg/L	0.3-1.0 mg/l	0.3 mg/l	Colorimetric
Chloride	30 mg/L	150-600 mg/l	NF	Mercuric nitrate titration
Arsenic	0.003 mg/L	0.05 mg/l	0.01 mg/l	Colorimetric
Residual chlorine	<0.2 mg/L	0.2 mg/l	NF	DPD Ferrous Titrimetric
Total Coliform	0 n/100 mL	0 n/mL	0 n/mL	Membrane Filtration
Fecal Coliform	0 n/100 mL	0 n/mL	0 n/mL	Membrane Filtration
Ammonia	0.35 mg/L	0.5 mg/L	NF	Nesslerization method
Nitrate	2.15 mg/L	10 mg/L	50 mg/L	Specific ion electrode
Phosphate	3.65 mg/L	6 mg/L	NF	Ascorbic acid

*Standard for drinking water.

*NF-Not Found.


 17.05.2015
 Md. Hasanul Islam
 Sr. Manager (Engineering)


 17.05.2015
 Nigar Sultana
 Sr. Chemist


 17.5.15
 Syed Hosney Jahab
 Sr. Environmental Engineer(Lab)



Adroit Environment Consultants Ltd.

A HOUSE OF ENVIRONMENT MANAGEMENT

AECL LABORATORY ANALYSIS REPORT AMBIENT AIR QUALITY TEST REPORT

Memo # AECL : 455
Enterprise : Ashuganj 400 MW CCCP (East) Project
Project address : Ashuganj, Brahmanbaria-3402, Dhaka.

Description of Sample : Ambient air quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 1-2 July, 2015.
Reporting date : 22nd July, 2015.

Description of analysis

SN	Sample Description	Ambient Air Pollution Concentration in micro gram/cubic meter ($\mu\text{g}/\text{m}^3$)					
		PM _{2.5}	PM ₁₀	SPM	SO ₂	NO _x	CO
01	Method of analysis	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator Tube
02	Test Duration (Hours)	24	24	8	24	24	8
03	Bangladesh (DoE) Standard for ambient Air	65	150	200	365	100 annual	10000
04	International /World Bank Standard	75	150	NF	125	NF	NF
05	Test result in near Old Ferry Ghat, Meghna Bridge N- 24°02'28.1" E- 091°00'02.2"	53	81	163	13	11	102
Remarks		Pollution source from normal activities					


Note: This monitoring report was accomplished by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550)

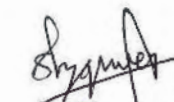
1. Fine Particulate Matter (PM_{2.5}).
2. Respirable Dust Content (PM₁₀).
3. Suspended Particulate Matter (SPM).
4. Oxides of Nitrogen (NO_x).
5. Sulphur Di-Oxide (SO₂).
6. Carbone Mono-Oxide (CO).

The weather was sunny and the wind direction was from the south- west to north-east.

 22/7/15

Md. Hasanul Islam
Sr. Manager (Engineering)

 22/7/15
Nigar Sultana
Sr. Chemist

 22/7/15
Syed Hosney Jahab
Sr. Environmental Engineer (Lab)



Adroit Environment Consultants Ltd.

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AECL LABORATORY ANALYSIS REPORT AMBIENT AIR QUALITY TEST REPORT

Memo # AECL : 455
Enterprise : Ashuganj 400 MW CCCP (East) Project
Project address : Ashuganj, Brahmanbaria-3402, Dhaka.

Description of Sample : Ambient air quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 1-2 July, 2015.
Reporting date : 22nd July, 2015.

Description of analysis

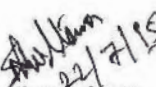
SN	Sample Description	Ambient Air Pollution Concentration in micro gram/cubic meter ($\mu\text{g}/\text{m}^3$)					
		PM _{2.5}	PM ₁₀	SPM	SO ₂	NO _x	CO
01	Method of analysis	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator Tube
02	Test Duration (Hours)	24	24	8	24	24	8
03	Bangladesh (DoE) Standard for ambient Air	65	150	200	365	100	10000
04	International /World Bank Standard	75	150	NF	125	NF	NF
05	Test result in near APSCL Dormitory N- 24°02'47.6" E- 091°01'07.1"	36	77	149	19	12	98
Remarks		Pollution source from normal activities					


Note: This monitoring report was accomplished by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550)

1. Fine Particulate Matter (PM_{2.5}).
2. Respirable Dust Content (PM₁₀).
3. Suspended Particulate Matter (SPM).
4. Oxides of Nitrogen (NO_x).
5. Sulphur Di-Oxide (SO₂).
6. Carbone Mono-Oxide (CO).

The weather was sunny and the wind direction was from the south- west to north-east.


22/7/15
Md. Hasanul Islam
Sr. Manager (Engineering)


22/7/15
Nigar Sultana
Sr. Chemist


22/7/15
Syed Hosney Jahab
Sr. Environmental Engineer (Lab)



AECL LABORATORY ANALYSIS REPORT

AMBIENT NOISE QUALITY TEST REPORT

Memo # AECL : 455
Enterprise : Ashuganj 400MW CCPP (East) Project
Project address : APSCL, B-Baria, Bangladesh.

Description of Sample : Ambient noise quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 1-2 July, 2015.
Reporting date : 22nd July, 2015.

Description of analysis

Concentration present (LA _{eq}) dBA.					
Site Description: Test result near APSCL Dormitory					
Location Coordinated : N- 24°02'47.6" E- 091°01'07.1"					
SN	Time	Minimum	Maximum	Average	Remark
01	06.00 AM	75.8	78.5	77.15	Noise source from near power plant activities.
02	07.00 AM	74.3	79.3	76.8	Noise source from near power plant activities.
03	08.00 AM	74.5	80.1	77.3	Noise source from near power plant activities.
04	09.00 AM	71.2	80.5	75.85	Noise source from near power plant activities.
05	10.00 AM	76.9	82.4	79.65	Noise source from near power plant activities.
06	11.00 AM	79.9	83.6	81.75	Noise source from near power plant activities.
07	12.00 PM	80.1	83.9	82.0	Noise source from near power plant activities.
08	01.00 PM	78.1	84.1	81.1	Noise source from near power plant activities.
09	02.00 PM	78.5	85.0	81.75	Noise source from near power plant activities.
10	03.00 PM	76.6	86.2	81.4	Noise source from near power plant activities.
11	04.00 PM	77.4	85.7	81.55	Noise source from near power plant activities.
12	05.00 PM	79.8	84.6	82.2	Noise source from near power plant activities.
13	06.00 PM	80.3	84.5	82.4	Noise source from near power plant activities.
14	07.00 PM	76.4	81.8	79.4	Noise source from near power plant activities.
15	08.00 PM	74.1	79.7	76.9	Noise source from near power plant activities.
16	09.00 PM	74.3	77.5	75.9	Noise source from near power plant activities.
17	10.00 PM	74.3	77.8	75.9	Noise source from near power plant activities.



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18	11.00 PM	75.1	76.3	75.7	Noise source from near power plant activities.
19	12.00 AM	74.5	76.2	75.35	Noise source from near power plant activities.
20	01.00 AM	74.6	77.9	76.25	Noise source from near power plant activities.
21	02.00 AM	74.5	77.4	75.95	Noise source from near power plant activities.
22	03.00 AM	73.8	76.5	75.15	Noise source from near power plant activities.
23	04.00 AM	74.8	78.9	76.85	Noise source from near power plant activities.
24	05.00 AM	75.7	77.4	76.55	Noise source from near power plant activities.
Bangladesh (DoE) Standard					
		Day		Night	
Industrial area		75		70	
Commercial Area		70		60	
Mixed Area		60		50	
Residential Area		55		45	
World Bank/IFC Standard					
Industrial		70		70	
Residential; Institutional; Educational		55		45	

All units are in (LA_{eq}) dBA.

Note: This noise data was accomplished by – Lutron Sound Level Meter (Model – 4010)

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AECL LABORATORY ANALYSIS REPORT

AMBIENT NOISE QUALITY TEST REPORT

Memo # AECL : 455
Enterprise : Ashuganj 400MW CCPP (East) Project
Project address : APSCL, B-Baria, Bangladesh.

Description of Sample : Ambient noise quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 1-2 July, 2015.
Reporting date : 22nd July, 2015.

Description of analysis

Concentration present (LA _{eq}) dBA.					
Site Description: Test result near Old Ferry Ghat, Meghna Bridge					
Location Coordinated : N- 24°02'28.1" E- 091°01'02.2"					
SN	Time	Minimum	Maximum	Average	Remark
01	06.00 AM	61.3	65.3	63.3	Noise source from nearby traffic activities
02	07.00 AM	62.4	65.7	64.05	Noise source from nearby traffic activities
03	08.00 AM	60.7	66.9	63.8	Noise source from nearby traffic activities
04	09.00 AM	62.7	67.1	64.9	Noise source from nearby traffic activities
05	10.00 AM	63.2	70.3	66.75	Noise source from nearby traffic activities
06	11.00 AM	63.8	72.4	68.1	Noise source from nearby traffic activities
07	12.00 PM	66.1	75.9	71	Noise source from nearby traffic activities
08	01.00 PM	62.7	77.8	70.25	Noise source from nearby traffic activities
09	02.00 PM	60.2	77.5	68.85	Noise source from nearby traffic activities
10	03.00 PM	64.5	77.1	70.8	Noise source from nearby traffic activities
11	04.00 PM	68.9	77.4	73.15	Noise source from nearby traffic activities
12	05.00 PM	67.7	75.4	71.55	Noise source from nearby traffic activities
13	06.00 PM	65.5	72.8	69.15	Noise source from nearby traffic activities
14	07.00 PM	61.2	69.1	65.15	Noise source from nearby traffic activities
15	08.00 PM	62.4	67.4	64.9	Noise source from nearby traffic activities
16	09.00 PM	61.8	67.1	64.45	Noise source from nearby traffic activities
17	10.00 PM	59.5	66.2	62.85	Noise source from nearby traffic activities
18	11.00 PM	58.8	66.3	62.55	Noise source from nearby traffic activities

2/12, Flat (2A-B), Block-B, Humayun Road, Mohammadpur, Dhaka-1207, Bangladesh,

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19	12.00 AM	58.9	65.8	63.35	Noise source from nearby traffic activities
20	01.00 AM	57.1	61.2	59.15	Noise source from nearby traffic activities
21	02.00 AM	55.0	61.8	58.4	Noise source from nearby traffic activities
22	03.00 AM	56.1	60.2	58.15	Noise source from nearby traffic activities
23	04.00 AM	58.7	64.5	61.6	Noise source from nearby traffic activities
24	05.00 AM	59.7	64.9	62.3	Noise source from nearby traffic activities
Bangladesh (DoE) Standard					
			Day	Night	
Industrial area			75	70	
Commercial Area			70	60	
Mixed Area			60	50	
Residential Area			55	45	
World Bank/IFC Standard					
Industrial			70	70	
Residential; Intitutional; Educational			55	45	

All units are in (LA_{eq}) dBA.

Note: This noise data was accomplished by – Lutron Sound Level Meter (Model – 4010)

Md. Hasanul Islam
Sr. Manager (Engineering)

Nigar Sultana
Sr. Chemist

Syed Hosney Jahab
Sr. Environmental Engineer (Lab)



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AECL LABORATORY ANALYSIS REPORT SURFACE WATER QUALITY TEST REPORT

Memo : 454
Subject : Ashuganj 400 MW Combined Cycle Power Plant (East) Project
Project Location : Ashuganj, Brahmanbaria.

=====

Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Description of Sample : Surface water (Meghna River)
Sample Location : Ashuganj, Brahmanbaria (Near project area).
Sample Collection date : 1st July, 2015.
Reporting date : 1st August, 2015.

=====

Description of analysis

Name of the Parameter	Concentration present	Method of analysis
Oil & Grease	<5.5 mg/L	APHA 5520.B

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Adroit Environment Consultants Ltd.

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AECL LABORATORY ANALYSIS REPORT **AMBIENT AIR QUALITY TEST REPORT**

Memo # AECL :
Enterprise : Ashuganj 400 MW CCCP (East) Project
Project address : Ashuganj, Brahmanbaria-3402, Dhaka.

Description of Sample : Ambient air quality analysis report
Sample Collector : Adroit Environment Consultants Ltd (Monitoring team).
Sampling date : 12th-13th October, 2015.
Reporting date : 14th October, 2015.

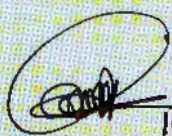
Description of analysis

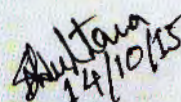
SN	Sample Description	Ambient Air Pollution Concentration in micro gram/cubic meter ($\mu\text{g}/\text{m}^3$)					
		PM _{2.5}	PM ₁₀	SPM	SO ₂	NO _x	CO
01	Method of analysis	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator Tube
02	Test Duration (Hours)	24	24	8	24	24	8
03	Bangladesh (DoE) Standard for ambient Air	65	150	200	365	100	10000
04	International /World Bank Standard	75	150	NF	125	200 (1 hr)	NF
05	Test result in near East Dormitory. N- 24°04'57.17" E- 91°01'94.73"	32	68	161	16	20 48 (1 hr)	105
06	Test result in near project site N- 24°02'41.3" E- 091°01'06.2" (1 hr Nox)	-	-	-	-	56 (1 hr)	-
Remarks		Pollution source from normal activities					

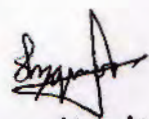
Note: This monitoring report was accomplished by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550)

1. Fine Particulate Matter (PM_{2.5}).
2. Respirable Dust Content (PM₁₀).
3. Suspended Particulate Matter (SPM).
4. Oxides of Nitrogen (NO_x).
5. Sulphur Di-Oxide (SO₂).
6. Carbone Mono-Oxide (CO).

The weather was sunny and the wind direction was from the south-west to north-east.


14/10/15
Md. Hasanul Islam
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STACK EMISSION DISPERSION MODELING OF 400 MW CCPP (EAST) ASHUGANJ POWER STATION CO LTD.

At
Ashuganj, Brahmonbaria



Prepared By:



Adroit Environment Consultants Ltd (AECL)

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Oct 2015

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1. INTRODUCTION

Air Emission Dispersion modelling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source. Based on emissions and meteorological inputs, a dispersion model can be used to predict concentrations at selected downwind receptor locations. These air quality models are used to determine compliance with National and international Ambient Air Quality Standards.

In order to estimate the pollutant concentration from a point source emission, USEPA AERMOD view 8.0.5 model has been used. AERMOD view is a Gaussian plume model that incorporates source-related factors, meteorological factors, receptors, terrain and building downwash factors to estimate pollutant concentration from continuous point source emission. The following report describes the prediction of emission of NO₂ from the gas fired engine generated power plant and its impact on ambient air quality within 5 Km radius.

2.0 METHODOLOGY

2.1 About AERMOD View

AERMOD View is a complete and powerful air dispersion modelling package that seamlessly incorporates the popular U.S. EPA models, AERMOD, ISCST3, and ISC-PRIME into one interface without any modifications to the model. These models are used extensively to assess pollution concentration and deposition from a wide variety of sources.

Features

Create impressive presentations of the model results with the easy and intuitive graphical interface of AERMOD View. We can customize the project using display options such as transparent contour shading, annotation tools, various font options, and specify compass directions.

- Specify model objects such as sources, receptors and buildings graphically.
- Automatically eliminate receptors within the facility property line.
- Import base maps in a variety of formats for easy visualization and source identification.
- Use the major digital elevation terrain formats - USGS DEM, NED, GTOPO30 DEM, UK DTM, UK NTF, XYZ Files, CDED 1-degree, AutoCAD DXF.
- Interpret the effects of topography by displaying the model results with 3D terrain using the powerful 3D visualization built right into the interface.
- Complete building downwash analysis effectively and quickly using the necessary tools that AERMOD View provides.
- Prepare meteorological data quickly and accurately using AERMET view by the step-by-step meteorological pre-processing interface.

- Take advantage of AERMOD View's integrated post-processing with automatic contouring of results, automatic gridding, blanking, shaded contour plotting and posting of results.

The dispersion modelling was conducted to appraise environmental impact assessment (EIA) for the proposed reciprocating engine power plant. In the study, the NO₂ emissions for natural gas fired engine discharged through stack was modelled to obtain maximum possible concentration. This model was also tested in case of area source and showed good correlation with the measured data under Bangladesh condition.

Information required for the model includes:

- a) Pollutant emission rate
- b) Stack exhaust exist temperature
- c) Stack exhaust exist velocity flow
- d) Stack diameter
- e) Stack height
- f) Meteorological data

All the required information was obtained from manufacturer specification. Discharge concentration was estimated at 500m increments from the plant up to minimum 5 km radius.

2.2 Meteorological Condition

The Ashuganj area where the power plant is located has a sub-tropical climate and is under the influence of the strong southwest or summer monsoon and weak northeast or winter monsoon. It has been understood from last few years of air quality monitoring, the air quality level of the area greatly influenced by the Asian monsoon. The air quality characteristic over the area and it's surrounding shows distinct seasonal variations, with high pollution episode observed during winter, while summer has relatively cleaner ambient air. During dry winter and part of the post-monsoon season, the strength of north, northwest wind coming from India, Nepal and Southeast China to the Bay of Bengal through Bangladesh may transport the air pollutants to the city. Moreover, during dry season the wind speed is so low that the pollutants emitted from the local sources cannot travel away from the city.

The use of site-specific meteorological data has been collected from the World Meteorological Organization (WMO) who has provided 1 Year of MM5-Preprocessed site specific Meteorological data for the period of Jan 01, 2013 to Dec 31, 2013 at Latitude: 24.0325 N, Longitude: 90.0033 E, Time Zone: UTC +6. These data contain hourly value of wind speed & direction, wind velocity, surface roughness, bowen ratio, albedo, temperature & reference height, precipitation rate, relative humidity, surface pressure and cloud cover over the period mentioned above. The data then have been analysed and processed through MET processing model AERMET View which uses Samson format to process the data and create surface met data file & profile met data file computable to the USEPA AERMOD view dispersion model. These surface met data file & profile met data file were then used in AERMOD view as Met input data for calculation.

The wind rose plots were drawn from the AERMET view met processor model and shows distinct four wind directional patterns representing four seasons in a year as per air blowing to and from (Figure 2.1 & 2.2). The mixing height in the boundary layer is one of the important factors to assess the influence of meteorology on the dispersion of pollutants.

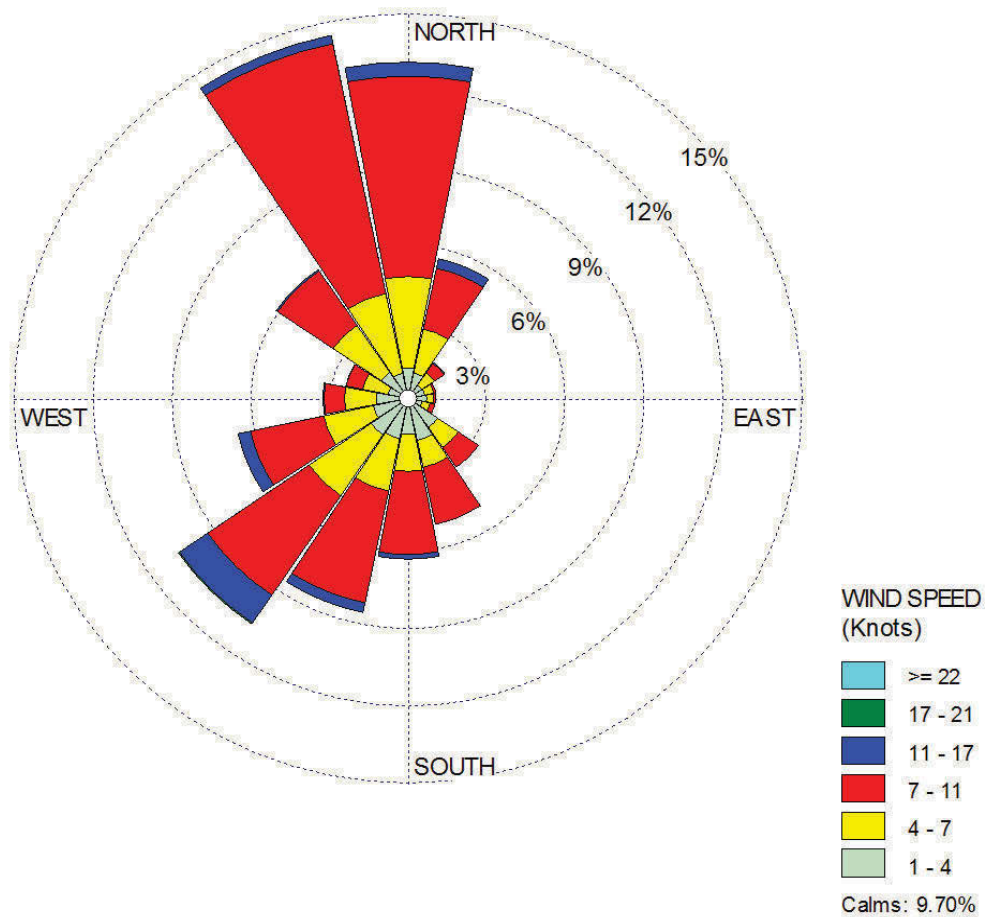


Figure 2.1: Seasonal wind direction (Pre-monsoon, Monsoon, Post-monsoon and winter respectively) blowing to the project location based on Samson data processing obtained from AERMET view.

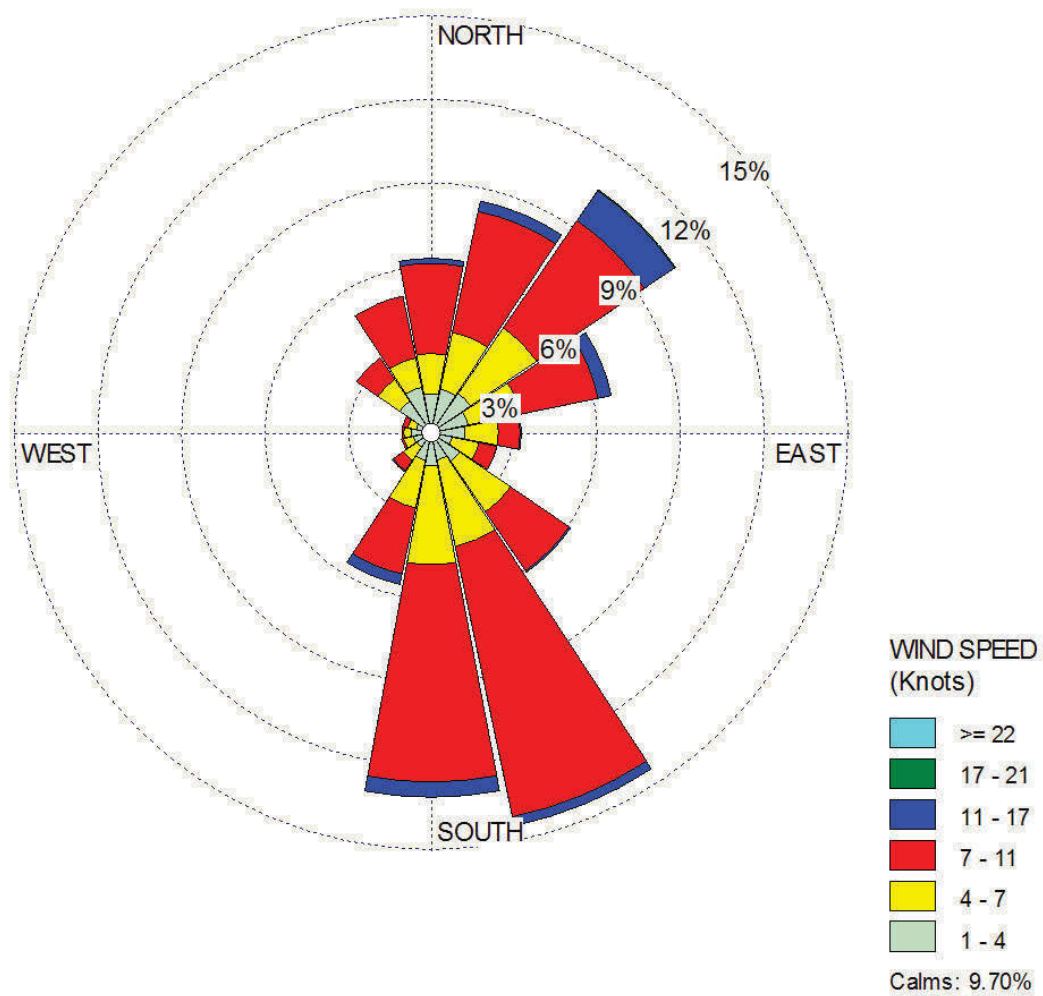


Figure 2.2: Seasonal wind direction (Pre-monsoon, Monsoon, Post-monsoon and winter respectively) blowing from the project location based on Samson data processing obtained from AERMET view.

3.0 STANDARDS AND GUIDELINES

Since natural gas will be used for the proposed engine power plant, the principal air pollutant of concern is nitrogen dioxides (NO₂). The guideline value for NO₂ in case of ambient air is shown in Table 3.1.

Table 3.1: Ambient air quality guideline for NO₂.

Pollutants	Average period	Standard in µg/m ³		
		BNAAQS***	WHO/IFC 2007*	US EPA
NO ₂	1 hr		200**	188
	Annual	100	40**	100

* IFC Environmental Health & Safety Guidelines 2007

** Ambient air quality standard for small combustion facility using gas fuel and spark engine

***Bangladesh National Ambient Air Quality Standard

4.0 SOURCE PARAMETERS

An effect on ambient air quality has been assessed based on preliminary air quality modelling results. An advanced air emission dispersion modelling has been conducted for determining the ground concentration of pollutants from the stack and turbine emission. In the study, the NO₂ emissions for the gas turbine stack exhaust system were modelled to obtain maximum possible downward ground concentration. USEPA AERMOD view version 8.8.9 model was used to estimate emission concentration from the plant. The air emission modelling has been done for individual stack emission dispersion from the APSCL 400 MW (east) and also from the cumulative concentration from the under construction power plants of APSCL in the same campus.

A. Ambient Air Quality by considering the individual stack of APSCL 400 MW CCPP (east)

The proposed power project will have a 289 MW gas turbine fitted with 135 MW steam turbine and the model calculates the values in different configurations (single and cumulative) by considering individual stack emissions with 65m stack height of NO₂ emissions from different stacks. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO₂ concentration contour has been analyzed with 500 m interval with a radius of 5000m from the point source. The NO₂ concentration contour of 1 hour and annual average of maximum concentration have been analyzed.

The parameters and corresponding values are summarized in Table 4.1,

Table 4.1: The exhaust specifications and stack parameters for individual stack

Parameters	Values
Stack height (m) =	65m
Stack inside diameter (m) =	6.25m
Stack gas exit velocity (m/s) =	9 m/s
Exhaust temperature (K) =	$(90+293) = 383$
Exhaust flow rate (m ³ /sec) =	276.11
NO ₂ emission rate as NO ₂ (g/s) =	15.38
Ambient temperature (K) =	293
Receptor height above ground=	0.000

B. Ambient Air Quality by considering the cumulative concentration from other proposed projects of APSCL.

An effect on ambient air quality has been assessed based on the cumulative ground concentration of NO₂ emissions together with other proposed power project of APSCL at the same complex. In addition to the 400 MW CCPP east, APSCL is now constructing two 450 MW CCPP north & south, one 225 MW CCPP and one 200 MW reciprocating gas engine power project (by UAEL). USEPA AERMOD view version 8.8.9 model was used to estimate emission concentration from all the plant considering point source emission.

In this calculation, we have considered 20 reciprocating gas generators and 4 combined cycle power plant stack together as point source. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO₂ concentration contour has been analyzed with 500 m interval with a radius of 5000m from the point source. The NO₂ concentration contour of 1 hour and annual average of maximum concentration have been analyzed.

The parameters and corresponding values are summarized in Table 4.2 & 4.3

Table 4.2: The exhaust specifications and stack parameters (for 20 stacks)

Parameters	Values
Stack height (m) =	40m
Stack inside diameter (m) =	1.20
Exhaust temperature (K) =	$(170+293) = 463$
Exhaust flow rate (m ³ /sec) =	4.94
NO ₂ emission rate as NO ₂ (g/s) =	0.988
Ambient temperature (K) =	293
Receptor height above ground=	0.000

Table 4.3: The exhaust specifications and stack parameters (for 450 north & south)

Parameters	Values
Stack height (m) =	50
Stack inside diameter (m) =	6.09
Exhaust flow rate (m ³ /sec) =	472.12
Exhaust temperature (K) =	384
NO ₂ emission rate as NO ₂ (g/s) =	24.078
Ambient temperature (K) =	293
Receptor height above ground=	0.000

Table 4.4: The exhaust specifications and stack parameters (for 225 MW)

Parameters	Values
Stack height (m) =	50
Stack inside diameter (m) =	5.8
Exhaust flow rate (m ³ /sec) =	364.48
Exhaust temperature (K) =	384
NO ₂ emission rate as NO ₂ (g/s) =	18.88
Ambient temperature (K) =	293
Receptor height above ground=	0.000

5.0 MODELING RESULTS

A. Stack emission dispersion results for APSCL 400 MW CCGT:

The NO₂ concentration contour of 1 hour and annual average of maximum concentration have been analyzed. The maximum of 1 hour concentration of NO₂ (10-18 µg/m³) has been predicted at a radius of 1000m east, west & south to the power projects. The concentrations will be expected to reduce from 10 µg/m³ to 3 µg/m³ uniformly surrounding the project within 4000m from the stack. The concentrations will be further below to 3 µg/m³ beyond 4000m around the project. The maximum annual concentration of NO₂ has been detected as 0.50-0.60 µg/m³ at 1000m to 5000m west to the project, whereas the concentration are below 0.50-0.10 µg/m³ at the either sides further down to the project site up to 5000m.

The following are the emission contour maps of the proposed project at 1 hour and annual average of NO₂ concentrations:

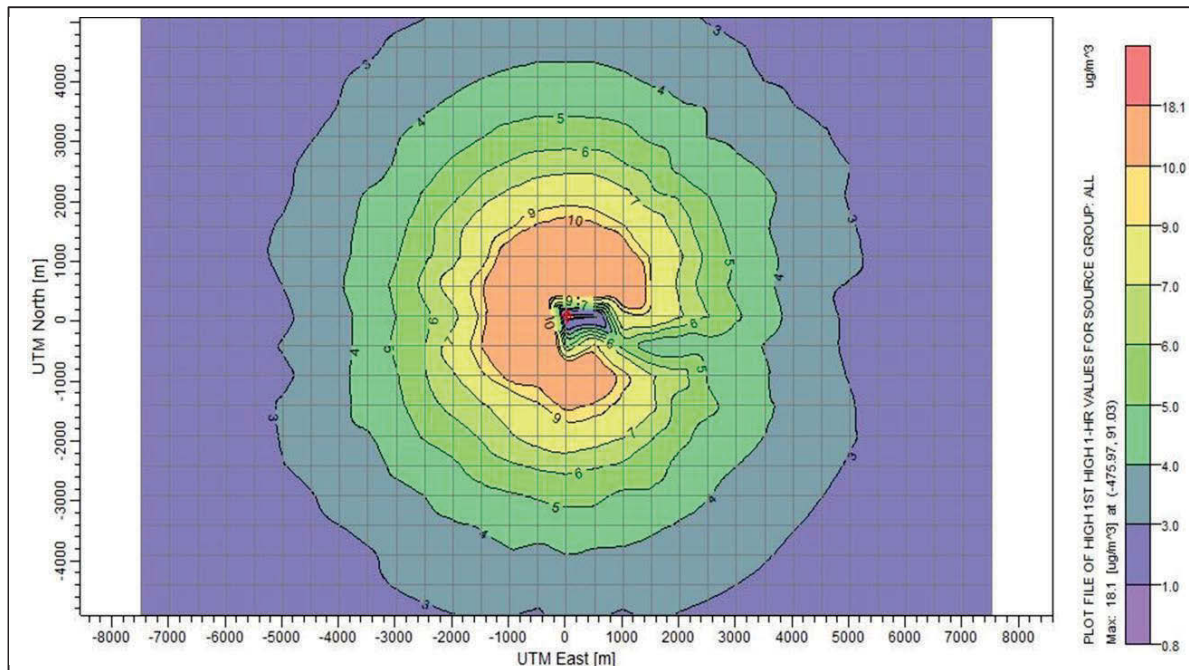


Figure 5.1: Emission contour map showing the NO₂ concentration (1 hour average)

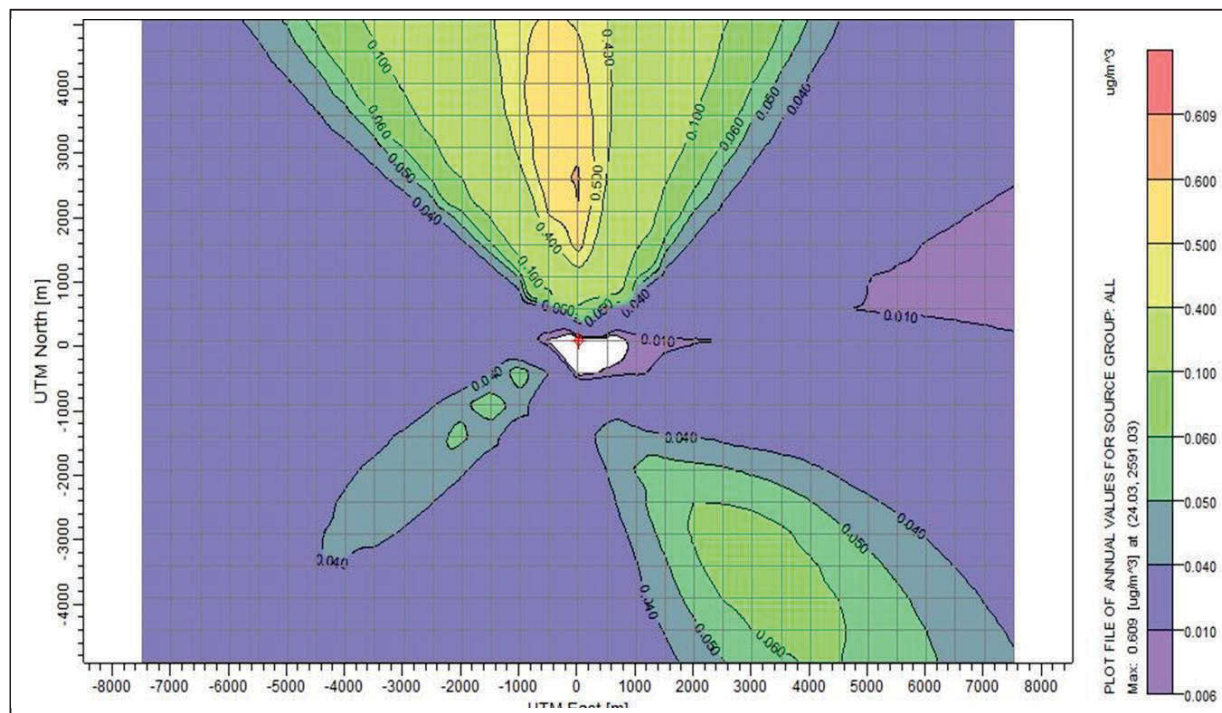


Figure 5.2: Emission contour map showing the NO₂ concentration (annual average)

B. Dispersion model result by considering the cumulative concentration from other proposed projects of APSCL.

The NO₂ concentration contour of 1 hour and annual average of maximum concentration have been analyzed. The maximum of 1 hour concentration of NO₂ has been predicted below 100-153 µg/m³ at a radius of 0-1000m around the project, whereas the concentrations are within 50-100 µg/m³ from 1000-3000m around the project site and the concentrations are below 50 µg/m³ has been predicted at further down beyond 400m radius. The maximum annual concentration of NO₂ has been detected as 10-20 µg/m³ at a radius up to of 3000m west to the project forming a pocket whereas the concentration are within 5-0.30 µg/m³ at the either sides further down to the project site up to 5000m.

The following are the emission contour maps of the proposed project at 1 hour and annual average of NO₂ concentration:

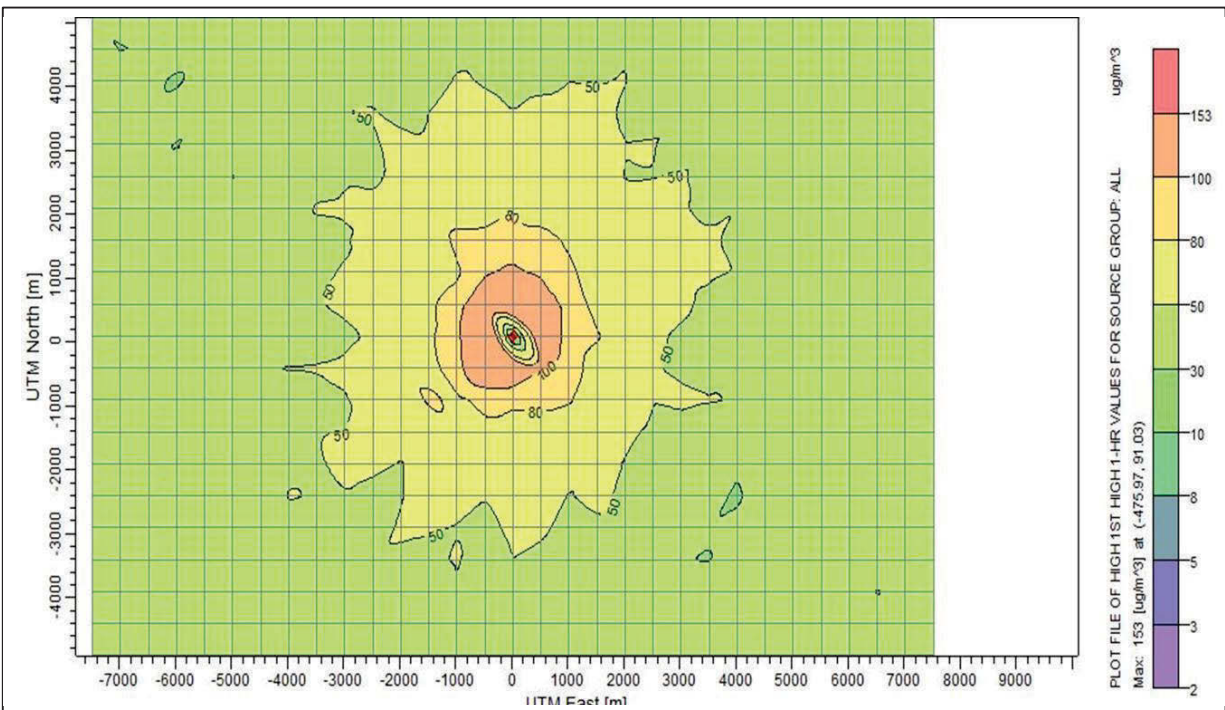


Figure 5.3: Emission contour map showing the NO₂ concentration (1 hour average) combined source

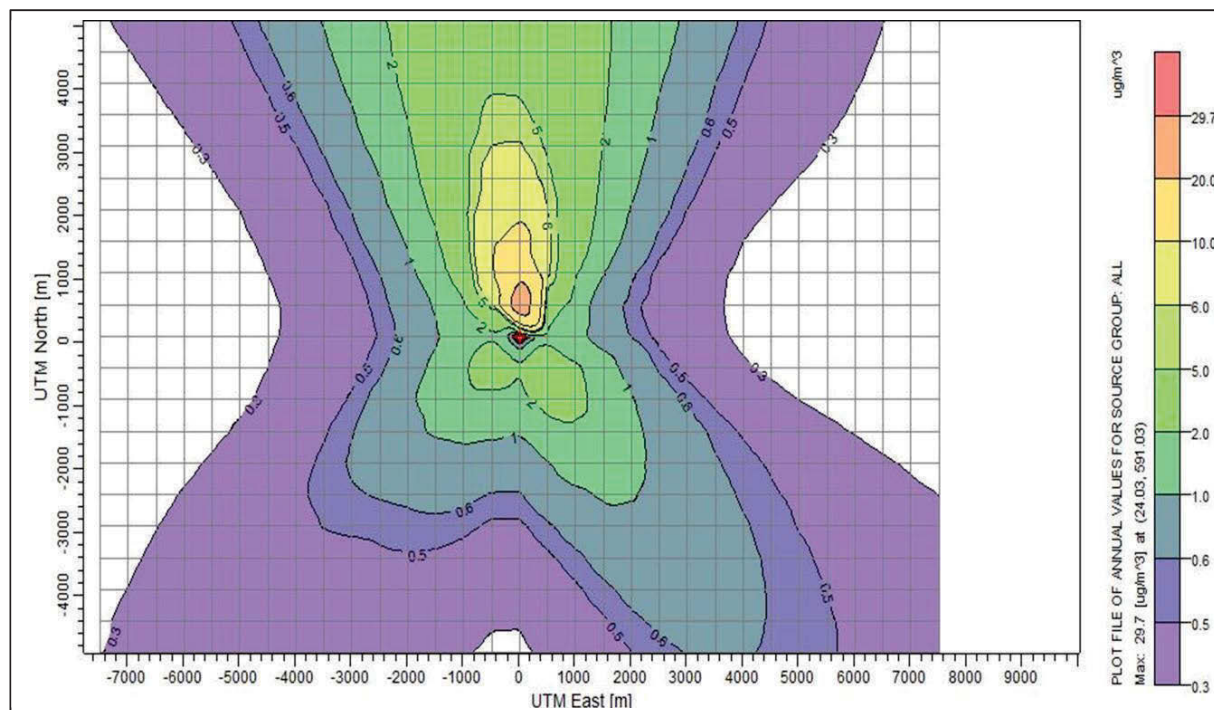


Figure 5.4: Emission contour map showing the NO₂ concentration (annual average) combined source

6.0 CONCLUSION

Review of modelling results (single source):

The modelling result shows the 1 hour concentration of NO₂ (10-18 µg/m³) has been predicted at a radius of 1000m east, west & south to the power projects site which is within the IFC standard (200 µg/m³) for 1 hour concentration. The maximum annual concentration of NO₂ has been found 0.50-0.60 µg/m³ at 1000m to 5000m west to the project which are also less than the Bangladesh, WHO/IFC and USEPA standard. These indicate that the expected power plant does not have major significant adverse impact on the prevailing air quality of that area.

Table 6.1: Predicted NO_x Concentrations (ug/m³)

Distance Downwind	1-hour (ug/m ³)
0-1500 meters all sides	10-18
1500-4000 meters all sides	3-10
Beyond 400m all sides	>3
Annual (ug/m ³)	
1000-5000m west	0.50-0.60
100-500 meters north-west & south-west	0.40-0.05
1.5000 meters North, South & east	>0.05

ug/m³ = micrograms per cubic meter

Review of modelling results (cumulative emission):

The modelling result shows the maximum 1 hour ground level concentration of the NO₂ is 100-153 µg/m³ at a radius of 0-1000m around the project which is within the IFC standard (200 µg/m³) for 1 hour concentration. Since this is not an individual contribution to air shed and no other major NO_x polluting sources exists within the air shed, the calculated concentration may be compared with the standard.

The maximum annual concentration of NO₂ has been found 10-20 µg/m³ at a radius up to of 3000m west around the site is also less than the Bangladesh, WHO/IFC and USEPA standard as mentioned in the table 3.1. These indicate that the expected power plant does not have major significant adverse impact on the prevailing air quality of that area.

Table 6.2: Predicted NO_x Concentrations (ug/m³)

Distance Downwind	1-hour (ug/m ³)
0-1000 meters all sides	100-153
1000-3000 meters all sides	50-100
Beyond 3000 all sides	>50
	Annual (ug/m ³)
0-3000m west	10-20
0-1500 north & south	1-5
1.5000 meters Northwest & southwest	1-5

ug/m³ = micrograms per cubic meter

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Annexure-12 (b)
Thermal Plume Modelling
Report

**THERMAL PLUMEMODELING
OF
ASHUGANJ POWER STATION CO LTD.
400 MW CCPP (EAST)
At
Ashuganj, Brahmanbaria**



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July, 2015

The proposed project is named as 400 MW CCPP East will be established at the APSCL site. The cooling water requirement was estimated to be about 28,500 m³/hr or 7.91 m³/second. The total cooling water will be drawn by all plants including the existing and ongoing project would be about 56.4 m³/sec where the minimum river discharge is 2050 m³/sec. Adequate water appears available throughout the year from the Meghna River for the proposed 400MW combined cycle which release the heated water at 37.54°C after the condenser cooling.

The Objective of this study is to compliance the thermal plume dispersion with the regulatory mixing zone standard (i.e. 3 deg C at 100m distance from the outfall point) for new power generation unit (400MW CCPP East) after being operation of it's full capacity.

An island (char) is developed in front of 300m distance from the discharge channel. The width of Meghna river width is around 1.5km across the discharge point including 300m width sand bar. This sand bar is diverting a significant volume of river discharge during lean period. This study assumed around 20% of the total river water is flowing through this channel and finally confluence with the main river at downstream.

In order to predict the thermal plume dispersion properly, Cornell Mixing Zone Expert System (CORMIX3) software is used to predict the steady and un-steady state mixing behavior and plume geometry. It is a USEPA-supported mixing zone model and decision support system for environmental impact assessment of regulatory mixing zones resulting from continuous point source discharge. Heated water will be discharged from the APSCL to the river after traveling through an internal canal of APSCL of around 3 discharge canals among which the shortest is 600 m long receive all the cooling water discharge from the power plants and finally discharge to the meghna river at the south east boundary of APSCL. Therefore, around 1°C temperature assumed to be reduced when the thermal plume ultimate discharge to the Meghna river. At present, the recorded temperature besides the discharge channel is 30°C when other units are in operation. A number of input parameters are considered for this modeling process. **Table-XX** shows the input variables for thermal plume modeling.

TableXX: Input parameter for thermal plume modeling

	Unit	Data	Data Source
AMBIENT PARAMETERS:	Dry Period		
Cross-section		bounded	Field observation
Width	m	200	Schematized of Cross section
Channel regularity		2	Field observation
Ambient flow rate	m ³ /s	200	20% of the Minimum Flow
Average depth	m	5	Schematized channel depth
Depth at discharge	m	4	Field survey
Ambient velocity	m/s	0.2	Field survey
Manning's Coff.		0.035	Field observation
Wind velocity	m/s	4.1	Literature review
Temperature	deg C	30	Field investigation
Water density	kg/ m ³	995.6	Calculated
DISCHARGE PARAMETERS:	Surface Discharge		
Discharge located on		left bank	
Discharge configuration		flush discharge	
Distance from bank to outlet	m	0	Field investigation
Discharge angle	deg	90	Field investigation
Depth near discharge outlet	m	1.5	Field investigation
Bottom slope at discharge	deg	30	Field investigation
Discharge cross-section area	m ²	15	Field investigation
Discharge channel width	m	15	Field investigation

Discharge channel depth	m	1	Field investigation
Discharge aspect ratio		0.066667	Calculated
Discharge flow rate	m ³ /s	7.92	Design Condition
Discharge velocity	m/s	0.53	Calculated
Discharge temperature (freshwater)	degC	36	Design value
Corresponding density	kg/ m ³	993.6812	Calculated value
Density difference	kg/ m ³	1.9658	Calculated value
Buoyant acceleration	m/s ²	0.0194	Calculated value
Discharge concentration	degC	6	Design condition
Surface heat exchange coeff.	m/s	0.000018	Calculated value

After running the CORMX3 simulation for dry period, a continuous thermal plume path has been identified. **Figure-XX** shows the thermal plume dispersion with respect to the changing temperature and distance. Plume will be discharged from the left bank of the river and dispersed to the downstream. It will attach with the left bank downstream of the river. At this situation, the centerline temperature will reduce to 32.4 deg C at 100 m distance from the outfall.

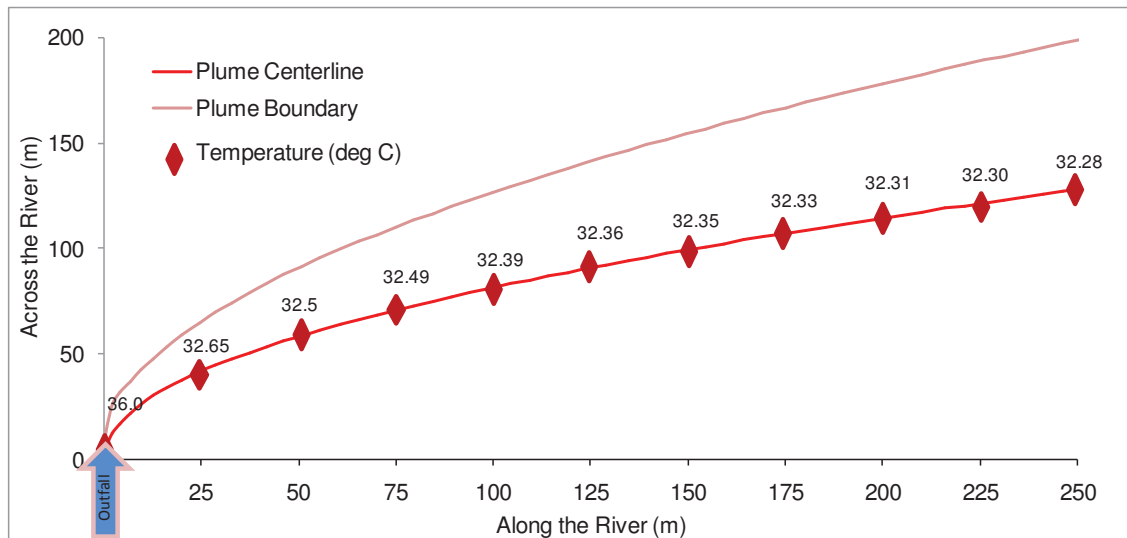


Figure-XX: Thermal plume dispersion from upstream to downstream

This result is confirmed that the increase of river water temperature around the discharge point do not exceeds 3⁰C near the mixing zone boundary in the river. It will be reduced by 3⁰C near (x=10m, y=27m) to the discharge point. Moreover, all the thermal plume related issues are considerably confined inside the sub channel (i.e. left bank of Meghna river near APSL to the island/char). After certain distance when the channel water will join with the main river water, the effect of thermal plume becomes significantly minuscule. From field investigation and modeling output of thermal plume, it is evident that the thermal plume of this project will satisfy the international standards adequately.

Annexure-13(a)

**Environment Clearance Certificate
of Plants inside APSCL**



গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

পরিবেশ অধিদপ্তর

ব্রাহ্মণবাড়িয়া জেলা অফিস, ব্রাহ্মণবাড়িয়া।



নম্বর- ২২০

[বাংলাদেশ পরিবেশ সংরক্ষণ আইন ১৯৯৫ এর (১২) ধারা ও পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এর বিধি (৭) অনুযায়ী ছাড়পত্র]

স্মারক নং- পরিবেশ/ব্রাহ্মণবাড়িয়া/ছাড়পত্র-৬৫৭/২০১৫/ ৮৮

২২/০৩/১৪২২ বঙ্গাব্দ
তারিখঃ ২৯/০৬/২০১৫ খ্রিঃ

পরিবেশগত ছাড়পত্র

পরিবেশ অধিদপ্তর, সদর দপ্তর, ঢাকার ২৭/০৫/২০১৫ তারিখের পরিবেশ বিষয়ক কমিটির ৩৮৬ তম সভার কার্যবিবরণীর ক-০৮ নম্বর সিদ্ধান্ত মোতাবেক পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ অনুযায়ী “লাল” শ্রেণীভুক্ত বিবেচনায় সোনারামপুর, আতগঞ্জ ব্রাহ্মণবাড়িয়া-এ অবস্থিত আতগঞ্জ পাওয়ার স্টেশন কোম্পানী লিমিটেড (এপিএসসিএল) এর চলমান ৭টি গ্যাস ভিত্তিক বিদ্যুৎ ইউনিট ৬৩৪ মেগাওয়াট বিদ্যুৎ উৎপাদন কেন্দ্র প্রকল্পটির অনুকূলে নিম্নবর্ণিত শর্তে পরিবেশগত ছাড়পত্র প্রদান করা হলো।

শর্তাবলীঃ

- ১। বিদ্যুৎ উৎপাদন কেন্দ্রের কোন কর্মকর্তা ও প্রক্ৰিয়া দ্বারা কোনভাবে পরিবেশ (মাটি, পানি, বায়ু ও শব্দ) দূষণ করা যাবে না।
- ২। এ ছাড়পত্র ৬৩৪ মেগাওয়াট বিদ্যুৎ উৎপাদনের জন্য প্রযোজ্য। প্রকল্পের উৎপাদন বৃদ্ধি, জায়গার সম্প্রসারণ, উৎপাদন প্রক্রিয়ায় বা তৎসংশ্লিষ্ট কোন প্রকার পরিবর্তনের জন্য পরিবেশ অধিদপ্তরের পূর্বনুমতি/ছাড়পত্রের প্রয়োজন হবে।
- ৩। বিদ্যুৎ কেন্দ্র হতে গ্যাসীয় পদার্থের নিঃসরণ (SOx, NOx, CO ইত্যাদি) এবং বস্তুকণার (Particulate Matters) নির্গমন পরিবেশ সংরক্ষণ বিধিমালা-১৯৯৭ এ উল্লেখিত মানমাত্রার মধ্যে হতে হবে। যে কোন সময় তাৎক্ষণিক সংগৃহীত নমুনায় এই মানমাত্রা অতিক্রম হতে পারবে না। কোন সময় দূষণ নিয়ন্ত্রণ ব্যবস্থা অকার্যকর হলে সাথে সাথে সংশ্লিষ্ট উৎপাদন ইউনিট বন্ধ করতে হবে। দূষণ নিয়ন্ত্রণ ব্যবস্থা সংস্কার করে বিধিবদ্ধ মানমাত্রা নিশ্চিতকরণ সাপেক্ষে বন্ধ ইউনিট পুনরায় চালু করা যাবে।
- ৪। এ ছাড়পত্র জারীর তিন মাসের মধ্যে বিদ্যুৎ কেন্দ্রের Down Wind Direction এবং যেসব জায়গায় Ground Level Concentration সবচেয়ে বেশি বলে অনুমিত হয় সেসব জায়গায় পরিবেষ্টক বায়ুর গুণগত মান (SOx, NOx, CO) এবং শব্দের গুণগতমান পরীক্ষাপূর্বক অত্র দপ্তরে দাখিল করতে হবে। বিশ্লেষিত ফলাফল পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭-এ উল্লেখিত মানমাত্রার বহির্ভূত হলে এ ছাড়পত্র বাতিল বলে গণ্য হবে।
- ৫। কুলিং ওয়াটার পুনঃ ব্যবহারের জন্য স্থাপিত সকল ব্যবস্থাদি যথাযথভাবে কার্যক্ষম রাখতে হবে।
- ৬। বায়বীয় বর্জ্য নির্গমনের জন্য স্থাপিত Exhaust চিমনীসমূহ সার্বক্ষণিক কার্যক্ষম রাখতে হবে।
- ৭। Spent Lubricating Oil এবং Oil Filter পরিবেশ অধিদপ্তরের ছাড়পত্র গ্রহণকারী প্রতিষ্ঠান ব্যতিরেকে অন্য কোন Vendor এর কাছে বিক্রি করা যাবে না।
- ৮। বিদ্যুৎ কেন্দ্রে স্ট্র Residual Filtrate অথবা তৈল মিশ্রিত বর্জ্য কোন জলাশয়ে ফেলা যাবে না।
- ৯। ইএমপি প্রতিবেদনে উল্লেখিত সকল মিটিগেশন মেজার্স সার্বক্ষণিক কার্যকরীভাবে চালু রাখতে হবে।
- ১০। বিদ্যুৎ কেন্দ্রের চতুরে ন্যূনতম ৩৩% জায়গা উপযুক্ত প্রজাতির ফলজ ও বনজ গাছ লাগিয়ে সবুজায়ন করতে হবে।
- ১১। Down Wind Direction এবং যেসব জায়গায় Ground Level Concentration সবচেয়ে বেশি বলে অনুমিত হয় সেসব জায়গায় পরিবেষ্টক বায়ুর গুণগত মান (SOx, NOx, CO) নিয়মিত মনিটর করতে হবে এবং মনিটরিং ফলাফল প্রতি তিন মাস অন্তর পরিবেশ অধিদপ্তরে দাখিল করতে হবে।
- ১২। বিদ্যুৎ কেন্দ্রের পরিবেশগত ব্যবস্থাপনার জন্য প্রশিক্ষিত জনবল রাখতে হবে। কারখানা/প্রতিষ্ঠানের বর্জ্য ব্যবস্থাপনা সম্পর্কে দৈনিক ভিত্তিতে রেকর্ড সংরক্ষণ করতে হবে। প্রতি তিন মাস অন্তর অন্তর সংরক্ষিত রেকর্ডের সার-সংক্ষেপ রিপোর্ট আকারে পরিবেশ অধিদপ্তরে দাখিল করতে হবে।
- ১৩। পেশাগত স্বাস্থ্য রক্ষার্থে সকল ব্যবস্থা সার্বক্ষণিক চালু রাখতে হবে। শ্রমিকদের নিয়মিত স্বাস্থ্য পরিক্ষা করতে হবে এবং এতদসংক্রান্ত রেকর্ড সংরক্ষণ করতে হবে।
- ১৪। অগ্নি দূর্ঘটনা নির্বাপনকল্পে প্রান্তে যথোপযুক্ত ব্যবস্থাদি যথা ফায়ার এক্সিট, ফোমিং কম্পাউন্ডসহ ফায়ার হাইড্রেন্ট, ইমারজেন্সি লাইট স্থাপন, ভূ-গর্ভস্থ বা ভূ-উপরিস্থ জলাধারে সর্বদা পর্যাপ্ত পানি সংরক্ষণ ইত্যাদি ব্যবস্থাদি সার্বক্ষণিক কার্যকর রাখতে হবে।
- ১৫। বিদ্যুৎ কেন্দ্রের শব্দ এবং তরল/বায়বীয় বর্জ্যের নিঃসরণ/নির্গমন মাত্রা যথাক্রমে শব্দ দূষণ (নিয়ন্ত্রণ) বিধিমালা, ২০০৬ এবং পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭-এ বর্ণিত মানমাত্রার মধ্যে হতে হবে।
- ১৬। উপরোক্ত শর্তসমূহ যথাযথ ভাবে বাস্তবায়িত/প্রতিপালিত না হলে পরিবেশগত ছাড়পত্র বাতিল করা হতে পারে।
- ১৭। বাংলাদেশ পরিবেশ সংরক্ষণ আইন ১৯৯৫, পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এ প্রদত্ত ক্ষমতা বলে উপরিলিখিত শর্তসমূহ এনফোর্স করা হবে।
- ১৮। এ ছাড়পত্র কোন অবস্থাতেই হস্তান্তর যোগ্য নয়।
- ১৯। পরিবেশগত ছাড়পত্রের মূলকপি বিদ্যুৎ কেন্দ্রে সংরক্ষণ করতে হবে। পরিবেশ অধিদপ্তরের পরিদর্শক ও পরিদর্শনের ক্ষমতাপ্রাপ্ত অন্যান্য কর্মকর্তাগণ কারখানা পরিদর্শনকালে ছাড়পত্র/নবায়নপত্র দেখতে চাইলে তা দেখাতে হবে এবং ছাড়পত্র/নবায়নপত্র কারখানার এমন স্থানে কুলিয়ে রাখতে হবে যা সহজে দেখা যায়।
- ২০। এই ছাড়পত্র জারীর তারিখ হতে পরবর্তী ১(এক) বৎসরের জন্য বহাল থাকবে এবং মেয়াদ শেষ হওয়ার অন্তত ৩০(ত্রিশ) দিন পূর্বে উহা নবায়ন করতে হবে।
- ২১। উপর্যুক্ত ১-২০ অনুচ্ছেদে বর্ণিত যে কোন শর্ত ভংগ করলে এ ছাড়পত্র বাতিল বলে গণ্য হবে এবং আপনার/আপনাদের বিদ্যুৎ কেন্দ্রের বিরুদ্ধে বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫; পরিবেশ সংরক্ষণ বিধিমালা ১৯৯৭ এবং শব্দ দূষণ (নিয়ন্ত্রণ) বিধিমালা, ২০০৬ অনুসারে আইনগত ব্যবস্থা গ্রহণ করা হবে।

(স্বাক্ষর সাহা)
সিনিয়র কমিস্ট

ফোন : ০৮৫১-৫৭৭৫৭

ব্যবস্থাপনা পরিচালক

আতগঞ্জ পাওয়ার স্টেশন কোম্পানী লিমিটেড (এপিএসসিএল)

আতগঞ্জ ৬৩৪ মেগাওয়াট গ্যাস ইঞ্জিন পাওয়ার প্লান্ট

উপজেলাঃ আতগঞ্জ, জেলাঃ ব্রাহ্মণবাড়িয়া।



পরিবেশ অধিদপ্তর

ব্রাহ্মণবাড়িয়া জেলা অফিস, ব্রাহ্মণবাড়িয়া।



নম্বর- ২১৬

[বাংলাদেশ পরিবেশ সংরক্ষণ আইন ১৯৯৫ এর (১২) ধারা ও পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এর বিধি (৭) অনুযায়ী ছাড়পত্র]

স্মারক নং- পরিবেশ/ব্রাহ্মণবাড়িয়া/ছাড়পত্র-৬৫৮/২০১৫/ ৮৮

১১/০২/১৪২২ বঙ্গাব্দ
তারিখঃ
২৫/০৫/২০১৫ খ্রিঃ

পরিবেশগত ছাড়পত্র

পরিবেশ অধিদপ্তর, সদর দপ্তর, ঢাকার ০৩/০২/২০১৫ তারিখের পরিবেশ বিষয়ক কমিটির ৩৮২ তম সভার কার্যবিবরণীর ক-০৫ নম্বর সিদ্ধান্ত মোতাবেক পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ অনুযায়ী “লাল” শ্রেণীভুক্ত বিবেচনায় সোনারামপুর, আশুগঞ্জ ব্রাহ্মণবাড়িয়া-এ অবস্থিত আশুগঞ্জ ৫০ মেগাওয়াট গ্যাস ইঞ্জিন পাওয়ার প্লান্ট নামক ৫০ মে.ওয়াট বিদ্যুৎ উৎপাদন কেন্দ্র প্রকল্পটির অনুকূলে নিম্নবর্ণিত শর্তে পরিবেশগত ছাড়পত্র প্রদান করা হলো।

শর্তাবলী :

- ১। বিদ্যুৎ উৎপাদন কেন্দ্রের কোন কর্মকাণ্ড ও প্রক্রিয়া দ্বারা কোনভাবে পরিবেশ (মাটি, পানি, বায়ু ও শব্দ) দূষণ করা যাবে না।
- ২। এ ছাড়পত্র ৫০ মেগাওয়াট বিদ্যুৎ উৎপাদনের জন্য প্রযোজ্য। প্রকল্পের উৎপাদন বৃদ্ধি, জায়গার সম্প্রসারণ, উৎপাদন প্রক্রিয়ায় বা তৎসংশ্লিষ্ট কোন প্রকার পরিবর্তনের জন্য পরিবেশ অধিদপ্তরের পূর্বানুমতি/ছাড়পত্রের প্রয়োজন হবে।
- ৩। বিদ্যুৎ কেন্দ্র হতে গ্যাসীয় পদার্থের নিঃসরণ (SOx, NOx, CO ইত্যাদি) এবং বস্তুকণার (Particulate Matters) নির্গমন পরিবেশ সংরক্ষণ বিধিমালা-১৯৯৭ এ উল্লেখিত মানমাত্রার মধ্যে হতে হবে। যে কোন সময় তাৎক্ষণিক সংগৃহীত নমুনায় এই মানমাত্রা অতিক্রম হতে পারবে না। কোন সময় দূষণ নিয়ন্ত্রণ ব্যবস্থা অকার্যকর হলে সাথে সাথে সংশ্লিষ্ট উৎপাদন ইউনিট বন্ধ করতে হবে। দূষণ নিয়ন্ত্রণ ব্যবস্থা সংস্কার করে বিধিবদ্ধ মানমাত্রা নিশ্চিতকরণ সাপেক্ষে বন্ধ ইউনিট পুনরায় চালু করা যাবে।
- ৪। এ ছাড়পত্র জারীর তিন মাসের মধ্যে বিদ্যুৎ কেন্দ্রের Down Wind Direction এবং যেসব জায়গায় Ground Level Concentration সবচেয়ে বেশি বলে অনুমিত হয় সেসব জায়গায় পরিবেষ্টক বায়ুর গুণগত মান (SOx, NOx, CO) এবং শব্দের গুণগতমান পরীক্ষাপূর্বক অত্র দপ্তরে দাখিল করতে হবে। বিশ্লেষিত ফলাফল পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭-এ উল্লেখিত মানমাত্রার বহির্ভূত হলে এ ছাড়পত্র বাতিল বলে গণ্য হবে।
- ৫। কুলিং ওয়াটার পুনঃ ব্যবহারের জন্য স্থাপিত সকল ব্যবস্থাদি যথাযথভাবে কার্যক্ষম রাখতে হবে।
- ৬। বায়বীয় বর্জ্য নির্গমনের জন্য স্থাপিত Exhaust চিমনিসমূহ সার্বক্ষণিক কার্যক্ষম রাখতে হবে।
- ৭। Spent Lubricating Oil এবং Oil Filter পরিবেশ অধিদপ্তরের ছাড়পত্র গ্রহণকারী প্রতিষ্ঠান ব্যতিরেকে অন্য কোন Vendor এর কাছে বিক্রি করা যাবে না।
- ৮। বিদ্যুৎ কেন্দ্রে সৃষ্ট Residual Filtrate অথবা তৈল মিশ্রিত বর্জ্য কোন জলাশয়ে ফেলা যাবে না।
- ৯। ইএমপি প্রতিবেদনে উল্লেখিত সকল মিটিগেশন মেজার্স সার্বক্ষণিক কার্যকরীভাবে চালু রাখতে হবে।
- ১০। বিদ্যুৎ কেন্দ্রের চত্তরে ন্যূনতম ৩৩% জায়গা উপযুক্ত প্রজাতির ফলজ ও বনজ গাছ লাগিয়ে সবুজায়ন করতে হবে।
- ১১। Down Wind Direction এবং যেসব জায়গায় Ground Level Concentration সবচেয়ে বেশি বলে অনুমিত হয় সেসব জায়গায় পরিবেষ্টক বায়ুর গুণগত মান (SOx, NOx, CO) নিয়মিত মনিটর করতে হবে এবং মনিটরিং ফলাফল প্রতি তিন মাস অন্তর পরিবেশ অধিদপ্তরে দাখিল করতে হবে।
- ১২। বিদ্যুৎ কেন্দ্রের পরিবেশগত ব্যবস্থাপনার জন্য প্রশিক্ষিত জনবল রাখতে হবে। কারখানা/প্রতিষ্ঠানের বর্জ্য ব্যবস্থাপনা সম্পর্কে দৈনিক ভিত্তিতে রেকর্ড সংরক্ষণ করতে হবে। প্রতি তিন মাস অন্তর অন্তর সংরক্ষিত রেকর্ডের সার-সংক্ষেপ রিপোর্ট আকারে পরিবেশ অধিদপ্তরে দাখিল করতে হবে।
- ১৩। পেশাগত স্বাস্থ্য রক্ষার্থে সকল ব্যবস্থা সার্বক্ষণিক চালু রাখতে হবে। শ্রমিকদের নিয়মিত স্বাস্থ্য পরিক্ষা করতে হবে এবং এতদসংক্রান্ত রেকর্ড সংরক্ষণ করতে হবে।
- ১৪। অগ্নি দুর্ঘটনা নির্বাপনকল্পে প্লান্টে যথোপযুক্ত ব্যবস্থাদি যথা ফায়ার এক্সটিংগুইশার, ফোমিং কম্পাউন্ডসহ ফায়ার হাইড্রেন্ট, ইমারজেন্সি লাইট স্থাপন, ডু-গর্ভস্থ বা ডু-উপরিস্থ জলাধারে সর্বদা পর্যাপ্ত পানি সংরক্ষণ ইত্যাদি ব্যবস্থাদি সার্বক্ষণিক কার্যকর রাখতে হবে।
- ১৫। বিদ্যুৎ কেন্দ্রের শব্দ এবং তরল/বায়বীয় বর্জ্যের নিঃসরণ/নির্গমন মাত্রা যথাক্রমে শব্দ দূষণ (নিয়ন্ত্রণ) বিধিমালা, ২০০৬ এবং পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭-এ বর্ণিত মানমাত্রার মধ্যে হতে হবে।
- ১৬। উপরোক্ত শর্তসমূহ যথাযথ ভাবে বাস্তবায়িত/প্রতিপালিত না হলে পরিবেশগত ছাড়পত্র বাতিল করা হতে পারে।
- ১৭। বাংলাদেশ পরিবেশ সংরক্ষণ আইন ১৯৯৫, পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এ প্রদত্ত ক্ষমতা বলে উপরিলিখিত শর্তসমূহ এনফোর্স করা হবে।
- ১৮। এ ছাড়পত্র কোন অবস্থাতেই হস্তান্তর যোগ্য নয়।
- ১৯। পরিবেশগত ছাড়পত্রের মূলকপি বিদ্যুৎ কেন্দ্র সংরক্ষণ করতে হবে। পরিবেশ অধিদপ্তরের পরিদর্শক ও পরিদর্শনের ক্ষমতাপ্রাপ্ত অন্যান্য কর্মকর্তাগণ কারখানা পরিদর্শনকালে ছাড়পত্র/নবায়নপত্র দেখতে চাইলে তা দেখাতে হবে এবং ছাড়পত্র/নবায়নপত্র কারখানার এমন স্থানে স্থুলিয়ে রাখতে হবে যা সহজে দেখা যায়।
- ২০। এই ছাড়পত্র জারীর তারিখ হতে পরবর্তী ১(এক) বৎসরের জন্য বহাল থাকবে এবং মেয়াদ শেষ হওয়ার অন্তত ৩০(ত্রিশ) দিন পূর্বে উহা নবায়ন করতে হবে।
- ২১। উপর্যুক্ত ১-২০ অনুচ্ছেদে বর্ণিত যে কোন শর্ত ভঙ্গ করলে এ ছাড়পত্র বাতিল বলে গণ্য হবে এবং আপনাত/আপনাদের বিদ্যুৎ কেন্দ্রের বিরুদ্ধে বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫; পরিবেশ সংরক্ষণ বিধিমালা ১৯৯৭ এবং শব্দ দূষণ (নিয়ন্ত্রণ) বিধিমালা, ২০০৬ অনুসারে আইনগত ব্যবস্থা গ্রহণ করা হবে।

২৫/৫/২০১৫
(সুকুমার সাহা)
সিনিয়র কমিস্ট

ফোন : ০৮৫১-৫৭৭৫৭

ব্যবস্থাপনা পরিচালক

আশুগঞ্জ ৫০ মেগাওয়াট গ্যাস ইঞ্জিন পাওয়ার প্লান্ট

আশুগঞ্জ ৫০ মেগাওয়াট গ্যাস ইঞ্জিন পাওয়ার প্লান্ট

Annexure-13(b)

**Site Clearance Certificate of Ashuganj
400 MW CCPP (East)**

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe.gov.bd

Memo No: DoE/Clearance/5484/2015/ 380

Date: 28/07/2015

Subject: Site Clearance for Ashuganj 400 MW Combined Cycle Power Plant (East) at Ashuganj under Brahmanbaria District.

Ref: Your Application dated 18/05/2015.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance for Ashuganj 400 MW Combined Cycle Power Plant (East) at Ashuganj under Brahmanbaria District subject to fulfilling the following terms and conditions.

1. This clearance shall only be applicable for the development of the infrastructure of the said project.
2. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE) and additional suggestions provided herein.
3. The EIA report should be prepared in accordance with following indicative outlines:
 1. Executive summary.
 2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references).
 3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared).
- 4a. Project activities:
 - A list of the main project activities to be undertaken during site clearing, construction as well as operation
 - Project Plan, Design, Standard, Specification, Quantification, etc.
- 4b. Project schedule: The phase and timing for development of the Project.
- 4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.
- 4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.
5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
 - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology and Hydrology
 - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
 - Environment Quality : Air, Water, Noise, Vibration, Soil and Sediment Quality

- Relate baseline in both Quantitative and Qualitative term with the anticipated comes, achievement of goals, objectives and changes due to project interventions

6. Socio-economic environment should include, inter alia, following:

- Population: Demographic profile and ethnic composition
- Settlement and housing
- Traffic and transport
- Public utilities: water supply, sanitation and solid waste
- Economy and employment: employment structure and cultural issues in employment
- Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.

7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).

In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man made or natural, wildlife, socio-economic aspect shall be incorporated in detail.

Appropriate models shall be used for prediction of potential impacts of the project on surface water and ambient air quality using updated data. Model prediction shall be compared with national water and air quality standards and specific sensitivity data of the organisms known to be present in the project area (likely impacted area) for impact assessment.

8. Management Plan/Procedures:

For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.

An outline of the Environmental Management Plan shall be developed for the project.

In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).

9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)

Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)

10. Risk assessment, risk management, system of valuation of environmental and properties damage, damage compensation issues shall be addressed

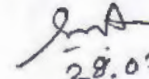
11. Conclusion and Recommendations

4. Without approval of EIA report by the Department of Environment, the Project authority shall not be able to open L/C in favor of importable machineries.
5. Without obtaining Environmental Clearance, the Project authority shall not start the operation of the project.



6. The Project authority shall submit the EIA along with a filled-in application for Environmental Clearance in prescribed form, the feasibility report, the applicable fee in a treasury Chalan, the no objection certificates from appropriate authorities (if applicable) and other necessary documents.
7. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to Brahmanbaria District Office with a copy to the Head Office of DOE at least 30 days ahead of expiry.

This Site Clearance Certificate has been issued with approval from the appropriate authority.


28.07.2015

(Syed Nazmul Ahsan)
Director (Environmental Clearance c.c)
Phone # 02-8181778

Managing Director

Ashuganj 400 MW Combined
Cycle Power Plant (East)
Sunarampur, Ashuganj
Brahmanbaria.

Copy Forwarded to :

- 1) PS to Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
- 2) Director, Department of Environment, Chittagong Divisional Office, Chittagong.
- 3) Deputy Director/Office In-charge, Department of Environment, Brahmanbaria District Office, Brahmanbaria.
- 4) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

Annexure-14 (a)

**Traffic Management Plan for
the Project**

Traffic Management Plan (TMP)

For

**TURNKEY EPC CONTRACT FOR
CONSTRUCTION OF
400MW COMBINED CYCLE POWER PLANT
(EAST)**

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1. Preface

This document is the Traffic Management Plan (TMP) for the Ashuganj Power Station Company's new 400MW Combined Cycle Power Plant (East) that will be built by the Turnkey EPC Contractors.

This TMP is required as part of a suite of resource consent conditions giving effect to the application by the contractor(s) during transportation and haulage of project cargoes from port/river port to project site.

It is stipulated that all cargoes/packages weighing more than 20Tons, all Heavy-lift (HL) and all Over Dimension Cargoes (ODC) shall be transported from port to Ashuganj by river transport (flat-barge). All other cargoes/standard packages weighing up to 20Tons shall be transported by trucks or long-body trailers from port to project site.

The environmental controls specified in this TMP shall be the minimum requirements that shall be complied with by Contractor(s) when undertaking project cargo transportation/haulage activities involving vehicle movements to and from the project.

While this TMP is a final document, the conditions of consent provide that it may be varied so long as any variation is confined to the methodology by which the objectives and environmental controls within this plan are achieved.

This TMP has been prepared in reliance on the transportation assessment and that the existing road network will continue to provide safe and convenient access to and from the proposed development site and that, with the suggested improvements and mitigation measures described herein the report, it will be able to accommodate the volumes of traffic likely to be generated during transportation of project cargoes from Chittagong Port and/or Temporary Jetty at Ashuganj.

2. Description of Site

The site is located within the boundary of existing Ashuganj Power Station Company Limited (APSCL) at Ashuganj. The physical location of the site is adjacent to Dhaka-Sylhet Highway N2 and the site lies between Dhaka-Sylhet Highway N2 and multi-storied staff quarters of APSCL. The site has been developed by sand-filling. Dredged river sand has been used for land development.

3. Overview

Successful completion of the project is primarily dependent on the availability of various plants, equipment and machineries that are integral and essential components of the power plant. All of those essential components are imported from foreign manufacturers/sources. Any damage in transit, from port/river port to project site, requiring replacement of damaged component, could be very expensive in terms of time and effort and may jeopardize the project completion schedule. As such, the prime purpose of the TMP is to ensure safety of the project cargoes during transportation and haulage from port/river port to project site.

The TMP sets out how traffic will be managed during transportation and haulage of project cargoes containing plants, equipment and machineries to ensure that the cargoes are delivered safely to the project site.

The TMP includes measures to manage effects on the environment during construction of those fixed elements of the project only, and does not include any ongoing management or monitoring measures except those pertaining to traffic movement related to transportation and haulage of project cargoes in particular.

3.1 Objectives:

The objectives of the TMP are to:

- Meet the specific requirements for traffic management including, where required, to obtain approval from road controlling authorities for the activities required. Where any approval is required from a private land holder, or a person having an interest in private land, to obtain those approvals before undertaking any work, be in accordance with the relevant By-Laws, Acts, Regulations prevailing in the country;
- Adopt Code of Practice for Traffic Management including any activity that varies the normal operating conditions of any road;
- Ensure the application of best practice methodology to all traffic controls associated with transportation and haulage of project cargoes from Chittagong port and Temporary Jetty at Ashuganj;
- Ensure compliance with relevant legislative requirements;
- Effectively manage project cargo traffic generated during the construction phase of the project so that:
 - Project traffic volumes are safely accommodated within the existing road network;
 - So far as is reasonable congestion or traffic delays are avoided;
 - Encourage positive attention to the needs of other road users and liaison with road controlling authorities, residents, businesses, sports facilities, major events organizers and emergency services.

3.2 Review of Traffic Management Plan

The Traffic Management Plan may be reviewed for the purposes of informing any variation of the methodology or means by which the environmental controls outlined in Section 3 will be met.

Reviews of Traffic Management Plan may be undertaken when:

- A previously unforeseen event occurs
- Following any major environmental incidents
- At the end of the project (to allow for improvements in subsequent projects)

4. Environmental Controls

The following environmental controls have been identified as those minimum requirements which all construction related traffic activities must adhere to in order to minimize any potential adverse environmental effects on the surrounding transportation network.

4.1 Travel Routes

EPC Contractor(s) shall use the specific travel routes for all traffic movements for transportation and haulage of cargoes by standard trucks and long-body trailers (excluding heavy haulage and over-sized loads).

Specific travel routes will be recommended to all sub-contractors with clear directives to utilize the following roads when traveling to and from the project site during the extent of the construction period, as far as practical;

National Highways N2 (Dhaka-Sylhet),
N1 (Dhaka-Chittagong),
N102 (Comilla-Sylhet),
N105 (Madanpur-Dhaka Bypass) Routes

4.2 Transportation and Haulage of Cargoes by Truck and Long-body Trailer from Chittagong Port

4.2.1 Only conventional packages weighing up to 20Tons, which can be safely transported on either a standard truck or a long-body trailer, shall be transported by road from port to project site.

4.2.2 Contractor(s) shall use the following National Highways for transportation and haulage of cargoes from Chittagong Port:

National Highways N2 (Dhaka-Sylhet),
N1 (Dhaka-Chittagong),
N102 (Comilla-Sylhet),
N105 (Madanpur-Dhaka Bypass) Routes

4.2.3 Route – 1:

Chittagong – Feni – Comilla – Moinamoti/Kakoli – Debidwar – Companyganj – Brahmanbaria – Khatihata – Bertola – Ashuganj.

Distance: 255km

4.2.4 Route – 2:

Chittagong – Feni – Comilla – Daudkandi – Meghnaghat – Modonpur – Bhulta – Madhabdi – Panchdona – Bhelanagar – Itakhola – Bhairab Bazar – Ashuganj.

Distance: 307km

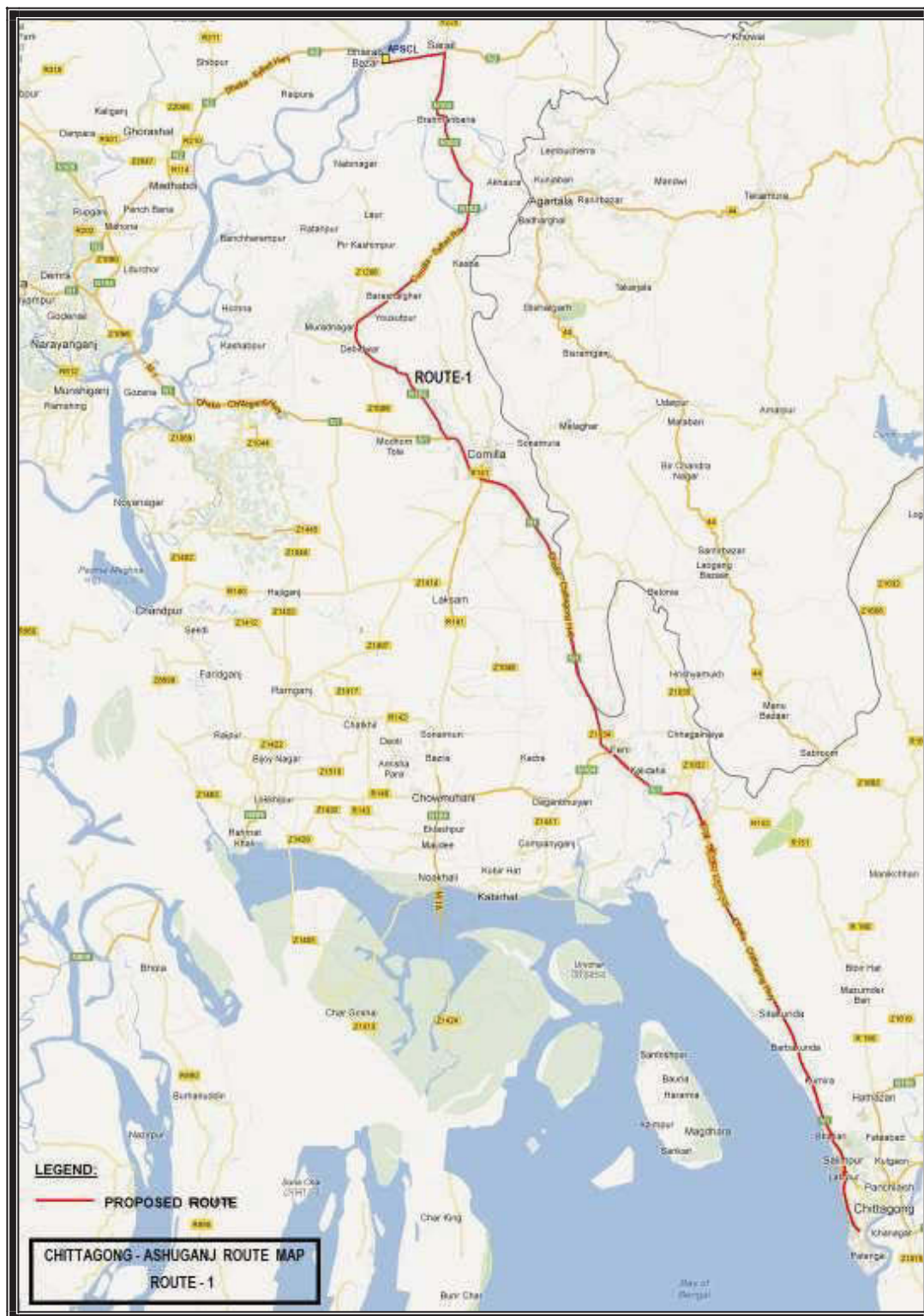


Figure-1: Chittagong – Ashuganj Route Map (Route – 1)

4.2.5 If the road condition permits, or if there is no restriction imposed by road owning agency, then Route-1 shall be used for transportation of cargoes/packages from Chittagong Port.

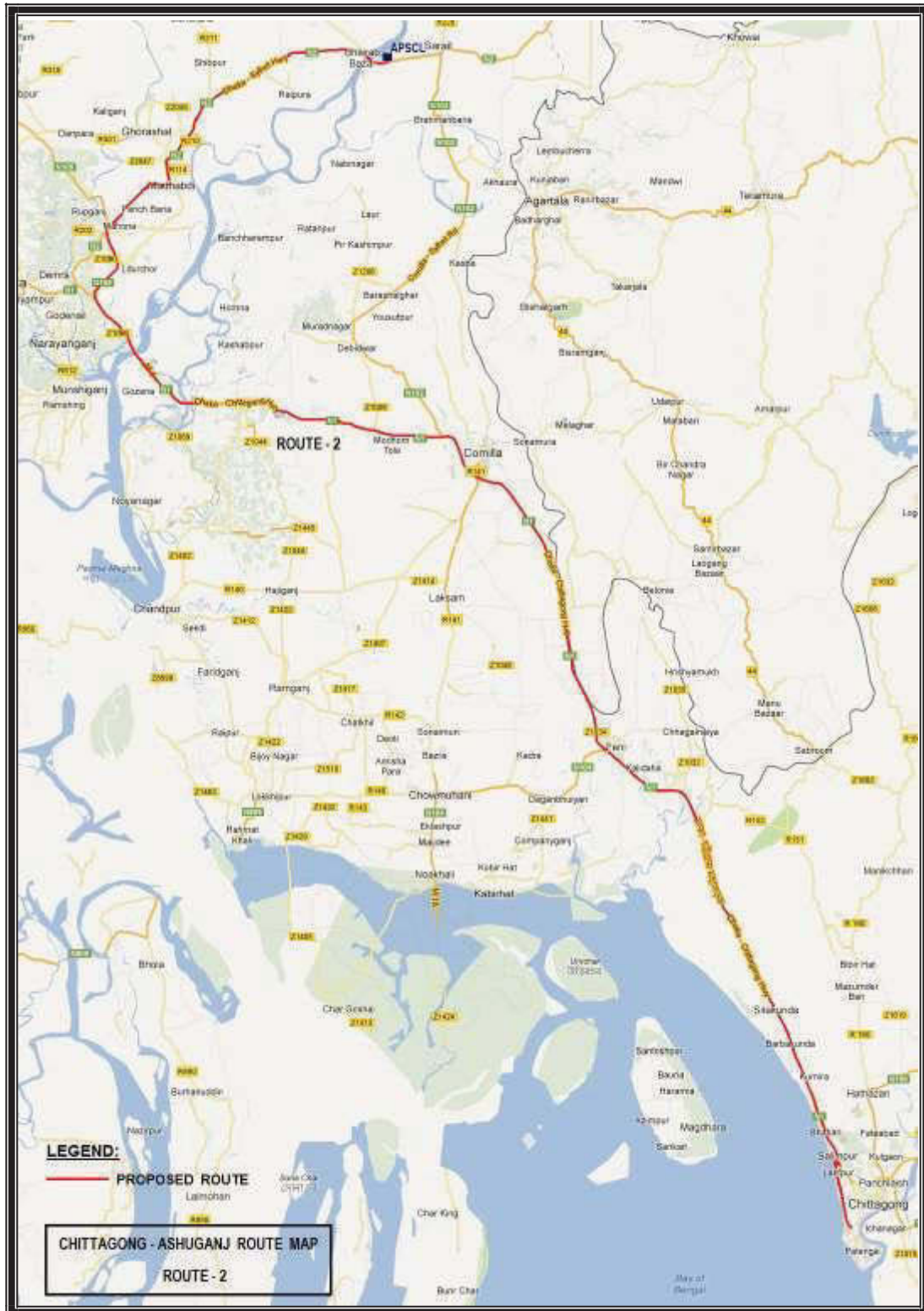


Figure-2: Chittagong – Ashuganj Route Map (Route – 2)

4.2.6 Route-2 shall be used only if Route-1 cannot be used, for any reason, for transportation of cargoes/packages from Chittagong Port.

- 4.2.7 Standard trucks and long-body trailers shall be used for transportation of cargoes. However, special directive will be given to individual vehicle operators about the route that shall be followed for transportation and haulage.
- 4.2.8 The movement of vehicles, engaged for transportation of project cargoes, shall usually be limited to daylight hours. However, under special circumstances, nighttime driving may be permitted that shall require obtaining special permit and require special additional safety precautions.
- 4.2.9 No vehicle, loaded with project cargo, shall move without either an Onboard Escort or Escort Vehicle(s), to be decided by EPC Contractors/APSCL prior to commencement of journey.
- 4.2.10 When more than one vehicle are required for transportation of delivered cargoes from port, then the vehicles shall move in convoy, with an escort vehicle moving ahead of the convoy and another escort vehicle moving at the trailing end of the convoy.
- 4.2.11 The maximum speed of vehicles engaged for transportation of project cargoes shall never exceed 45km per hour. The supervisor(s) in escort vehicle(s) shall monitor the speed and shall act appropriately to control the speed, if necessary.
- 4.2.12 Cell phones shall be used for communications with the vehicles in the convoy for controlling their movement and coordination.
- 4.2.13 All the drivers of the trucks and long-body trailers including their assistants, if any, shall have cell phones. Also, the drivers of escort vehicles and the supervisors shall have cell phones. However, the drivers under no circumstances shall converse on cell phones while driving. Either driver's assistant shall answer to any phone call, or the driver shall stop the vehicle at a suitable place, not interfering with traffic movement, and respond to phone call.
- 4.2.14 The cell phone numbers of the supervisor(s), accompanying the vehicle(s), shall be made known to EPC Contractors and APSCL officials prior to commencement of journey from Chittagong.
- 4.2.15 If overnight stoppage becomes essential, then the vehicle(s) shall be parked in a suitable parking space outside the highway, preferably in a filling station or any other roadside facility having suitable parking space. Under no circumstances, the vehicles shall be parked alongside the highway.

- 4.3.8 Special attention shall be paid when the heavy-lift or over-dimension cargoes reach the roundabout ahead of Ashuganj Toll Plaza of Syed Nazrul Islam Bridge, because there could be appreciable interference of public transports and pedestrians in the section between the roundabout and the entry to project site.
- 4.3.9 Controlling movement or total stoppage of public transports, vehicles and pedestrians between the roundabout and the entry to project site (approximately 450 meters) may become necessary during transportation of some heavy-lift cargoes and all over-dimension packages. Such action shall be taken in coordination with local traffic authorities and local police authorities prior to commencement of such movement of cargoes.

4.4 Detail Traffic Management

Detail traffic management measures and layout plans will be prepared and provided to EPC Contractors/Client for their prior approval. The detail traffic management measures shall include:

- Appointment of suitably trained Site Traffic Management Supervisor and/or a Traffic Controller and staffs, implementation and application of traffic management controls
- Arranging for the publication of approved notices in local newspapers or other media notifying of any potential delays due to movement of heavy-lift and/or over-dimension cargoes
- Recording details of regular inspections/audits of traffic management measures
- Reporting of any incident/accident at work.

4.5 Monitoring

EPC Contractors/APSCL shall follow a monitoring protocol to monitor movement of transport vehicles engaged for transportation of project cargoes. EPC Contractors/APSCL shall engage personnel for such monitoring. As a minimum the monitoring protocol will address the following matters:

- Delays and other disruptions resulting from slow-moving heavy-lift and/or over-dimension cargoes;
- Implementation and compliance with traffic management provisions outlined in Section 4.4 above, as required by the Code of Practice for Traffic Management

The monitoring is required to ensure that there are no inappropriate or unreasonable delays, disruption, or adverse safety effects on other vehicles using the network. Where that monitoring shows that there are problems, the contractor will take steps immediately to address them.

4.6 Communication Protocols

The following communications protocol shall be adopted and implemented including but not limited to the following matters:

- Names and contact details of key staff and/or contractors responsible for implementing the Transport Management Plan
- Contact details of key staff(s) within EPC Contractors/APSCL, and/or any other third party who have operational interests in the surrounding road network.
- Contact details and location of the main site office and any satellite offices
- Details of signage to be established, including content and locations

- Location of all relevant consents, managements plans, health and safety plans, and other key project documentation
- A process for receiving and responding to complaints, including a register for recording all complaints and actions taken
- A process for scheduling planned heavy haulage and over-sized load vehicle trips such that this can be communicated to the general public and local Traffic authorities
- A list of people and organizations that the TMP will be distributed to. All amendments and updates to the TMP will then be forwarded to those named on the list.

4.7 Emergency Response and Incident Management

Serious accidents or emergencies must be reported immediately to EPC Contractors, APSCL, the local police station and the relevant emergency services.

All reports of accidents and other environmental emergencies, regardless of their origin are to be reported to the Construction Manager. An environmental emergency is any event that causes or has the potential to cause material harm to the environment or people.

Where disruption to traffic or significant damage has occurred within the road network, the appropriate Traffic authority shall be notified immediately.

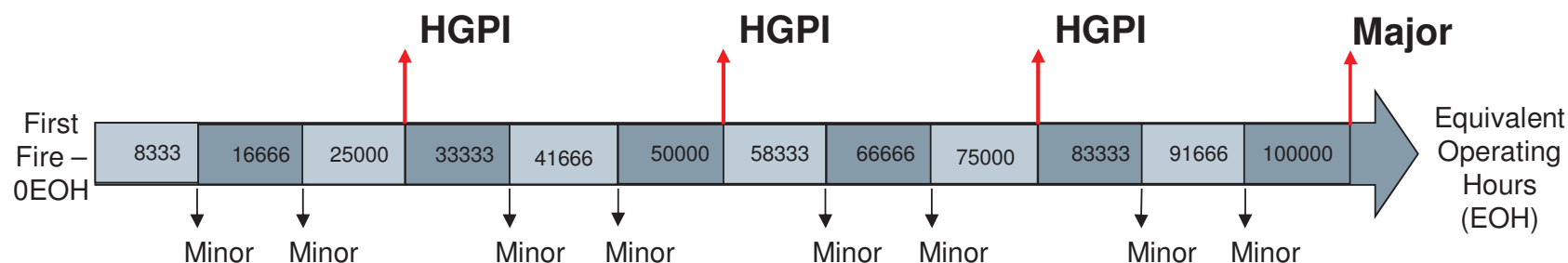
All incidents on the project involving environmental non-compliance will be recorded and reported through the EPC Contractors' incident and non-conformance procedures. An environmental incident register will held at the Site office. Environmental incidents will be regularly discussed between all parties involved in the project execution.

Annexure-14(b)
**Turbine Maintenance Plan for
the Project**

Maintenance – Scheduled Outage Example (4000F – APSCL)

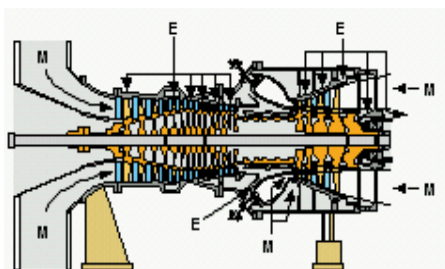
GT Inspection Schedule:

(25 kEOH Interval)

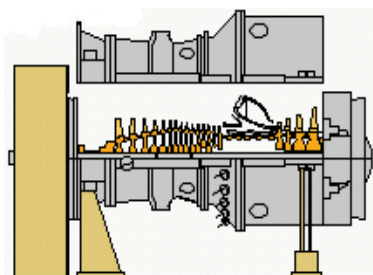


Inspection Types:

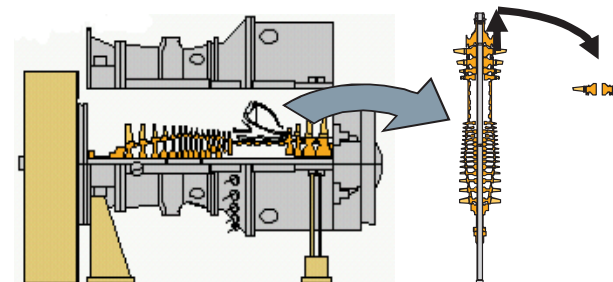
Minor Inspection (MI)



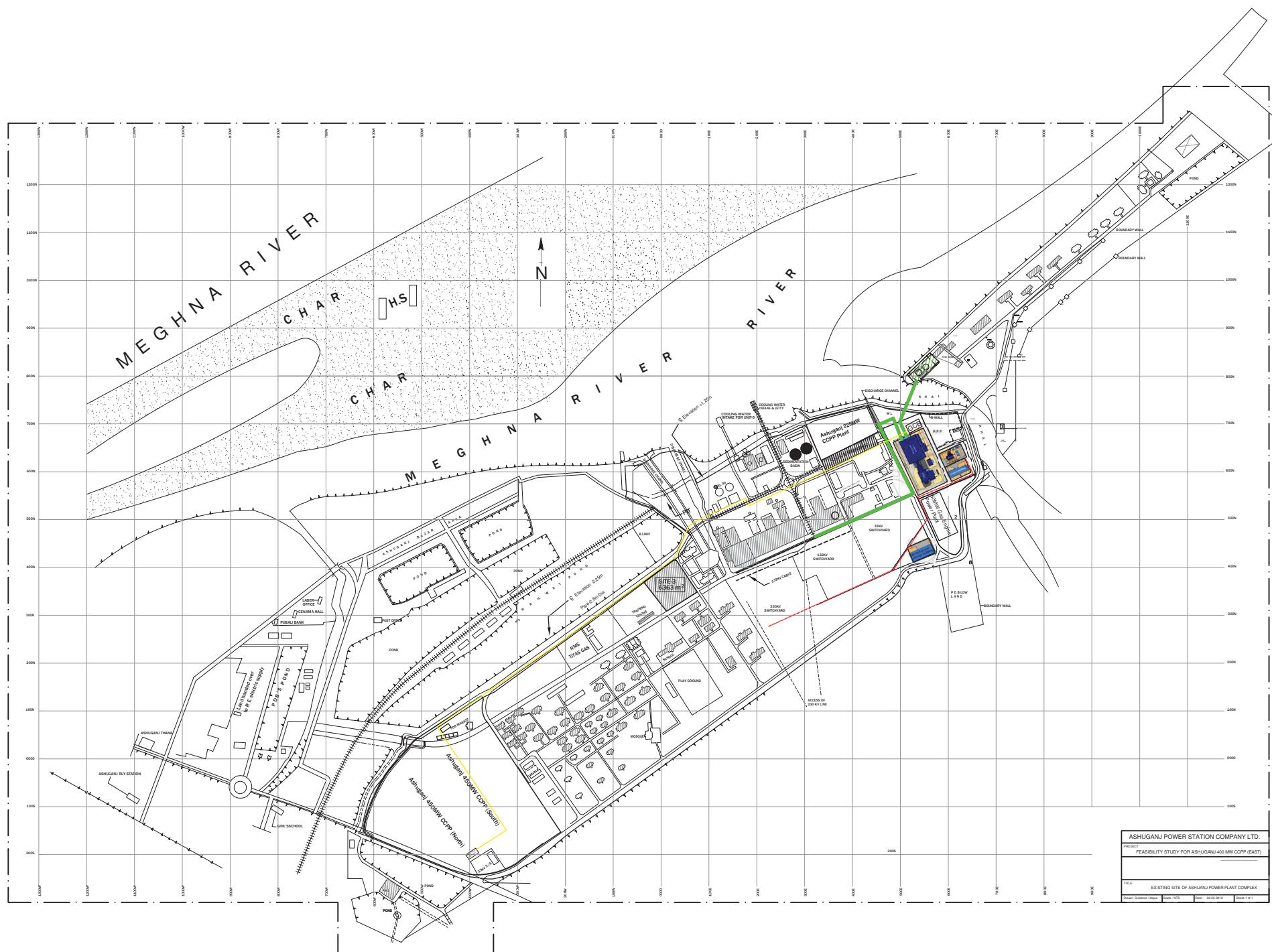
Hot Gas Path Inspection (HGPI)



Major Inspection (Major)



Annexure-15
Discharge Plan



Annexure-16
EIA of Associated Facility

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF POWER, ENERGY & MINERAL RESOURCES
POWER GRID COMPANY OF BANGLADESH LTD. (PGCB)



Report on
Environmental Impact Assessment (EIA)
for

ASHUGANJ – BHULTA 400 kV TRANSMISSION LINE PROJECT



Dhaka

May 29, 2014

Submitted by



**Center for Environmental and Geographic
Information Services**

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GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

MINISTRY OF POWER, ENERGY & MINERAL RESOURCES

POWER GRID COMPANY OF BANGLADESH LTD. (PGCB)



**REPORT
ON
ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

FOR

**ASHUGANJ – BHULTA 400 KV TRANSMISSION LINE
PROJECT**

May 29, 2014

Dhaka



Center for Environmental and Geographic Information Services
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Acknowledgements

The Centre for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources, Government of Bangladesh has been entrusted with the responsibility of conducting Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Studies for the “Ashuganj – Bhulta 400 kV Transmission Line Project” of the Power Grid Company of Bangladesh (PGCB) Limited. CEGIS expresses its gratitude to the PGCB Authority for entrusting CEGIS for the IEE and EIA studies. CEGIS is grateful to Masum-Al-Beruni, Managing Director, PGCB for giving it the scope to work with PGCB. CEGIS is also grateful to Engr. Chowdhury Alamgir Hossain, Executive Director (P&D), PGCB for his cordial cooperation for the study from very beginning. CEGIS is furthermore grateful to Engr. Kazi Ahsan Shafiq, Chief Engineer (P&D), and Engr. Farid Uddin Ahmed, Chief Engineer (Projects) in this regard. CEGIS gives special thanks to Engr. Md. Shafiqur Rahman the Superintending Engineer and Project Director (Addl. Charge) of Ashuganj – Bhulta 400 kV Transmission Line Project for coordinating the EIA study with due responsibility and diligence. The contributions of Engr. Bijoy Kumar Das, Executive Engineer (Addl. Charge), Engr. Md. Mamun Hasan, Executive Engineer, Kulaura-Sherpur Project of the PGCB are gratefully acknowledged in this regard.

Members of the EIA Team were impressed with the spontaneous response received from local people in providing data and information. Their contribution is also gratefully recognized by CEGIS. Special gratitude is expressed to the local people who had given their valuable time to respond to the EIA team during the different surveys, discussions and consultation meetings.

We also express our gratitude and thanks to the officials of Ashuganj Power Company Ltd. for their kind co-operation.

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Abbreviations

ARIPO	Acquisition and Requisition of Immovable Property Ordinance
AEZ	Agro-Ecological Zone
APCL	Ashuganj Power Company Limited
AP	Angle Point
BBS	Bangladesh Bureau of Statistics
BFD	Bangladesh Forest Department
BFIDC	Bangladesh Forest Industries Development Corporation
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BOOT	Build Own Operate and Transfer
BWDB	Bangladesh Water Development Board
CCPP	Combined Cycle Power Plant
CEGIS	Center for Environmental and Geographic Information Services
CITES	Convention on International Trade in endangered species
DEPC	Department of Environmental Pollution Control
DG	Director General
DIA	Direct Impact Area
DoE	Department of Environment
DoF	Department of Fisheries
DPP	Development Project Proforma
ECA	Environment Conservation Act
ECNEC	Executive Committee of the National Economic Council
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQS	Environment Quality Standards
FAO	Food and Agricultural Organization
FWIP	Future- with- Project
FWOP	Future- without- Project
GIA	General Impact Area
GIS	Geographic Information Services
GoB	Government of Bangladesh
GO	Government Organization
GTCL	Gas Transmission Company Limited
HES	Health Environment and Safety
HH	Household
HYV	High Yielding Variety
IEC	Important Environmental Component
IEE	Initial Environmental Examination
IESC	Important Environmental and Social Component
IoL	Inventory of Losses
IUCN	International Union for Conservation for Nature
LLP	Low Lift Pump

kV	kilo Volt
MoEF	Ministry of Environment and Forest
MW	Mega Watt
NCA	Net Cultivated Area
NCS	National Conservation Strategy
NEMAP	National Environmental Management Action Plan
NGO	Non- Governmental Organization
NOC	No Objection Certificate
NWRD	National Water Resource Database
OMS	Operation Management System
PAPs	Project Affected Persons
PD	Project Director
PCP	Project Concept Paper
PPE	Personnel Protective Equipment
PGCB	Power Grid Company Bangladesh Ltd.
RAP	Resettlement Action Plan
RCC	Reinforced Cement Concrete
RoW	Right of Way
RS	Remote Sensing
SRDI	Soil Research Development Institute
TL	Transmission Lines
UNCED	United Nations Conference on Environment and Development
WARPO	Water Resources Planning Organization
WTO	World Trade Organization

Executive Summary

Background of the Project

The Power Grid Company of Bangladesh Ltd. (PGCB) is planning to supply more electricity to Dhaka city area from the upcoming Power Plants in Ashuganj area to fulfil increasing future demand. The PGCB has planned to construct a double circuit power transmission line from Ashuganj to Bhulta and has accordingly developed a project named “Ashuganj–Bhulta 400 kV Transmission Line and 400/230 kV Substation at Bhulta Project” for implementation.

Objectives of the Project

The main objective of the Ashuganj-Bhulta 400 kV T/L Project is to supply electricity from the upcoming Power Plants in Ashuganj area to Dhaka city via Bhulta area for increasing reliability of power supply of this Mega City. The specific objectives are:

- I. To evacuate power to be generated in the upcoming 2X450 MW Combined Cycle Power Plant (CCPP) at Ashuganj and deliver power to the load centre (Dhaka);
- II. To supply more power through the Rampura 230/132 kV Sub-Station to meet the rapidly growing demand of the eastern region of Dhaka City; and
- III. To create power evacuation facilities for the future generating plants at Ashuganj.

Scope of work of the Project

The scope of the A-B 400 kV T/L Project is:

- I. Construction of Ashuganj to Bhulta 400kV Double Circuit T/L of around 70 km.; and
- II. Construction of a 400/230kV, 3X520MVA Sub-Station at Bhulta.

Physical Components of the Project

The major components of the Project are as follows:

- I. Construction of 70 km 400 kV Double Circuit Transmission Line from Ashuganj to Bhulta,
- II. Construction of a 400/230kV, 3X520MVA Sub-Station at Bhulta on 40 acre of privately owned land,
- III. In-out of Ghorashal-Rampura 230kV line to Bhulta 400/230 kV Sub-Station, and
- IV. In-out of Haripur-Rampura 230kV line to Bhulta 400/230 kV Sub-Station.

Study Area

The proposed Project is located in Dhaka and Chittagong administrative divisions of Bangladesh. The power transmission line will start from Ashuganj (Brahmanbaria district, Chittagong division) and end at Bhulta (Rupganj upazila of Narayanganj district, Dhaka

division). This line will cross Narsingdi Sadar upazila of Narsingdi district; Araihaazar, Rupganj and Sonargaon upazilas of Narayanganj district; and Ashuganj, Brahmanbaria Sadar, Nabinagar and Banchharampur upazilas of Brahmanbaria district.

In selecting the best alternative route for the transmission line 'option-4' has been finalised by analyzing the latest RS images and by considering the least impact to the socio-economic features and settlements.

Environmental and Socio-Economic Baseline

The gross area of the Project is 704 ha. The RoW crosses the Meghna River, the Titas River and a minor river named Pagla. About 55% of the study area is covered by F₂ type land. The prominent cropping pattern of the study area is Fallow-T Aman-HYV Boro which is practiced on 46.4% of the Net Cultivable Area (NCA). In terms of total annual cropped area, rice covers 89.5% and non-rice crops cover 10.5% area. Total crop production is 4,595 tons of which cleaned rice is 3,221 tons and non-rice is 1,374 tons. The fisheries resource of the study area is rich and diversified with mainly fresh water fish habitats comprising of capture and culture types. The estimated total capture fish habitat area is 150 ha while culture fish habitat area is 2 ha in the study area. The estimated total fish production is 37 ton, of which 34 tons comes from capture fisheries and 3 tons from culture fisheries.

The proposed 400 kV transmission lines pass through different ecosystems such as paddy fields, homesteads, road-side vegetation and aquatic ecosystems. The study area falls under four bio-ecological zones of (i) Brahmaputra-Jamuna Floodplain, (ii) Major Rivers, (iii) Haor Basin and (iv) Meghna Floodplain.

The total population of the study area is 560,437 of which 278,616 are male and 281,821 are female. The household number in total is 114,002 and on average each households have 5 members. The literacy rate is about 48%. Considering the total population, household work is the main occupation (40%) followed by agricultural work (14%) and business (5%). In terms of economic return, a significant percentage (24%) of the population has no work in the study area. The EIA Team identified that 312 households are located within the project Right of Way (RoW) of which 208 falls on the left side (40m) and 55 falls on the right side (40m) of the General Impact Area (GIA) and 49 falls in the middle of the Direct Impact Area (DIA). About 57% of the house structures are made of tin, while 35% are semi-pucca houses. The study households mainly use tube well water (93%) for drinking purposes. Use of sanitary latrine is 70% of which 21% are water-sealed and 49% are non water-sealed.

Impacts of the Project

The EIA study has identified that the proposed Project will have some impact on almost all of the resources in both positive and negative ways. The projected adverse impacts on the physical, agricultural and fisheries resources will be insignificant, but the impacts will be significant to some extent on the social and ecological resources. The damages to plants at the proposed tower and substation sites will have some negative impacts. On the other hand, the households that will be affected due to land acquisition may be directly impacted, which is important for the Project.

Environmental Management Plan (EMP)

The Project is not likely to have any significant negative impact. Therefore, no major mitigation measures would be required. The minor impacts are within the allowable and tolerable limits of the local people. All the direct impacts would be overcome by paying necessary compensation to the Project Affected Persons (PAPs) for land, structures and

trees. The recommended mitigation measures are expected to bring back the affected social, ecological and agricultural resources to their original form through implementation of the proposed EMP. The proposed Project will have no residual adverse impact on the environment or the eco-system.

Compensation Plan

Compensation should be given to the legal owners for land, and structures including houses as well as the cultivators of crops and owners of trees falling within the RoW of tower sites and substation site. In this regard, separate Inventory of Losses (IoL) survey needs to be prepared for assessing compensation to be made by the Ashuganj-Bhulta 400 kV T/L Project Authority of PGCB.

Monitoring Plan

The monitoring plan, if properly implemented during pre-construction, construction and post-construction and/or operation phases, will ensure that corrective measures are taken.

Budget for the Environmental Management Plan (EMP)

For implementing the Environmental Management Plan (EMP), it is estimated that about **Tk. 330 lakh** will be required. The cost for preparation of Resettlement Action Plan (RAP) under the EMP Tk. 80 lakh for Bhulta Substation and implementation of the RAP Tk. 120 lakh are included with the EMP cost. This cost might change subject to recommendations of proposed RAP Study to be conducted under the Project Authority. The cost for monitoring plan is included in the EMP.

Public Consultation

The local stakeholders all along the route of the transmission line expressed interest in the Project even after recognizing the fact that they will not get electricity directly from the transmission line. Local people along the transmission line will be benefited, as the Project will also generate some employment opportunities for them during the pre-construction and construction phases. However, their main interest is that the overall development of the power sector would contribute to national development.

Recommendations

The EIA study reveals that the Ashuganj – Bhulta 400 kV Double Circuit Transmission Line and 400/230 kV Substation at Bhulta Project will have no major negative impact, but will contribute to the overall national development by improving the transmission of electricity. The EIA study team as well as the local stakeholders came up with some recommendations for the Project proponents, as narrated in the following:

- Necessary assessment of land acquisition and compensation needs to be done before implementing the Project;
- All the PAPs should be compensated properly for their land, structures and trees;
- The compensation money should not be given through the Union Parishad or Upazila Parishad, but through cheque to the PAPs' bank account;
- The contractor should be specifically instructed to employ local laborers as much as possible;
- Efforts should be made to avoid cutting of trees as much as possible;
- Clearing of vegetation and cutting of trees at the pre-construction and construction phases should be supplemented by appropriate mitigation measures;

- Cutting of some trees might be unavoidable in which case more number of trees should be replanted in surrounding areas for conservation of biodiversity. In this case, homestead gardening with fruit and rapid growing timber trees will be emphasized;
- Selection of season for carrying out the work should be synchronized with the cropping season so that there is minimum damage on standing crops;
- Proper compensation for all types of damages must be paid and the land should be brought back to its original form before being handed back to the owners;
- The constructed labor camps should be provided with proper ventilation, water supply and sanitation facilities. The workers should be apprised of the required hygienic practices;
- The transportation of heavy equipment should be done by avoiding agricultural land and using water ways as and where possible;
- The stores and equipment yards should be properly guarded so that all equipment remain safe; and
- The substation should be fully equipped with firefighting equipment.

Finally, on proper examination it is observed that the Project has been proposed to be implemented safely and in an environment friendly manner. So, it is recommended that the Project may be given Environmental Clearance to proceed with the works immediately.

1. Introduction

1.1 Background of the Study

The demand for electricity is growing very quickly throughout the country for meeting industrial and household requirements. To cope with this high demand for power, new power plants are planned to be installed by the Government of Bangladesh (GoB) for generating more electricity. The generated power requires sufficient transmission facilities for evacuation as well as for linking the existing and future power plants. Dhaka being a mega city has a faster growing demand for power than elsewhere due to its rapid urbanisation and industrialisation process. The Power Grid Company of Bangladesh Ltd. (PGCB), therefore, is planning to supply more electricity to Dhaka City area from the upcoming Power Plants in Ashuganj area to fulfil the future demand. The PGCB has planned to construct a 400 kV power transmission line from Ashuganj to Bhulta and accordingly developed a Project named “Ashuganj – Bhulta 400 kV Transmission Line Project” for implementation.

Within the scope of the Project a 400 kV Double Circuit Power Transmission Line (T/L) from Ashuganj to Bhulta (located under Rupganj upazila of Narayanganj district) will be constructed. The proposed double circuit T/L will be used to transmit power from Ashuganj to Bhulta area as well as from Bhulta to Ashuganj area. In addition to the line, one 400/230kV, 3X520MVA Sub-Station will be constructed at Bhulta, where around 40 acres of land will need to be acquired from the private land owners. The Project will be implemented on Build Own Operate and Transfer (BOOT) basis.

According to the ‘Environment Conservation Act 1995’, ‘Environment Conservation Rules 1997’ and their amendments, the proposed Project falls under the ‘red category’ of projects, which requires both Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA). Therefore, the PGCB is mandated to conduct IEE and EIA studies with the help of capable consultants. In order to meet the legal obligation, the PGCB has to prepare the IEE Report for obtaining ‘site clearance’ and thereafter, the EIA Report for obtaining ‘environmental clearance’ from the Department of Environment (DoE).

In this context, the Center for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources, experienced in environmental, social impact assessment and resettlement planning, has been assigned by the PGCB to provide consultancy services in preparing an ‘Environmental Impact Assessment Report’ for the proposed Ashuganj – Bhulta 400 kV Transmission Line Project.

1.2 Objectives of the Project

The main objective of the Ashuganj-Bhulta 400 kV T/L Project is to supply electricity from the upcoming Power Plants in Ashuganj area to Dhaka City via Bhulta area for increasing reliability of power supply to the Mega City. The specific objectives are:

- i) To evacuate power to be generated in the upcoming 2X450 MW Combined Cycle Power Plant (CCPP) at Ashuganj and deliver power to the load centre (Dhaka);
- ii) To supply more power through the Rampura 230/132 kV Sub-Station to meet the rapidly growing demand of the eastern region of Dhaka City; and
- iii) To create power evacuation facilities for the future generating plants at Ashuganj.

1.3 Scope of work of the Project

The scope of the A-B 400 kV T/L Project is:

- i) Construction of Ashuganj to Bhulta 400kV Double Circuit T/L of around 70 km.; and
- ii) Construction of a 400/230kV, 3X520MVA Sub-Station at Bhulta.

1.4 Rationale of the Project

Considering the presence of the nodal point of natural gas distribution (by GTCL) and availability of gas with good pressure, a number of power plants are currently being implemented (e.g. 2X450 MW CCPP) as well as planned to be installed (223 MW CCPP) at Ashuganj by the Ashuganj Power Company Limited (APCL). It is a challenge to evacuate this huge amount of power in the future to areas where demand for power is growing rapidly. The demand from Dhaka city is increasing faster than other parts of the country, therefore, to feed the growing demand, necessary transmission line is required to be constructed between the generation and consumption points. After several case studies on load flow by the PGCB, it has been found that a dedicated double circuit 400 kV line from Ashuganj to Bhulta and a 400/230kV, 3X520MVA Sub-Station at Bhulta would be the best means of evacuating the upcoming power that would be generated at Ashuganj area. Therefore, construction of a new 400/230kV substation at Bhulta and a double circuit 400 kV T/L from Ashuganj to Bhulta has been planned to be implemented by the PGCB.

1.5 Objectives of the studies

The objectives of the studies have included the following:

- i. To conduct an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) study for the Project; and
- ii. To prepare an EIA Report and submit to the DoE for obtaining 'environmental clearance'.

1.6 Scope of the EIA Studies

The scopes of the EIA study are stated below:

- a. Conduct an environmental baseline survey and select environmental and social components likely to be impacted by the Project;
- b. Conduct detailed survey and impact analysis of specific environmental components (e.g. air, water, agriculture, plants, fisheries, socio-economic, etc.);
- c. Conduct public consultation to obtain people's perceptions of the Project;
- d. Prepare a detailed Environmental Management Plan (EMP);
- e. Prepare an Environmental Impact Assessment (EIA) Report; and
- f. Assist the client in presenting the EIA Report to the DoE for obtaining 'Environmental Clearance'.

1.7 Objectives of the EIA Study

In accordance with the 'DoE Guidelines for EIA of Industries, Power Plant and Electricity Distribution', the proposed project of construction or re-construction and/or extension work falls under the Red Category. The Red Category type of projects requires EIA

to be conducted preceded by IEE. As the proposed 'Ashuganj-Bhulta 400 kV T/L Project of PGCB' falls under the Red Category, it is required to undertake an EIA study for obtaining 'environmental clearance' from the DoE. The main objectives of the EIA study include:

- i. To describe the existing environmental and social baseline of the proposed Project area;
- ii. To identify important environmental and social components which may be impacted by the Project;
- iii. To assess the potential environmental impacts, including any residual impacts of the proposed Project;
- iv. To identify mitigation measures to minimize negative impacts;
- v. To prepare an Environmental Management Plan (EMP) including a monitoring programme;
- vi. To obtain 'environmental clearance' of the proposed Project by submitting the EIA Report to the DoE; and

1.8 Physical Components of the Project

The major components of the Project are as follows:

- i. Construction of a 70 km 400 kV Double Circuit Transmission Line from Ashuganj to Bhulta,
- ii. Construction of a 400/230kV, 3X520MVA Sub-Station at Bhulta on 40 acre of privately owned land,
- iii. In-out of Ghorashal-Rampura 230kV line to Bhulta 400/230 kV Substation, and
- iv. In-out of Haripur-Rampura 230kV line to Bhulta 400/230 kV Substation.

1.9 Study Area

The proposed project is located in Dhaka and Chittagong administrative divisions of Bangladesh. The power transmission line will start from Ashuganj (Brahmanbaria district) and end at Bhulta (Rupganj upazila of Narayanganj district). This line will cross Narsingdi Sadar upazila of Narsingdi district; Araihasar, Rupganj and Sonargaon upazilas of Narayanganj district; and Ashuganj, Brahmanbaria Sadar, Nabinagar and Banchharampur upazilas of Brahmanbaria district. **Table 1.1** presents the names of the districts, upazilas, unions and mouzas through which the transmission line will pass. The detailed locations of the EIA study areas are shown in **Map 1.1**.

Table 1.1: Names of Administrative Areas within the RoW

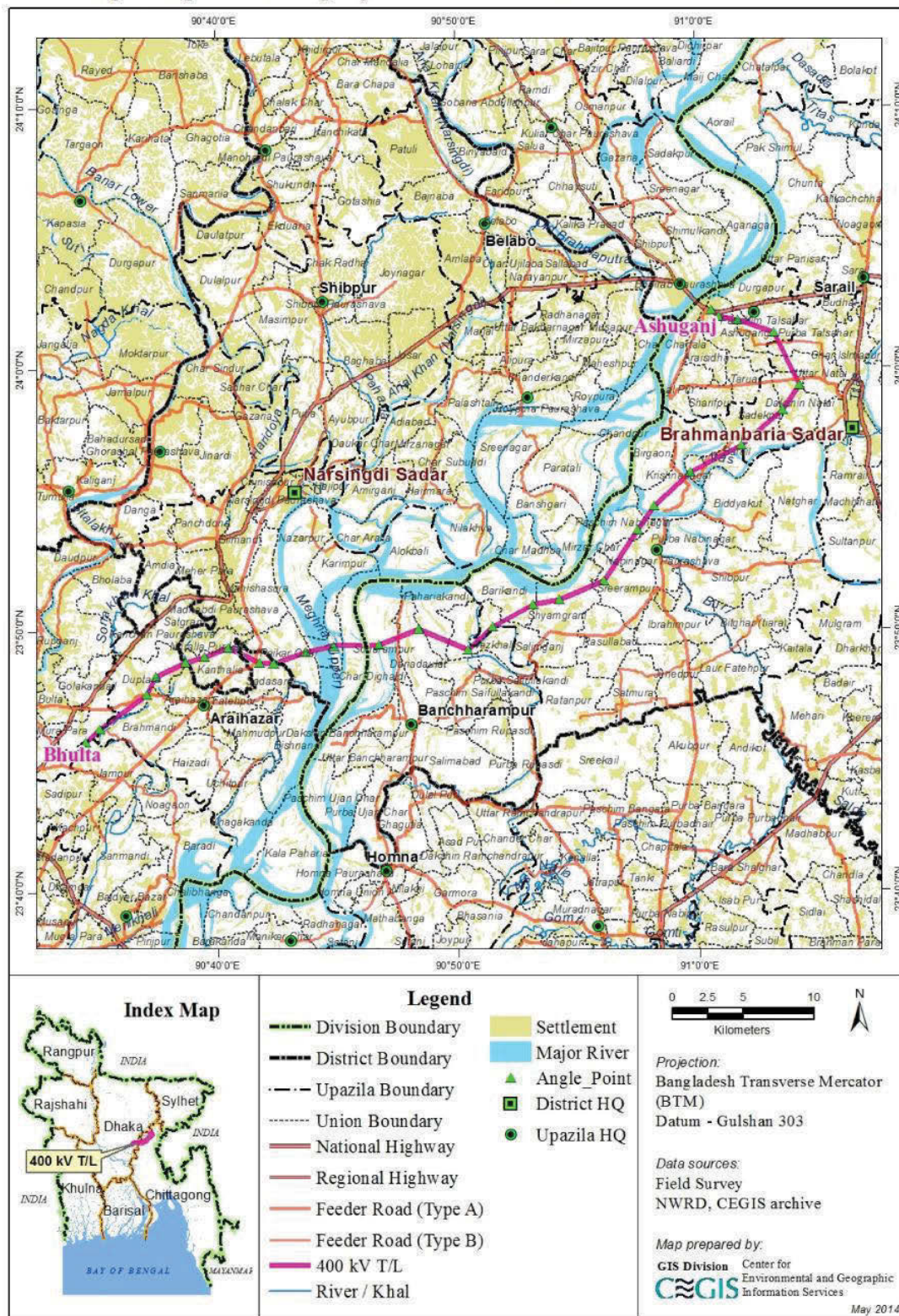
Upazila and District	Union	Mauza
Narsingdi Sadar, Narsingdi	Karimpur	Char Line
	Char Dighaldi	Kholbandha
	Nurulla Pur	Algi (Kanda Para)
		Nurullahpur

Upazila and District	Union	Mauza
	Paikar Char	Bara Khamar Char
		Nareshwardi
		Paikar Char
		Char Bhasania
		Khadimer Char
		Baniar Char
	Kanthalia	Daukandi
		Bara Maishadi
		Rahimdi
		Dogharia (Fazurkandi)
Araihazar, Narayanganj	Sadasardi	Nagardaukadi
	Duptara	Panchgaon
		Duptara
		Satyabhandi
	Sadasardi	Pathanerkandi
		Lakshmibardi
	Araihazar	Kamrangir Char
Rupganj, Narayanganj	Brahmandi	Binair Char
		Bhati Gobindi
		Darikandi
		Darikandi Chak
		Chhota Darikandi
		Datterkandi
Sonargaon, Narayanganj	Golakandail	Gabtali Hat
		Kahena
Ashuganj, Brahmanbaria	Jampur	Sonarampur
		Jatrapur
		Baratala
		Baikunthapur
	Paschim Talsahar	Talsahar
		Andidil
Brahmanbaria Sadar, Brahmanbaria	Purba Talsahar	Poothai
	Uttar Natai	Chhota Brahmanbaria
		Bhultara
	Dakshin Natai	Harankhola
		Narasingheswar
	Sadekpur	Damchail (Alakpur)
		Chilokut
		Sadekpur

Upazila and District	Union	Mauza
Nabinagar, Brahmanbaria	Barail	Barail
		Jalsuka
		Gonsaipur
		Char Gonsaipur
		Radhanagar
	Krishnanagar	Krishnanagar
		Dakshin Lakshmipur
		Ashrafpur
		Sitarampur
		Daulatpur
	Paschim Nabinagar	Fatehpur
	Paurashava	Alamnagar
	Sreerampur	Gopalpur
	Shyamgram	Nasirabad
	Barikandi	Jafrabad
	Shyamgram	Sahabazpur
		Sreeghar
Banchharampur, Brahmanbaria	Salimganj	Barail
		Nilakhi
	Barikandi	Thollakandi
	Dariadaulat	Daria Daulat
	Tezkhali	Akanagar
		Bishnurampur
	Pahariakandi	Pahariakandi
	Sonarampur	Char Dariadaulat (D. Rampur)
		Sonarampur
		Char Seaton

Source: GIS Database, CEGIS, 2013

Base Map: Proposed Ashuganj-Bhulta 400kV Transmission Line



Map 1.1: Base map of proposed Ashuganj – Bhulta 400 kV T/L Line Project

The transmission line has avoided major settlement areas and passes mostly over agricultural and fallow lands. A 100 meter wide Right of Way (RoW) covering a 40 meter buffer impact zone on each side (40m+40m) and 20 meter at the middle between the buffer zones have been defined as the General Impact Area (GIA), while the 20 meter at the middle of GIA has been defined as the Direct Impact Area (DIA) for the Project. In order to carry out the EIA study DIA have been evaluated in detail.

1.10 The EIA Study Team

The multi-disciplinary team comprising the following professionals conducted the EIA study.

Mr. Mujibul Huq, Environment Expert, Study Team Leader
 Dr. Ahmadul Hassan, Water Resource Expert
 Mr. Subrata Kumar Mondal, Socio- Economist
 Mr. Quamruzaman, Ecologist
 Mr. Shibly Sadik, Environmental Law Specialist
 Mr. Hasan Tawfic Imam, Geologist/ Remote Sensing Specialist
 Md. Sadiqur Rahman, Agronomist
 Mr. Mobasher Bin Ansari, Junior Anthropologist
 Mr. Md. Jafrul Alam, Junior Engineer
 Mr. Shafiqul Islam, Junior Sociologist
 Mr. Uzzal Kumar Saha, Junior Ecologist

In addition to the above, a number of professionals with multidisciplinary backgrounds helped the team in preparing the EIA Report. The additional professionals were:

Dr. Anil Chandra Aich, Agronomist
 Mr. Ashok Kumar Das, Fishery Biologist
 Mr. A T M Shamsul Alam, Sociologist
 Dr. Ashraful Alam, Environmentalist
 Mr. Md. Sharif Hossain Sourav, Ecologist
 Mr. Md. Mosleh Uddin, Junior Agronomist
 Mr. Fahad Khan Khadim, Junior Water Resources Engineer
 Mr. Shafiul Alam, GIS/RS Technologist
 Mr. Minhazur Rahman, Junior Sociologist

1.11 Structure of the Report

The report has been structured in compliance with the requirements of the ToR.

Chapter 1: Introduction: The introduction chapter presents a brief overview of the assignment along with its background, project objectives, study objectives, scope of work, study team and structures of reports etc.

Chapter 2: Policy and Legislation: Chapter Two outlines the Policy and Legislation on environmental and social issues.

Chapter 3: Approach and Methodology: Chapter Three describes the methodology of the conducting EIA study including EIA process, scooping, bounding, impact analysis, EMP and EMP cost estimation.

Chapter 4: Description of the Project: Chapter four describes the proposed interventions and activities of the project, background, project category, need for the project, location, size and magnitude of operation.

Chapter 5: Alternative Route Selection: Chapter Five presents the description of the alternatives sites and suitability analysis considering ownership and resentments issues of the proposed sites for selecting best route.

Chapter 6: Environmental and Social Baseline: Chapter Six presents the description of the environmental and social baseline situation of the project area.

Chapter 7: Public Consultation: Chapter Seven presents the public perceptions about the proposed project and their suggestions.

Chapter 7: Important Environmental Social Components: This chapter deals with the important IESCs and its rationales of the proposed project sites.

Chapter 8: Impact Assessment: This chapter deals with the environmental impacts of the proposed project and possible mitigation measures.

Chapter 9: Environmental Management Plan: The chapter mainly deals with the environmental management plan, which includes an implementation plan of mitigation measures and environmental monitoring program of the project. The EMP also includes specific compensation, monitoring and enhancement plan.

Chapter 10: Public Consultations: Chapter Ten presents the public perceptions about the proposed project and their suggestions.

Chapter 11: Conclusions and Recommendations: This chapter presents the findings, conclusion, and recommendations of the EIA study.

2. Policy and Legislations

2.1 Overview

Construction of the proposed transmission line and a substation under the Ashuganj-Bhulta 400 kV Double Circuit T/L Project to be implemented by the PGCB requires strict compliance with laws, rules and regulations pertinent to the environment. The Department of Environment (DoE) of the GoB is responsible for ensuring the application of environmental laws and issuance of necessary clearances for the proposed projects.

The procedures and requirements for Environmental Impact Assessment (EIA) under the power sector are dictated by the Environment Conservation Act of 1995, which introduced a requirement for any proposed "industrial unit or project" to obtain prior approval under environmental legislation from the DoE.

The Environment Conservation Act has classified projects to be assessed (by the DoE) in four categories (Green, Amber A, Amber B, and Red). The power development projects are allocated to the red category, which triggers an automatic requirement for an Initial Environmental Examination (IEE) followed by a full EIA. Subject to a satisfactory review of the environmental assessment, the DoE issues an authorisation for the project to proceed further. The authorisation consists of two parts: a "site clearance", which gives approval to the site proposed for the Project and "environmental clearance", which approves the content of the Project.

The PGCB, as project proponent, is responsible for carrying out IEE and EIA studies of the proposed Ashuganj-Bhulta 400 kV Double Circuit T/L Project. Therefore, it has the responsibility for administering necessary environmental assessment by engaging competent Consultants, review the findings, and submit the reports/documents to the DoE for their review for providing clearance.

A key requirement is to prepare an Environment Management Plan (EMP) within the IEE/EIA process for the projects classified in the Amber and Red categories. The function of the EMP is to enable the project proponent to show the DoE how it will deliver the environmental performance assessed in the IEE/EIA (for which DoE approval is sought). The EMP must describe in detail the organisation and management responsibilities, give details of how mitigation measures identified in the IEE/EIA will be implemented and explain how monitoring will be carried out.

Possession of "clearance" from the DoE does not relieve the developer of a project from the requirement to comply with other environmental regulations. In particular, the Bangladesh National Environment Quality Standards (EQS) for industrial effluent have been set and compliance is mandatory. In addition, there are statutory instruments applicable to power development projects, which are not primarily environmental but which influence environmental impacts. Compliance with such statutory instruments is mandatory.

2.2 Procedure for Obtaining Site/Environmental Clearance

2.2.1 Requirement for Initial Environmental Examination (IEE) Report

All industries and projects fall within the Red Category have to conduct IEE, which help the project proponent in understanding the potential extent of environmental changes and finding ways to mitigate negative impacts by considering available information, past

experience or standard operating practices. The steps for conducting IEE are:

- i. Collection of baseline information in respect of the Project and the environmental setting of the project area and specific sites.
- ii. Setting of boundaries of the IEE by identifying the significant issues.
- iii. Impact assessment suggesting an Environment Management Plan (EMP), alternative sites or other project modifications, if any.
- iv. In the event of IEE for the project or industry reveals that further investigation is to be carried out, therefore, the sponsors will have to conduct a detailed EIA.

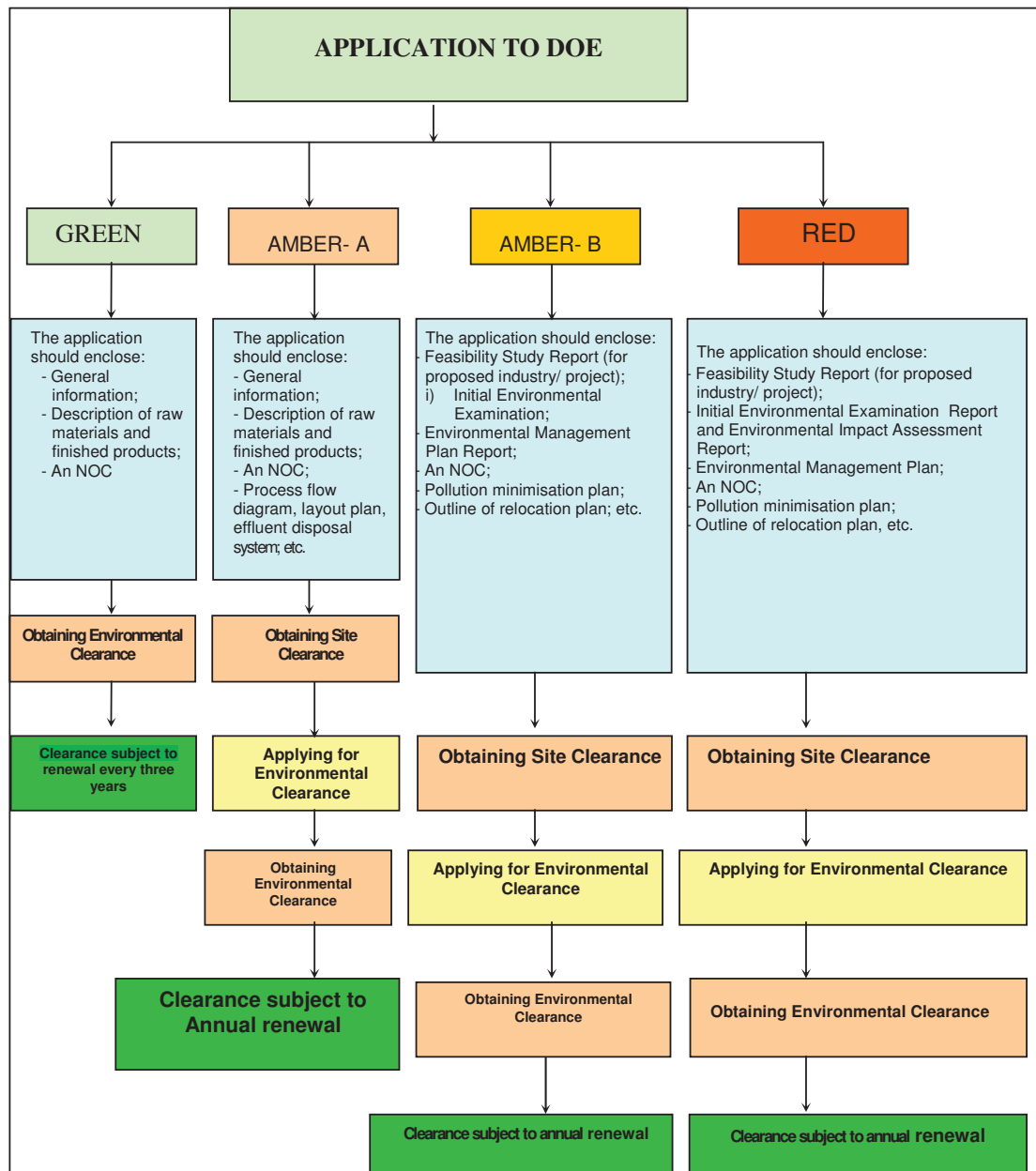
2.2.2 Procedure for Obtaining Clearance

After completion of the IEE/EIA report the project proponent should apply to the DoE in the prescribed format for site/environmental clearance. The application for the site/environmental clearance for a project classified in the 'Red' category should be accompanied by the following documents:

- I. For 'site clearance'
 - a. Development Project Proforma (DPP);
 - b. IEE Report;
 - c. Detail Project Map;
 - d. ToR of the EIA Study; and
 - e. Initial NOC (No Objection Certificate) from the local authorities.
- II. For 'environmental clearance'
 - a. Feasibility Study Report;
 - b. EIA Report;
 - c. An NOC from the specific local authorities concerned;
 - d. Pollution minimization plan including emergency plan for the mitigation of adverse environmental impacts;
 - e. Outline of relocation plans (where applicable); and
 - f. Other information as deemed necessary.

It is also mentioned in the Environment Conservation Rules, 1997 that the Director General of the DoE can issue environmental clearance directly without issuing any site clearance to any industry or project if he (the Director General) finds appropriate reasons for doing so.

As the proposed construction of the 70 km transmission line and a substation falls under the "Red" category, all necessary requirements mentioned above have been adopted for the Project. **Figure 2.1** shows the activities involved in obtaining environmental clearance from the DoE.



NOC = No Objection Certificate, usually obtained from local government institutions.

Note: 1. These requirements vary from those of the DoE (1997) in requiring EMPs for proposed, as well as current, projects.

2. Procedure of obtaining Environmental Clearance:

for Green Category Projects the gestation period for granting Environmental Clearance has been fixed at within 15 days;

for Orange A, Orange B and Red Category Projects at first Location Clearance and thereafter Environmental Clearance will be granted. The gestation period for Location Clearance is within 30 days for Orange A and within 60 days for Orange B and Red Category Projects.

Source: Adapted from the Environmental Guidelines for Industry (DoE, 1997)

Figure 2.1: DoE Environmental Clearance Procedures

2.3 Organization Related with Enforcement of Environmental Standards

The roles and responsibilities of different ministries and departments related with enforcement of environmental requirements are described below in brief:

2.3.1 Ministry of Environment and Forest (MoEF)

The Ministry of Environment and Forest (MoEF) is the key government institution in Bangladesh for all matters relating to national environmental policy and regulatory issues. Realizing the ever-increasing importance of environmental issues, the MoEF was created by replacing the Ministry of Agriculture and Forest in 1989 and is at present a permanent member of the Executive Committee of the National Economic Council (ECNEC). This group is the major decision-making body for economic policy issues and is also responsible for approving all public investment projects. The MoEF oversees the activities of the following technical/ implementing agencies:

- Department of Environment (DoE)
- Bangladesh Forest Department (BFD)
- Bangladesh Forest Industries Development Corporation (BFIDC)

Department of Environment (DoE)

In order to expand the scope of environmental management and to strengthen the power for achieving it, the Government adopted the Environmental Pollution Control Ordinance in 1977. The ordinance provided for the establishment of an Environmental Pollution Control Board, which was assigned with the responsibility of formulating policies and proposing measures for their implementation. In 1982, the Board was renamed as the Department of Environmental Pollution Control (DEPC). Six divisional offices were established in Dhaka, Chittagong, Khulna, Barisal, Sylhet and Rajshahi.

A special Presidential Order again renamed the DEPC as the Department of Environment (DoE) and placed it under the newly formed MoEF in 1989.

The DoE is a department of the MoEF and is headed by a Director General (DG). The DG has complete control over the DoE. The power of the DG, as given under the Act, may be outlined as follows:

- The DG has the power to close down activities considered harmful to human life or the environment. The operator has the right to appeal and procedures are in place for this. However, if the incident is considered an emergency, there is no opportunity for appeal.
- The DG has the power to declare an area affected by pollution as an ecologically critical area. The DoE governs the type of work or process, which can take place in such an area.
- Before undertaking any new development project, the project proponent must take an Environmental Clearance from the DoE. The procedures to take such clearance are in place.
- Failure to comply with any part of the Environment Conservation Act (ECA) 1995 may result in punishment by a maximum of 5 years imprisonment or a maximum fine of Tk. 100,000, or both.

Bangladesh Forest Department

This Department under the MoEF is responsible for the protection and management of all Reserve Forests of the country. The personnel of the department extend down to the union level in areas where there are Reserve Forests. It has recently started some agro forestry programs. The Bangladesh Forest Department officers are also responsible for the protection of wildlife in the forests.

Related Other Organizations

There are several other organizations, which are related with certain social and environmental functions. These organizations include:

- Ministry of Power, Energy & Mineral Resources: Power Division
- Ministry of Land: Land Reform and Land Acquisition Directorate
- Ministry of Water Resource: Bangladesh Water Development Board (BWDB)
- Ministry of Shipping: Bangladesh Inland Water Transport Authority (BIWTA)
- Ministry of Fisheries and Livestock: Department of Fisheries

2.4 National Policies and Legislation Relevant to Environment

National Strategies, Policies, Acts and Rules related to the environment include the following:

- The Environment Pollution Control Ordinance, 1977
- The Environmental Quality Standards for Bangladesh, 1991
- The National Conservation Strategy (NCS), 1992
- The Environment Policy, 1992
- The National Environment Management Action Plan (NEMAP), 1995
- The Environment Conservation Act (ECA), 1995
- The Environment Conservation Rules (ECR), 1997
- The ECR, 1997 were adopted under the provision of the ECA, 1995.

Other relevant laws related with the environment include:

2.4.1 Bangladesh Wildlife Preservation Order (1973; amended to Act, 1974)

The Bangladesh Wildlife (Preservation) Order of 1974 provides for the preservation, conservation and management of wildlife in Bangladesh. The earlier legislations on wildlife preservation, namely, the Elephant Preservation Act, 1879, the Wild Bird and Animals Protection Act, 1912, and the Rhinoceros Preservation Act, 1932 have been repealed and their provisions have been suitably incorporated in this law.

2.4.2 The National Forest Policy (1994)

The National Forest Policy of 1994 is the amended and revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major target of the policy is to conserve the existing forest areas and bring about 20% of the country's land area under the forestation program and increase the reserve forest land by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

2.5 Policy Related with Energy Development

2.5.1 The Electricity Act, 1910

The Electricity Act was enacted in 1910 to amend the laws relating to the supply and use of electrical energy. Under this Act, any person can get a license to supply energy and to lay down or place electric supply lines for the conveyance and transmission of energy. The licensee can open and break up the soil and pavement of any street, railway or tramway and can lay down any line or do other work near other utility services (like gas, T&T, water, sewer, etc.), provided prior permission is taken from the respective authority, as stated in Section 12 – 18 of this Act.

According to Section 19 (1) of this Act, the licensee shall give full compensation for any damage, detriment or inconvenience caused by him or by anyone employed by him.

Sub- section (1) of Section 51 of the Electricity Rules, 1937; advise that the licensee should take precautions in laying down electric supply lines near or where any metallic substance or line crosses in order to avoid electrocution.

2.5.2 The Telegraph Act (1885)

Part III Power to place Telegraph Lines and posts

Under the Act 10- 19, the government can build towers on public land without giving any land compensation.

2.5.3 The Power Policy, 1995

Like the Petroleum Policy, this is presently an integral part of the National Energy Policy, 1996. It has different policy statements on demand forecast, long-term planning and project implementation, investment and lending terms, fuels and technologies, power supply to the west zone, isolated and remote load centers, tariff, captive and stand by generation, system loss reduction, load management and conservation, reliability of supply, system stability, load dispatching, institutional issues, private sector participation, human resource development, regional/international cooperation, technology transfer and research program, environment policy and legal issues.

As the proposed project is a Power Transmission Project, all necessary requirements mentioned above will be adopted for the project.

2.5.4 The Energy Policy (1996)

The National Energy Policy provides for the utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy source and environmentally sound sustainable energy development programmes. The policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, or introduction of economically viable and environment friendly technology.

2.5.5 The Industrial Policy (1999)

The National Industrial Policy, 1999 aims to ensure a high rate of investment by the public and private sectors, a strong productive sector, direct foreign investment, development of labor intensive industries, introduction of new appropriate technology, women's

participation, development of small and cottage industries, entrepreneurship development, high growth of export, infrastructure development and environmentally sound industrial development. WTO guidelines have been proposed to be followed in the Industrial Policy.

2.6 Compliance with International Requirements

Bangladesh has acceded to, ratified or signed a number of major international treaties, conventions and protocols related to environment protection and conservation of natural resource.

2.6.1 Rio Declaration (1992)

The 1992 United Nations Conference on Environment and Development (UNCED) adopted the Global Action Program for sustainable development called 'Rio Declaration' and 'Agenda 21'. Principle 4 of The Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it".

2.6.2 Convention on Biological Diversity (1992)

The Convention on Biological Diversity, 1992 was adopted on 05 June 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March 1994. This is the overarching framework for biodiversity and the signatories are required to develop a National Biodiversity Strategy and Action Plan that incorporates the articles of the convention into national statutes.

The obligations have been placed on state parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity.

2.6.3 Convention on Wetlands of International Importance, Ramsar (1971)

The convention on Wetlands of International Importance, especially waterfowl habitat, which is also known as the Ramsar Convention. It was adopted on 02 February 1971 and entered into force on 21 December 1975. Bangladesh ratified the Convention on 20 April 2002. This provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resource. There are 127 Parties with 1085 wetland sites designated as 'Wetlands of International Importance'.

This is an intergovernmental treaty, which provides the framework for international co-operation for the conservation of wetland habitats. Obligations for Contracting Parties include the designation of wetlands to the "List of Wetlands of International Importance", the provision of wetland considerations within their national land use planning, and the creation of Natural reserves.

Bangladesh has two Ramsar sites- Parts of the Sundarbans Reserved Forest (Southwest of Bangladesh) and Tanguar Haor (Northeast of Bangladesh). The proposed project will not have any effect on these two Ramsar sites.

2.6.4 UNs Convention on the Law of the Sea, Montego Bay (1982)

This Convention was adopted on 10 December 1982 at Montego Bay, Jamaica. Bangladesh has ratified this Convention.

2.6.5 Others (Conventions and Agreements)

The following conventions and agreements may include provisions relevant to different aspects of oil and gas operations for environmental management, nature protection, and biodiversity conservation:

- Convention relative to the Preservation of Fauna and Flora in their Natural State 1933; International Convention for the Protection of Birds, Paris, 1950;
- International Plant Protection Convention, Rome, 1951;
- Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972 has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties). These are the 'Jewels in the Crown' of conservation;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (Popularly known as CITES): This provides a framework for addressing over harvesting and exploitation patterns, which threaten plant and animal species. Under CITES governments agree to prohibit or regulate trade in species which are threatened by unsustainable use patterns; and
- Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979 (Amended 1988): This provides a framework for agreements between countries important to the migration of species that are threatened.

2.7 The Building Construction Act.1990 and Building Construction Rules, 1996

The Building Construction Act dates back to the early fifties of the last century. Documents however, indicate the existence of the Government Buildings Act, 1899, which provide for the exemption from the operation of municipal building laws of certain building and lands, which are the property or in the occupation, of the Government and situated within the limits of a municipality. The provision of Municipal Building Laws to regulate the creation, recreation, construction, alteration or maintenance of buildings within the limits of any municipality has been superseded by this Act. Subsequently, the need to provide for the prevention of haphazard construction of buildings was felt by the East Bengal Legislative Assembly in 1952. Accordingly the "Building Construction Act, 1952" was promulgated on 21 March 1953 as the East Bengal Act II of 1953. The B.C. Act 1952 was conceived to enforce the activities towards streamlining planned development and beautification programmes of the government.

Since its promulgation in 1953 the Act was in force with very little or no amendment up to 1986 when a very important modification of far-reaching consequence was added through proclaiming an Ordinance titled, " The Building Construction (Amendment) Ordinance, 1986 (Ordinance No. LXXII of 1986)" by the then government. Later in 1987, the National Assembly in its March session adopted the ordinance for enactment as "The Building Construction (Amendment) Act, 1987 (Act No. 12 of 1987)". The

preamble to state the objectives of the amendment reveals that "although the trial court has the power to order removal of unauthorized construction after passing the order of conviction under section 12, this power has been found to be insufficient, as a criminal case can not normally be finally disposed of quickly, besides even after disposal of the criminal case by the trial court, the prosecution is lingered by way of appeals". In order to take steps to prevent unauthorised construction or to remove such construction, the authorised officer is empowered through this amendment so that he/she can take necessary action in this respect without intervention of the court.

The Act was subjected to another amendment in 1990 allowing some power to the A/O issuing limited sanction to cut down or raze any hill within the area to which this Act applies.

To support the implementation of the provisions laid down in the B.C. Act, 1952, the Government made the B.C. Rules, 1953. This was superseded by the *Imarat Nirman Bidhimalas*, 1984. Later in 1996 the Government framed the *Imarat Nirman Bidhimala*, 1996 (Building Construction Rules, 1996). The Rules are more comprehensive for taking care of the present day circumstances and issues of building construction and other related development activities.

2.8 Land Acquisition Rules and Regulations:

The Acquisition and Requisition of Immovable Property Ordinance (ARIPO), 1982 (subsequent amendments of it up to 1994) is the principal legal instrument governing land acquisition in Bangladesh. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, and houses); and (ii) any other damages caused by such acquisition. The Ordinance provides certain safeguards for the owners and has provision for payment of "fair value" for the property acquired. The Ordinance, however, does not cover project-affected persons without titles or ownership record, such as informal settler/squatters, occupiers, and informal tenants and lease-holders (without document) and does not ensure replacement value of the property acquired. The act has no provision of resettlement assistance and transitional allowances for restoration of livelihoods of the non-titled affected persons.

The rules under ARIPO, 1982 (Ordinance No. II of 1982) spell out the procedural details required for the acquisition of immovable properties in the following subheads:

- a) Proceedings for acquisition;
- b) Notices under section 3, 6, and 7;
- c) Declaration of acquisition and possession;
- d) Declaration of abatement and revocation of proceedings;
- e) Transfer of acquired land;
- f) Assessment of compensation and;
- g) Unutilized acquired property.

Forms A, B, C, D, E, F, G and H, which need to be appended to these rules, have also been specified. Consequent upon these rules, the Ministry of Lands has issued several circulars to regulate the land acquisition process. The circular No. 4/95 issued on 14/03/1995 specifies some actions required to be taken to process land acquisition cases.

2.9 Rules and Policies in Related Fields

In addition to the policies, rules and regulations related to the environment and energy, the following rules and regulations, listed in **Table 2.1**, are to be checked for compliance for maintaining a sustainable environment.

Table 2.1: Environmental Laws, Regulations and Standards of Bangladesh

Year	Title	Objectives
1950	East Bengal Protection and Conservation of Fish Act	Protection and conservation of fish in Bangladesh.
1985	The Protection and Conservation of Fish Rules	Prevention of harming fisheries resource and fisheries habitat in coastal and inland waters.
1953	Town Improvement Act	Improvement and development of Dhaka City.
1958	Antiquities Act	Protection and preservation of archaeological and historical artifacts
1960, 1966	Port Rules, Shipping Operation	Control of discharges in ports; waterway rules.
1965	Factories Act	Industrial workers' health and working conditions.
1971	Pesticide Ordinance	Pesticide use, production, selection and importation.
1976	Antiquities (Amendment) Ordinance	Protection and prohibition export of archaeological artifacts.
1977	Municipal Ordinance	Municipal activities in health, sanitation, water supply, drainage, etc. in the city.
1979	Factory Rules	Disposal of wastes and effluents.
1980	Agricultural Pesticides (Amendment) Act	Selection, use and handling of pesticides in the agricultural sector.
1982	Municipal Act	Drainage, sewerage, water supply and sanitation.
1983	Agricultural Pesticides (Amendment) Ordinance	Revised Agricultural Pesticides Ordinance.
1985	The Pesticide Rules	Pesticide sale, use and safety measures.
1990	Bangladesh standard specification for drinking water.	Formulation and revision of national standards.
1860	The Penal Code	This contains several Articles related with environmental protection and pollution management.

3. Approach and Methodology

3.1 Overall Approach

The process followed in conducting the Environmental Impact Assessment (EIA) study of the proposed 400 kV transmission lines is shown in **Figure 3.1**.

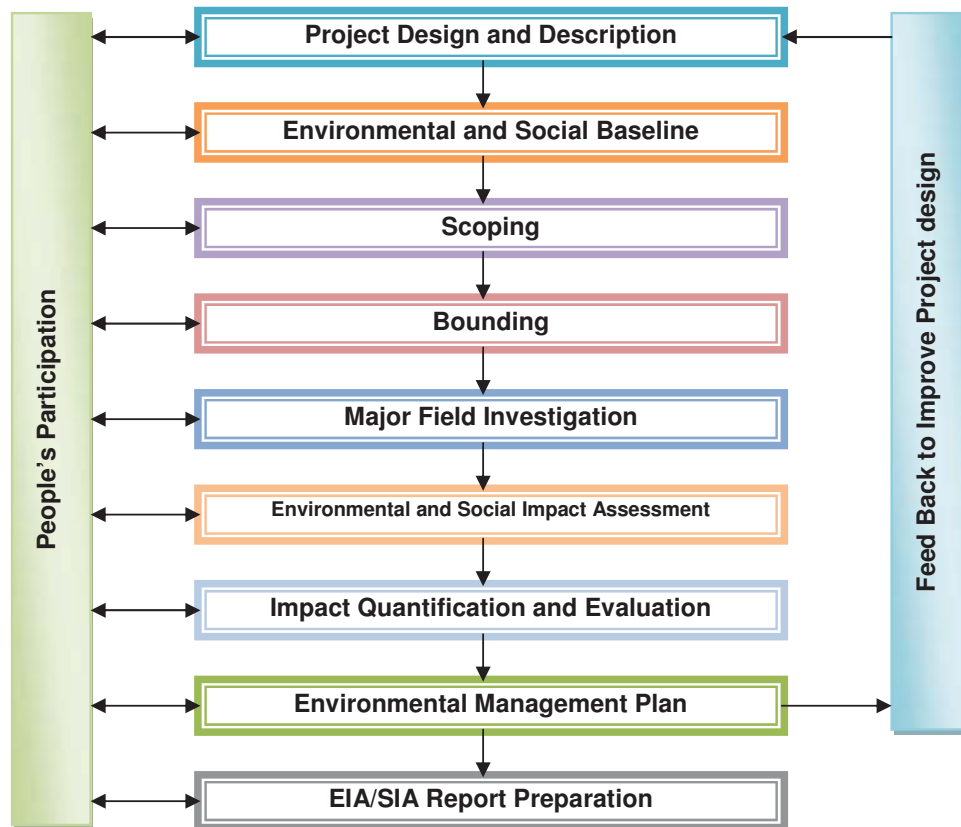


Figure 3.1: Process followed in the EIA study

3.2 Detailed Methodology

The methodology followed at each stage of the EIA study of the proposed transmission lines are briefly described below:

3.2.1 Project Design and Description

Detailed information on the proposed interventions of the proposed 400 kV transmission lines and the associated sub-stations were collected from the PGCB. The EIA team made reconnaissance field visits to these areas for obtaining first hand information on specific location where the Sub-stations would be established along with the alignment of the proposed transmission line with particular emphasis on the tower locations.

3.2.2 Environmental and Social Baseline

Field visits were made in the project area and later Rapid Rural Appraisals (RRA), Participatory Rural Appraisals (PRA), and Focus Group Discussions (FGD) were conducted. During the field visits, the multidisciplinary EIA team members made professional observations pertaining to their individual areas of expertise. The field teams used a structured questionnaire to record the information on different resources.

In order to generate qualitative and quantitative data and information, baseline surveys were carried out through applying different tools and techniques like RRA, FGDs and KII using appropriate instruments e.g. checklists and semi-structured formats.

Local knowledgeable persons including community representatives, traders, teachers, journalists and political leaders were interviewed individually.

All qualitative and quantitative data and information gathered from different surveys and secondary sources were used appropriately in preparing the environmental and socioeconomic baseline of the project and are presented in this report. All primary data and information contained in the report should be considered as expert estimations and opinions of local people and project stakeholders.

3.2.3 Scoping

A scoping process was followed for identifying Important Environmental and Social Components (IESCs), which are likely to be impacted by the 400 kV transmission lines. This was done in two stages. Individual professional EIA team members made a preliminary list of the components pertaining to their disciplines, which could be impacted by the project. The second stage included village-scoping sessions where stakeholder perceptions were obtained about the environmental and social components, which could be impacted by the project interventions. Professional judgment of the EIA team members as well the stakeholder opinions obtained in the village scoping sessions were considered in selecting the IESCs.

3.2.4 Bounding

The geographical boundary of the "General Impact Area - GIA" and the potential "Direct Impact Area - DIA" were delineated as a requirement of the environment assessment study. The GIA is the physical location of the proposed power transmission lines and sub-station of the project while the "DIA" covers the geographic extent of the environmental and socioeconomic impacts resulting from implementation of the proposed power transmission lines including pre-construction, construction and post-construction conditions. It is recognized that the benefits of the proposed 400 kV transmission lines will extend to the regional as well as national scale. For the EIA, the focus of the study was limited to areas where the impacts of the activity will be directly felt. A half km buffer along both sides of the power transmission lines and sub-stations sites were considered for environmental analysis. However, the major emphasis was given to the 40m RoW of the proposed transmission lines. A general socioeconomic profile was prepared for the administrative units over which the Power Transmission lines shall traverse.

3.2.5 Major Field Investigation

Data on the IESCs were collected through RRA, PRA, and informal discussion using checklists for water resource, agriculture, ecosystem and socio-economic components. Intensive consultation with the local people was carried out in each case for securing

people's participation. The multidisciplinary EIA team members also made professional observations during the field visits. This time the concentration was on the historical status of the IESCs and the possible condition of the same against the proposed interventions.

Information on individual households whose land and livelihood could be permanently or temporarily impacted was collected through a questionnaire survey which has developed and field-tested before conducting the actual survey.

3.2.6 Environmental and Social Impact Assessment

Environmental and social impacts of the proposed 400 kV transmission lines project on the IESCs was assessed through three different phases i.e. pre implementation, during implementation and post implementation phases were considered. In the post implementation phase or operation phase the Future-without-Project (FWOP) condition was generated through trend analysis and consultation with the local people. This reflected conditions of IESCs in the absence of the implementation plan. Changes expected to be brought about due to the proposed 400 kV transmission lines was assessed to generate the Future-with-Project and improvement (FWIP) condition. The difference between the FWOP and FWIP condition has been presented as the environmental and social impacts of the proposed transmission lines in operational phase. This included both positive and negative impacts which were considered in the preparation of the environmental management plan.

3.2.7 Impact Quantification and Evaluation

Attempts were made to quantify the impacts of the proposed 400 kV transmission lines project. But it was not possible to quantify all impacts, specially the impacts on some of the environmental and social components. In those cases, qualitative impacts were assessed and scores were assigned with (+) sign for positive impacts and (-) sign for negative impacts. Magnitudes of the impacts have been indicated in a scale of 1 to 10 for both positive and negative impacts.

3.2.8 Assessment Methodology

The assessment of effects and identification of residual impacts takes account of any incorporated mitigation measures adopted due to any potential impact of Project activities, and will be largely dependent on the extent and duration of change, the number of people or size of the resource affected and their sensitivity to the change. Potential impacts can be both negative and positive (beneficial), and the methodology defined below will be applied to define both beneficial and adverse potential impacts.

The criteria for determining significance are generally specific for each environmental and social aspect but generally the magnitude of each potential impact is defined along with the sensitivity of the receptor. Generic criteria for defining magnitude and sensitivity used for the Project are summarized below.

3.2.9 Magnitude

The assessment of magnitude has been undertaken in two steps. Firstly the key issues associated with the Project are categorized as beneficial or adverse. Secondly, potential impacts have been categorized as major, moderate, minor or negligible based on consideration of the parameters such as:

- Duration of the potential impact;
- Spatial extent of the potential impact;
- Reversibility;
- Likelihood; and
- Legal standards and established professional criteria.

The magnitude of potential impacts of the Project has generally been identified according to the categories outlined in **Table 3.1**.

Table 3.1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Negligible/Nil
Duration of potential impact	Long term (more than 35 years)	Medium Term Lifespan of the project (5 to 15 years)	Less than project lifespan	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

3.2.10 Sensitivity

The sensitivity of a receptor has been determined based on review of the population (including proximity/numbers/vulnerability) and presence of features on the site or the surrounding area. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in **Table 3.2**.

Table 3.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low /Negligible	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

3.2.11 Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the potential impact significance matrix shown in **Table 3.3**.

Table 3.3: Assessment of Potential Impact Significance

Magnitude of Potential impact	Sensitivity of Receptors			
	Very High	High	Medium	Low / Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

3.2.12 Mitigation Measures

Subsequent to the impact assessment discussed above, appropriate mitigation measures have been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance per the Table 3.3 require appropriate avoidance/ mitigation/compensatory measures to reduce the significance. Impacts having low to negligible significance can be left alone not needing any mitigation measures.

Generally, preference is given to the avoidance of the impact with the help of options available for nature, siting, timing, method/procedure, or scale of any Project activity. If avoidance is not possible, appropriate mitigation and control measures are proposed to reduce the consequence significance of the predicted impact. Finally, if impact reduction is not possible, compensatory measures are proposed.

3.2.13 Assessment of Residual Impact

The final step in the impact assessment process is determining the significance of the residual impacts, which essentially are the impacts which would be experienced even after implementing the mitigation/compensatory measures. Ideally, all of the residual impacts should be of negligible to low significance. For any residual impacts having moderate significance, monitoring mechanism is necessary to ensure that their significance does not increase. No residual impacts having major or critical significance are generally acceptable

3.2.14 Identification of Enhancement and Mitigation Measures

From literature survey, applying expert judgment and consultation with stakeholders, possible enhancement and mitigating measures were identified for beneficial and adverse effects respectively.

3.2.15 Preparation of Environmental Management and Monitoring Plan

An environmental management plan (EMP) for the proposed Project was prepared comprising the mitigation/ enhancement measures with institutional responsibilities, environmental monitoring plan, training and capacity building plan, and reporting and documentation protocols.

3.2.16 EIA Report Preparation

At the end of the study, the present report was prepared incorporating all the findings of the EIA.

4. Description of the Project

4.1 Introduction

It is evident that the demand of electric power in Dhaka City is growing faster in comparison with other parts of the country. Hence, it is a challenge to feed the demand of the city. Among the different locations of existing gas transmission systems, Ashuganj is considered to have some strategic importance. In recent years, several piping systems have been tied up at Ashuganj, especially the Bakharabad and GTCL installations, resulting in satisfactory gas pressure at the Ashuganj end. Bearing this, a program has been taken to install several new power plants at Ashuganj, such as the 223 MW combined cycle power plant and 2X450 MW combined cycle one. These proposed power plants are supposed to generate a substantial amount of power at Ashuganj and evacuating this amount to Dhaka City will not be possible with the existing transmission lines, especially considering the huge power carriage load which is to be generated due to the functioning of the proposed 2X450 MW combined cycle power plant. With this rationale PGCB has developed a project titled as “Ashuganj – Bhulta 400 kV Transmission Line and 400/230 kV Substation at Bhulta Project”.

4.2 Project Component

A number of load flow studies have been carried out during the pre-feasibility stage of the project. The findings of these studies have revealed that the construction of a dedicated double circuit 400 kV line from Ashuganj to Bhulta and a 400/230 kV sub-station at Bhulta will be the best solution with optimal load flow. The scope of works to be carried out under the project mainly comprises the following two sets of activities:

- a) 400 kV double-circuit three-phase transmission line on vertical formation double circuit lattice steel towers with 2 bundle ACSR (Finch) phase conductor and one ACSR (Dorking) earth wire and one equivalent OPGW from Ashuganj sub-station to 400/230 kV proposed Bhulta sub-station (approximate length: 70 km), and
- b) Design, supply, delivery, installation, testing and commissioning of a new 400/230 kV Air Insulated Switchgear (AIS) sub-station. The configuration of the 400 kV and 230 kV bus-bars shall be 1 and ½ bus-bar scheme.

As the proposed transmission line will be required for evacuating power to be generated in the proposed 2X450 MW power plant (which is under construction by APCL in Ashuganj), the construction of the line would continue simultaneously with the construction works of the power plant.

The alignment of the proposed transmission line will pass through mainly agricultural and fallow lands avoiding major settlements. The alignment would cross the river Meghna at one location. The final alignment has been chosen among four alternative options, considering different technical as well as socio-economic factors.

4.3 Project Category

Under the criteria of the DoE the transmission line falls under Red Category that requires an Environmental Impact Assessment study. As per the EIA guidelines of the DoE, it is

mandatory to carry out an Initial Environmental Examination (IEE) for red category projects prior to conducting the EIA. Prior to EIA study, an IEE study for the proposed project has been carried and ToR for EIA study has been approved from the DoE. The EIA study should prepare a detailed environmental management and monitoring plan.

4.4 Project Location

The project area for the 'Ashuganj-Bhulta 400kV Transmission Line' has been developed considering 40 meter buffered distances on either side of the 70 km transmission line. The distance of 20 m between the two buffer zones therefore, results in a 100 meter wide boundary for the project area throughout its length. The project area for the environmental study has been estimated as 704 ha, which falls partly on both the Chittagong and Dhaka divisions, starting from the Ashuganj union of Ashuganj upazila at Brahmanbaria District (Chittagong Division) and ending at the Golakandail union (near Bhulta) at Rupganj Upazila, Narayanganj District (Dhaka Division) (**Table 1.1**).

4.5 Physical Features of the Transmission Line and Sub-station

The major physical features of 400 kV transmission line and 400/230 kV sub-station is given in **Table 4.1** below. The transmission line will be double circuit and conductor materials will be ACSR Finch. The line supporting towers will be steel towers which are of two types– Tension and Suspension. Tension towers will be installed in angle points and suspension towers will be installed along the line as load bearing support. The average dimensions for base foundation of towers are considered as 15m x 15m (**Figure 4.1**). A disc type insulator will be used in the towers to bear the conductor.

Table 4.1: Physical Features of transmission line and substation

Sl. No.	Physical Features	Attribute
1	Voltage Rating for Transmission Line	400 kV
2	Voltage Rating for Substation	400/ 230 kV
3	Type of Transmission Line	Double Circuit
4	Width of T/L Right of Way	100 meters (40 m left + 20m DIA + 40 m right)
5	Type of Line Support	Steel lattice Towers
6	Conductor Material	ACSR Finch
7	Line Insulator	Disc type, Porcelain
8	Type of Connection	Approximately 36 months
9	Duration of Project Implementation	40 Acres
10	Land acquisition (for substation)	225 sqm
11	Average Area for Tower Foundations	400 kV
12	Funding Source	Public Private Partnership (PPP)

Source: PD, Ashuganj-Bhulta 400 kV project



Photo 4.1: Tower in the angle point



Photo 4.2 Suspension Tower.

4.6 Component of the Construction Works

The typical activities to be undertaken under the project are listed below:

- Construction of the 70 km 400 kV overhead transmission line
- Land acquisition (40 acre land will be required for sub-station site)
- Clearing of RoW
- Establishment of temporary access tracks
- Establishment of material storage areas and work sites
- Transport of materials and equipment to site
- Establishment of construction camps for workers
- Tower erection
- Conductor stringing
- Switchyard foundation of substation
- Equipment set up
- Equipment wiring

The proposed project has the following security measures:

a) Firefighting Equipment

As the sub-stations are vital installations, fire fighting equipment of appropriate specification will be procured and installed.

b) First aid Materials

First aid boxes are to be kept at the installation.

c) Boundary Wall and Security

A boundary wall of reasonable height will be constructed and protection wire will be put up on the walls for all sub-stations sites. Trained security guards will also be provided.

4.6.1 Civil Construction Works

a) Land development

Construction of the sub-station may need land development to raise the ground level up to required height by carrying earth by truck from nearby areas or by sand filling using dredgers.

b) Earth Work in Foundation

Construction of the sub-station needs earthwork for excavating the foundation up to the required depth. The excavated earth should be kept in a nearby vacant place and after finishing the foundation work, back filling of the excavated area will be done with local soil and sand.

c) Foundation Treatment

The foundation area will be investigated geo-technically. The test result will help in designing the foundations of the structures. It will help to identify if foundation treatment is required. The type of treatment like pre-cast RCC piling or in situ concrete piling, removal of peat or loose soil will be suggested after geo-technique investigation.

d) RCC Work

The RCC works would be required for tower foundation, roof, column, beam, floor, foundation of transformer, circuit breaker and steel structure etc.



Photo 4.3 Placing steel ring bunds



Photo 4.4: Welding of reinforcements



Photo 4.5 Stripping the tower footing with steel



Photo 4.6 Providing detail reinforcements



Photo 4.7 Casting CC into tower foundation



Photo 4.8 Placing Tower on its foundation

e) Brick Work up to Plinth Level and Superstructure

Brick work will be done for constructing the substation building with first class bricks and coarse sand and cement up to roof level.

f) Back Filling with Local Sand

Back filling of the excavated area of the foundation and floor of the building will be done with local sand.

g) Plastering and Finishing (electric wiring, distemper or plastic paint)

Concealed electric wiring of good quality and proper size is to be done and bulbs and switchboards are to be provided. Plastering of walls inside and outside as well as the roof of the building will be done accordingly and curing works will be done for at least three weeks. After that distemper or plastic painting will be done on the walls and roof of the building.

h) Wood Works/Thai Aluminum for Doors and Windows and Glass Fittings

Wood/Thai aluminium works are to be done on door shutters and windows of the building along with glass fittings.

i) Sanitary Works

Sanitary works such as placing of sewerage line (either PVC or RCC), installation, fittings and fixing of toilet accessories will be done in the building.

j) Water Supply System

The water supply system where available will be activated for the workers and staff of the back to back station. In places where there is no supply system, tube wells will be set up.

k) Boundary Fencing with Concrete Pillar and Barbed Wire

The project area will be protected from encroachment and unauthorized entrance of the public by fencing the boundary with a 8 to 10 feet high wall with barbed wire fitted with concrete pillars 3 meters apart.

4.6.2 Electrical Works

Installation of equipments will include transformers, circuit breakers, CTs, PTs, isolators, lightening arresters, panel boards, batteries and battery chargers etc. After completion of the building, all equipment will be installed at the sub-station (outdoor and indoor) as per specification and standard. For this project all substation material will be procured from foreign countries. Therefore, domestic resource utilization will be minimum; only local materials like bricks, sand, cement, rods, etc. will be utilized for the installation works.

Transformers are heavy equipment. The transportation of such equipment may require grading of river embankment and skidding through open field. The landowners may be required to be paid compensation.

a) Erection of Tower

The towers will be constructed to take the load of the tower, conductors, accessories as well as wind load and earthquake load. The towers in paddy fields will have proper clearance at the sag (lowest point on bottom conductor). At homesteads, if any, the sag will be above the canopy.

b) Stringing of Transmission Line

The transmission line will be strung keeping suitable clearance at all locations. The lowest sag point will be considered during stringing.

4.6.3 Testing and Commissioning of Equipment

After installation (outdoor and indoor), each and every equipment will be tested as per specification and standard. If all the tests are successful, the sub-stations will be commissioned accordingly.

4.7 Construction Equipment

For this project all equipment to be installed will be procured from foreign countries. Therefore, domestic resource utilization in the project will be minimum; only local materials such as bricks, sand, cement, rods, etc. will be utilized for installation/construction works.

4.8 Work Schedule

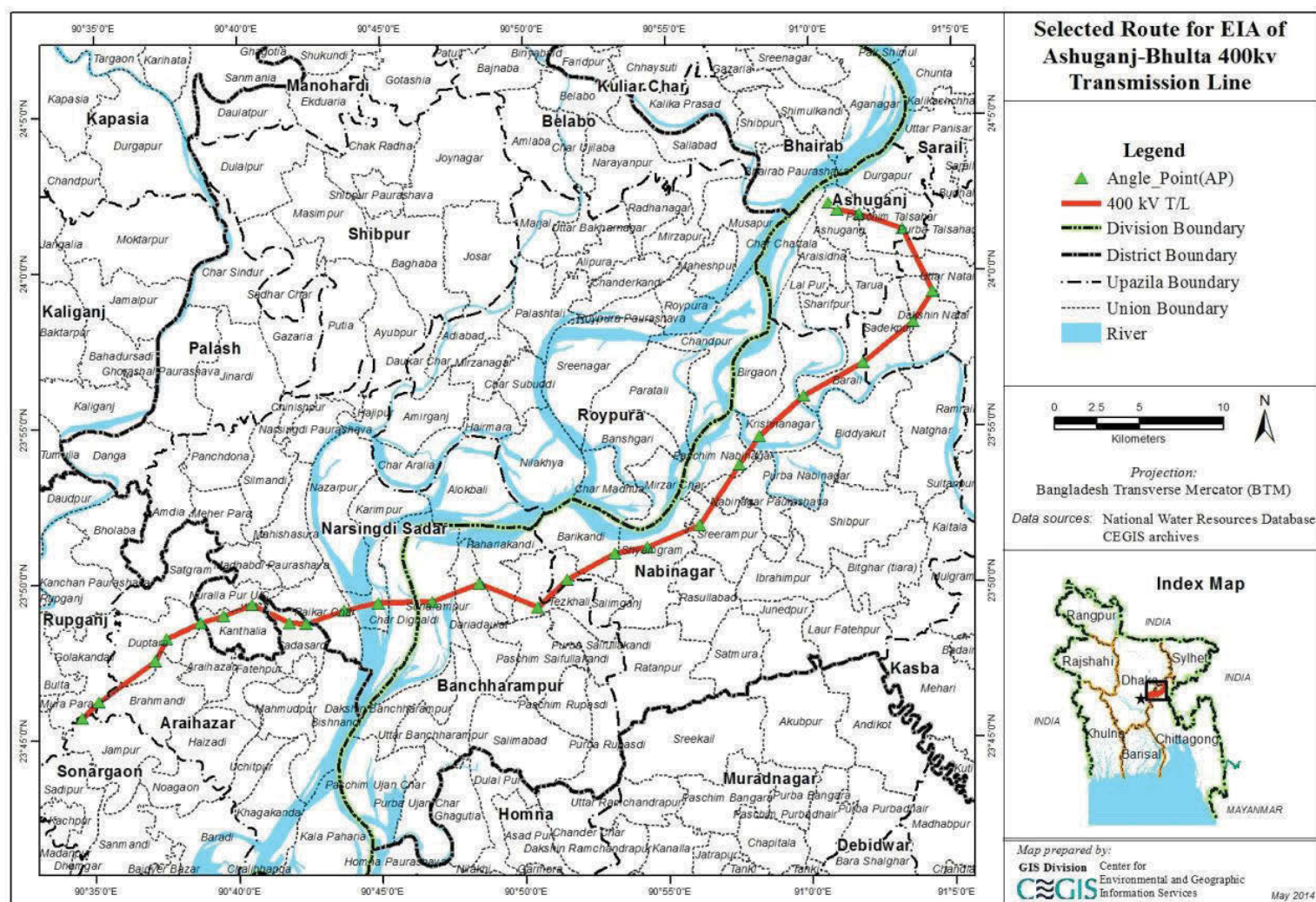
The completion of works will take approximately 36 months, starting from July, 2014 and ending on June, 2017.

5. Alternative Route Selection

5.1 Alignment Selection Factors

A number of factors are generally considered while selecting a final option from a set of alternatives, which are developed in different scenarios. In our study, the following criterion was considered as of having significant importance during the selection of the final alignment.

- Upcoming power plants near Ashuganj by 2015
- Power to be generated from the existing and upcoming power plants
- Upcoming transmission infrastructure around Ashuganj area by 2015
- Condition of existing substation at Ashuganj
- Capacity of existing transmission lines from Ashuganj
- Load Flow Study for different options.
- Best possible ways of power evacuation from Ashuganj
- Requirement of new transmission facilities for power evacuation.



Map 5.1: Selected Route for Construction of Ashuganj - Bhulta 400 kV T/L

5.2 Alternative Options

The load flow study was simulated using a total number of seven scenarios developed for the year 2015, to meet the national demand of 10300 MW (**Table 5.1**).

Table 5.1: Scenarios considered during the Load Flow study

Scenario	Consideration
1	The existing transmission facility is to be used for evacuating the upcoming 2X450 MW power without adding any new transmission infrastructure.
2, 3a and 3b	For power evacuation, different new 230 kV transmission facilities will be built at 400 kV but energized at 230 kV
4	Considers different 400 kV transmission facilities for power evacuation.

Among the options listed in **Table 5.1**, “Scenario-4” is found to be the most suitable one (both technically and economically), and considering this as a ‘base case’ four more ‘options’ have been investigated in detail (**Table 5.2**).

Table 5.2: Options considered under ‘Scenario-4’

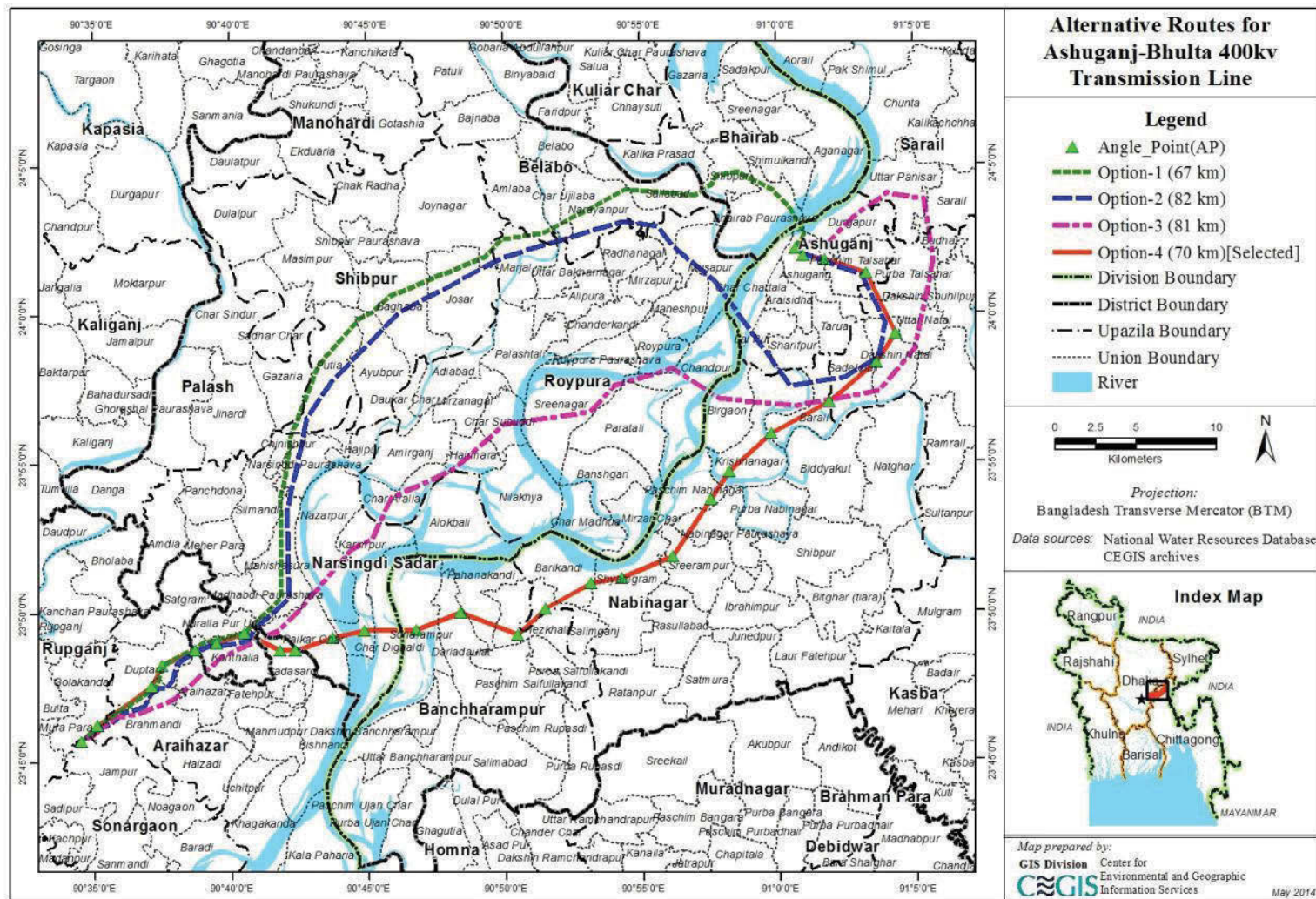
Option	Description
1	<ul style="list-style-type: none"> ➤ 2X450 MW power from upcoming Ashuganj CCPP will be evacuated through a 400 kV double circuit Transmission Line from Ashuganj 400 kV substation to Bhulta 400/230 kV substation. ➤ The 230 kV Bus of Bhulta Substation will have an In-Out from Ghorashal-Rampura and Haripur-Rampura double circuit 230 kV lines. ➤ Rampura 230 kV Substation will have 4 nos. of 230 kV lines parallel from Bhulta 230 kV Bus. ➤ This facility will help to supply a bulk quantity of power (approximately 1200 MW) inside the city through Rampura substation.
2	<ul style="list-style-type: none"> ➤ Ashuganj Power Station Company Ltd. (APSCL) will build 450 MW CCPP (North) by 2014. By this time 400 kV Ashuganj-Bhulta transmission line and Bhulta substation may not be possible to construct. ➤ Before the 400 kV system is commissioned, generated power will have to be evacuated through the existing 230 kV network, and for thus a 400/230 kV inter bus transformer can be installed under the scope of power plant project ➤ In scenario 4a1 and 4b1 full 2X450 MW power is considered to be evacuated rapidly to 400 kV Bhulta S/S and in scenario 4a2 and 4b2 the 400/230 kV Inter bus Transformer at Ashuganj is considered in operation. ➤ It appears that when some amount of power (143 MW in case of 4a2 and 122 MW in case of 4b2) flows from 400 kV to 230 kV bus of Ashuganj, it does not have much effect on the flow of 1st and 2nd EWI but a major portion of this power comes to Bhulta 230 kV bus through Ghorashal.
3	<ul style="list-style-type: none"> ➤ APSCL is currently working on a 225 MW power plant which is planned to be connected at 132 kV bus of APSCL substation by decommissioning equal

Option	Description
	<p>quantity of old power plants from the same bus.</p> <ul style="list-style-type: none"> ➤ But at present due to the power shortage of the country APSCL is instructed to delay the decommissioning of older power plants. ➤ The 132 kV exits of Ashuganj substation in 2015 scenario is studied in details where the highly loaded Ashuganj-Ghorashal 132 kV line is observed. ➤ In scenario 4a1 and 4a2 the 225 MW plant is considered to be connected at 132 kV and in scenario 4b1 and 4b2 the 225 MW plant is considered to be connected at 230 kV bus. ➤ Scenario 4b1 and 4b2 is acceptable as the highly stressed 132 kV Ghorashal-Ashuganj Line is found to be reasonably loaded than in scenario 4a1 and 4a2.
4	<ul style="list-style-type: none"> ➤ Since a number of new large power plants are going to be added at Ashuganj so the short circuit study has also been conducted as well. ➤ It is found that at 132 kV and 230 kV level maximum fault level will reach up to 40 kA, so the short circuit ratings of the existing equipments will have to be checked and replaced if needed. ➤ And also for selecting the new equipments the calculated short circuit level has to be taken into account.

Table 5.3 and **Map 5.2** below show the detail information for different alignment options. The ‘option-4’ has been finalized at last, predominantly because of the least impact it causes to settlements. The selection of best route was done through using the analysis of latest RS images and by considering the least impact to the socio-economic features and settlements.

Table 5.3: Information Matrix for suggested alternative alignment options

Alternatives	Total Length (km)	Settlement (ha)	Remarks
Option 1	67	264	Not Selected
Option 2	82	326	Not Selected
Option 3	81	177	Not Selected
Option 4	70	97	Selected



Map 5.2: Alternative Alignments considered for the Ashuganj – Bhulta 400 kV T/L

6. Environmental and Social Baseline

6.1 Project Bounding

The geographical boundary of the "Project Area" and the potential "Impact Area" is delineated as a requirement of the environment assessment study. The project area is the physical location of the proposed power transmission line and sub-station of the project while the Impact area covers the geographic extent of the environmental and socio-economic impacts resulting from implementation of the proposed power transmission line during pre-construction, construction and post-construction periods. It is recognized that the benefits of the proposed 70 km of 400 kV transmission line will extend to the regional as well as national scale. For the EIA of 400 kV T/L, the focus of the study will be limited to the area where the physical impacts of the activity will be directly felt. A 20m area through the RoW has been defined as the Direct Impact Area (DIA). A 40m buffer along both sides (i.e. 40m+40m=80m) of the power transmission line has been considered for environmental analysis as General Impact Area (GIA). So, for the EIA study total 100m RoW has been considered for the baseline study area. A general socio-economic profile has been prepared for union-based administrative units over which the power transmission line shall traverse. The list of administrative area for the Project is shown in **Table 1.1**.

6.2 Physical Environment and Water

6.2.1 Climate

The projected area is located in a typical monsoon climate area within Bangladesh. It has three main seasons:

- Summer/pre-monsoon - March to May
- Rainy season/monsoon - June to October
- Winter season - November to February

The rainy season is hot and humid having about 80 percent of the annual rainfall. The winter is predominately cool and dry. The summer is hot and dry interrupted by occasional heavy rainfall. The Ashuganj-Bhulta 400 kV transmission line project lies in the South East and North Central hydrological regions of Bangladesh, where monsoon comes in the month of July and recedes in late October. The Bangladesh Meteorological Data (BMD) at Dhaka has been considered relevant for the meteorological analyses of rainfall, temperature, humidity, evaporation, wind speed and sunshine hours and as such meteorological information have been collected and summarized for the station from 1953 to 2008.

(a) Rainfall

The results of maximum and average monthly rainfall analyses are given in **Figure 6.1**. The pre-monsoon and monsoon periods undergo significant rainfall whereas the dry period experiences little or no rainfall.

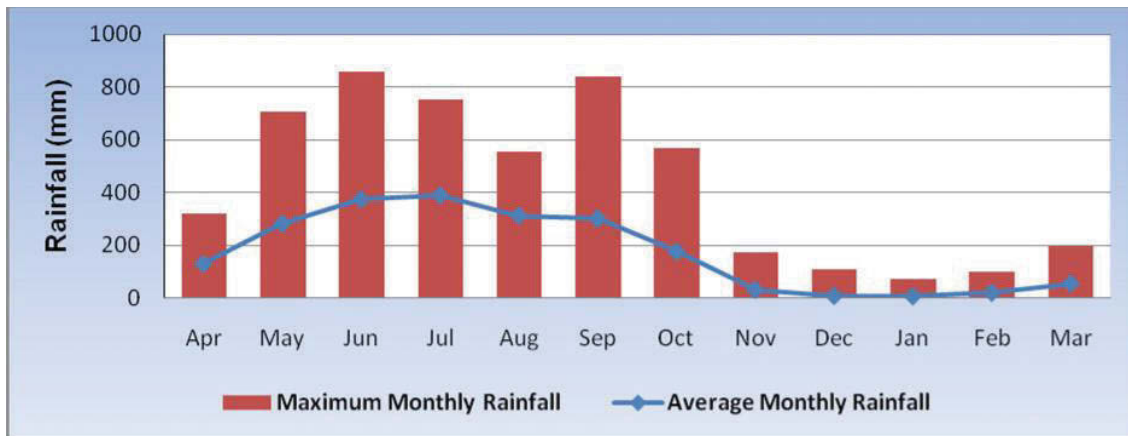


Figure 6.1: Maximum and Average monthly rainfall in Dhaka

(b) Temperature

The average values of maximum and minimum monthly temperature have also been studied for the Dhaka station (**Figure 6.2**). The warmest month is April, experiencing 34°C whereas January is the coolest month with around 12°C average temperature.

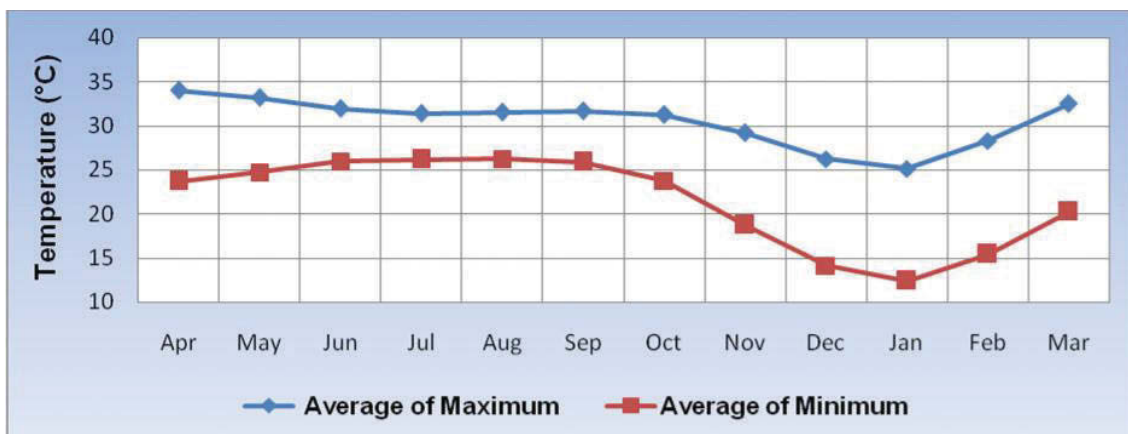


Figure 6.2: Average of maximum and minimum temperature in Dhaka

(c) Humidity

The range of average relative humidity is 62% to 85% (**Figure 6.3**). Humidity is highest during July-August (85%) and lowest in March (62%).

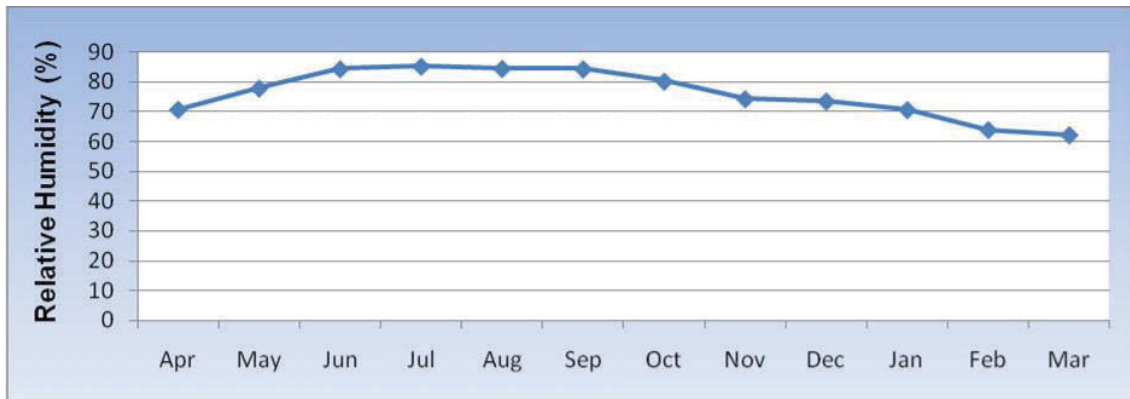


Figure 6.3: Monthly average humidity in Dhaka

(d) Evaporation

Mean evaporation rate varies within the range of 1.28 to 2.76 mm/day where the highest and lowest values are observed during the months of April and December. The results of mean monthly evaporation analysis are given in **Figure 6.4**.



Figure 6.4: Monthly average rate of evaporation in Dhaka

(e) Wind Speed

The monthly average wind speed in Dhaka region varies from 129 to 225 km/day. The variation of monthly average wind speed is shown **Figure 6.5** below. The figure shows that the average speed of wind is highest in April (225 km/day) and lowest in November (129 km/day).

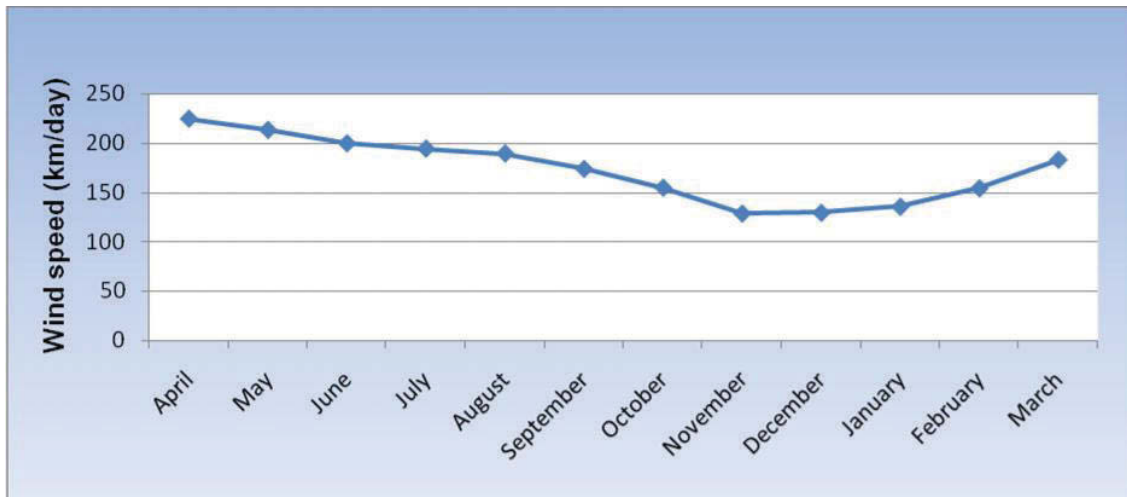


Figure 6.5: Monthly variation of average wind speed in Dhaka

(f) Sunshine Hour

The monthly average values of sunshine hours in Dhaka station vary from 4.5 to 8.3 hour/day. The average value of sunshine hours is highest in March (8.3 hr/day) and lowest in July (4.5 hr/day) (**Figure 6.6**).

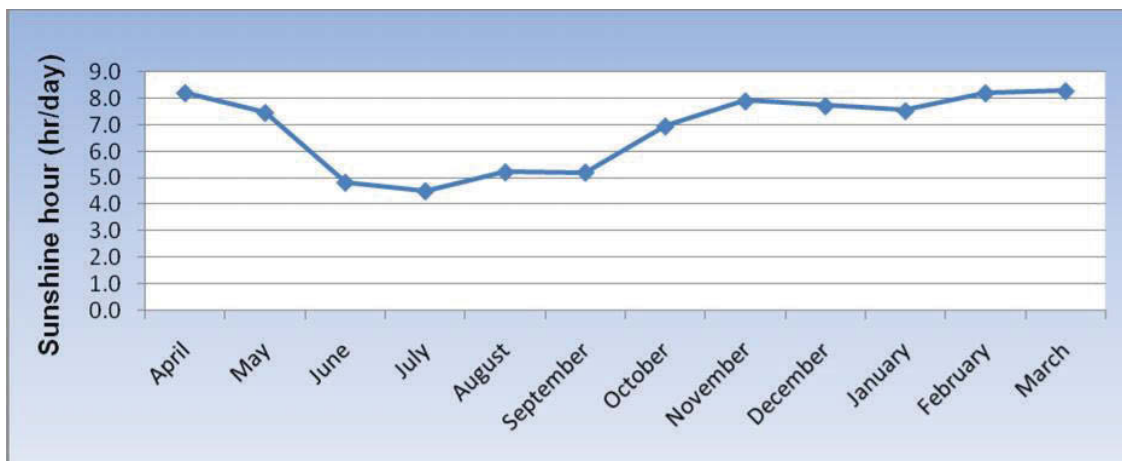


Figure 6.6 : Monthly average sunshine hours per day in Dhaka

6.2.2 Climate Change

The study area lies in the South East and North Central hydrological regions of Bangladesh. The climate of the area is tropical wet and dry, generally marked with monsoons, high temperature, considerable humidity and heavy rainfall. The hot season commences early in April and continues till August. The maximum temperature observed during April to June and the minimum temperature recorded in January. The highest rainfall is observed during monsoon.

In order to assess the change in climatic factors, trend of annual variations of the aforementioned meteorological parameters were analyzed. Historically, the major impact caused by climate change is rise in temperature. As per analyses made in the study, the average temperature is found to be gradually increasing in the area. In last 50 years, the

mean annual temperature has experienced a rise of about 0.013°C per year. The variation of mean annual temperature recorded at Dhaka station is shown in **Figure 6.7** below.

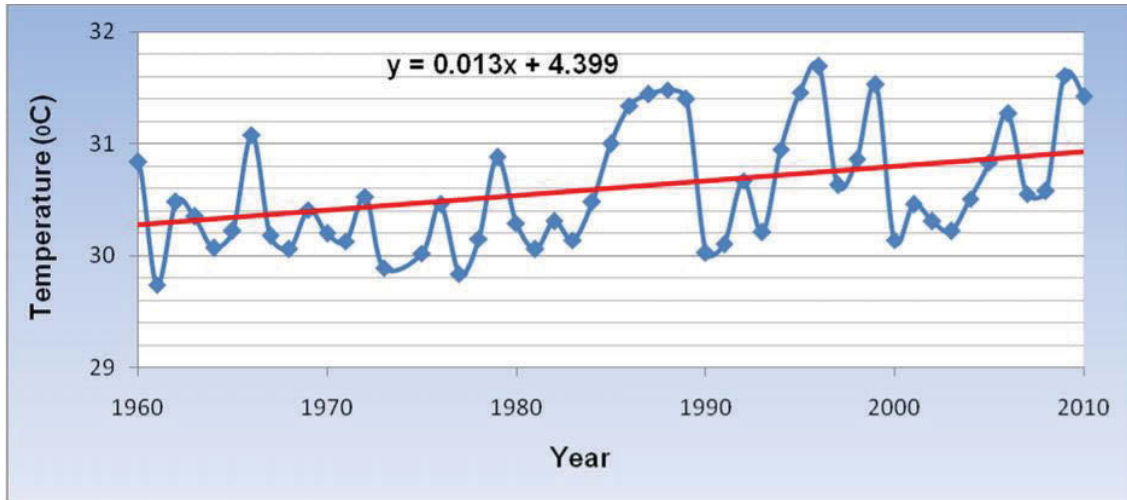


Figure 6.7: Annual Variation of Mean Temperature in Dhaka

The increase in mean annual temperature affects the rate of evaporation and thus rainfall intensities. The evaporation rates recorded at Dhaka station shows a decreasing trend (decreasing by 0.006 mm/day each year in last 25 years). The following figure (**Figure 6.8**) shows the decreasing trend in Evaporation rate. During this period, spring season has been shortened and monsoon has been shifting towards May. These days, monsoon starts from the month of May and lasts up to mid October. Due to such timing, water scarcity is often observed in the Boro season. This phenomenon affects the cropping patterns as well as the biodiversity and ecosystem of the study area. Now-a-days, farmers initiated hybrid cropping, which eventually improved their socio-economic status.

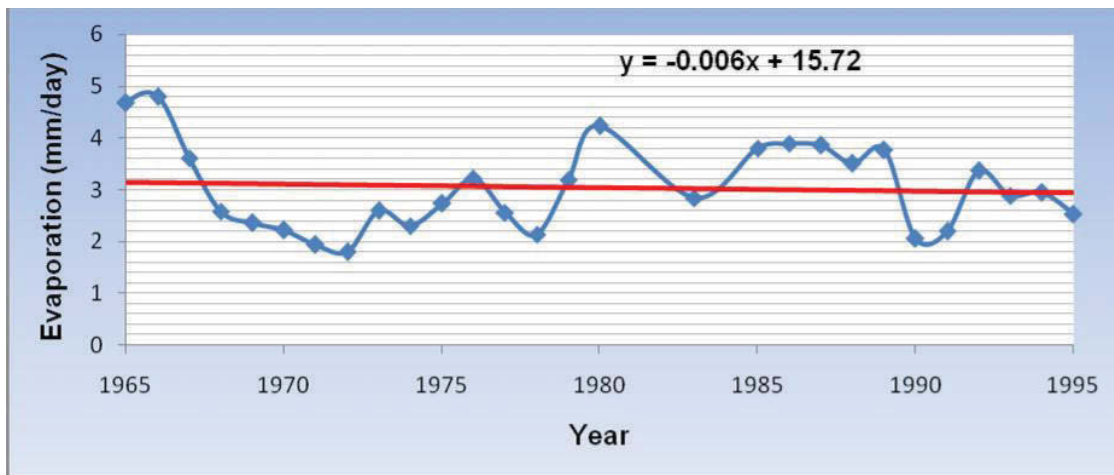


Figure 6.8: Annual Variation of Mean Evaporation in Dhaka

The rainfall intensities and patterns have also been changed and the extreme consequences of it are affecting the study area. In the last 55 years (from 1953 to 2008), the annual summation of rainfall has decreased by 0.328 mm per year at Dhaka. The annual variation of summation of rainfall recorded at BMD station of Dhaka is shown below in **Figure 6.9**.

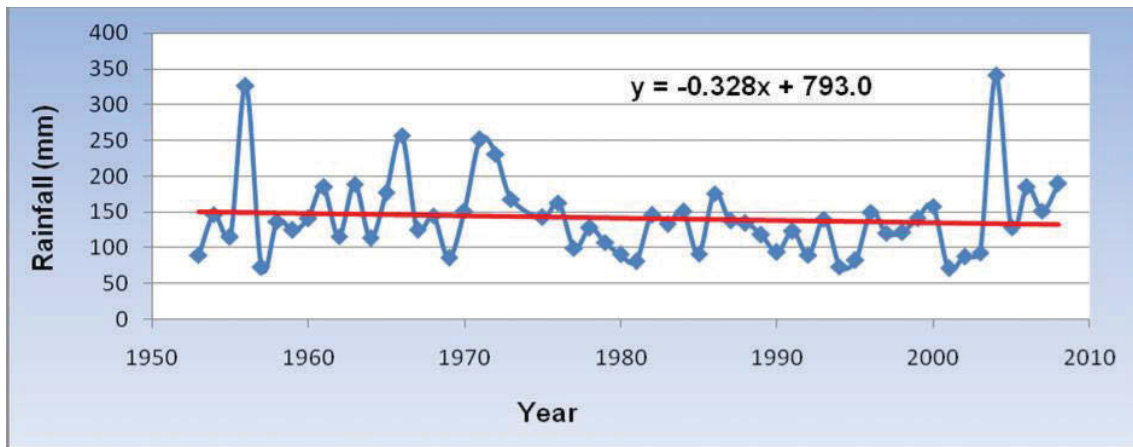


Figure 6.9: Annual Variation of Rainfall in Dhaka

The average humidity has also experienced minor changes in the last five decades. The magnitude of average relative humidity has decreased by 0.070% per year (**Figure 6.10**) at Dhaka. The following figure shows the annual variation of average relative humidity in Dhaka.

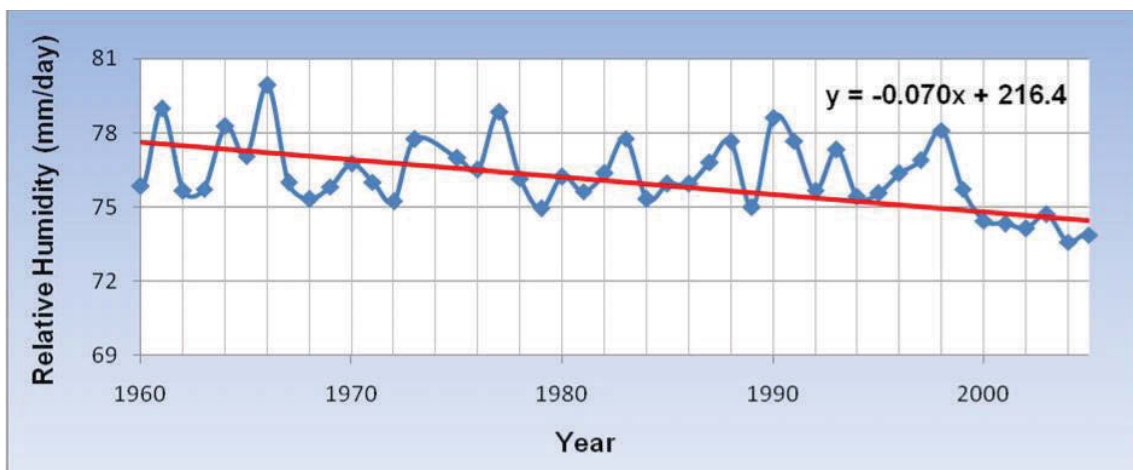


Figure 6.10: Annual Variation of Mean Relative Humidity in Dhaka

Apart from the meteorological changes discussed above, climate change also has important impacts on the frequency and intensity of natural disasters (Drought in particular) in the study area.

6.2.2 Water level/ flooding

For analyzing the flooding status using secondary information sources, two surface water level measuring stations at Bhairab Bazar and Nabinagar have been studied in detail. **Figure 6.11** below show a hydrograph showing the monthly average values of flood levels in the two aforementioned locations. The two stations almost depict hydrological identical situations, in which flood values rise typically in the monsoon, up to a value of around 6 m +PWD.

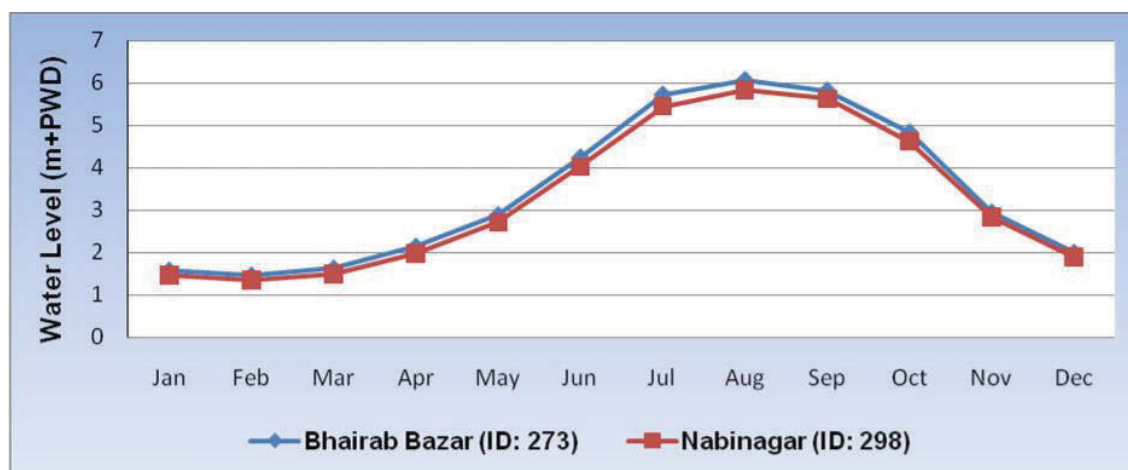


Figure 6.11: Flood hydrograph showing monthly average variations in water levels.

Table 6.1 below shows the synopsis of a flood frequency analysis at the two locations for different return periods.

Table 6.1: Water level at different return periods

Return Period (Years)	Water Level (m+PWD) (Bhairab Bazar)	Water Level (m+PWD) (Nabinagar)
2.33	6.34	6.07
5	7.19	6.85
10	7.88	7.48
20	8.55	8.09
50	9.41	8.88
100	10.05	9.47

Source: BWDB

6.2.3 Air Quality

Air pollution is a primary social and environmental concern for health and sustainability of the ecosystem. When the presence of solid particles, liquid droplets or gaseous compounds in the air is higher than normal, it becomes harmful to living organisms and the air becomes polluted.

There are five primary pollutants which together contribute more than 90% of global air pollution. These are: CO₂, NO_x, HC, SO_x, and PM. The standard values of ambient air for the area of different categories are shown in the following **Table 6.2**.

Table 6.2: Concentration of micrograms per meter cube in the air

Area	Categories	Concentration micrograms per meter cube			
		SPM	SO ₂	CO ₂	NO _x
A	Industry	500	120	5000	100
B	Commercial	400	100	5000	100
C	Residential and rural area	200	80	2000	80
D	Sensitive	100	30	1000	30

Source: Environmental Conservation Rules, 1997, DoE

The transmission line will avoid rural and urban settlements. Since the proposed transmission line will not have any lasting impact on air quality, no data on air quality has been collected.

The main concern is suspended particulate matter (SPM), which is often higher in concentration than the national air quality standard during the pre-construction and construction period.

Heating is the main biological effect of the electromagnetic fields produced from the high voltage transmission line. To date, no adverse health effects from low level, long-term exposure to power frequency have been observed.

6.2.4 Ambient Noise Quality

The noise level has been analyzed in the field. The values of noise level in different locations are presented in **Table 6.3** below:

Table 6.3: Daytime noise levels of the study area

Sl. No.	Location	Maximum Noise level (dBA)
1	Singhab	48.1
2	Ashuganj	54.8
3	Talsahar	44.3
4	Nabinagar	49.2
5	Paikar Char	44.9
6	Daukandi	47.5
7	Krishnanagar	46.9
8	Choto Haran	49.8
9	Kalagachia	53.1
10	Bishnurampur	51.2

Source: CEGIS field survey, February 2014

Table 6.2 shows the standard values for noise in Bangladesh. Noise levels exceeding 80dB is usually considered as noise pollution in Bangladesh. However, the permissible limits for Bangladesh are less (**Table 6.4**). The study area can be regarded as a residential area and the observed noise levels have been found to be exceeding the permissible limits for daytime at Ashuganj, Kalagachia and Bishnurampur. However, the average values do not exceed the standard noise pollution value.

Table 6.4: Standards of noise levels for different zones of Bangladesh

Zone Class	Limits in dB	
	Daytime	Nighttime
	(6 am – 9 pm)	(9 pm-6 am)
Silent zone	45	35
Residential zone	50	40
Mixed	60	50
Commercial zone	70	60
Industrial zone	75	70

Source: Bangladesh Gadget, 2006

6.2.5 Water availability and quality

Surface Water

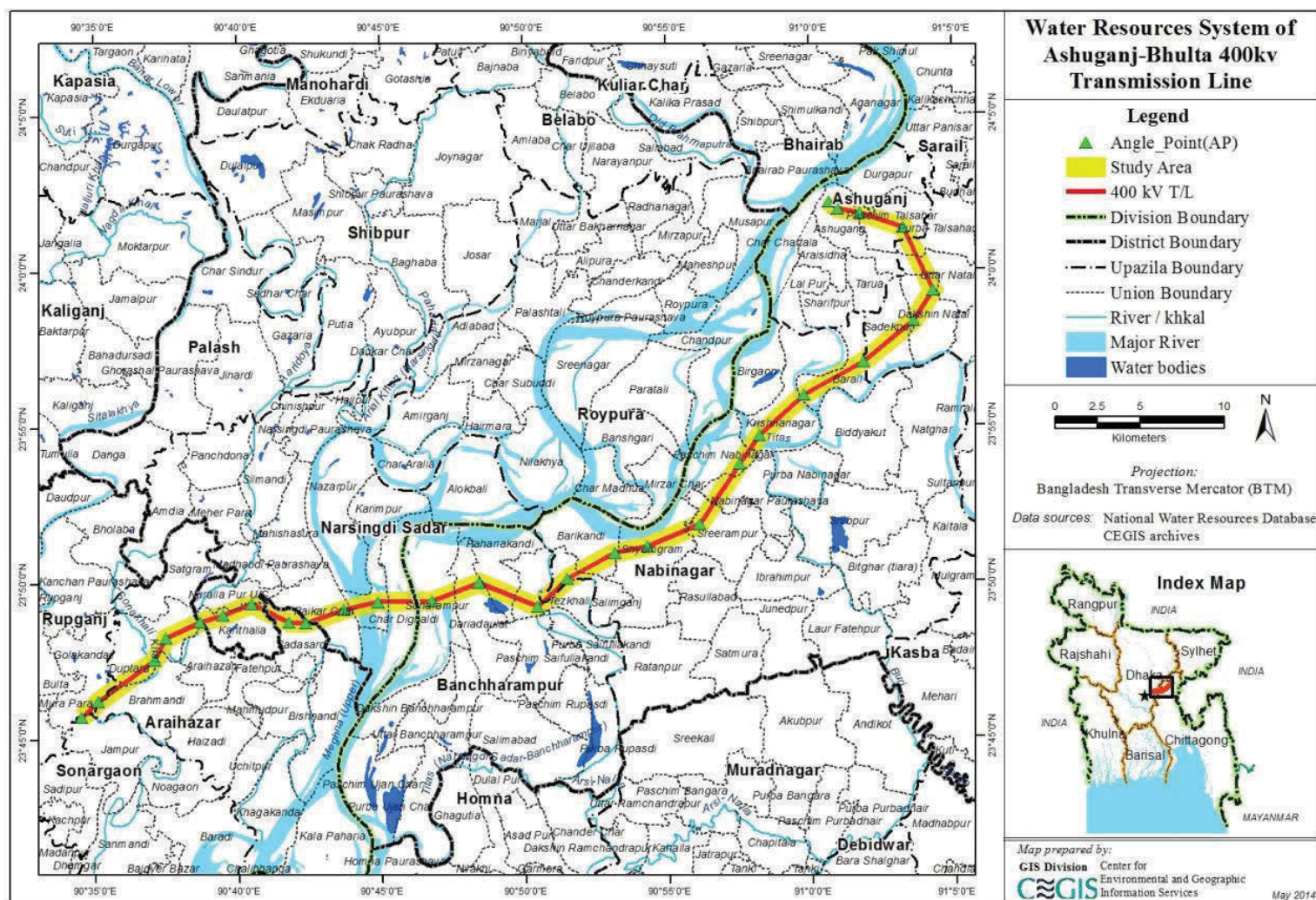
The Meghna river, Titas river and Gazipura river governs the hydrology of the project area. There are also a number of khals/ water bodies in the area as shown in **Map 6.1**. These existing rivers are used for navigation and other purposes and to carry runoff water from adjoining agricultural lands, which might contain pesticides and residual fertilizers. During site observation the water quality of these river were found very bad specially Gazipura river due to prevalence of significant dying industries at Narsingdi and Narayanganj. The Color, Odor and taste of the water of these rivers are declining tremendously in recent years. The water quality data of these rivers are given below. The standard values of the same set by DoE, Bangladesh have also been shown for comparison.

Table 6.5: Water Quality in Meghna River, Titas River and Gazipura River

River Name	Sample Location	Water Quality Parameters				
		Temperature (°C)	TDS (ppm)	EC (mS/cm)	DO mg/L	pH
Meghna River	Narsingdi Sadar	28.0	920	480	5.9	8.8
Titas River	Krishnanagar	29.0	1030	520	5.6	8.2
Gazipura River	Puran Char	28.5	1170	610	4.8	7.9
Standard value (Bangladesh)	Irrigation	20-30	-	-	5.0	7.0-8.5
	Fishing	20-30	-	-	4.0-6.0	6.7-9.5

Source: CEGIS field survey, February 2014

As the transmission line will not have any impact on water bodies, a further detailed analysis of the water quality was not required for the project.



Map 6.1: Water Resources System of Ashuganj-Bhulta 400 kV T/L Project area

Ground Water

As other parts of the country, the study area also receives sufficient amount of rainfall and there is good availability of groundwater used by hand pumps for drinking and domestic purposes. Some industries also use deep tube wells within their premises to meet the requirement of good quality water for various purposes. Groundwater level data are collected and analyzed from three different BDWB observation wells located at Araihaazar, Narsingdi Sadar and Banchharampur. The monthly variation of mean ground water level at Araihaazar (from 1971 to 2003), Narsingdi Sadar (from 1971 to 2003), and Banchharampur (from 1971 to 2003), are shown in **Figure 6.12** below.

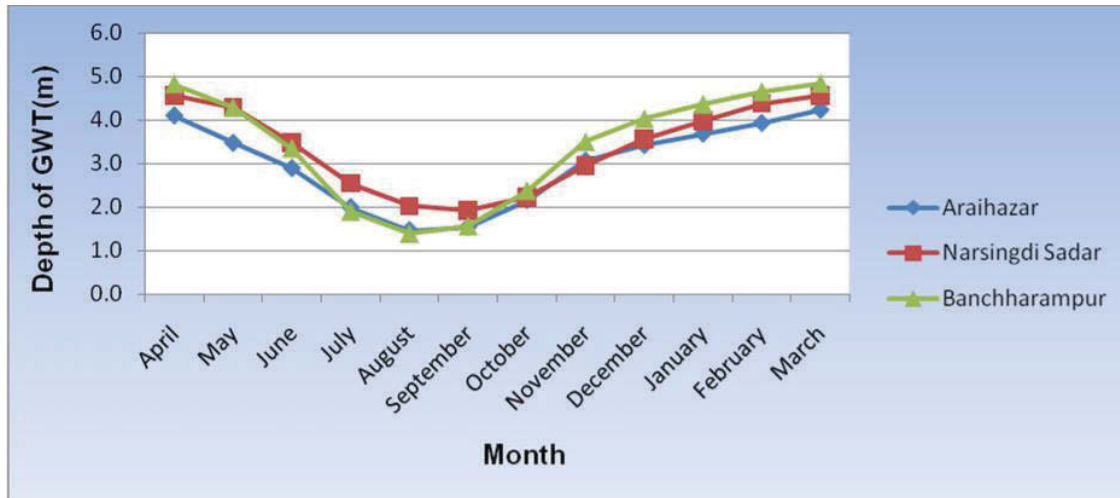


Figure 6.12: Ground Water Table (GWT) of the study area

The Ground Water Table (GWT) measured at the aforementioned locations at ten year intervals are shown in **Table 6.6**. Values are analyzed for the months of April (Considered as dry period) and September (considered as wet period). In the dry season, increased dependency of the local people on ground water lowers the GWT. During monsoon, the higher availability of surface water leads to higher recharge of ground water sources. **Table 6.6** shows that the GWT in the dry period and wet period differ significantly over the years.

Table 6.6: Ground Water Tables (GWT) shown at ten year intervals

New ID	Location	1970		1980		1990		2000	
		Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
NAG 002	Araihaazar	4.25	1.67	3.89	1.22	3.1	1.86	6.02	1.82
BRA 004	Banchharampur	3.94	1.32	4.84	1.55	4.25	2.09	5.49	2.69
NAR 004	Narsingdi Sadar	4.76	2.03	5.25	2.17	4.87	2.4	4.05	1.38

6.2.6 Natural Hazards

Seismicity

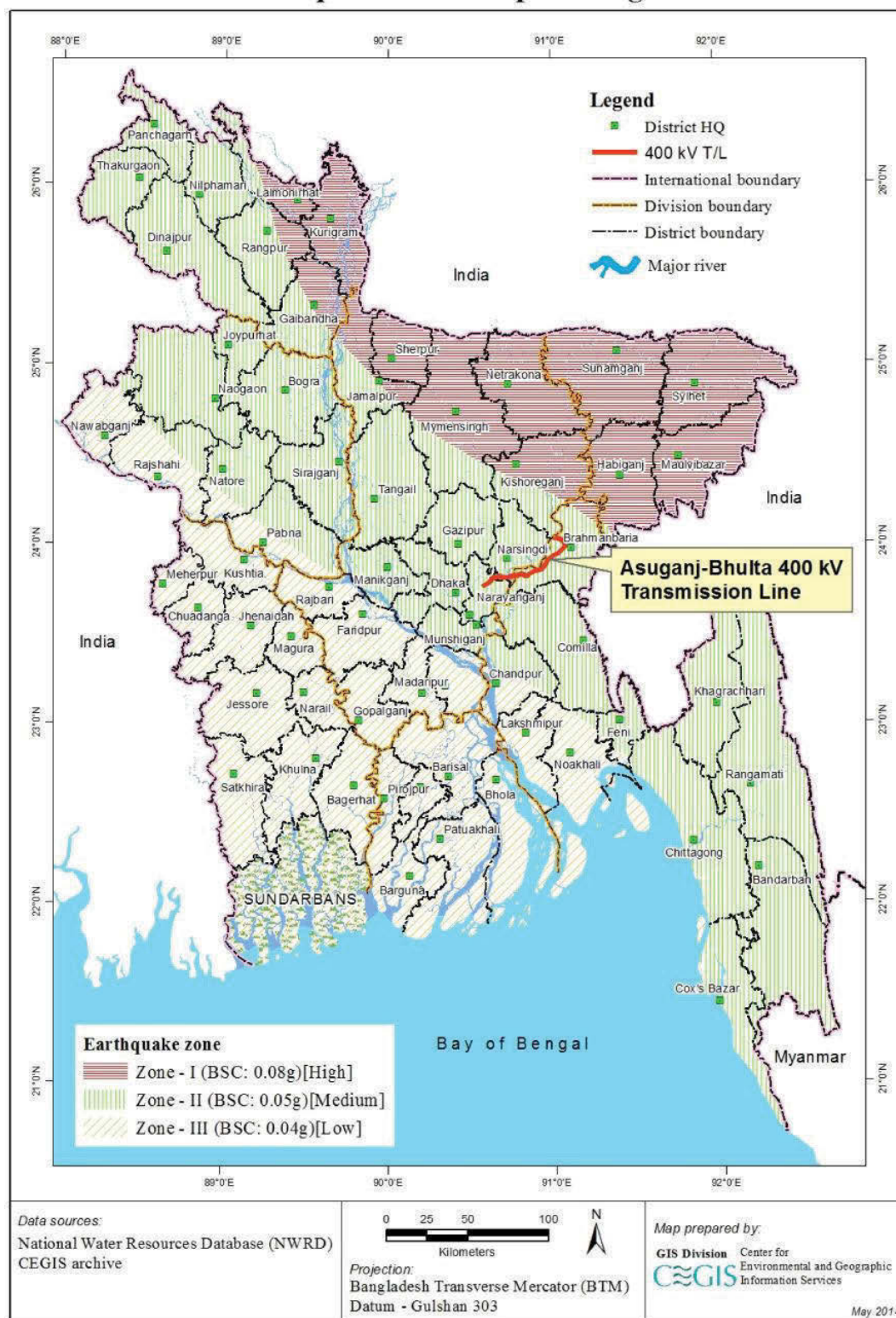
Bangladesh and northeast Indian states have long been one of the seismically active regions of the world, and have experienced numerous large earthquakes during the past 200 years at an average rate of one in every 30 years.

The catastrophic earthquakes of 1762 and 1782 are believed to have been partially responsible for the diversion of the Old Brahmaputra River from the west of its main Arial Khan distributary to the present Padma channel. Similarly it may have assisted the change of the Teesta, which formerly flowed southwards down the Atrai and Purnarbhaba courses to the Atrai basin and all the way to its present east-southeast course to the Brahmaputra-Jamuna at Ulipur. Since 1860 over 20 shallow and intermediate major earthquake epicenters have been recorded in Bangladesh and surrounding areas.

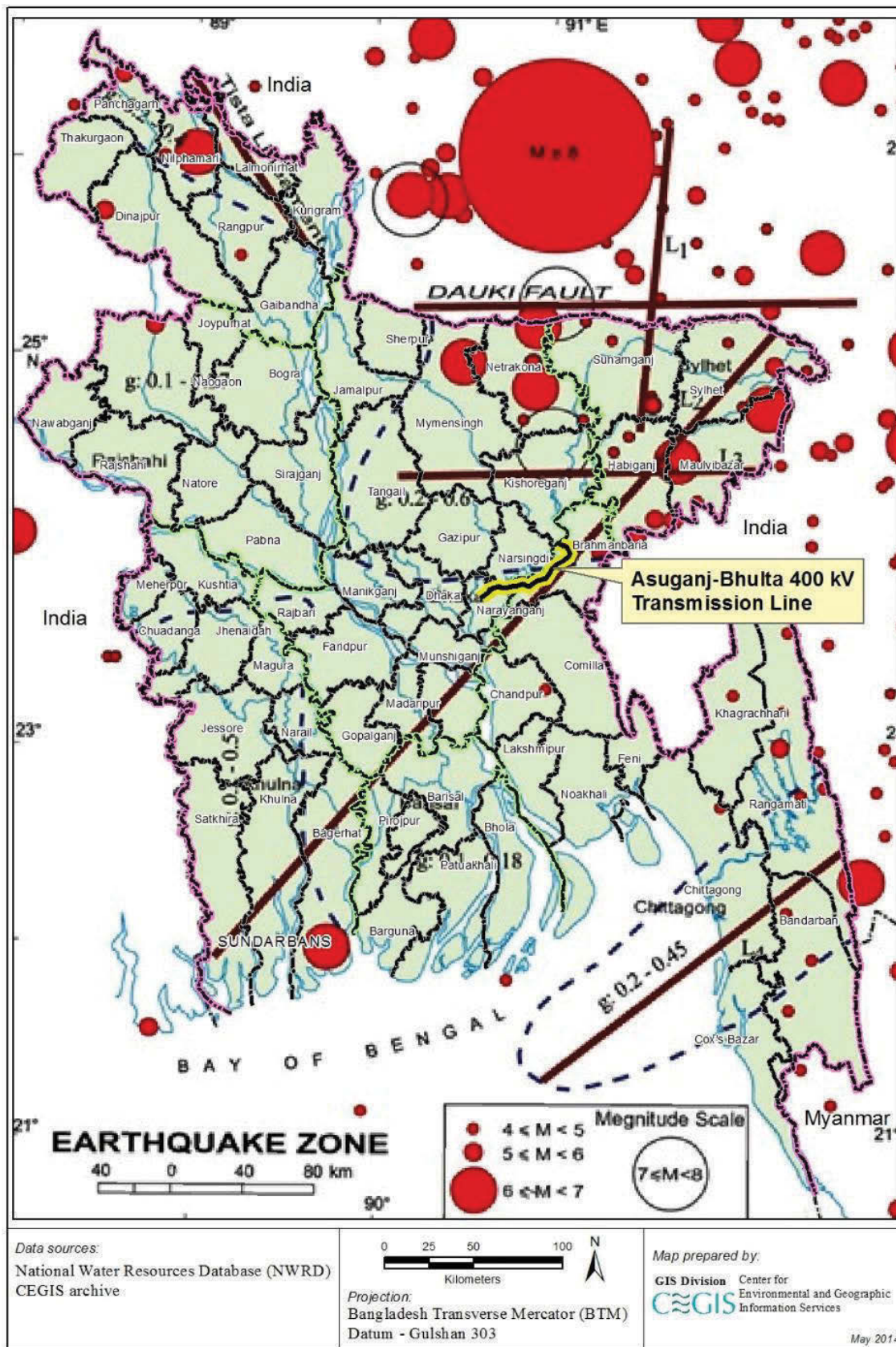
Seismotectonic studies have been undertaken by various workers in Burma comprising the Indo- Burma ranges and their western extension in the northern India. A complete list of references is provided in Haque, (1990), using data from various sources. A seismicity map of Bangladesh and its adjoining areas has also been prepared by Mominuddin (1991).

Bangladesh has been classified by BGS as a country that falls into 3 seismic zones: zone-I, zone-II and zone-III. According to this division, the study area falls under Zone-II, which is characterized by medium earthquake prone site and has a basic seismic coefficient of 0.05g (Map 6.2) respectively. There are also different geological faults in and around the country, as shown in Map 6.3. According to it, the maximum magnitude of earthquake is within the range of $4 \leq M < 5$ on the Richter scale in and around of the study area. The proposed project site and project area is in low earthquake prone as there is no fault line near the area (**Map 6.3**). The buildings and land-based structures for this project should be designed to withstand ground acceleration during earthquake.

Earthquake Zone Map of Bangladesh



Map 6.2: Seismic Map of Bangladesh showing the Project Area



Map 6.3: Fault lines of Bangladesh (Source: GSB)

Erosion

The Meghna river banks suffer from erosion problems annually, mostly in the monsoon and post monsoon periods.

As the transmission line will not have any impact on erosion, a further detailed analysis of erosion was not required for the project.

Flooding

Flooding situation of the study area is very nominal. The local people informed that, only the historical flash flood occurred in the year of 1988, 1998 and 2004. Flooding of 1988 and 1998 severely affected almost the entire study area. The duration of 1988 and 1998 flood was around 1-1.5 months with flood level of 6-7 ft. and in the year 2004, the duration was around 20 days with flood level of 3-4 ft. The resources like, agricultural crops, fisheries, vegetations and social livelihood were damaged during these flood. The main reasons of flooding are heavy rainfall, storm surge, water level rise and entrance of river water in the study area by overtopping the riverbanks.

Storm

There are some evidences of local seasonal storms, popularly known as nor'westers (*Kalbaishakhi*). Severe nor'westers is generally associated with tornadoes. The frequency of nor'westers usually reaches maximum in April, whereas it is low in May and minimum in March. Nor'westers and tornadoes are more frequent in the afternoon. Nor'westers may occur in late February due to early withdrawal of winter from the Shillong Plateau of India.

There could be effect of tornados on the towers of the transmission line. However, proper design could protect the towers from accidents.

6.3 Land Resources

6.3.1 Agro-ecological region

Thirty agro-ecological regions, eighty eight sub-regions and five hundred thirty five agro-ecological units have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential in Bangladesh. These layers are: (i) Physiography (land forms and parent materials); (ii) Soils and their characteristics; (iii) Depth and duration of seasonal flooding; (iv) Length of the rain fed Kharif and Robi growing periods; (v) Length of the pre-Kharif period of unreliable rainfall; (vi) Length of the cool winter period and frequency of occurrence of extremely low temperature; (vii) Frequency of occurrence of extremely high ($> 40^{\circ}\text{C}$) summer temperature (FAO, 1988). Agro-ecological regions and sub-regions are very broad units. This leads to the large variation in the fertility levels even between adjacent plots. For detailed information about physical and chemical properties of soils, respective Upazila *Nirdeshika* may be consulted (BARC, 2005).

The proposed transmission line project area is covered by three agro-ecological zones (AEZ), namely Old Brahmaputra Floodplain (AEZ-9), Middle Meghna River Floodplain (AEZ-16) and Old Meghna Estuarine Floodplain (AEZ-19).

Old Brahmaputra Floodplain

The region has broad ridges and basins. Soils of the area are predominantly silt loams to silty clay loams on the ridges and clay in the basins. General Soil Types predominantly includes Dark Grey Floodplain soil. Organic matter content is low on the ridges and moderate in the basins, topsoil moderately acidic and sub soils neutral in reaction. General fertility level is low. However, the status of P and CEC is medium and the K status is low.

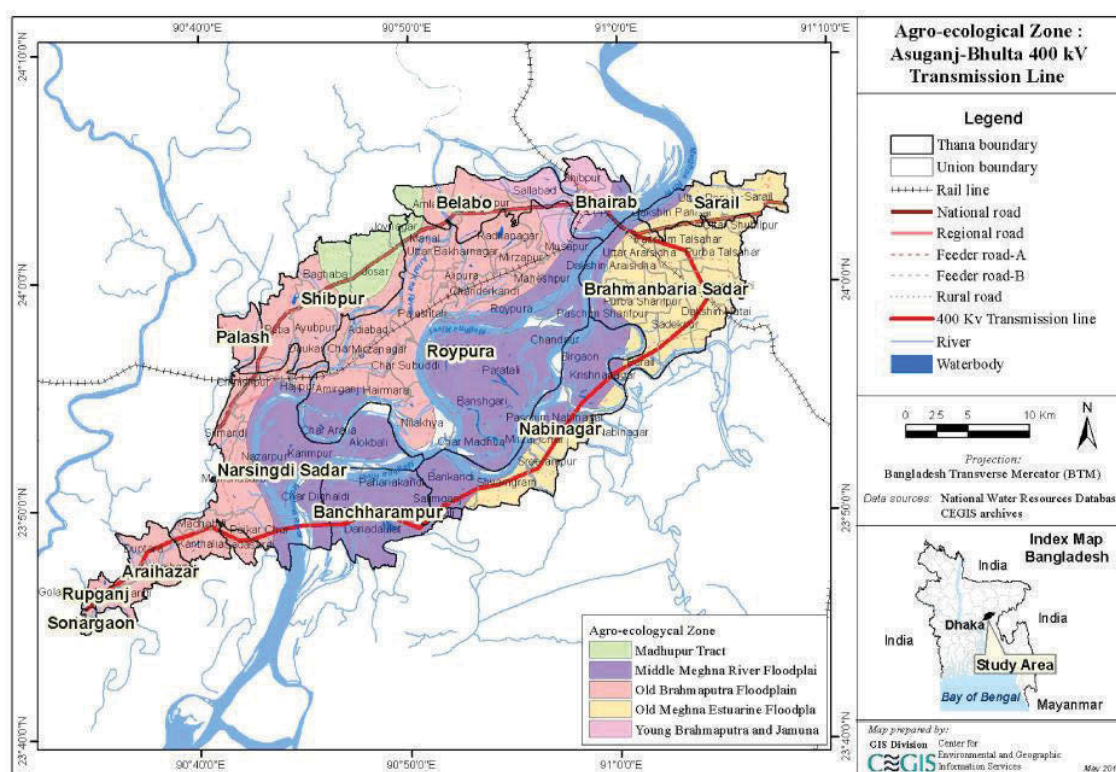
Middle Meghna River Floodplain

This region occupies abandoned channel of the Brahmaputra River on the border between the greater Dhaka and Comilla districts. This region includes islands – former Brahmaputra chars, within the Meghna River as well as adjoining parts of the mainland. Soils of the area are grey, loamy on the ridges and grey to dark grey clays in the basins. Grey sands to loamy sands with compact silty topsoil occupy areas of Old Brahmaputra char. Dominant General Soil type is Non-calcareous Grey Floodplain soils. Topsoils are strongly acidic and subsoil moderately acidic to slightly alkaline. General fertility level is medium with low N and organic matter contents. The P, Zn and B levels are low to medium.

Old Meghna Estuarine Floodplain

This region occupies a large area, mainly low-lying between south of the Surma-Kusiyara Floodplain and northern edge of the Young Meghna Estuarine Floodplain. It comprises smooth, almost level, floodplain ridges and shallow basins. Seasonal flooding occurred due to accumulated rainwater. It is moderately deep or deep in the north and west, but it is shallow in the south east.

Silt loam soils predominate on highlands and silty clay to clay in low lands. Non-calcareous Dark Grey Floodplain soils are the only general type of the area. Organic matter content of the soils is moderate. Moisture holding capacity is medium. Topsoils are moderately acidic, but sub soils are neutral in reaction. General fertility level is medium.



Map 6.4: AEZ of the project area

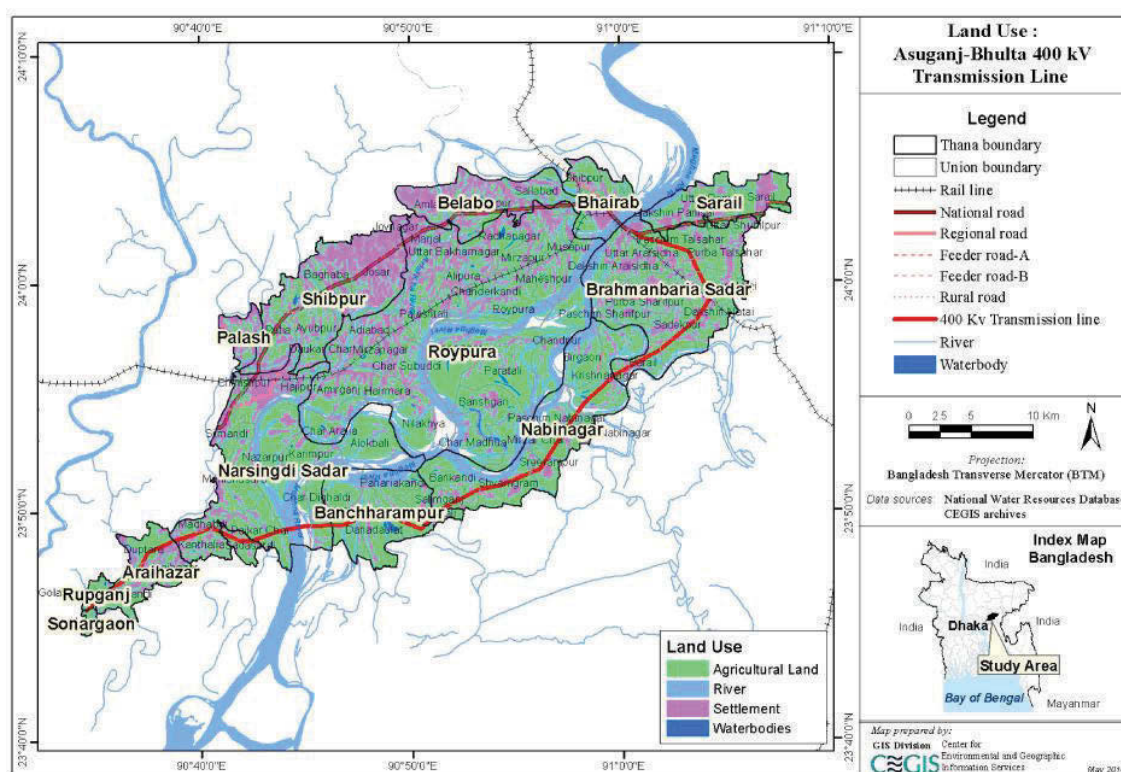
6.3.2 Land use

The total project area is about 704 ha of which 88.8% is net cultivable area (NCA). The settlements and river cover 6%, and 5.2% respectively. Details of land use of the project area are presented in **Table 6.7** and **Map 6.5**.

Table 6.7: Present land use of the study area

Land use	Area (ha)	% of Gross area
Gross area	704	100
Net Cultivated Area (NCA)	625	88.8
Settlements	42.4	6.0
River	36.4	5.2
Water bodies	0.2	0.0

Sources: CEGIS estimation from SOLARIS



Map 6.5: Present land use of the project area

6.3.3 Land Form

The landforms influence the land use related to agricultural crop production. About 91.3% and 8.7% of the net cultivable areas of the study area are ridge and basin respectively (Table 6.8).

Table 6.8: Detailed distribution of land form of the study area

Land form	Characteristics	Area (ha)	% NCA
Basin	A basin land form is a big identification in the earth's surface. It is usually surrounded mostly by higher land areas, the water the either quickly evaporates, sinks into the ground or forms lakes or marches.	54	8.7
Ridge	A ridge is a geological feature consisting of a chain of mountains or hills that form a continuous elevated crest for some distance.	571	91.3
Total		625	100

Source: CEGIS estimation from Land and Soil Resources Utilization Guide, SRDI

6.3.4 Land type

Land type classification is based on depth of inundation during monsoon season due to normal flooding on agriculture land. According to Soil Resource Development Institute (SRDI, 1988), five land types have been classified in terms of depth of flooding. About 2%, 25%, 55%, 11.5% and 6.5% areas are covered by Highland (F_0), Medium highland (F_1), Medium lowland (F_2), Low land (F_3) and Very lowland (F_4) respectively. Distribution of land type of the study area is presented in Table 6.9

Table 6.9: Distribution of land type in the study area

Land type	Characteristics	Area (ha)	% NCA
F ₀	The land which is not generally inundated under normal flood situation. This class has been subdivided into two classes: (i) Land which is above normal flood-level. (ii) Normally flooded from 0- 30 cm deep where water normally can be stored by constructing ail and Aman can be transplanted.	12	2.0
F ₁	Land which normally is flooded between 30- 90 cm deep during the flood season. This can be divided into two classes: (i) Very shallow inundated land where HYV Aman can be practiced; (ii) Shallow inundated land which is considered very deep flooding for HYV T. Aman.	156	25.0
F ₂	Land which normally is flooded between 90 -180 cm deep of inundation continuously for few months in flood season.	344	55.0
F ₃	Land which normally is flooded between 180 and 275 cm deep of inundation continuously for few months in flood season.	72	11.5
F ₄	Land which normally is flooded deeper than 275 cm during flood season continuously for few months.	41	6.5
Total		625	100

Sources: CEGIS estimation from SOLARIS

6.3.5 Soil Texture

Soil texture is the relative proportions of sand, silt and clay. It is very important for agriculture crop production. Data on soil texture is presented in **Table 6.10**

Table 6.10: Detailed soil texture of the surface soil (0-15 cm) in the study area

Soil Texture	Area (ha)	% of NCA
Clay	60	10
Clay Loam	187	30
Loam	376	60
Sandy Loam	2	0.0
Total	625	100

Sources: CEGIS estimation from SOLARIS

6.3.6 Available soil moisture

The available soil moisture is very important for the cultivation of Rabi crops. Most of the area (75%) is under medium level of available soil moisture. The distribution available soil moisture of the project area is presented in **Table 6.11**

Table 6.11: Detailed distribution of available soil moisture in the project area

Available soil moisture	Characteristics	Area (ha)	% of NCA
High	Plant extractable moisture remained in field level from more than three months	120	19
Medium	Plant extractable soil moisture remained in field level from one to two months	469	75
Low	Plant extractable soil moisture remained in the field level less than one month	36	6
Total		625	100

Source: CEGIS estimation from SOLARIS

6.3.7 Drainage Characteristics

Drainage plays a role in the management of soil in the project area. As per the SRDI (1988), the drainage characteristics have been divided into six classes from the agriculture point of view. Most of the study area is poorly drained (94%). Areas with different drainage characteristics of the project are presented in Table 6.12

Table 6.12: Detailed drainage characteristics of the study area

Drainage	Characteristics	Area (ha)	% of NCA
Imperfectly Drained	Water drained from soil badly or slowly. This soil often remains wet in rainy season due to rainfall. In normal situation, water does not stand on land more than 15 days at a stretch. In rainy season, groundwater stands within 1 meter at least for some time.	33	5
Poorly Drained	The soil remains under water from 15 days to 7/8 months. Water is drained from the soil slowly. In most cases, the land remains wet/water logged for a considerable period of time after the rainy season.	586	94
Very Poorly Drained	a. The land remains submerged under water for more than 8 months and remains wet throughout the year.	6	1
Total		625	100

Source: CEGIS estimation from SOLARIS (NWRD)

6.4 Agriculture Resource

6.4.1 Farming practices

Farming practices in the project area are largely controlled by physical, biological, climatologically and socioeconomic factors.

Agricultural crops are grown by cropping seasons. There are two distinct cropping seasons in a year. They are Kharif and Rabi seasons. The Kharif season starts from March and ends in October while the Rabi season starts from November and ends in February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into Kharif-1 (March-June) and Kharif-II (July-October) season.

The Kharif-I is characterized by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. In this project, about

80% lands remained fallow in this season. The Kharif-II season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Wet land rice is the predominant crop grown during this season due to the submergence of soil. Local Transplanted Aman (Lt Aman), Broadcasting Aman (B. Aman) and High Yielding Varieties of Transplanted Aman (HYV T. Aman) rice are grown in Kharif-II season in the project area.

The Rabi season starts from November and ends in February. During this season, crops are favored with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield because of very low or evens no rainfall throughout the season. Major crops grown in this season in the project is High Yielding Variety (HYV) of Boro rice. Limited areas are covered with Mustard, Wheat, Potato and Vegetables. However, there are occasional overlaps such that Boro is harvested in Kharif-I season and Aman rice is harvested in Rabi season.

6.4.2 Crop production constraints

Main constraint of crop production is tidal river flood. Flash flood and drought are responsible for damaging Aman rice crops. In rainy season the over rainfall water also affect the normal growth or production of crops.

6.4.3 Cropping pattern

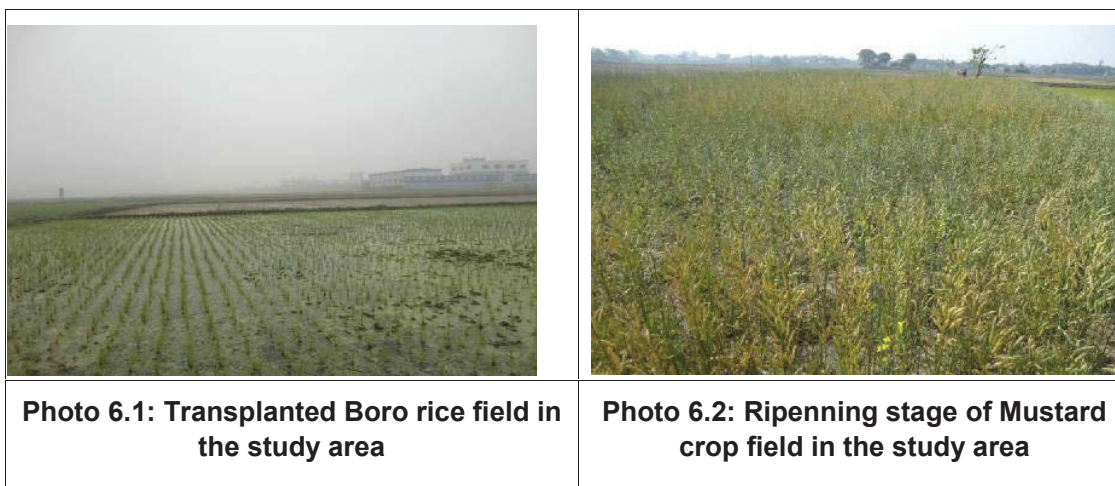
In Ashuganj-Bhulta 400 KV transmission line area, the dominant cropping pattern is Fallow – Lt. Aman- HYV Boro practice in 35% in medium low land. Fallow- B. Aman – HYV Boro occupied about 20% in medium low land area.

In Kharif-I season; Jute and local Aus are grown in about 8% and 10% of the NCA but 82% of area remains fallow. In Kharif-II season, HYV Aman, Lt. Aman and B. Aman are grown in about 23%, 35% and 20% of the NCA respectively. The rest of area (22%) remains fallow. In Boro /Rabi season, HYV Boro and local Boro are grown in about 75% and 5% of the NCA. Rabi crops (mustard, wheat, potato and vegetables) occupied about 5% (each) of the NCA. Detailed cropping patterns are presented in **Table 6.13**.

Table:6.13: Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Area (ha)	% of NCA
High land	Vegetables	Fallow	Vegetables	12	2
Medium highland	Fallow	HYV Aman	HYV Boro	63	10
Medium highland	Jute	HYV Aman	Vegetables	19	3
Medium highland	Lt. Aus	HYV Aman	Mustard	31	5
Medium highland	Lt. Aus	HYV Aman	Wheat	31	5
Medium highland	Jute	Fallow	Potato	31	5
Medium lowland	Fallow	Lt. Aman	HYV Boro	219	35
Medium lowland	Fallow	B. Aman	HYV Boro	125	20
Low land	Fallow	Fallow	HYV Boro	63	10
Lowland	Fallow	Fallow	Local Boro	31	5
Total				625	100
Cropping Intensity (%)				198	

Sources: Estimation from CEGIS field information.



6.4.4 Crop area and cropping intensity in the project

Total annual cropped area is about 1237 ha of which 85% is covered with rice and the rest 15% is occupied by non-rice crops (**Table 6.13**). The single, double and triple cropped area is 15%, 72% and 13% respectively. The cropping intensity is about 198%.

6.4.5 Crop damage

Data on crop damage/ production loss has been collected from the field in consultation with stakeholder farmers and officials of the DAE. Annual crop damage along with area in the project area has been evaluated. Crop production loss has been calculated using the formula: *Crop production loss = Total cropped area × damage free yield - (damaged area × damaged yield + damaged free area × damage free yield)*. Total 48 tons of rice was lost in 82 ha of land in the project area. Detailed crop damage information is presented in **Table 6.14**.

Table 6.14: Crop wise damage in the project location

Crop name	Location Mauza & union	% of damage area	Timing	Causes of damage
HYV Aman	Singlabo, Rupgonj Daukandi, Kathalia, Alom nagar, Bishnurampur	20	August- September (2010 to 2012)	Tidal river flooding & drainage congestion
Lt. Aman	Alomnagar, Narayanpur, Ashuganj, Bishnurampur	10	August- September(2010 to 2012)	same
B. Aman	Sonarampur, Talshar, Aoamnagar, Bishnurampur	25	August- September(2010 to 2012)	same

Source: Based on field information

6.4.6 Crop yield level (Normal and damaged)

The crop yield rate was estimated from the information collected from secondary data and consultation with the beneficiaries/ farmers at field level. The average yield value of different crops of the project area is presented in **Table 6.15**.

Table 6.15: Crop Yield level by different crops

Crop name	Yield (ton/ha)	
	Normal	Damaged
HYV Boro	3.3	-
Local Boro	2.6	-
HYV Aman	2.5	1.8
Lt. Aman	2.0	1.6
B.Aman	1.8	1.2
Local Aus	1.75	-
Jute	2.5	-
Mustard	0.9	-
Wheat	2.5	-
Potato	15	-
Vegetables (s)	12	-
Vegetables (w)	10	-

Sources: Based on field information;

6.4.7 Crop production

The total crop production was calculated on the basis of damage-free area and damaged area. In the damage-free area, the normal yield of crops was considered. In the damaged area, the damaged yield against the damaged area was considered. This may be expressed as: *Total crop production = damage free area × normal yield + damaged area × damaged yield*. Major agricultural production of the study area is coming from the rice crops. Total crop production is about 3867 ton of which rice production stands about 2712 tons and rice crop loss is 48 tons. Production of non-rice crops was 1155 tons.

Table 6.16: Annual agriculture crop production with damage (area, yield and loss).

Crop name	Crop area (ha)	Damage free area		Damaged area		Total production (ton)	Production lost (ton)
		Area (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)		
HYV Boro	469	469	3.3*	-	-	1,547	-
Local Boro	31	31	2.6*	-	-	81	-
HYV Aman	144	115	2.5*	29	1.8*	340	20
Lt. Aman	219	197	2*	22	1.6*	429	9
B. Aman	125	94	1.8*	31	1.2*	206	19
Local Aus	63	63	1.75*	-	-	109	-
Total rice	1,051	969		82		2,712	48
Jute	50	50	2.5	-	-	126	-

Crop name	Crop area (ha)	Damage free area		Damaged area		Total production (ton)	Production lost (ton)
		Area (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)		
Mustard	31	31	0.9	-	-	28	-
Wheat	31	31	2.5	-	-	78	-
Potato	31	31	15	-	-	469	-
Vegetables(s)	12	12	12	-	-	144	-
Vegetables(w)	31	31	10	-	-	310	-
Total non-rice	186	186				1,155	-
Total	1,237	1,155				3,867	48
NCA= 625 ha, Cropping Intensity (%)						198	

Sources: Based on field information; *indicated milled rice

6.4.8 Agricultural input

Input means seed, labour, irrigation and fertilizer-pesticide. Fertilizer use varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability. Farmers are applying fertilizers for all crops grown in the RoW of the transmission line and sub-station areas. They apply fertilizers at the rate of 150-80-50 kg/ha of urea, TSP and MP respectively both T Aus and T Aman crop. In HYV Boro crop, they use Urea, TSP and MP fertilizer at the rate of 180-100-60 kg/ha respectively. Application of pesticides has been noticed for 1-2 times to control pest and diseases for the rice crops grown in the study area. In general, farmers apply liquid pesticides with the help of hand/power sprayer but sometime they mix granular pesticides with the urea fertilizers and then apply to the paddy fields having standing water. Farmer use own produced seed but sometimes they use supplied seed of BADC. Labour is available in local area but wage rate is high for peak period of crop harvesting period. Surface water irrigation (river, khal & pond) is available in the study area. Farmer use Low Lift Pump (LLP) in their Boro crop field.

6.5 Fisheries Resources

The water body is an important source of fish as well as other aquatic resources e.g. aquatic invertebrate, phytoplankton, zooplankton etc. The proposed 400 kV transmission line starting from the Ashuganj union of Ashuganj upazila at Brahmanbaria District (Chittagong Division) and ending at the Golakandail union (near Bhulta) at Rupganj Upazila, Narayanganj District. The line will cross over the different fish habitats of the three districts. One sub-station of this transmission line will be established in Bhulta of Narayanganj district. The area selected for sub-station is low lying area and inundate during monsoon and water exist couple of month in that location. A khal exist beside the proposed location of sub-station. However, different types of fish habitats of both capture and culture fisheries are found in the study area. Though the transmission line mainly fall in Brahmanbaria and Narayanganj districts separated by the Meghna River, Open water fish habitat and habitat quality those districts is different. Water quality of river and khals in Rupganj and Araihasar upazilas (Narayanganj district) is much more polluted due to industrial discharge coming from number of dyeing industries. In dry season, fish habitations in these polluted water bodies are totally unsuitable. The local people reported that a few number of fish species is found in the monsoon which is not suitable for consumption due to bad smell. On the other hand, fish habitat quality of river,

khals and floodplain in Brahmanbaria district is generally satisfactory for fish and which covers major part of the study area. The area has a close connection with the Titas and Meghna rivers providing support to a numbers of fresh water fishes. Tidal influence is also present partially. Major part of the floodplain inundates in monsoon and water stays about three to four month which contribute to fish production. The Meghna and Titas is important river and inundate the surrounding floodplain and beel in monsoon and maintain the biological balance of the aquatics resources including fish.



Meghna River



Gazipura River (Polluted)

Photo 6.3: Fish habitat in the study area

6.5.1 Issues and Problems

The major fisheries problems and issues are identified during the baseline survey are as follows:

- Over exploitation of fish including brood fish species;
- Water pollution due to rapid industrialization;
- Application of pesticides deteriorating the water quality and as such hampering fish species diversity;
- Siltation in the river and khals;
- Obstruction of fish migration routes due to development of road network;
- Excessive use of current net and fine mesh net and indiscriminate fishing.
- Fishing by dewatering;
- Poor extension services with modern fish culture technology due to lack of sufficient manpower;
- Lack of hatchery and nursery under the government enterprise; and
- Fisheries management practice is absent in the project area.

6.5.2 Capture and Culture Fish Habitat Description

Habitat Distribution

Fish habitats of the study area are situated in Brahmanbaria, Narsingdi and Narayanganj districts. Fish habitat is mostly concentrated in Brahmanbaria which comprises 68% of total area. Distribution of fish habitat in the study area is shown in **Figure 6.13**.

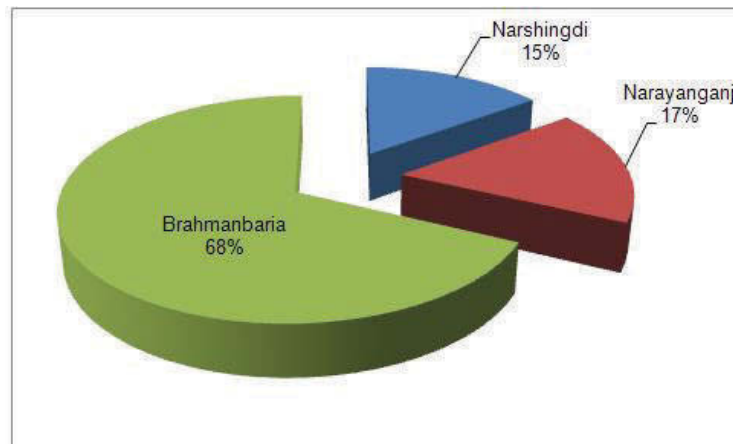
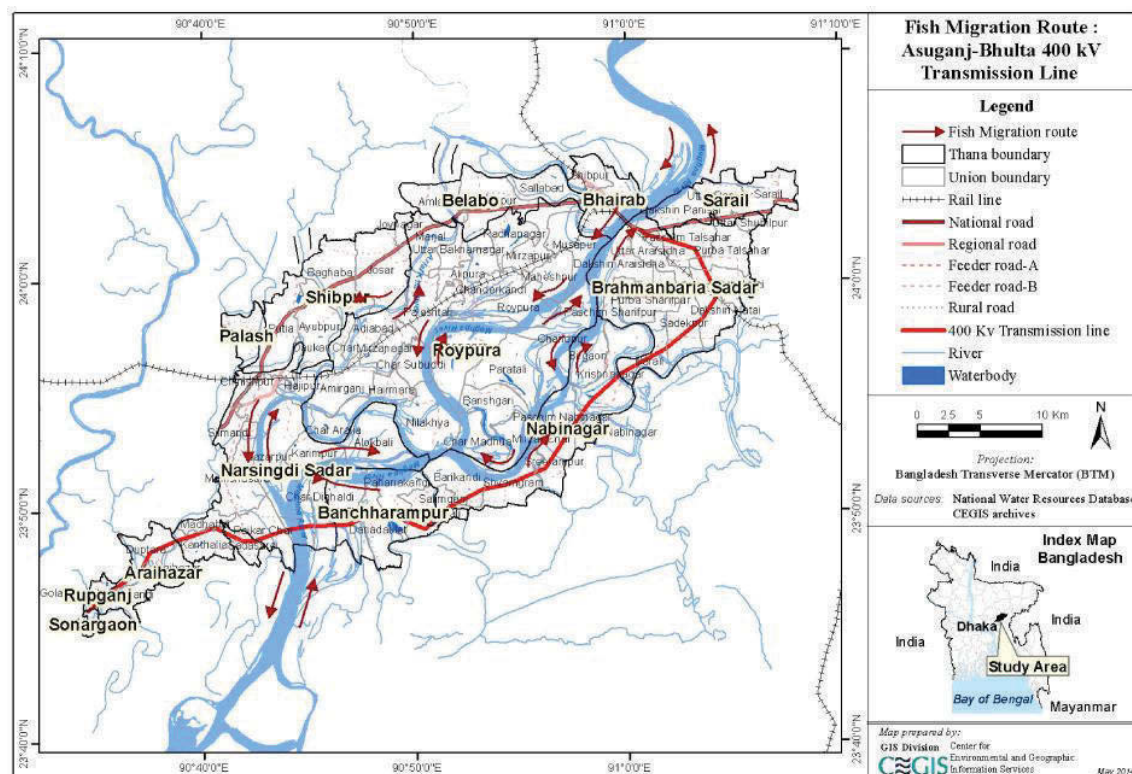


Figure 6.13: Distribution of fish habitats of the project area



Map 6.6: Fish habitat in the study area

Fish Habitat Classification

Fish habitat of the study area includes river, floodplain, seasonal beel, pond and ditches. The fish habitat in the study area is given in the following **Figure 6.14**.

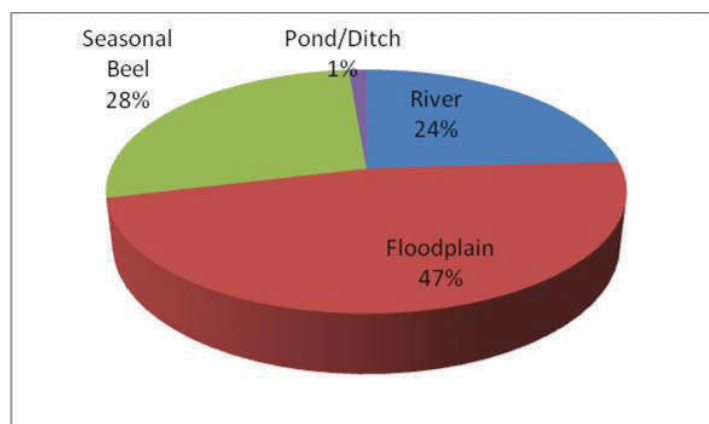


Figure 6.14: Fish habitats distribution in the study area

Capture fish habitats of the study area are classified into River, floodplain and seasonal beel. Most of the wetland habitat like beel, floodplain, khal etc in the study area serves as breeding and feeding grounds for beel and floodplain fishes. The estimated total capture fish habitat area in study area is about 152 ha. Sub-station and transmission tower will establish within this area.



Photo 6.4: Pond in the study area

Culture fish habitats of the study area (photo 6.4) are classified as closed water of fish ponds and ditches. The estimated culture fish habitat area is 2 ha. Fish habitat area in the study area is shown in the following **Table 6.17**.

Table 6.17: Fish habitat status of the study area

SL. No	Fisheries Type	Habitat	Area (Ha)
1	Capture	River	36
		Floodplain	72
		Seasonal beel	42
	<i>Sub-Total</i>		150
2	Culture	Pond/ditches	2
	<i>Sub-Total</i>		2
	Grand Total		152

Source: CEGIS estimation using RS image, 2014

6.5.3 Fish Production

Estimated total fish production of the study area is about 37 Ton, which comes from both capture fisheries about 34 Ton of which floodplain fish production is dominant and culture fisheries about 3 Ton. The production from different fish habitats are given in **Table 6.18**.

Table 6.18: Fish production of the study area

SL. No	Fisheries Type	Habitat	Total Production (Ton)
1	Capture	River	6.5
2		Floodplain	17.3
3		Seasonal beel	10.5
	<i>Sub-Total</i>		<i>34.3</i>
4	Culture	Pond/ditches	3.0
	<i>Sub-Total</i>		<i>3.0</i>
	Grand Total		<i>37.3</i>

Source: CEGIS analysis using FRSS, 2011-12 published data and on-field estimation

6.5.4 Fishing Effort

Fisher Number

A few number of fisher is found in the study area because a portion of the study located at Narsingdi and Narayanganj considered to be industrial belt. Due to increasing of industries and decreasing of habitat quality many fishers have changed their occupation. It is reported that about 2% of people are involved in fishing as a whole. Most of the fishermen are Muslim. There is a fishery Palli (village) in the study area where about 25 households of commercial fishers are reported in *Bistorampur* village of Bancharampur upazila. The commercial fishers catch fish in Meghna and Titas River and beel area round the year. Part-time and subsistence fishermen are also present in the study area. They usually catch fish in the nearby floodplains and rivers using country boat and *dingi* boats particularly during wet season.

Fishing Season

Fishing in floodplain starts in March and continue up to September while fishing in rivers is seen round the year. The seasonality of major fishing is furnished in the **Table 6.19**.

Table 6.19: Fishing seasonality of the study area

Seasonality of fishing types													
Fishing Gears	Seasonality												
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
	Boishakh	Jaishthya	Ashar	Sravan	Bhadra	Ashwin	Kartik	Agrahayan	Paush	Magh	Falgun	Chaitra	
Current jal (Gill net)													
Chandi jal (Gill net)													
Thela jal (Push net)													
Dharma jal (lift net)													
Jhaki ial (Cast net)													
Khora jal (lift net)													
Moiya jal (Push net)													
Katha (fish seltering)													
Trap gear (Dugair/Chau)													
Lining (Borshi)													
	High			Medium		Low			No occurrence				

Fishing Crafts and Location

Country fishing boats are widely used to catch the fish in the study area. The fishers catch fish in Meghna River round the year, but catch fish in floodplain in monsoon only. The subsistence fishers catch fish in floodplain in the study area especially in monsoon.

Fishing Gears

Seven types of nets/gears are mainly used for fishing in the study area. These are: (a) currant jal, (b) Chandi Jal, (c) Thela jal (d) Dhorma jal, (e) Jhaki jal, (f) Vesal /Khora and (g) Moiya jal, etc. Only 25% of fishers have fishing boats and around 60% fishermen have fishing gears/nets. The other fishing practices in the area are through lining (Borshi), spear (koch), trap (anta) etc. *bana*, *dugair*, *charu* fishing and *katha* fishing. Fishing gears in the study area are shown in the **Photo 6.5**.



Photo 6.5: Different types of fishing in the study area

6.5.5 Fish migration

In monsoon, river water enters into study area through river and khal. Nutrients influx the study area from river to floodplain and vice versa. In monsoon, *beels* to floodplain, floodplain to river and vice-versa lateral migration occurs in the fish species viz. *tengra*, *punti*, *chela*, *baim*, *chanda*, *gutum*, *taki*, *chang*, *taki*, *koi*, *kakila*, *khorsula*, *gutum* etc.

6.5.6 Fisheries Biodiversity

The species composition of the study area is still rich in its diversity. More than 110 fish species are found in the study area. Among the fishes *tengra*, *puti*, *kholisha*, *chanda*, *ru*, *catla*, *koi*, *shing*, *shoal*, *taki*, *boal* are abundant in the study area. Tilapia and some carp species are culturing in the study area. Composition of fish species in the study area are shown in the following **Photo 6.6**.

It is reported by the local fishermen that the biodiversity of fishes are declining over the years. Factors affecting the species diversity include ever-increasing fishing pressure, obstruction in fish migration routes, rapid siltation of fish habitats, squeezing of spawning and feeding grounds, fishing by dewatering, deterioration of water quality due to establishment dying industries especially in the Nayaranganj and Narsingdi area of the study area.



Photo 6.6: Composition of fish species in the study area

Fishes occupy the catch composition from different habitats clupid; carp, gobids, catfish etc. are the dominant fishes of the catches. A list of indicative fish species of the study area are given in **Table 6.20**.

Table 6.20: Indicative fish species diversity of different fish habitats

Sl.	Scientific Name	Local name	Habitat			
			River	Beel	Floodplain	Pond
1	<i>Mystus tengara</i>	Tengara	P	P	P	A
2	<i>Puntius sophore</i>	Jatputi	P	P	P	A
3	<i>Puntius ticto</i>	Tit Puti	P	P	P	A
4	<i>Tetradon cutcutia</i>	Potka	P	P	P	A
5	<i>Aila coila</i>	Kajoli	P	P	P	A
6	<i>Lepidosephalus guntia</i>	Gutum	P	P	P	A
7	<i>Macrognathus aculatus</i>	Baim	P	P	P	A
8	<i>Mastacembalus armatus</i>	Sal baim	P	P	P	A
9	<i>Monopterus cuchia</i>	Kuicha	P	P	P	A
10	<i>Mystus tengara</i>	Bajari-tengra	P	P	P	A
11	<i>Nandas nandas</i>	Meni	P	P	P	A
12	<i>Rhinomugil corsula</i>	Khorsula	P	P	P	A
13	<i>Glossogobius giurus</i>	Baila	P	P	P	A
14	<i>Rasbora daniconius</i>	Dankina	A	P	P	A
15	<i>Chela cachius</i>	Chela	P	P	P	A
16	<i>Gudusia chapra</i>	Chapila	P	A	A	A
17	<i>Mastacembalus armatus</i>	Guchi	P	A	A	A
18	<i>Xenentodon cancila</i>	Kakila	P	P	P	A
19	<i>Aila coila</i>	Kajoli	P	A	A	A
20	<i>Labio calbasu</i>	Kalibaus	P	A	A	A
21	<i>Wallagu attu</i>	Boal	P	P	P	A
22	<i>Tenuulosa ilisha</i>	Il-ish	P	A	A	A

Sl.	Scientific Name	Local name	Habitat			
			River	Beel	Floodplain	Pond
23	<i>Oreochromis niloticus</i>	Tilapia	A	A	P	P
24	<i>Catla catla</i>	Catla	P	P	P	P
25	<i>Cirrhinus mrigela</i>	Mirka	P	P	P	P
26	<i>Ctenopharyngodon idellus</i>	Grass carp	A	A	A	P
27	<i>Cyprinus carpio</i>	Carpio	A	A	A	P
28	<i>Hypophthalmichthys molitrix</i>	Silver carp	A	A	A	P
29	<i>Labeo calbasu</i>	Calbasu	P	P	P	P
30	<i>Labeo rohita</i>	Rui	P	P	P	P

Here, A=Absent and P=Present

Sources: Field observation, 2014

6.5.7 Species of Conservation Significance

Fish species variety which are locally unavailable for last (10-15) years or have become rare as reported by the local fishers and concerned elderly peoples are given in the following Table 6.21.

Table 6.21: List of species of conservation significance

Sl.	Local Name	Scientific Name	Local Status	
			Rare	Unavailable
1	Deshi Sarputi	<i>Puntius sarana</i>		✓
2	Pabda	<i>Ompok pabda</i>		✓
3	Gojer	<i>Channa marulius</i>		✓
4	Tara Biam	<i>Macrornathus aculeatus</i>		✓
5	Baila	<i>Glossogobius giurus</i>		✓
6	Darkina	<i>Rasbora daniconius</i>	✓	
7	Rita	<i>Rita rita</i>	✓	
8	Chital	<i>Notopterus chitala</i>	✓	
9	Foli	<i>Notopterus notopterus</i>	✓	

Sources: Field Observation, CEGIS, 2014

6.5.8 Area of Conservation Significance

The river Meghna and Titas are used as feeding and spawning ground of most of the open water fishes. Some deep parts of the river can conservation to enhance the fish biodiversity and production in the study area as conservation significance.

6.5.9 Fish Marketing and Post Harvest Facilities

Local fishermen (part-time and subsistence fishermen) sell their fish in case of large catch to the local markets (Taltola, Bhulta-Gausia bazar, Gopaldi Bazar, Araihasar bazar, Madabdi bazar, Narsingi, Bistorampur bazar, Narayanpur, bazar, Nabinagar, Ashuganj bazar etc.). Mainly the fish are coming from the outside of the project area. Two to three fish depots are present Salimabad bazar and five to seven ice factory are also present here which make ice principally for ice-cream. Fish traders/Aratdars collect fish from fish farmers and fishermen

and reach in the town area (Narsingdi, Brahmanbaria, Comilla and Dhaka). Fish retailers buy fish from fish wholesalers (Aratdars) and sell to the local fish markets. Fish storage facility is very low. Auto-rickshaw, van and on foot are the fish transportation facilities at route level. Navigation through the Meghna River is also used for fish transportation facilities at the east part of the study area. Hatchery is not found in the study area. Fish farmer collect fish fry from the fish hatcheries of Narsingdi, Mymensing, Brahmanbaria and Comilla. Availability of fish feeds for culture ponds are sufficient.

6.5.10 Fisher's Lifestyle

Commercial, part time and subsistence fishermen exist in the study area. Income of fishermen depends on fishing season and water availability in the fish habitat. Average daily incomes of commercial fishermen, part time fishermen and subsistence level fishermen are Tk. (300-400), Tk. (250-300) and Tk. (200-250) respectively. Income level of traditional fishermen is decreasing due to shrinking of open water fish habitat and increase in the number of fishers, deterioration habitat quality, declining of fish population etc. Consequently, they are changing their occupation.

6.5.11 Fisheries Management

There is no fisher based community association in the study area. Department of Fisheries (DoF) has limited initiatives for fisheries resource conservation and management in this area. The fishermen in the study area have full access to fishing right on existing fish habitat. Department of fisheries (DoF) has activity on extension services and aquaculture training in this area. Some NGOs (ASA, BRAC, Grameen Bank, Buro Bangladesh) are working, but they are very much limited in micro credit rather than extension services and aquaculture training. Enforcement of fisheries regulation is very weak. No fish sanctuary is found in study area during field visit.

6.6 Ecological Resources

The proposed 400 kV transmission lines pass through different ecosystems such as paddy fields, rivers, homesteads, and roadside vegetation as well as aquatic ecosystem. The study area is a stable landform silted by the Meghna and Teetas River systems during the monsoon.

6.6.1 The Bio-ecological Zone

IUCN, The World conservation Union, Bangladesh has divided the whole country into 25 Bio-ecological Zones (Nishat et al, 2002) in context of biological diversity and ecological features. The study area has fallen under four Bio-ecological Zones, i.e. Brahmaputra-Jamuna Floodplain, Major Rivers, Haor Basin and Meghna Floodplain. The study area (both directly and indirectly impacted area) occupies terrestrial as well as aquatic ecosystems. **Map 6.4** shows bio-ecological zones inside the study area. Short details of the Bio-ecological zone within the study area are described below.

Brahmaputra-Jamuna Floodplain

The mighty Brahmaputra River which is interchangeably known also as the Jamuna since the latter's channel is comparatively new and its course can be clearly distinguishable from that of the older Brahmaputra. The Brahmaputra floodplain comprises the active channel of the Brahmaputra River and the adjoining areas of the 'young' floodplain lands formed, since about 1780, when the river shifted to its present course (i.e. the Jamuna River) to the south

of Dewanganj in Jamalpur district. The main river course is strongly braided. It consists of several interconnecting channels, which erode and form new lands on a large scale during each flooding season. The Brahmaputra-Jamuna floodplain possesses a unique variety of plants, medicinal herbs, fruit bearing trees, hundreds of jungle shrubs, creepers and climbers, flowering trees, etc., many of which yield valuable products. Some of the floral species, which are valued as timber producers are: the Banyan (*Ficus bengalensis*), Tamarind (*Tamarindus indica*), Sada koroï (*Albizia procera*), Simul (*Bombax ceiba*) and Ashwath (*Ficus religiosa*). The prominent fruit-bearing trees of this zone are: the Mango (*Mangifera indica*), Jackfruit (*Artocarpus heterophyllus*), and Litchi (*Litchi chinensis*). Bushes of reeds and canes are also found here. This zone is similarly enriched with orchids. The Rasna (*Vanda roxburghii*) is commonly found in this zone. Like the floral diversity; this zone equally enjoys riches of faunal variety. Leopards were frequently cited in this zone. A few species of deer, such as the Sambar (*Cervus unicolor*), Hog deer (*Axis porcinus*), Swamp deer (*Cervus duvauceli*), and Barking deer (*Muntiacus muntjak*) were also once found in abundance everywhere in the forests of this zone. Among the bird species, partridges, and several varieties of pheasants were commonly found. On the other hand, the most common poisonous snake is the Banded krait (*Bungarus fasciatus*) in this zone, which could easily be identified by its broad black and yellow bands.

Major Rivers

Bangladesh is a country of rivers; it has about 24,000 kms (i.e. approx. 15,000 miles) of rivers, streams and canals. It lies across the delta of four major rivers: the Ganges-Padma, Brahmaputra-Jamuna, Meghna and Teesta. Together, they cover about 7% of the country's total surface and are noticeably rich in biodiversity. These major rivers also contain numerous chars. Jamuna River provides the highest amount of char lands. Interesting point to note here is that many of the species' natural distribution, migration and storage are primarily functioned via these rivers into other wetland ecosystems. A diverse range of waterfowl are directly or ecologically dependant on these rivers and its associated ecosystems, such as cormorants, darters, grebes, egrets and herons, storks, gulls and terns, ducks and geese, waders (e.g. plovers, sandpipers, shank, godwit, etc.) and some prey birds (e.g. fish eagle, kites, harriers, falcons, etc.). However, it is quite alarming that, with the exception of a few species of turtles, all other river biodiversity is threatened with extinction, which include the Ganges river dolphin (*Platanista gangetica*), Gangetic gharial (*Gavialis gangeticus*), Indian skimmer (*Rynchops albicollis*), Brahminy river turtle (*Hardella thurjii*) and Spot-billed duck (*Anas poecilorhyncha*).

Haor Basin

The haor basin is an internationally important wetland ecosystem, which is situated in Sumanganj, Habiganj, Sylhet, Kishorganj, Moulavibazar and Netrokona districts. It is a mosaic of wetlands habitats, including numerous rivers, streams and irregular canals with large areas of seasonally flooded cultivated plains, and hundreds of haors and beels. The Haor basin contains about 400 haors and beels in different sizes. These haors and beels provide habitats for various types of aquatic species of plants and animals. These haors and beels support major subsistence and commercial fisheries while the seasonally flooded lake margins support major rice-growing activities and abundant aquatic vegetation provides ideal grazing for domestic livestock and a source of fuel and fertilizers for the local inhabitants. The wetlands are also a home to a wide variety of resident and migratory waterfowls including perhaps as many as 100,000 to 150,000 duck and provide a refuge to many other species of wildlife. Keeping in mind all these ecological benefits, the Tanguar haor which is

located in this zone has been declared as a Ramsar site as well as Ecologically Critical Area (ECA). The Haor basin is the only region in Bangladesh where remnant patches of freshwater swamp and reed lands still exist. Hizal (*Barringtonia acutangula*), Koroch (*Pongamia pinnata*), Pitali (*Trewia polycarpa*), Barun (*Crataeva nurvala*), Bhui dumur (*Ficus heterophyllus*), Nol (*Arundo donax*), Khagra (*Phragmites karka*), Bon golap (*Rosa involucrate*), Chitki (*Phyllanthus disticha*) are the main species found in these swamp forests. Common mammalian species include fishing cat (*Prionailurus viverrinus*) and Common otter (*Lutra lutra*). About 150 species of waterfowl have been recorded in this zone, but over 70 of these are now rare. A globally as well as nationally threatened raptorial bird, Pallas's fish eagle (*Haliaeetus leucoryphus*) still have the largest breeding population in this area. Population of amphibians and reptiles are also fairly healthy in this region.

Meghna Floodplain

A major part of the Meghna floodplain was created by the deposition of sediments brought in by the old Brahmaputra River, before it changed its course. The rest of the sediments were laid down principally by the Meghna River itself and by some minor rivers draining from Tiperrah hills. The floodplain is characterized by many broad meandering channels, char and low lying landscape and is mostly affected by seasonal flooding while river bank erosion is occurred commonly. The luxuriant growth of palm trees is the dominant characteristic feature of the vegetation type of this zone. The Betel nut Supari (*Areca catechu*) is most visible as the dominant species in the western portion of this region. This zone has also abundance in several varieties of cane, a good deal of bamboo and thatching grass. Faunal diversity is richer here than other part of the country. Among the mammalian species, Bats, several species of monkeys, pangolins, and raptorial birds are found.

6.7 Ecosystem

The ecosystem is generally divided into two groups: a) Terrestrial and b) Aquatic Ecosystem. Among these major types, proposed alignment of power transmission line and its surroundings possesses following sub- types of ecosystems:

- Homesteads and roads
- Crop fields
- Seasonal floodplains and
- Rivers and canals.

6.7.1 Terrestrial Ecosystems

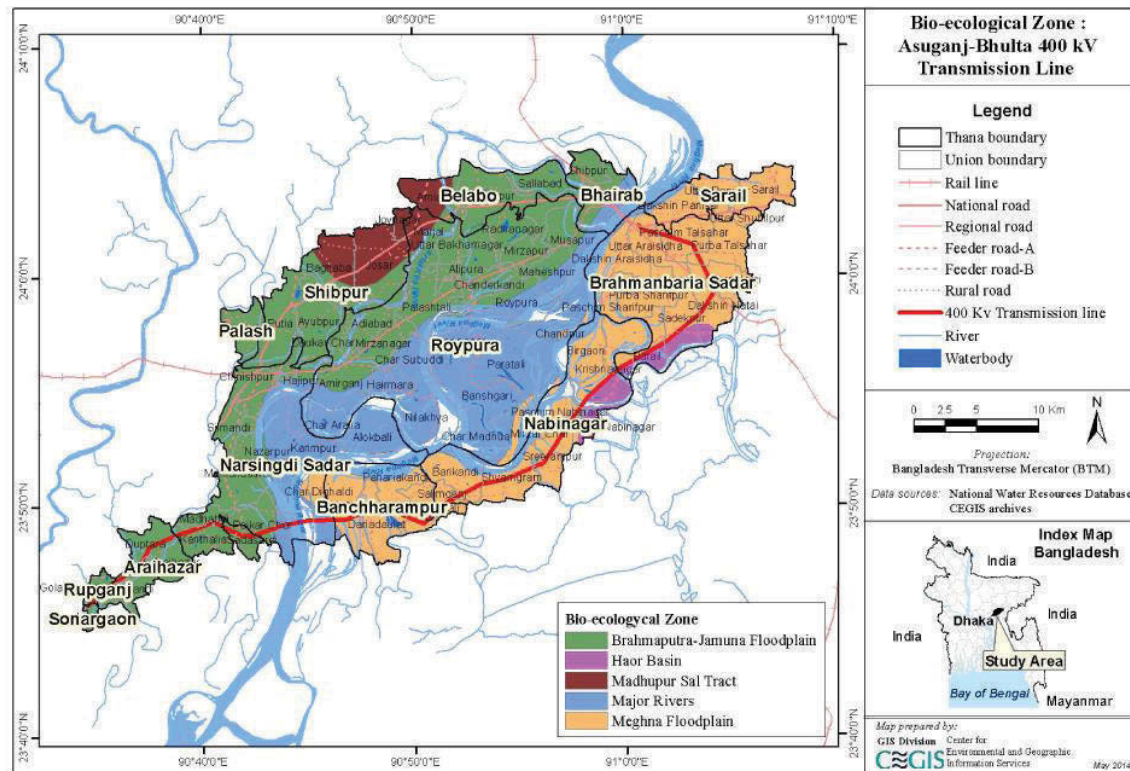
Terrestrial ecosystem of the study area is divided into two major divisions namely Homesteads and Agricultural lands. This type of ecosystem is the source of habitats for all terrestrial and wildlife species. Terrestrial vegetation among the study area can be categorized as:

- i) Homestead vegetation,
- ii) Crop field vegetation and
- iii) Road side vegetation.

Homesteads vegetation

Homestead and roadside vegetations are moderate in terms diversity. Most of the homestead is cultivated with local plants and rest of the portion is covered with wild herbs and shrubs. These vegetations have great support in meeting food, shelter, fodder, medicine and other household demands of the community. The homestead garden and bushes have

very good support to the wildlife, especially the birds. The peripheral bushes provide good ecological niche, and niche contributes a good support to bush-dwellers like jackals, foxes, mongoose, lizards and a great variety of birds. In the study area, homestead vegetation is among the most important plant communities. This vegetation includes two types of plants: those cultivated for their economic value and species those are self-propagation. The settlement species are not as diverse as natural species, because only economically important species are cultivated. Despite this, the significant variation occurs to the composition of homestead vegetations. The most dominant species observed in the survey area is bamboo that covers more than half of the canopy in many areas. Other common species are Kola (*Musa Sp.*), Akasmoni (*Acacia mingium*), Kanthal (*Artocarpus heterophyllus*), Supari (*Areca catechu*), Aam (*Mangifera indica*), Narikel (*Cocos nucifera*), Taal (*Borassus flabelifer*), Segun (*Tectona grandis*), Nim (*Azadirachta indica*), Lebu, etc. The jackfruit, mango, coconut, and banana are the most popular fruits and almost every house has at least one plant of such type. Some orchards also found during the study period. Tree species and their number in RoW (Right of the Way) of proposed transmission line are presented in **Table 6.26**.



Map 6.7: Study area inside Bio-ecological zones of Bangladesh

Table 6.22: Number of trees within RoW of 400 kV Ashuganj – Bhulta T/L

Sl.No.	Name of the Trees	Number of Trees			
		RoW Left side(40m)	RoW middle side(20m)	RoW Right side(40m)	Total RoW(100m)
1	Narikel (<i>Cocos nucifera</i>)	93	24	63	180
2	Aam (<i>Mangifera indica</i>)	207	109	211	527
3	Supari (<i>Areca catechu</i>)	73	63	116	252
4	Rain tree (<i>Albizia saman</i>)	113	81	103	297

Sl.No.	Name of the Trees	Number of Trees			
		RoW Left side(40m)	RoW middle side(20m)	RoW Right side(40m)	Total RoW(100m)
5	Segun (<i>Tectona grandis</i>)	05	01	04	10
6	Mehagoni (<i>Swietenia mehagoni</i>)	174	99	191	464
7	Kanthal (<i>Artocarpus heterophylla</i>)	28	03	17	48
8	Kola (<i>Musa sp.</i>)	85	96	178	359
9	Karoi (<i>Albizia procera</i>)	104	51	72	227
10	Chumbul (<i>Albizia richardiana</i>)	111	25	85	221
11	Eukalyptus (<i>Eukalyptus sp.</i>)	147	58	43	248
12	Bamboo (<i>Bamboosa sp.</i>)	1170	325	705	2200
13	Taal (<i>Borassus flabelifer</i>)	06	03	10	19
14	Chathim (<i>Alstonia scholaris</i>)	04	02	-	6
15	Boroi (<i>Zizyphus sp</i>)	114	45	43	202
16	Kadom (<i>Anthocephalus sp</i>)	17	08	08	33
17	Sirish (<i>Albizia lebbek</i>)	105	69	100	274
18	Pitali (<i>Trewia nudiflora</i>)	49	17	14	80
19	Dumur (<i>Ficus hispida</i>)	-	-	01	1
20	Bot (<i>Ficus bengalensis</i>)	01	-	-	1
21	Sisso (<i>Dalbergia sissoo</i>)	66	02	6	74
22	Shimul (<i>Bombax ceiba</i>)	-	02	-	2
23	Ipil-ipil(<i>Leucaena laucocephalata</i>)	08	-	-	8
24	Guava (<i>Psidium guava</i>)	15	02	-	17
25	Akashmoni (<i>Acacia monilliformis</i>)	114	41	81	236
26	Nim (<i>Azadirachta indica</i>)	02	12	04	18
27	Jam (<i>Syzigium cumuni</i>)	23	03	19	45
28	Tetul (<i>Tamarindus indica</i>)	-	04	-	4
29	Sajna (<i>Moringa oleifera</i>)	18	02	08	28
30	Barun (<i>Crataeva nurvala</i>)	05	-	08	13
31	Bilombhi (<i>Averrhoa bilomb</i>)	03	-	-	3
32	Papaya (<i>Carica papaya</i>)	15	06	-	21
33	Hijal(<i>Barringtonia acutangula</i>)	-	02	08	10
34	Sonalu (<i>Cassia Fistula</i>)	08	-	01	9
35	Arjun (<i>Terminalia arjuna</i>)	03	-	-	3
36	Assawath (<i>Ficus religiosa</i>)	03	-	-	3
37	Babla (<i>Acacia nilotica</i>)	05	-	-	5
Total		2894	1155	2099	6148

Source: IEE of A-B Project, CEGIS, 2014



Photo 6.7: Homestead vegetation of study area

Crop field vegetation

Crop field of this study area is mainly used by paddy cultivation once or twice (Boro and or Aman) in a year and vegetable cultivation. Detail description of crop varieties and their production are described in agricultural section of this report. However, in dry season crop field contains numerous wild herbs except cultivated varieties, which are considered as weeds. Among the weeds, *Amaranthus spinosus*, *Cynodon dactylon*, *Alternanthera sessilis*, *Polygonum sp*, *Oxalis corniculata* etc. are common species. Along the river side Binna gash (*Vetiveria zizanioidis*), Kash (*Saccharum spontaneum*), Ghagra (*Xanthium indicum*), Ban Palang (*Rumex maritimus*) are commonly sighted. Crop field vegetation has importance to provide not only food for human but also good habitat for small animals like insects, reptiles and various avifaunas. Crop field along the river levees are bordered by Khagra (*Phragmites karka*) other grasses, are luxuriously grown during monsoon.

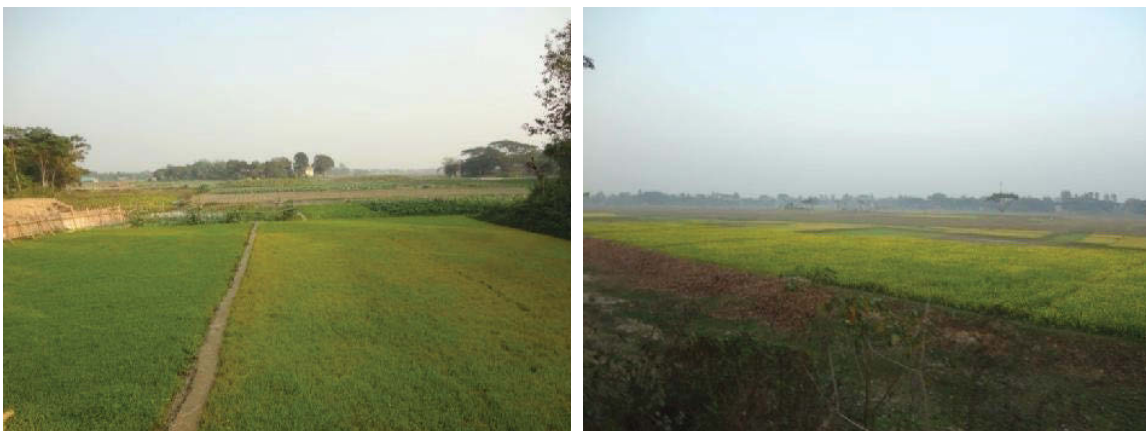


Photo 6.8: Crop field vegetation of study area

Road-side vegetation

Major species along the road-side are Assawath (*Ficus religiosa*), Bash (*Bamboosa sp.*), Mahogoni (*Swietenia mahagoni*), Pitali, Aam, Veron, Chatim (*Alstomia scholaris*), Bot (*Ficus benghalensis*), Rainde (*Albizia saman*), Sada koro (*Albizia procera*) etc. Raintree, and Mahogoni are the dominant species of road side vegetation.



Photo 6.9: Vegetation along the roadside

Terrestrial Fauna

Big mammals such as Golden Jackal are found in the study area and small mammals such as Bengal Bandicoot Rat (*Bandicota bengalensis*), Common House Rat (*Rattus rattus*), Jungle Cat (*Felis chaus*); House mouse (*Mus musculus*), Small Indian Mongoose (*Herpestes auropunctatus*), Indian Hare, Greater Short-nosed Fruit Bat (*Cynopterus sphinx*), Indian Pipistrelle (*Pipistrellus coromandra*) and Indian Flying Fox are the common. Terrestrial birds can be divided into two major groups: birds observed in wetland and birds observed in dry land habitat such as homestead, open woodland, Char land areas, scrub, and grass land. Birds of prey survive well in the area. Common bird of prey species found inside the study area are: Black Drongo (*Dicrurus macrocercus*), Crested Serpent Eagle (*Spilornis cheela*), Brahminy Kite (*Heliastur indus*), White breasted Kingfisher (*Halcyon smyrnensis*), Common Myna (*Acridotheres tristis*), Asian Pied Starling (*Sturnus contra*), Spotted Dove (*Streptopelia chinensis*), Red-vented Bulbul (*Pycnonotus cafer*), House Sparrow (*Passer domesticus*), Black Kite (*Milvus migrans*), Oriental Magpie Robin (*Copsychus saularis*), Brown Fish Owl (*Ketupa zeylonensis*), Rufous Treepie (*Dendrocitta vagabunda*) etc. are found most of the village groves and homestead forests. Other common birds species are Jungle Mayna (*Acridotheres fuscus*), Blue Rock Pigeon (*Columba livia*), Asian Koel (*Eudynamys scolopacea*), Coppersmith Barbet (*Megalaima haemacephala*), Black Hooded oriole (*Oriolus xanthornus*), Common Hoopoe (*Upupa epops*) etc. The common lizards found within the area include House gecko (*Hemidactylus frenatus*), Keeled Grass Skink (*Mabuya carinata*) and Common Garden Lizard (*Calotes versicolor*). Amphibian species favor wetland and the marginal dried areas. Some species, Common Toad (*Duttaphrynus melanostictus*), Asian Brown Tree frog (*Polypedates leocomystax*), Ornate Microhylid (*Microhyla ipine*), Indian Bull frog, Skipper frog prefer the cool, damp habitat of the bamboo grooves.

6.7.2 Aquatic Ecosystems

The study area has mighty rivers such as Meghna and Titasi. The major wetland types of this area are:

- Floodplains
- River
- Canals and creeks and
- Ponds and ditches.

Floodplains are the landforms of the study area which are inundated in each monsoon. Vegetation of the floodplains is changing its forms with fluctuation of water level. This type of seasonal wetland is dominated by grasses and rooted floating plants. During dry season, floodplains are converted in agricultural field. The vast area of Meghna River possesses perennial forms of wetland round the year that follow water fluctuation in terms of seasonal variation. Water coverage and depth of the river is highest in monsoon. The river have numerous creeks those hold water during part of the year. Inside the study area, numerous ponds are found on homestead platforms and are used for domestic purposes or fish culture. Most of the canal and river has been polluted due to dying industries. That is why the aquatic vegetation composition is reducing every year. Ditches found inside the agricultural field are a type of natural wetland and contain water till winter. Along the river bank line, creeks and ditches are frequently filled by sand during flood season by sedimentation process. However all kinds of wetland have a good contribution to sustain local aquatic ecosystems. Perennial wetlands contain water for whole of the year. Among the study area, River and homesteads ponds are the perennial wetlands. The wetland which holds water for a certain period of a year is called seasonal wetland. Perennial wetland provides refuge and shelter for most of the aquatic flora and fauna. The seasonal wetland serves as the grazing ground for fish and other aquatic animals.



Photo 6.10: Aquatic ecosystem within the study area

Aquatic Flora

Diversity and density of floral plants vary according to wetland types as well as water depth and velocity. Floodplains possess high density and diversity of aquatic plants especially during monsoon. Kochuripana/water hyacinth (*Eicchornia crassipes*) is the most common free floating hydrophytes that cover maximum portion of water area of internal canals and

ditches. River water possesses very few number of aquatic flora for having continuous flow and sandy bed soils. Topapana (*Pistia strateotes*) are found in most of the ditches as well as ponds mixed with hyacinth. Nil Shapla (*Nymphaea stellata*), Chandmala (*Nymphoides sp*) are dominating the community of floodplain vegetation. Sedges are quite common during monsoon inside all types of wetlands. Helencha (*Enhydra fluctuans*), Ludwgjia, *Echinocola*, *Hygrorhyza*, *Ficus heterophylla* are the main floral composition of marginal sedges vegetation.

Aquatic Fauna

Population of aquatic faunal species is varied according to wetlands characteristics and area of water inside the water bodies. Fishes comprise the major aquatic faunal species and these are described in detail in fisheries section of this report. The skipper frog (*Euphlyctis cyanophlyctis*) is common amphibians found in all over the year. They have been the most successful fauna in adapting to the all kinds wetlands. Abundance of Indian Bullfrogs (*Hoplobatrachus tigerinus*) increase in rainy season at paddy fields, ditches and other marshy places. Common aquatic snakes include the chequered keel back (*Xenocrophis piscator*) and smooth water snake (*Enhydris enhydris*). Ganges River Dolphin (*Platanista gangetica*) is common in Meghna River. But their abundance is high at the deeper meander points due to having available fishes for their feeding. Different species of migratory birds are roaming on the Char lands with their mudflats and sandy beaches during winter and these landforms are the major staging grounds for them. Indian roofed turtle (*Pangshura tectum*) and Median Roofed Turtle (*Pangshura tentoria*) are common of them whereas Brown Roofed Turtle (*Pangshura smithii*) is very rare.

6.8 Socio- Economic Condition

Socio-economic data has been collected from secondary as well as primary sources. The demographic data including population by sex, literacy rate, electricity facilities, occupational pattern have been collected from the secondary sources, i.e. mainly from BBS. Data on migration, income and expenditure, poverty status, employment and livelihood pattern have been collected from study area through participatory rural appraisal (PRA) method using rapid rural appraisal (RRA) and public consultation meeting (PCM) techniques.

6.8.1 Demographic Features

Population and household

The demographic features of the Project area have been generated based on the union level data and information collected from the available BBS publications. The demographic feature for the proposed area is presented in the **Table 6.23**. The demographic features include household number and size, total population by male and female with ratio (**Figure 6.15**) and the literacy rate comprising with the national rates.

Table 6.23: Demographic scenario of the project area

No. of total households	Average HH size	Population			Literacy rate (above 7 years)		
		Male	Female	Total	Total (National: 45.39)	Male- (National: 49.60)	Female- (National: 40.80)
114002	4.97	278616	281821	560437	47.63	48.67	46.58
Male-Female Ratio		49	51				

Source: Estimated Data, BBS, 2011

Dependency ratio refers to ratio of dependent population (population aged below 15 years and above 59 years) to the working age population (population aged between 15 to 59 years). It is found that the dependency rate is 78 in the study area which denotes that almost 78 persons are dependent on 100 working people.

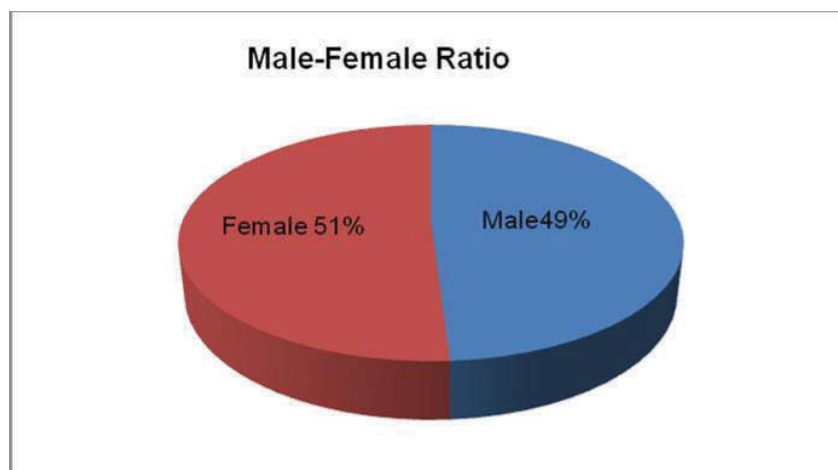


Figure 6.15: Male-female ratio in the study area

6.8.2 Occupation and Wage

Occupation

The percentage of population having different occupation in the area is presented in **Table 6.24**. 'Household work' is the main occupation which constitutes 40% of the total population followed by agricultural work (14%) and business (5 %). A significant percentage (24%) of population has no work in this area. The percentage of the population with main occupation is presented in the following **Table 6.24**.

Table 6.24: Percentage of population by main occupation in project area

Main occupation	% of population
Household work	40
Not working	24
Agriculture	14
Business	5
Looking for work	1
Industry	2
Transport	2
Construction	1
Service	2
Others	9
Total	100

Source: BBS, 2011



Photo 6.11: Source of income in the study area



Photo 6.12: Source of income in the study area

Availability of labour and wage rate

The data collected from the project sites shows that the labour availability is medium and the employment opportunity of laborer is low. The number of female engaged in employment in the study area is low. Mainly women are engaged in non-paying household work. According to data (**Table 6.25**), the male laborers get minimum 250 taka and maximum Tk300 for farming, while wage rate is Tk250 to Tk350 for non-farming male labors. The wage rates for non-farming female laborers are between Tk150 to Tk200.

Table 6.25: Availability of labour and wage rate

Type of Activities	Male labour			Female labour		
	Availability	Wage (taka)		Availability	Wage (taka)	
		Ave. max.	Ave. mini.		Ave. max.	Ave. mini.
For farming activities	High	300	250	Nil	-	-
For non-farming activities	Low	350	250	Low	200	150

Sources: RRA, CEGIS, 2014

Labour migration

Seasonal migration of the day laborers is a common phenomenon in the study area. Usually, the unemployed day laborers and landless farmers of the study area migrate to the nearby city and towns in search of temporary employment. These laborers prefer to go to Dhaka, Narayanganj, Narsingdi and Brahmanbaria; usually engaged themselves in diversified occupations like day laboring in brickfield, rickshaw pulling, industrial work etc (**Table 6.26**). About 30% populations generally migrate-out seasonally while rate of permanent in/out migration is very negligible. Besides, seasonal in migration is nil in the study area.

Table 6.26: Labour migration status in the study area

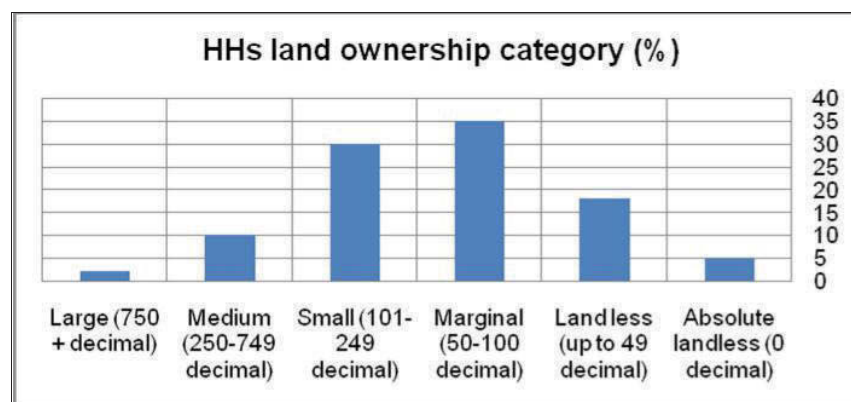
Type of Migration	Out Migration		In Migration	
	Place of destination	% of total population	Place of origin	% of total population
Seasonal labour migration	Dhaka, Narayanganj, Narsingdi, Brahmanbaria	30%	-	-

Sources: RRA, CEGIS, 2014

6.8.3 Land Ownership and Price

Land ownership

In the study area, it is found that more than one-third landholders belong to marginal landholding category (35%). Small holding comprises 30% and medium holding comprises 10%. About 18% households belong to functional landless category, while an insignificant number of households are absolute landless (5%) and large landholders (2%) of the area. The distribution of households according to land ownership categories is given in **Figure 6.16**.



Source: RRA, CEGIS, 2014

Figure 6.16: Households with different land ownership category in the study area

Land price

The prices of different types of land in the project area are presented in **Table 6.27**. The project mainly occupies agriculture land (89%) along with a minor settlement area (6%). Settlement and elevated lands are very much valuable in the project area. Based on the use, lands are categorized as homestead, agriculture, floodplains, commercial etc.

Table 6.27: Price of land by different categories

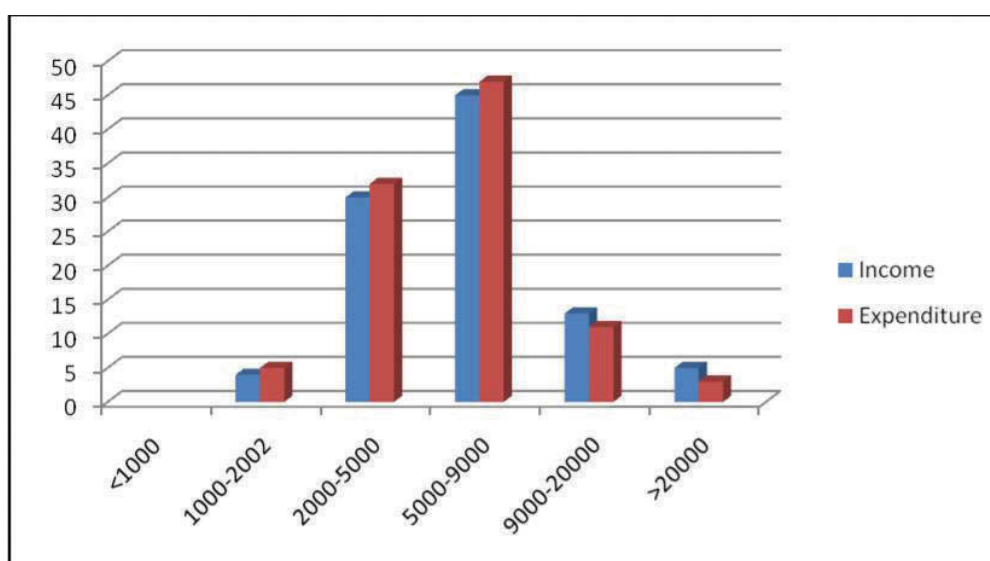
Sl. No.	Land categories	Price per acre (Tk.)
1	Homesteads land	3,00,00,000
2	Agricultural land	53,12,500
3	Floodplains	37,50,000
4	Commercial land	1,43,75,000

Source: IEE of A-B Project, CEGIS, 2014

6.8.4 Income and Poverty

Household income and expenditure

In the study area it is found that most of the people earns (45%) and expenses (47%) within the range of Tk. 5000 to Tk. 9000 per months. On other hands only 5% and 3% people earn and make expenses of Tk. 20,000/month (**Figure 6.17**).

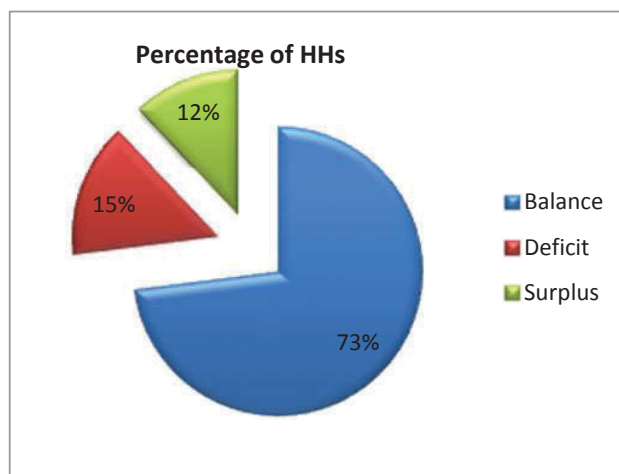


Source: RRA, CEGIS, 2014

Figure 6.17: Distribution of income and expenditure by ranges

Poverty

Measurement of poverty in the study area has been self-assessed. This assessment has been done based on yearly income and food consumption. In this process the respondents were asked to assess the overall poverty level of people living in the study area. Their responses were assembled into three categories classified as deficit, balance/breakeven and surplus.



Source: RRA, CEGIS, 2014

Figure 6.18: Poverty status in the study area

By following the procedure outlined above, it was estimated that about 73% of total population living in the study area belongs to balanced or breakeven category, i.e. their economic activities are subsistence oriented. Around 12% household belongs to surplus category, while, 15 percentage belongs to deficit groups. Considering the standard consumption of food e.g., three meals a day, the deficit group on average takes two meals in a day in the lean period but can afford three meals a day during the other period of the year.

6.8.5 Quality of Life

Housing status

Upazila wise housing status of the study area is presented in **Table 6.28**. The data shows that there are four categories of house in the area as per the BBS. Average kancha houses have been reported highest (70.50%) in the area which indicates a common housing condition like other parts of the country.

Table 6.28: Housing status

Sl. No.	District	Name of the Upazilas	% of hhs having			
			Jhupri	Kucha	Semi Pucca	Pucca
1	Brahmanbaria	Banchharampur	0.6	87.9	8.0	3.4
2		Brahmanbaria Sadar	0.6	56.3	23.4	19.7
3		Ashuganj	0.3	67.1	19.4	13.3
4		Nabinagar	0.4	85.4	10.1	4.1
5	Narayanganj	Araihazar	0.3	82.4	13.1	4.2
6		Rupganj	0.8	57.9	32.5	8.8
7	Narsingdi	Narsingdi Sadar	0.7	56.1	31.5	11.8
		Total	0.5	70.5	20	9

Source: BBS, 2011

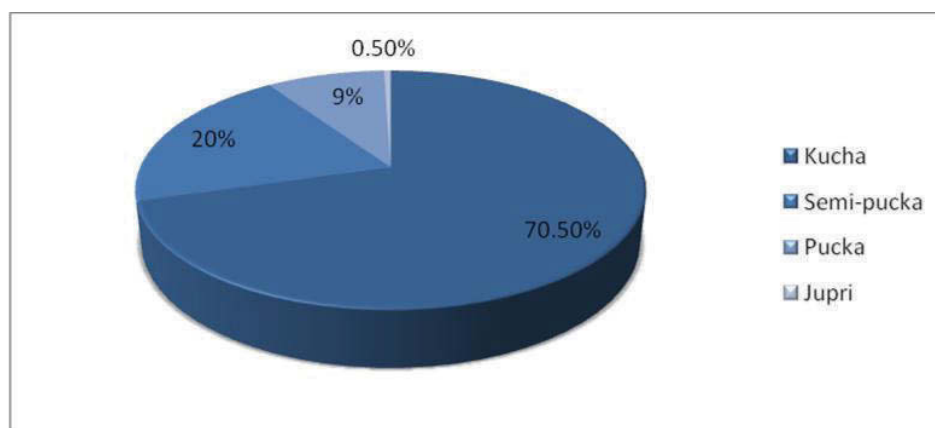


Figure 6.19: Housing condition in the study area

During EIA study, it was observed that around 84% of houses of DIA are kucha (tin-made) (**Table 6.29**) which indicates a moderate housing condition in the area compared to other areas of our country.

Table 6.29: Housing structures on the RoW of 400 kV Ashuganj-Bhulta T/L

Sl No.	Name of the features	Nos. of Housing structures				
		RoW (40m)	Left side	RoW Middle side (20m)	RoW Right side (40m)	Total RoW (100m)
1	Brick Built house	15		01	08	24
2	Semi Pacca house	63		07	40	110
3	Tin sheet house	130		41	07	178
	Total	208		49	55	312

Source: IEE of A-B Project, CEGIS, 2014



Photo 6.13: Housing pattern in the study area

Drinking water

The sources of drinking water within the study areas are presented in **Table 6.30**. The status of safe drinking water is quite good as per the BBS data. Most of the people (93%) can collect drinking water from tube well and only 4% from others sources. Collection of drinking water from tap sources (3%) is very negligible. Statistics shows that Ashuganj upazila comprises the highest tap water (8%) whereas Nabinagar upazila comprises the highest tube well for drinking water purpose (96%).

Table 6.30: Drinking water source

District	Upazila	Number of Households	Source of Drinking Water (%)		
			Tap	Tube-Well	Other
Brahmanbaria	Banchharampur	59596	0.2	91.3	8.5
	Brahmanbaria Sadar	95353	6.8	91.3	1.8
	Ashuganj	33304	8.0	90.5	1.5
	Nabinagar	94726	0.5	95.9	3.6
Narayanganj	Araihazar	77155	1.0	95.4	3.6
	Rupganj	119002	1.8	94.7	3.5
Narsingdi	Narsingdi Sadar	147027	6.3	91.2	2.5
Total & percentage		626163	3	93	4

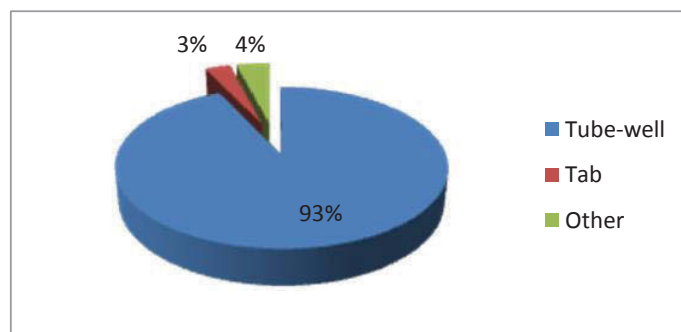
Source: BBS, 2011



Photo 6.14: Drinking water sources in the study area



Photo 6.15: River water use for different domestic purpose



Source: BBS 2011

Figure 6.20: Drinking water pattern in study area

Sanitation

The sanitation status of the project area is presented in **Table 6.31**. In the study area about 70% household reported that they have sanitary toilet facilities of which 21% with water-sealed and 49% with non-water sealed. On the other hand, 26% household has non-sanitary latrines and 4 % of households have no sanitation facilities at all. Data shows that sanitation facility of the study area is moderately satisfactory. Most of the households have ring slab latrines.

Table 6.31: Toilet facilities within 400kV T/L area

Sl. No.	Toilet types	Percentage of households
1	Sanitary (water-sealed)	21
2	Sanitary (non water-sealed)	49
3	Non-sanitary	26
4	None	4

Source: BBS, 2011



Photo 6.16: Sanitation facilities in the study area

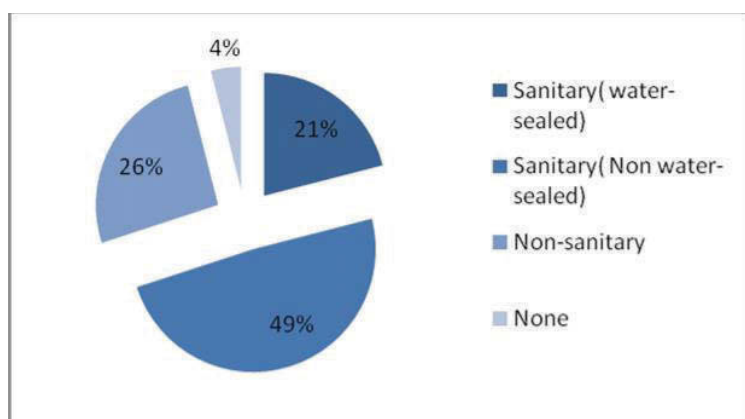


Figure 6.21: Sanitation system in the project area

Diseases and health

The diseases by ranking of incidence are presented in the **Table 6.32**. It has been reported that, most of the people are suffering from influenza and cold induced health problems. Diabetes and gastric are commonly seen to the elderly people. Incidence of hypertension is low in the study area.

Table 6.32: Incidence of diseases by ranking

S1.No	Disease	Ranking by incidence
1	Influenza/Common fever	1
2	Cough/Cold	2
3	Malaria	5
4	Diabetes	4
5	Gastric	3
6	Hypertension	6

Source: RRA, CEGIS, 2014

Electricity

In the study area, average 86.07% households are covered by electricity connection, which portrays a very high-quality status compared to the national coverage (53%). Maximum electricity coverage are identified in Sonargaon Upazila (96.90%) where electricity coverage is minimum (66.40%) at Nabinagar. Generally, People reported that they are happy on present grid connection.

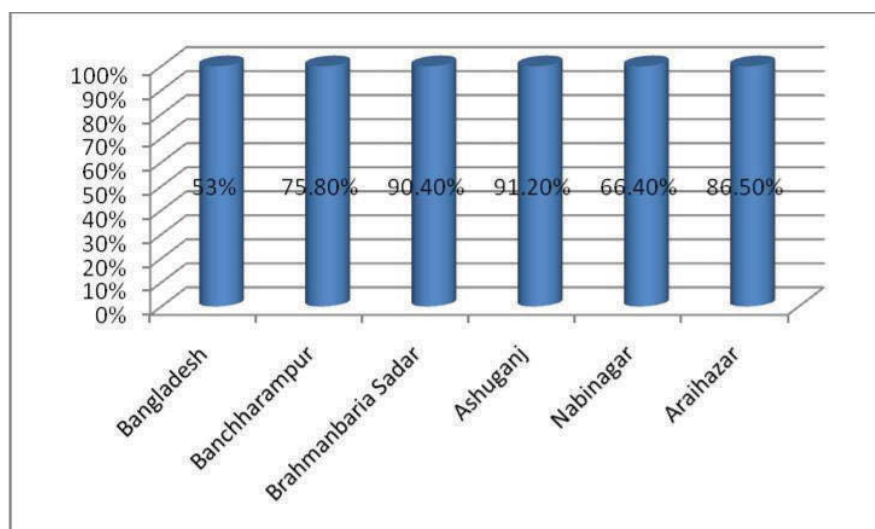


Figure 6.22: Percentage of electricity connection in the study area

Source: BBS, 2011

6.8.6 Social Services

Treatment facilities

The local people reported that they have limited health services /facilities in and around the study area. People of the study area don't have any hospital or adequate health facilities but they receive proper treatment from the hospitals/clinics located at peripheral town areas. There are only one family welfare center and three community clinics within the study area which are not adequate to serve the inhabitants of the study area (**Table 6.33**). Local people usually to go to Narayanganj, Narsingdi and Brahmanbaria district headquarters for receiving treatment facilities as peripheral health services.

Table 6.33 : Numerical distribution of health services and facilities

Type of Facility	Number of Facilities
District/ Sadar Hospital	-
Upazila Health Complex	1
Union Sub-Center	2
Union Family Welfare Center	1
Community Clinic	2
Private Health Clinics/hospitals	-
Other (if any)	-

Source: RRA and FGD, CEGIS, 2014

People reported that still people have tendency to go to the local healer (47%) for treatment (**Figure 6.23**). In addition, paramedic physician is also providing services to almost 35% of the people and only 15% of the people go to the trained physician. It is assumed that economic wellbeing may drive them toward receiving treatment facilities from trained physicians who are no doubt more expensive but are effective. It is matter of concern that, almost 3% people do not get any medical facilities due to lack of consciousness about the diseases and/or financial inability.

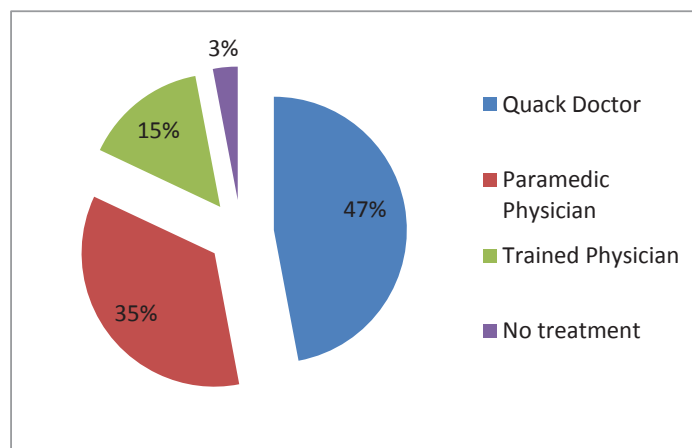


Figure 6.23: Treatment facilities in study area

Source: RRA and FGD, CEGIS, 2014



Photo 6.17: Union Health and Family Welfare Complex

Education facilities

In the study area, status of education is medium level. The literacy rate is more than the national level (51.8%). Using Household and Population Census 2011, it is estimated that in the study area, almost 47.31% of female are literate whereas 49.67% male are literate as well as overall literacy rate is 48.5%. The details of literacy rate are shown in **Figure 6.24**, it is found that that highest literacy rate is in Rupganj (54.60%) and lowest is in Banchharampur (38.50%).

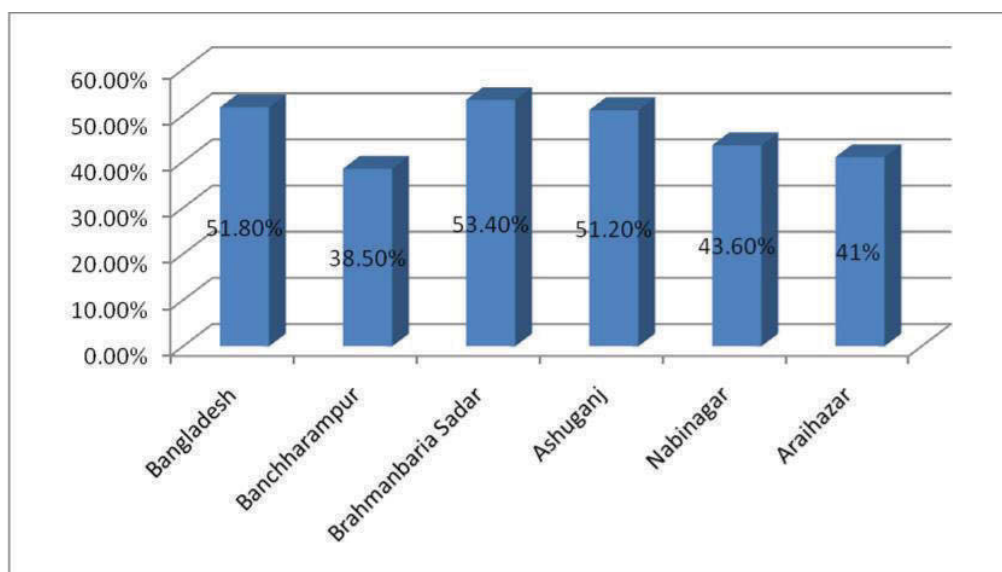


Figure 6.24: Literacy Rate in the study area

Source: BBS, 2011

It has been observed during the survey that each and every mauza has a primary level educational institution. Moreover secondary level educational institutions are also within union level. There are 7 primary schools and 4 high schools, 2 colleges, 4 Ebtedayee Madrasa, 1 Dakhil Madrasa and 3 Alim/Fazil Madrasa in the study area. The details of educational institutions are given in **Table 6.34**. Local people have a tendency to send their children in Madrasa instead of school. In the earlier period they preferred to send their children to earn rather than go to schools. The rate of school going children as well as achieving modern education is still low. However, this tendency is gradually relieving and there is a growing positive attitude towards education.

Table 6.34: Numerical distribution of educational institution in the study area

Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
Primary School	7	Ebtedayee Madrasa	4
High School	4	Dakhil Madrasa	1
College	2	Alim/Fazil Madrasa	3

Source: RRA and FGD, CEGIS, 2014



Photo 6.18: Education institution



Photo 6.19: Madrasa in study area

Communication facilities

Communication system is good in the study area. The internal road communication is very good those are well connected with the regional and national highways. People use also water way for communication purposes. The Meghna, the Titas Rivers are flowing adjacent to the study area and used as a perennial means of waterway communication.



Photo 6.20: Communication in water way



Photo 6.21: Railway communication in study area

6.8.7 Natural Disaster and Damage

The people of study area reported flood, hail storm, water logging, storm etc. as the major natural hazards causes for disaster. There are tangible and intangible losses of natural hazards which are frequent in the study area. The tangible losses include death of cattle, damage of crops and home etc. while intangible losses include reducing income source, negative effect on agricultural land etc.

Water logging is identified as one of the main problems for damage of agricultural production. However, sometimes seasonal storm and hail storm hit on the study area and damages agricultural crops. In order to reduce the risks and vulnerability as well as losses from natural hazards, people are found adaptive through increasing capacity and by building up awareness.

Table 6.35: Impacts of recent natural disaster in the study area

Disaster	Frequency	Affected Area (%)	Affected HHs (%)	Crop Damaged (%)	Major Damaged Crop
Flood	2013	30	15	25	Paddy, Vegetable
Hail storm	Each year	25	10	15	Paddy, Vegetable
Water logging	Each year	20	12	14	Paddy, Vegetable
Storm	Every year	7	5	6	Paddy, Vegetable

Source: RRA, CEGIS, 2014

6.8.8 Social Safety Nets

The people of the study area those are economically affected by natural hazards and those are living under poverty level are served by different social safety net programs provided by Government Organizations (GOs) and NGOs. Government safety net interventions served by different GOs are limited in extent. On the other hand, NGOs activities are based on mainly microcredit. There are only handful programs run by the NGOs on education, health and women empowerment while programs on forestry, fishery, livestock rearing, disaster and human rights are nearly absent. The coverage of GO and NGO social safety net programs are limited compare to their needs.

Table 6.36: Name of GOs-NGOs with their activity and coverage

Name	Activity	% of HHs Coverage
BRAC	Credit, health and education	20
ASA	Credit	8
BSC	Credit	3
Sidar	Credit	5
Multipurpose	Credit	4
Grameen Bank	Credit, women empowerment	15
Sridib	Credit	2
Government Bank i.e. Krishi, Agrani, Janata, Sonali and Pubali	Credit	10

Source: RRA, CEGIS, 2014

6.8.9 Important Socio-economic Features

A good number of important socio-economic features like shop, school, Mosque, Madrasa, Majar, Greveyards, Temples, roads, khal, river, pond, Railway line, Transmission line, industry are placed within the RoW of the Ashuganj-Bhulta 400 kV T/L Project area (**Table 6.36**).



Photo 6.22: Dhaka-Brahmanbaria Highway



Photo 6.23: Union Parishad

Table 6.36: Important socio-economic features on RoW of 400 kV T/L

Sl. No.	Name of the Features	Other Social Features (Nos.)			
		RoW Left side (40m)	RoW Middle (20m)	RoW Right side (40m)	Total RoW (100m)
1	Shop	28	-	13	41
2	School	-	-	-	-
3	Mosque	-	-	-	-
4	Majar	-	-	-	-
5	Graveyard	-	-	-	-
6	Khal	04	02	03	04
7	River	04	04	03	04
8	Pond	02	02	04	08
9	Mandir	-	-	-	-
10	Poultry farm	-	-	-	-
11	Petrol pump	-	-	-	-
12	Bazar	09	06	06	09
13	Industry	02	-	04	06
14	Highway Road	02	02	02	02
15	Pucca Road	24	24	24	24
16	Kucha Road	22	22	22	22
17	Railway Line	01	01	01	01
18	Transmission Line	09	09	09	09

Source: IEE of A-B Project, CEGIS, 2014

6.8.10 Historical, Cultural and Archaeological Site and Tourism

No important sites in terms of historical, cultural or archaeological heritage are located in the study area.

7. Important Environmental Social Components

7.1 Introduction

The interventions proposed for the Ashuganj – Bhulta 400 kV Transmission Line (A-B 400kV T/L) project may have impact on the specific environmental and social components. Some components may be significantly impacted while the others may be substantially independent of the consequences of the project interventions. Environmental and social components likely to be impacted by the project interventions are termed as 'Important Environmental and Social Components' (IESCs). In the A-B 400kV T/L Project the IESCs have been selected through initial screening conducted by the EIA study team at desk and later through field verification as well as validation during consultation meetings with the local people.

7.2 Selection of IESCs and its Rationale

During the EIA study, IESCs which are likely to be impacted by the construction of the A-B 400kV T/L have been identified based on some rationale. Selected IESCs along with the rationale of their selection under water resources, land resources, agriculture, fisheries, ecosystem and socio-economic condition are described in the following sections.

7.3 Physical Environment and Water

7.3.1 Ambient Air Quality

The construction of overhead transmission line will generate minor amount of air pollution from fuel combustion (light fuel oil) used for supplying Lorries and equipment. These may impact ambient air quality. Therefore, air quality has been considered as a temporal IEC.

7.3.2 Ambient Noise Quality

During pre-construction and construction phase, mobilization of construction materials, operation of equipment and machineries will generate noise in different locations of the study area. Therefore, noise quality has been considered as a temporal IEC.

7.3.3 Interference with road crossing

There may be interference in crossing points of rural roads and regional high ways during stringing the transmission lines.

7.3.4 Water Quality

Water quality can be impacted not only by work within a waterway but also by nearby vegetation clearing and other construction activities. Moreover, Construction wastes in the sub- station and tower site may degrade the water quality of the study area. Therefore, water quality is considered as an IEC.

7.3.5 Navigation

The proposed transmission line alignment would cross a number of water bodies and most predominantly the Meghna River. This may hamper the navigation of such water courses, and as a result navigation has been regarded as an IEC.

7.3.6 River Course

The establishment of riverside suspension towers may hamper the river course, as the frequency, location and time of morphological events such as erosion/ accretion can be effected. As such river course has been considered as an IEC.

7.4 Soil and Agriculture

7.4.1 Land type and land form

Construction of the platform for the proposed sub-stations might change the land type and land form in the selected place. Therefore, it has been selected as an IEC.

7.4.2 Soil texture

The project site will be filled up with external soils, sands and dredged materials and that's why soil texture might be impacted. Therefore, soil texture has been selected as one of the IECs.

7.4.3 Land use

The present land use practice may be changed in the sub-station area. The present crop land may not be used for crop production. Hence, land use has been considered as one of the IECs.

7.4.4 Soil potential

In the study area, the soils will be dug to construct the tower. After construction, the dug hole will need to be refilled. In carrying out this work, the topsoil, subsoil and sub-stratum soils may be mixed up and it may cause disturbance of the valuable top soil and sub-soils. The soil potentiality may be degraded for good production of agriculture crops in future. Under this consideration, soil potential has been selected as one of the IECs.

7.4.5 Crop production

During pre-construction and construction period, the growing crops in this area may be affected. So that, the production might be reduced from the expected level of production. Because of this, crop production has been considered as an IEC

7.4.6 Intercultural operation

In the Tower (Angle point) site, intercultural operation may be hampered during pre-construction and construction period. For this reason, it has been considered as an IEC.

7.5 Fisheries

7.5.1 Fish Habitat

Any types of intervention alter the aquatic habitat quantity and quality of the study area. Under this project activity, transmission line tower and sub-station line will be constructed. Generally fish habitat is not lost or damaged due to the construction of transmission line tower. But a Sub – Station will be constructed in the low land area which might alter the existing physical setup of the fish habitat. Considering these consequences, fish habitat has been considered as an IEC of this study.

7.5.2 Fish Production

As floodplain (low land) area would be lost due to construction of sub–station, catch of fish species as well as fish yield may alter in the study area. It is expected that fish production might be changed within the study area due to intervention. So fish production has been considered as an IEC.

7.6 Biological Environment

7.6.1 Terrestrial Vegetation

Construction activities of towers and plants on the ROW might be cut or damaged. Moreover, there may be restriction to plant tall tree under the transmission wires. All of these phenomena may induce to change terrestrial vegetation condition of the RoW. Therefore, terrestrial vegetation is selected an IEC.

7.6.2 Wildlife and their habitat

Wildlife is usually depending on vegetation for their habitats. Cutting or damaging of vegetation has direct impact on wildlife. Beside this, changing of physical environment due to noise, human movement, structural interventions may be also deteriorating habitat quality of an area. Construction activities and establishment of towers and substation may change wildlife habitat condition due to vegetation loss as well as changing of physical environment. So, wildlife and their habitat are being considered an important IEC for this study.

7.7 Socio- Economic Environment

7.7.1 Land acquisition

Sub-station site may need land acquisition from private owners. So, land acquisition has been selected as an important social component for the study.

7.7.2 Land price

Land price increases normally in the country as a result of increasing demand and scarcity effect. As a result of power line encroachment through present land under cultivation, future productivity of land is most likely to decline. So, land price may be affected due to construction of transmission line. Therefore, land price has been selected as an ISC.

7.7.3 Employment opportunities during construction (technical and non- technical)

Unemployment of unskilled labour is an important issue in the area. Many people have no regular opportunity of work in study area. They would involve temporarily in technical and non-technical work of constructing transmission line project. Temporary employment of unskilled and skilled labour in the transmission line construction activities may be impacted by the unemployment situation of the locality. That is why employment opportunity has been chosen as an ISC.

7.7.4 Occupational Health and safety

Occupational health is a major concern during construction work. Especially during the construction phase supply of drinking water, sanitation and treatment facilities to the workers will be a major issue. Scarcity of drinking water and proper sanitation and medical facilities will threaten worker's health which may impact proposed construction activities. On the other hand, occupational safety is an important element of work place. Physical accident may be occurred during construction of high power transmission lines in study area. Therefore occupational health and safety has been chosen as an ISC.

7.7.5 Regional as well as national economic development

The power is the key element of the regional as well as national economic development. The Ashuganj-Bhulta 400kV T/L Project may ultimately impact on the overall development of the country. So regional as well as national economic development has been selected as an ISC.

8. Impact Assessment

8.1 Preamble

This Chapter identifies the environmental and social impacts that may potentially be caused by various Project phases, and also proposes appropriate mitigation measures to avoid, offset, reduce, or compensate these impacts. Potential Intervention which may cause potential environmental impacts during pre-construction, construction, and post-construction stages have been identified in Chapter 4. The project influence area considering indirect and direct impacted area has been identified in Article 3.1.4 of Chapter 3. The following detailed investigations are being carried out to assess the magnitude of these prioritized impacts:

- RRA survey to assess the loss of vegetation, occupation, income and poverty levels of the affected households, etc.
- Environmental quality baseline monitoring of noise, surface water, groundwater and soil,
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and wet land,
- Expert consultations, informal discussions, and public consultations.

8.2 Impact Screening

As part of the environmental impact assessment process, a screening matrix was tailored specifically to the proposed Project, focusing the potential environmental impacts during the design, construction and operation phases. The matrix examined the interaction of project activities with various components of the environment. The impacts were broadly classified as physical, biological and social, and then each of these broad categories further divided into different aspects. The potential impacts thus predicted were characterized as follows:

- Highly negative (adverse) impact;
- Moderately negative impact;
- Insignificant impact;
- Highly positive (beneficial) impact;
- Moderately positive impact.

The matrix is provided in **Table 8.1**. The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures were recommended as part of this EIA, thus reducing the occurrence possibility and severity of the potentially adverse impacts. The potentially negative impacts identified through this process are discussed in the subsequent sections.

Table 8.1: Environmental and Social Screening Matrix (Without mitigation measures)

Project Phases and activities	Physical & Water					Land & Agriculture						Fisher ies		Ecolog y		Socio-economic					
	Ambient Air Quality	Noise and Vibration	Water Quality	Navigation	River course	Land type and land form	Soil texture	Land use	Soil potential	Crop production	Intercultural operation	Fish habitat	Fish production	Terrestrial vegetation	Wildlife habitat	Land acquisition	Land price	Employment opportunities	Occupational health and safety	Regional /national economic development	
Pre -Construction phase																					
Materials/equipm ent mobilization (Carrying as well as storing)	I	I	I	I	I	I	I	I		I	N I	I	I	I	I	NI I	I	I	I	NI	
Construction phase																					
Construction of labor sheds																					
Land development for sub-station	I	NI	I	N I	N I	M N	M N	I	N I	M N	I	M N	M N	I	I	H N	I	I	I	NI	
Earth Work in Foundation	I	I	I	I	I	M N	M N	I			I	I	I	M N	M N		I	I	I	NI	
Foundation Treatment	N I	NI	N I	N I	N I	I	NI	N I	I	I	I	NI	NI	I	I	NI	H P	I	I	NI	
RCC Work	I	M N	N I	N I	N I	NI	NI	N I	N		I	I	I	N	M N	M N	P	I	I	NI	
Brick Work up to Plinth Level and Superstructure Back Filling with Local Sand	I	I	N I	N I	N I	NI	NI	N I	N I	NI	N I	NI	NI	NI	NI	NI	NI	I	I	NI	
Plastering and Finishing (electric wiring, distemper or plastic paint)	N I	NI	N I	N I	N I	NI	NI	N I	N I	NI	N I	NI	NI	NI	NI	NI	NI	N	H N	NI	
Boundary Fencing with Concrete Pillar and Barbed Wire	N I	I	N I	N I	N I	NI	NI	N I	N I	NI	N I	NI	NI	NI	I	NI	NI	I	I	NI	
Erection of Tower	N I	I	N I	N I	N I	NI	NI	N I	N I	NI	N I	NI	NI	NI	NI	NI	M N	I	I	NI	
Stringing of Transmission Line	N I	I	I	I	N I	NI	NI	N I	N I	NI	N I	NI	NI	M N	I	NI	NI	M P	H N	NI	
Post -Construction																					
Repair and maintenance of Transmission line	N I	NI	N I	N I	N I	NI	NI	N I	N I	I	N I	NI	NI	M N	M N	NI	H N	H P	M N	HP	

Note: No Impact (NI); Highly negative (adverse) impact (HN); Moderately negative impact (MN); Insignificant impact (I); Highly positive (beneficial) impact (HP); Moderately positive impact (MP).

8.3 Impact during pre-construction phase

8.3.1 Ambient air quality

At present, the quality of air is normal. Air quality may deteriorate slightly for transportation of materials to the towers/ sub-station sites. Further deterioration may occur due to soil digging, concrete works at tower / sub-station sites during project implementation. But the air quality will be gradually improved during post project situation.

The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigations

- Construction material (sand/soil) to be covered with thick polythene while transporting
- Water to be sprinkled as and where needed
- Exhaust emissions from vehicles and equipments should comply with standards

Residual Impacts

With the help of above mitigation measures, the impacts associated with air pollution are likely to be adequately addressed and the significance of residual impact will be Low.

8.3.2 Ambient Noise Quality

In present condition sound is within tolerable limit. No significant source of noise is found. It may deteriorate slightly for transportation and unloading of materials. Further deterioration may occur during concrete works, construction of tower/ sub-station. However, there will be no impact during post-construction phase.

The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigations

- Movement of material carrying vehicles should be restricted/ limited during the day time
- Noise levels from vehicles, equipment and machinery to comply with national noise standards

Residual Impacts

With the help of above mitigation measures, the impacts associated noise quality is likely to be adequately addressed and the significance of residual impact will be Low.

Table 8.2: Impact matrix during pre-construction phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
Physical Environment & Water				
Activity: Transportation of construction materials and equipments by heavy vehicle				
Air quality	1. Ashuganj 2. Talsahar 3. Krishnanagar 4. Nabinagar 5. Singhab 6. Paikar Char 7. Sonarampur 8. Chotto Haran 9. Kalagachia	Air quality is good	Dust may temporarily be generated during vehicle movement and transportation of construction materials by heavy vehicles.	-1
Noise	10. Bishnurampur 11. Darikandi 12. Alamnagar 13. Araihasar 14. Brahmandi 15. Uttar Natai 16. Baratala 17. Andidil 18. Poothai	Sound is within tolerable limit, No significant source of noise found	Noise generation due to mobilization of construction materials and equipment by heavy vehicles.	-1
Land Resources (There would be no impact during this phase)				
Agricultural Resources (There would be no impact during this phase)				
Fisheries Resources (There would be no impact during this phase)				
Ecological Resources (There would be no impact during this phase)				
Socio-economic Condition				
Activity: Land development for sub-station				
Land acquisition	Sub-Station site	No compensation needed	<ul style="list-style-type: none"> Some people will lose their crop land and livelihood due to land acquisition. Project affected persons (PAPs) may be deprived of getting proper compensation. 	-5

* No impact (0); Positive impact (+); Negative impact (-); Low impact (1-3); Medium impact (4-6); High impact (7-8); Very high impact (9-10)

8.4 Impact during construction phase

8.4.1 Ambient air quality

At present, the quality of air is normal. Air quality may deteriorate slightly for transportation of materials to the towers/ sub-station sites. Further deterioration may occur due to soil

digging, concrete works at tower / sub-station sites during project implementation. But the air quality will be gradually improved during post project situation.

The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigations

- Covering construction material with polythene (sand, coarse aggregates).
- Water sprinkling where needed

Residual Impacts

With the help of above mitigation measures, the impacts associated with air quality are likely to be adequately addressed and the significance of residual impact will be Low.

8.4.2 Ambient Noise Quality

In present condition sound is within tolerable limit. No significant source of noise is found. It may deteriorate slightly for transportation and unloading of materials. Further deterioration may occur during concrete works, construction of tower/ sub-station. However, there will be no impact during post-construction phase.

The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigations

- Noise levels from equipment and machinery to comply with national noise standards
- Machineries to have proper mufflers and silencers

Residual Impacts

With the help of above mitigation measures, the impacts associated with noise are likely to be adequately addressed and the significance of residual impact will be Low.

8.4.3 Water Quality

Surface water quality may adversely be impacted at construction period. Construction work within a waterway, throwing of liquid and solid waste into surface water, vegetation clearing and other construction activities will further deteriorate the water quality.

The significance of this potential unmitigated impact has been assessed as Moderate on the basis of impact magnitude and receptor sensitivity.

Mitigations

- Throwing of solid and liquid waste into water should be banned.
- Adjustments of selected locations for labor shed, stock yard etc. if possible, select places far from water bodies.

Residual Impacts

With the help of above mitigation measures, the impacts associated with water quality are likely to be adequately addressed and the significance of residual impact will be Low.

8.4.4 Navigation

The proposed transmission line would be crossing the Meghna River at Char Dighaldi and Paikar Char at Narsingdi sadar. Construction work in waterway will hamper the navigation for local people at construction period. In addition the lower transmission lines would approximately be at an elevation of around 65 m above the mean sea level (considering an average tower height of 90 m, elevation of the lowest wires at 70 m, and a vertical sag of 5 m), which may have impact on navigation in the longer perception.

Mitigations

- Diversion channel should be created before starting the construction work.
- Arrange navigation signal during wiring at the water way

Residual Impacts

With the help of above mitigation measures, the impacts associated with navigation are likely to be adequately addressed and the significance of residual impact will be Low.

Table 8.2: Impact matrix during constuction phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
Physical Environment and Water				
Activity: Construction of tower and sub-station site				
Air quality	1. Pakunda 2. Darikandi 3. Panchgaon 4. Kanthalia 5. Mollar Char 6. Paharikandi 7. Kalagachha	Air quality is good	(i) Further deterioration of air quality may occur during soil digging by heavy equipment (ii) Dust generation from concrete mixture machine during mixing	-1
Noise	8. Paikar char 9. Dariadaulat 10. Kolbandha 11. Sonarampur 12. Nilakhali 13. Tezkhali 14. Sreeghar 15. Bishnorampur 16. Sitharampur	Sound is within tolerable limit, No significant source of noise found	(i) Noise generation due to construction of tower (ii) Noise generation from concrete mixture machine	-1
Interference with road crossing	17. Nabinagar 18. Krishnanagar 19. Sadekpur 20. Damchail 21. Shalgaon 22. Natai, 23. Poyaggram 24. Poothai 25. Andil 26. Talsahar	Normal	Temporary impact while stringing wires.	-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
Water Quality	1.Singhab 2. Pakunda 3. Paikar Char 4.Sadasardi 5.Char dighaldi	Normal	Surface water quality will deteriorate by construction waste	-2
Navigation	6.Tezkhali 7.Paschim Nabinagar 8.Krishnanagar 9.Barail	Continuous movement of waterway transport	Construction work in waterway will hamper the movement of boat/traller and other waterway transport.	-2
River Course	10.Talsahar	Erosion prone	Placing suspension structures near the river banks will increase river erosion	-1

Land Resources**Activity: Activity: Construction of tower and sub-station site**

Land type and land form	Study area	Plain land and high to very lowland (F ₀ -to F ₄)	Land type will be changed and lowland would turn into high land	-1
Soil texture	Study area	Mainly Clay loam to loamy texture soil	The clay loam/ loamy textural soil might turn sandy soil	-1
Soil Potentiality	Study area	Moderately potential for agricultural crops	Will Impact in Tower locations	-1

Activity: Land development for sub-station

Land use	Sub-station area	Proposed Ashuganj-Bhulta sub-station on agriculture land	Land use would be changed	-1
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Agricultural Resources**Activity: Land development for sub-station site
Construction of tower and sub-station site**

Crop production	Sub-station area and in RoW areas	Yield rate of HYV Boro, HYV Aman and Lt. Aman rice are about	Partial loss of crop production on RoW and total loss at sub-station site.	-2
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IEC	Location	Baseline condition	Impacts	Magnitude of impact*
		3.5, 2.8 and 2.4 ton/ha respectively.		
Fisheries Resources				
Activity : Land development for construction of Sub-Station				
1. Fish Habitat 2. Fish Production	Sub-Station area at, (Pakundia Bhulta).	Low and seasonal floodplain, Water retain only rainy season, HYV boro and Aman are cultivated in this land.	<ul style="list-style-type: none"> Fish habitat would be lost by 8 ha due to land development for Sub-Station. Partial loss of fish and aquatic biodiversity resulting partial loss of fish production. 	-1
Ecological Resources				
Terrestrial Vegetation	Sub-station area and in RoW areas	Moderate density of terrestrial vegetation, major types are homestead and crop field vegetation	Damages of all plants at proposed tower site. Additional damages of herbaceous plants for material storing, labour and construction vehicle movement. Large homesteads trees on the RoW. Will be cut. Temporary damage of vegetation for wire stringing	-5
Wildlife and their habitat	Sub-station area and in RoW areas	Population and diversity of wildlife is moderate Major habitat type is homestead forest, floodplains and crop fields	Relocation of wildlife for habitats loss due to vegetation damage. Wildlife will be disturbed for generation of noise from construction vehicles and labour	-2
Socio-economic Condition				
Activity: Establishment of construction camps for workers				
Employment opportunities	Sub-Station and transmission line areas	Many people are unemployed in study	<ul style="list-style-type: none"> A temporary employment may be created for unskilled laborers during 	+3

IEC	Location	Baseline condition	Impacts	Magnitude of impact*
		area	construction of labour sheds	
Activity: Construction of the 70 km 400 kV overhead transmission line				
Employment opportunities	All over study area	About 20% of total people is not working due to limited opportunity	<ul style="list-style-type: none"> Local people will be engaged in construction of new transmission line as because of created employment opportunities in construction work 	+2
Activity: Land development for sub-station				
Employment opportunities	Sub-Station area (Pakundia at Bhulta)	A significant portion of total people do not work	<ul style="list-style-type: none"> Local people may be engaged in land development for sub-station 	+2
Activity: Tower erection, conductor stringing, switchyard foundation of substation equipment set up, equipment wiring				
Occupational Health	Transmission line and sub-station area	There are no medical facilities available near the working area.	<ul style="list-style-type: none"> The workers will suffer from different water borne diseases due to lack in supply of safe drinking water as well as improper sanitation system. 	-3

* No impact (0); Positive impact (+); Negative impact (-); Low impact (1-3); Medium impact (4-6); High impact (7-8); Very high impact (9-10)

8.5 Impact during Post- Construction phase

8.5.1 Land resources

Future without project

If the project would not be implemented, there would be no impact on land use.

Future with project

Different industrial park and bazaar might be established in agricultural land after project implementation for sub-station dwellers and local beneficiaries. As a result land use might be changed for that purpose.

8.5.2 Agriculture resources

Future without project

If the project would not be implemented, there would be no impact on crop production.

Future with project

During post construction phase, land use might be changed for the establishment of bazaar /industrial park. As a result, partial crop production loss would be occurring.

8.5.3 Fisheries resources

Future without Project

In FWOP, habitat quality of open water fish habitats would deteriorate for some extent due to humanitarian activities like industrial effluent coming from nearby dying industries of Sub - Station and decomposition of paddy and duck weed. It is found during field visit that water of river and khal has already been polluted which has made water unsuitable for fish habitation. In monsoon, this polluted water spread over the surrounding floodplain which causes mortality of fish species as well as aquatic animals. However, it is expected that the polluted water would aggravate the aquatic condition in future which will cause unsuitable for fish habitation seriously in this area. But culture area would remain same as base condition.

Future with Project

Fish habitat loss and its quality degradation will not be occurring due to construction of transmission line tower. On the other hand, construction of sub-station will require 8 hectare of land. The proposed land is seasonal floodplain and water depth during monsoon varies from 5 to 8 feet. Due to construction of Sub-Station in floodplain, 8 ha of floodplain fish habitat would be lost permanently. It is projected that culturable fish pond would be transformed into culture fish pond and improved culture technology would be adopted by the farmers. The expected fish habitat both capture and culture area would be 144 ha.

8.5.4 Fish Production

Future without Project

The average yield rate of capture fish habitats in the sub-station area is unsatisfactory due to deterioration of habitat quality for water pollution. The polluted water has caused disappearance of many fish species from the Sub-Station area. If this situation is continued, the production rate of capture fish habitats e.g. River and khal, floodplain would decline enormously. However, Capture fish production would be 33.9 tons. Culture fish production would remain same.

Future with Project

The proposed Sub-Station will cause permanent loss to 8 ha of seasonal floodplain fish habitat area which will ultimately reduce fish production. Capture fisheries production at the station area will be decreased due to reduction of seasonal floodplain area. As such, total capture fisheries production with project situation will be 32.3 tons. It is expected that culture pond would be increased which will meet up the loss of fish production partially. The estimated and expected total fish production from different habitats of the study area would be 35.3 tons.

8.5.5 Ecological resources

Future without Project

The existing terrestrial vegetation and wildlife composition and diversity of the study area will further partially change

Future with Project

In FWIP, trees on the RoW will be cut. Relocation of wildlife species due to vegetation damage/ terrestrial vegetation, disturb and increase risk of death to flying mammals and

birds while passing through the TL. Transmission tower will provide resting place of some birds dependent on floodplains

8.5.6 Socio-economic resources

Future without Project

In FWOP, the economic and social situations of study area will remain almost same due to lack of development initiatives. Working opportunity may be expanded slowly following the normal development trend. The livelihood of local people including their income, employment opportunities etc within the study area will typically be improved with normal pace of growth. The lives and properties of the local people would not be significantly changed in respect of local demand. The quality of life of local dweller would remain same or improve to some extent compare to the present condition.

Future with Project

In FWIP, the project will impact the PAPs in terms of land acquisition at sub-station and tower areas. On the other hand, it will create employment opportunity at the project level and initiate a regional and/or national development process through transmission and distribution of electricity to the potential areas. Use of electricity in agriculture, industry and other sectors will promote overall development of the local communities also. The livelihood of local people will be improved directly and/or indirectly with support of different income and employment generation opportunities in potential sectors. The improvement in road communication, public health, education as a result of the project will be generated as secondary level benefits for the local people. All these would enhance the standard of living as well as quality of life of the project area people.

Table 8.3: Impact matrix after constuction /operation phase

IEC	Base Condition	FWOP	FWIP	Magnitude of impact*
Water Resources				
There would be no impact during post-construction phase				
Land Resources				
Land use	Proposed Ashuganj-Bhulta sub-station on agriculture land	No impact	Land use would be changed	-2
Agricultural Resources				
Crop production	Yield rate of HYV Boro, HYV Aman and Lt. Aman rice are about 3.5, 2.8 and 2.4 ton/ha respectively	No loss of crop production	Partial crop production loss would be occurring.	-1
Fisheries Resources				
Fish habitat	Low land and seasonal floodplain, Water retain only rainy season, HYV boro and Aman are cultivated in this land. -Total fish habitat is 152 ha	Fish habitat will be same but habitat quality will be deteriorated compare to base condition due to water pollution by	Fish habitat area would be 144 ha Capture: 142 ha Culture: 2 ha	-1

IEC	Base Condition	FWOP	FWIP	Magnitude of impact*
	Capture: 150 ha Culture: 2 ha	industrial effluent.		
Fish production	Total fish production is 37.3 tons Capture: 34.3 tons Culture: 3 tons	<ul style="list-style-type: none"> ○ Fish production would be 36.9 tons ○ Capture: 33.9 tons. ○ Culture: 3 tons. ○ Fish biodiversity as well as fish biodiversity will be declined due to degradation of habitat quality. 	<ul style="list-style-type: none"> ○ Fish production would be 35.3 tons ○ Capture: 32.3 tons ○ Culture: 3 tons 	-1
Ecological Resources				
Terrestrial Vegetation	Moderate density of terrestrial vegetation, major types are homestead and crop field vegetation	The existing terrestrial vegetation diversity of the study area will further partially change	Restriction for planting large trees on the RoW	-3
Wildlife and their habitat	Population and diversity of wildlife is moderate Major habitat type is homestead forest, floodplains and crop fields	Wildlife composition and diversity of the study area will further partially change	Restriction for planting large trees on the RoW	-2
Socio-economic Condition				
Land Price (Sub-station area)	Homesteads: Tk.4,13,33,333/Ac Agricultural: Tk.2,33,33,333/Ac Commercial: Tk.3,03,33,343/Ac Others: Tk.2,00,00,000 Ac	Land price would be increased normally	Land price would be increased	+4
Land Price (Transmission)	Homesteads: Tk. 3,00,00,000	Land price would be	Land price would be	-2

IEC	Base Condition	FWOP	FWIP	Magnitude of impact*
line)	/Ac. Agricultural: Tk. 53,12,500/Ac. Floodplains: Tk. 37,50,000/Ac. Commercial: Tk. 1,43,75,000 /Ac.	increased gradually	decreased steadily	

* No impact (0); Positive impact (+); Negative impact (-); Low impact (1-3); Medium impact (4-6); High impact (7-8); Very high impact (9-10)

9. Environmental Management Plan

9.1 Introduction

Environmental Management Plan (EMP) generally includes the mitigation, enhancement, compensation and contingency plans for managing the consequences of the Project interventions at pre-construction, construction and post-construction phases of the project. In order to prepare EMP within the IEE of Ashuganj-Bhulta 400 kV T/L Project, the literature review along with the reconnaissance field survey was done and finally expert judgment was applied as and where required. A number of mitigation, enhancement, compensation and contingency measures have been suggested in this regard considering the beneficial and/or adverse impacts of the project interventions. A monitoring plan is also included in under the EMP. The EMP for the Ashuganj-Bhulta 400 kV T/L Project is presented below.

9.2 Compensation Plan

Compensation should be given to the legal owners for land, and structures including houses as well as the cultivators of crops and owners of trees which fall within the RoW of tower sites and substation site. In this regard separate inventory of losses (IoL) survey along with necessary assessment for compensation is required to be done by the Project Director, Ashuganj-Bhulta 400 kV T/L Project.

9.3 Institutional Requirements and Monitoring Plan

The environmental monitoring plan will help in detecting changes taking place during as well as after establishing the transmission line and substation so that necessary steps can be taken to rectify defects or deficiencies, if any. The monitoring plan focused on the implementation of the mitigation/ enhancement measures during pre-construction, construction and post-construction/ operation stages. The project implementation will be carried out under the overall supervision of the Project Director, Ashuganj-Bhulta 400 kV T/L Project. For detailed supervision and monitoring, an external agency with experience in conducting environmental studies and monitoring with the application of Remotely Sensed (RS) satellite images and GIS facilities should be engaged.

9.4 Physical Environment and Water

9.4.1 Pre-construction phase

Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
Dust may temporarily be generated during vehicle movement and transportation of construction materials by	-2	(i) Construction material (sand/soil) to be covered with thick polythene while transporting (ii) Water to be sprinkled as and where needed (iv) Exhaust emissions from vehicles and equipments	-1	PGCB and Contractor

Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
heavy vehicles.		should comply with standards		
Noise generation due to mobilization of construction materials and equipment by heavy vehicles.	-2	(i) Movement of material carrying vehicles should be restricted/ limited during the day time (ii) Noise levels from vehicles, equipment and machinery to comply with national noise standards	-1	PGCB and Contractor

9.4.2 Construction Phase

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
Further deterioration of air quality may occur during soil digging by heavy equipment (ii) Dust generation from concrete mixture machine during mixing	-2	(i) Covering construction material with polythene (sand, coarse aggregates). (ii) Water sprinkling where needed	-1	PGCB and Contractor
(i) Noise generation due to construction of tower (ii) Noise generation from concrete mixture machine	-2	(i) Noise levels from equipment and machinery to comply with national noise standards (ii) Machineries to have proper mufflers and silencers	-1	PGCB and Contractor
May create disturbance to the surrounding land, water and settlements.	-1	(i) The surrounding area should be kept clean. (ii) Signboards and public awareness are also required.	0	PGCB and Contractor
Temporary impact while stringing wires.	-1	(i) Stringing wire work should be done in the early morning (ii) Scaffoldings should be placed over the	0	PGCB and Contractor

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
		crossing points of roads while stringing conductors. (iii) Danger signs and public awareness are also required		
Surface water quality may adversely be impacted	-2	Adjustments of selected locations for labor shed, stock yard etc. if possible and select places far from water bodies.	-1	PGCB and Contractor
Navigation might be adversely impacted	-1	N/A	0	PGCB
River course might be adversely impacted	-1	Providing erosion preventing structures in places where towers are constructed on vulnerable places	0	PGCB and Contractor

9.4.3 Post-construction Phase

As there will be no impact on Post construction phase, No EMP is required.

9.5 Land and Agricultural Resources

9.5.1 Pre-construction phase

9.5.2 Construction phase

Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
Land type will be changed and lowland would turn into high land	-1	The basement/ platform construction will change the land type of the project area. It should be ensured that the change in land type will be limited within the project boundary.	0	PGCB and Contractor
The clay loam/ loamy textural soil might turn sandy soil	-1	The area under the project will be filled up with external soils and sand materials. Precaution should be taken to place top-soil on the top layer.	0	PGCB and Contractor

Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
Will Impact in Tower locations	-1	During the construction period, the contractor should carefully dig the hole for erecting the Pole. The excavated soils should be properly stacked and the hole should be refilled with the stacked soil by maintaining the sequence of the profile (i.e. substratum – Subsoil – Topsoil). The loosened topsoil on the surface must be compacted well so that no erosion can take place. Adequate compensation for crop loss should be paid to the actual landowners/ sharecroppers.	0	PGCB and Contractor
Partial loss of crop production on RoW and total loss at sub-station site.	-2	The mobilization and construction work of the project should be carried out carefully, so that during construction, standing crop would not be damaged. If needed, the project work should be delayed for allowing the farmers to harvest their crop. The work should not be continued through the ripened crop fields.	0	PGCB and Contractor

9.5.3 Post-Construction phase

Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
Land use would be changed	-2	N/A	0	PGCB
Partial crop production loss would be occurring.	-1	N/A	0	PGCB

9.6 Fisheries Resources

9.6.1 Pre-construction phase

As there will be no impact on Post construction phase, No EMP is required.

9.6.2 Construction phase

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
<ul style="list-style-type: none"> ○ Fish habitat would be lost by 8 ha due to land development for Sub-Station ○ Partial loss of fish and aquatic biodiversity resulting partial loss of fish production. 	-1	<ul style="list-style-type: none"> ○ Select high land much as possible ○ Avoid the construction work during monsoon as well as fish migration period e.g. month of May to July. 	0	PGCB, Contractor and DoF in coordination with the local community

9.6.3 Post-construction phase

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
<ul style="list-style-type: none"> ○ Estimated net loss to fish habitat area would be 8 ha 	-1	<ul style="list-style-type: none"> ○ To abstain from discharging of untreated industrial effluent and using agro chemicals as far as possible and using the organic manure through piloting by DAE. ○ Awareness development program should be introduced and disseminate the knowledge about the importance of natural resources ○ Encourage improved culture fish practices to fish farmers. ○ Training on fish nursery and pond culture should be conducted by DoF. 	0	PGCB and DoF in coordination with the local community
Fish production loss would be 1.6 ton	-1	<ul style="list-style-type: none"> ○ Mentioned above 	0	PGCB and DoF in coordination with the local community

9.7 Ecological Resources

9.7.1 Pre-construction phase

As there will be no impact on Post construction phase, No EMP is required.

9.7.2 Construction phase

Impact	Magnitude of impact	Mitigation/ Compensation/Enhancement	Magnitude with EMP	Responsibility
Damages of Vegetation	-3	<ul style="list-style-type: none"> Minimize vegetation loss as much as possible during earthwork and wire stringing Use barren land for storing materials and vehicle movement Aware local people to plant medium high trees to maintain plant diversity in the area Give proper compensation against homestead tree felling to the owners Plantation of selected trees species of medium height and high productivity (local plants, lemon, guava, and timber yielding) should be done in the sub- station area. In this case wild tree and rapid growing timber trees should be emphasized. 	-1	PGCB and Contractor
Impacts on wildlife and their habitats	-2	<ul style="list-style-type: none"> Minimize vegetation loss as much as possible during earthwork and wire stringing Avoid construction work during breeding season and destruction of nest and wildlife habitat. Use low sound emitting machineries for construction and avoid works in night. Covered transmission line should be used to avoid the impact on aerial wildlife. Use adequate color bands/flags with transmission wires so that the flying animals will aware while pass through the line. Create the same habitat (i.e. pond) beside the new proposed substation to avoid impact on wildlife. Avoid killing wildlife so that they can at least escape to other places. Construction work should be taken up in the dry season; it would minimize damage to wetland wildlife Plantation of fruiting tree species of medium height and high productivity should be done in the right of way to feeding support of wildlife 	0	PGCB and Contractor

9.7.3 Post-construction phase

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible Agency
Restriction for planting large trees on the RoW	-3	<ul style="list-style-type: none"> Minimize vegetation loss as much as possible during earthwork and wire stringing Use barren land for storing materials and vehicle movement Aware local people to plant medium high trees to maintain plant diversity in the area Give proper compensation against homestead tree felling to the owners 	-1	PGCB
Wildlife and their habitat would be impacted	-2	<ul style="list-style-type: none"> Plantation of fruiting tree species of medium height and high productivity should be done in the right of way to feeding support of wildlife 	-1	PGCB

9.8 Socio-economic Condition

9.8.1 Pre-construction phase

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible agency
<ul style="list-style-type: none"> Some people will lose their crop land and livelihood due to land acquisition in substation Project affected persons (PAPs) may be deprived of getting proper compensation 	-5	<ul style="list-style-type: none"> Ensure proper compensation to the PAPs Compensation should be paid through local government institutions e.g. UP 	0	PGCB and RAP Consultant

9.8.2 Construction phase

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible agency
A temporary employment may be created for unskilled laborers during construction of labour sheds	+3	Local labour including PAPs should be given priority in construction of labour sheds	+4	PGCB and Contractor
Local people will be engaged in	+2	<ul style="list-style-type: none"> The PAPs should be given priority in civil work during 	+3	PGCB and Contractor

Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	Responsible agency
construction of new transmission line as because of created employment opportunities in construction work		construction <ul style="list-style-type: none"> Local labour should be given priority in construction work of transmission line 		
Local people may be engaged in land development for sub-station	+2	<ul style="list-style-type: none"> Local sand/soil suppliers/contractors would be given priority in land development work 	+3	PGCB and Contractor
Local technicians may be engaged in conducting technical activities of the transmission line construction	+2	Technicians from domestic sources would be recruited side by side of the foreign technicians	+3	PGCB and Contractor
Some workers and local people may be injured due to occurrence of accidents in constructing sub-station and transmission line	-3	<ul style="list-style-type: none"> Occupational safety measures should be introduced during construction by ensuring use of PPE i.e. helmet, hand gloves, protective clothing, gumboot, special glass for protection of radiation for the working personnel Organize a training and awareness program for the workers and local communities Provide health insurance for employees during working periods Keep registers/records on incidents of accidental events 	0	PGCB and Contractor
The workers will suffer from different water borne diseases due to lack in supply of safe drinking water as well as improper sanitation system.	-3	<ul style="list-style-type: none"> Drinking water and proper sanitation facilities for the working personnel should be ensured. Keeping of First Aid Box for each labour shed Worker's awareness training on safety and health risks during construction operations. Keeping of registers/ records on treatments provided to the ill workers 	0	PGCB and Contractor

9.8.3 Post-construction phase

No EMP is required during post-construction phase.

9.9 Monitoring Plan

9.9.1 Pre-construction Phase

In this phase, no implementation monitoring plan is needed for checking EMP implementation works.

9.9.2 Construction phase

	Power Grid Company Bangladesh	
	ASHUGANJ – BHULTA 400 KV TRANSMISSION LINE PROJECT	

EMP IMPLEMENTATION

Book No. _____	Monitoring Report No. _____
Date: _____	Time: _____
Contract: _____	
Contractor: _____	
Work Sites (s): _____	

SI	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5	SI	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5
1	Correct disposal of construction waste of tower				10	No social issue created			
2	Interference with road crossing				11	Health precautions taken			
3	Ambient air quality				12	Fire fighters with materials			
4	Ambient noise quality				13	Earth work for foundation			
5	Correct disposal of liquid waste				14	Spoil earth dumping system			
6	Vehicles with no smoke or noise				15	Top-soil protection system from borrow pit area			
7	Vehicles within				16	Labour camp			

SI	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5	SI	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5
	speed limit					location & management in order			
8	No pollution from construction site				17	Drinking water and sanitation facilities for labour			
9	No Oil/Diesel spills on land or water				18	Awareness of workers about hazardous materials and proper handling methods			

B. EXPLANATION (of any of above points)	Total Scores = _____%

C. NON COMPLIANCE:

Non Compliance # Period Description	Class
	1. Minor: Under One Month (Contractor alerted)
	2. Moderate: Over One Month but under Two Months (Contractor warned)
	3. Major: About Two Months (Contractor's local bill withheld by RE* till compliance)
	4. Critical: Over Three Months (Contractor's overall bill withheld by RE and PM* till compliance)

D. CIRCULATION

1) Chairman, PGCB 2) DG, DOE 3) PD, 400 kV TL Project 4) EE, Local PGCB Office

Field EHS* Monitor of Consultant (Full Name & Signature)	Field EHS Expert of Contractor (Full Name & Signature)
*EHS- Environment Health & Safety *RE – Resident Engineer *ES – Environmental Supervisor of Consultants.	

9.9.3 Post Construction phase

Water Resources Monitoring Plan

No monitoring plan is required during this phase.

Agricultural Monitoring Plan

Indicators	Method	Locations	Frequency	Monitoring Agency
Land recovery after waste removal by contractor	Field observation	Labor shed	Once after implementation	PGCB, Environmental Consultant

Fisheries Monitoring Plan

Indicator	Method	Location	Frequency	Responsible Agency
Awareness Development	Observation of wetland/ natural resource base national and international days	Around the Sub-Station area	Selected days and continue at least two year.	PGCB, Environmental Consultant, DoF, Community Base Organizations, Local community

Ecological Monitoring Plan

Measure/Indicator	Method	Locations	Frequency	Responsible Agency
Vegetation growing under the transmission line with regular pruning	Direct Observation	Row sites and sub- station site	Once in each 6 months for project life time	PGCB, Environmental Consultant
Wildlife occurrence	Direct Observation	RoW and sub- station site	Twice in a year for next 2 years after operation of the project	PGCB, Environmental Consultant

Social Monitoring Plan

Indicator	Method	Location	Frequency	Responsible Agency
Implementation of resettlement activities	KII with the Officials and FGD and RRA with the affected households	Sub-station area	Quarterly at pre and during construction period	PGCB, Deputy Commissioner and RAP Consultant with support from LGIs
Occupational safety	Review of Registers/Records prepared on incidents of accidental events	Sub-station and transmission RoW area	Fortnightly during construction period	PGCB and Environmental Consultant
Employment opportunities during construction (technical and non- technical)	KII with the PGCB and Contractor RRA and observation	Sub-station and transmission RoW area	Monthly during construction period	PGCB and Environmental Consultant

9.10 EMP Cost Estimate

Sl. No.	EMP Measures	Cost (Lakh Tk.)	Sl. No.	Monitoring Item	Cost (Lakh Tk.)
1	During the construction period, the contractor should carefully dig the hole for erecting the Pole. The excavated soils should be properly stacked and the hole should be refilled with the stacked soil by maintaining the sequence of the profile (i.e. substratum – Subsoil – Topsoil).	20.00	1	Land recovery after waste removal by contractor	10.00
			2	Awareness development	10.00
			3	Vegetation growing under the transmission line with regular pruning	10.00
2	Adequate compensation for damage of crops has to be paid.	20.00	4	Wildlife occurrence (Lump sum)	10.00
3	Plantation of selected trees at the Power Sub-station area	20.00	5	Implementation of resettlement activities	10.00
4	Fund for ‘Conducting RAP Study’ for the Bhulta Substation	80.00	6	Occupational safety	10.00
5	Fund for ‘Implementing RAP activities in Bhulta Substation area	120.00	7	Employment opportunities during construction (technical and non- technical)	10.00
Sub-total		260.00	Sub-total		70.00
Grand Total = 330.00*					

* Amount may be changed subject to recommendations of proposed RAP Study to be conducted under the Project Authority

Source: EIA study, CEGIS.

10. Public Consultations

10.1 Introduction

Public Consultation and Disclosure is mandatory for the Environmental Impact Assessment (EIA) study of any development initiative according to the EIA Guidelines of the DoE, GoB. Public consultation and disclosure is a part of the EIA process aimed at involving the project stakeholders into the project development and implementation process. During the consultation process the proposed project interventions were discussed. In the consultation process, the stakeholders got involved with the study consultants in reforming/developing the study interventions considering the local needs and aspirations in line with the problems and solutions suggested by them. The proposed interventions of the “Ashuganj–Bhulta 400 kV Transmission Line Project” and the possible impacts were shared with the local stakeholders for obtaining their perceptions, views and feedbacks on the probable changes likely to happen within the study area.

10.2 Objectives

The objectives of the public consultation meetings were to inform local people about:

- the concept and aim of the proposed project;
- the interventions of the proposed project;
- temporary problems that could be created from the proposed project interventions;
- perceived impacts of the proposed project;
- possible suggestions to resolve the perceived problems; and
- scope of participation of the local community in the project development and implementation process.

10.3 Public Consultation Methodology

The consultant team prepared a checklist for the consultation meetings. The issues on the overall study planning as well as project interventions and probable impacts of project on the environment, socio-economy and institution were incorporated in the checklist. The issues of discussion were also shared with the implementing authority for obtaining their response and suggestion. The probable places of meeting were selected in consultation with the PGCB officials and local knowledgeable persons of the study area.

A Socio-economist from the multi-disciplinary EIA consultant team facilitated the consultation process with instantly available local people separately to collect/record opinions and views from their own perspectives. The other members of the EIA team also attended and assisted as necessary. The team used maps of the study area during discussion to share about the interventions for the participants of the consultation meetings. The facilitators explained all relevant points and issues in order to enable the participants to comprehend the proposed interventions/ activities properly and to respond accordingly. The team took utmost care in recording opinions and views of the participants relevant to the EIA study. Most of the cases the women were found not willing to attend in the meetings held at the local markets/shops/public places.

10.4 Summary of Consultation

Consultation with stakeholders, which is a continuous process till the completion of the project, was held at the time of the field survey. School teachers, village leaders, and local government members were consulted in groups as well as individually. Female heads of the households were also interviewed either in group or individually. The project implementation authority (PGCB) will also need to consult with the local stakeholders during the implementation of proposed project. Some important findings of the public consultation are given below.

10.4.1 Positive perceptions

1. The high voltage electricity transmission line will improve the electricity supply system in city as well as study area;
2. People should be considered for employment during the construction of the project for both technical and non-technical labor which will generate additional income of the study area;
3. This project will ensure uninterrupted supply of electricity;
4. It will meet the current and growing demand of electricity of the Dhaka city as well as study area;
5. The numbers of industries will be increased in the study area using more power supply;
6. More industrialization will help to generate employment opportunities in the study areas and ensure local and national economic growth.

10.4.2 Negative perceptions

1. Some agricultural land will be acquired for installing sub-station and towers
2. Some trees may be cut down for the sub-station and towers
3. Land owners of sub-station area may suffer for improper compensation for their land to be acquired by PGCB;
4. Cultivation of land at the tower basement area will be highly interrupted;
5. In the period of rainy season, especially in thunder, high voltage lines become dangerous. So safety is a matter of worried;
6. Accidents occur every year due to the presence of transmission line, which is low in height. Proper maintenance is required;
7. Risk may arise during dismantling the existing sub-station buildings.

10.4.3 Suggestions

1. Damaged road should be repaired after construction of power transmission line;
2. Proper compensation should be given against land acquisition for sub-station and tower and actual value should be paid against the damaged crops and trees;
3. Real land owners and sharecroppers should be identified for compensating land;
4. No work should be started for implementing the project until proper compensation is paid to the displaced people;
5. Compensation money should be paid through bank accounts of displaced people;
6. The affected persons should be trained for income generation and livelihood restoration programs;
7. Plantation of trees would be required when cutting of trees would be essential;
8. During construction period, health and safety issues should be mitigated properly by the implementing agencies.

10.5 Outputs of Discussions

10.5.1 Issues discussed with problems and suggested solution

Table 10.1: Problems and suggested Solutions

SL. No.	Issue	Problems	Suggested solution
1	Less employment opportunity	<ul style="list-style-type: none"> • Employment opportunities are not sufficient to employ the local labour force • Agricultural labors are at high risk as because crops are frequently damaged by flooding, and water logging which ultimately shrinking employment in agriculture sector 	<ul style="list-style-type: none"> • Employment opportunity should be extended for the vulnerable project affected persons under the project
2	Poor communication system	<ul style="list-style-type: none"> • Paved and semi-paved road will be hampered by the heavy engineering vehicles 	<ul style="list-style-type: none"> • Damaged road should be repaired after construction of power transmission line
3	Safety in compare to poor health facilities	<ul style="list-style-type: none"> • Health and safety condition may be deteriorated during and post construction period 	<ul style="list-style-type: none"> • Health and safety issues should be given appropriate attention
4	Impact on income from agricultural land	<ul style="list-style-type: none"> • Some of farmers whose land will be acquired for the purpose of project would be unable to cultivate land • Agricultural income will be reduced due to land acquisition 	<ul style="list-style-type: none"> • Minimization of acquisition of lands, crops and trees during construction of project • Proper compensation should be given against acquired land • The project proponent through Government may peruse necessary amendment of current policies/acts on compensation against acquisition/requisition of land for tower construction
5	Damage of standing crops	<ul style="list-style-type: none"> • Huge standing crops will be damaged due to construction of project 	<ul style="list-style-type: none"> • Actual value should be paid against the damaged crops.
6	Hamper of structures	<ul style="list-style-type: none"> • Some houses will be destroyed for the project 	<ul style="list-style-type: none"> • Settlement should be avoided by Angle Point
7	Displacement	<ul style="list-style-type: none"> • Some people including 	<ul style="list-style-type: none"> • Displaced people should

SL. No.	Issue	Problems	Suggested solution
		vulnerable one will be displaced from own house due to project	be resettled by the project • Special assistance should be given to them under the development project
8	Compensation and assistance	• Compensation and assistance may be given insufficient against current market price	• Compensation have to be paid according to the present market price
9	Local people participation	• Most of the local people do not about development project in preferable area	• Of course, during the project have to be involved to the local people
10	Local people participation	• Most of the local people do not about development project in preferable area	• Of course, during the project have to be involved to the local people

10.6 Public Disclosure

After finalization of the EIA report, PGCB will place the report to PGCB website for comments of all stakeholders.

10.7 Photographs of Consultations



Photo 10.1: Discussion at Narayanpur, Nabinagar



Photo 10.2: Discussion at Singlabpur village, Jumpur, Araihaazar



Photo 10.3: Discussion at Talshahar



Photo 10.4: Discussion at Daokadi village, Narsingdi Sadar



Photo 10.5: Discussion at Bisnurampur, Banchharampur



Photo 10.6: Discussion at Choto Haran



Photo 10.7: Discussion at Puran Bazar, Narsingdi Sadar



Photo 10.8: Proposed land of Pakunda sub-station

10.8 Participants of Discussions

A participants list of different consultation sites has shown in the Table 10.2.

Table 10.2: List of Participants

SI. No	Name	Age	Occupation	Village/Union	Mobile no.
1	Hakim Mia	35	Business	Singlabor	01856908363
2	Md. Neyamot Ullah	32	Business	Singlabor	01942946754
3	Md. Shaon	20	Student	Pakunda	01855533755
4	Md. Masud	38	Business	Singlabor	01836953611
5	Md.Anawer	40	Agriculture	Brahman Daokadi	01816273249
6	Md. Ali Ajar	45	Service	Brahman Daokadi	01716165571
7	Md. Guljar	42	Agriculture	Brahman Daokadi	01733454933
8	Md. Mamun-or-Rashid	38	Business	Karai Tola	01947364181
9	Md. Farhad	33	Quack doctor	Puranchar	01734233584
10	Md. Moharam Ali	65	Business	Bisnurampur	-
11	Md. Amir Hossain	35	Business	Bisnurampur	01816366562
12	Md.Shaheen	28	Rickshaw puller	Narayanpur	01950847860
13	Md. Rahmat Ullah	40	Agriculture	Jolla	01715925097
14	Jahurul Islam	38	Agriculture	Talshahar	-
15	Md. Rabiul	45	Wage labor	Choto Haron	-
16	Md. Shaheen Miah	25	Rickshaw puller	Narayanpur	01949019168
17	Md. Jahangir Miah	25	Rickshaw puller	Narayanpur	-
18	Md. Al Amin	24	CNG driver	Do	-
19	Md. Jakir Hossain	26	Immigrant	Do	-
20	Md. Sharif Miah	25	Business	Do	-
21	Md. Mukul Miah	60	Talsher, Ashuganj	Service (retired)	-
22	Md. Abul Basher	40	Talsher, Ashuganj	Daily labour	-
23	Md. Helal Miah	40	Sighab, Bhulta	Business	01720250248
24	Bacchu Miah	30	Agriculture	Bishnurampur	
25	Nazmul Islam	42	Agriculture	Bishnurampur	01731676621
26	Md. Kader Miah	35	Business	Narayanpur	01936192029
27	Md. Kibria	28	Business	Narayanpur	01925147690
28	Md. Habibur Rahman	35	Agriculture	Sonarampur	01726547187
29	Md. Bakul Miah	32	Agriculture	Thaliara	-
30	Md. Dildor Hossain	40	Business	Singlabo	-
31	Md. Sadek Hossain	32	Agriculture	Baraikani, Kathalia	01820087004

11. Conclusions and Recommendations

11.1 Conclusions

The PGCB is required to take environmental clearance from the DoE for implementing the transmission line and other ancillary works. The EIA report has been prepared with this end in view.

The proposed Ashuganj – Bhulta 400 kV Double Circuit Transmission Line Project of PGCB has selected the best possible alignment from four (4) alternatives considering fewer impacts on ecological resources and social amenities. The EIA study identified that the proposed project will have impact to some extent on almost all of the resources in both positive and negative ways. The projected adverse impacts are insignificant on the physical, agricultural and fisheries resources, but impacts are significant to some extent on the social and ecological resources. The damages of plants at proposed tower and substation sites will have some negative impacts. On the other hand, the households those will be affected due to land acquisition may have direct impact, which is important for the project.

The project is not likely to have any significant negative impact. Therefore, no major mitigation measures would be required. The minor impacts are within the allowable and tolerable levels experienced by the local people. All the direct impact would be overcome by paying necessary compensation to the PAPs for the land, structure and trees. The recommended mitigation measures of EMP are expected to bring back the affected social, ecological and agricultural resources to their original form. The proposed project will have no residual adverse impact on the environment or the eco-system.

The monitoring plan, if properly implemented during the pre-construction, construction and post- construction and/or operation phases, will ensure taking of corrective measures.

The local stakeholders all along the route of the transmission line have expressed interest to the project even after recognizing the fact that they will not get electricity directly from the transmission line. Local people along the transmission line will be benefited, as the project will generate some employment opportunities for them during the pre-construction and construction phases. However, main interest of the local people is that the overall development in the power sector would contribute to the national development of the country.

11.2 Recommendations

The EIA study reveals that Ashuganj – Bhulta 400 kV Double Circuit Transmission Line Project have no major negative impact, but will contribute to the national development by improving the transmission of electricity. The EIA study team as well as the local stakeholders has some recommendations to the project proponents as follows:

- Necessary assessment on land acquisition and compensation needs to be done before implementing the project;
- All the project affected people (PAPs) should be compensated properly for their land, structures and trees;

- The compensation money should not be given through the Union Parishad or Upazila Parishad, but through the cheque to the PAPs' bank account;
- The contractor should be specifically instructed to employ local laborers as much as possible;
- Clearing of vegetation and cutting of trees at the pre-construction and construction phases should be taken care of by taking proper mitigation measures;
- Efforts should be made to avoid cutting of trees as much as possible;
- Cutting of some trees might be unavoidable. In such cases more should be replanted in surrounding area for conservation of biodiversity. In this case, homesteads gardening should be emphasized with fruit and rapid growing timber trees in the surrounding area;
- Selection of the season for carrying out the work should be made by adjusting with the cropping season so as to inflict minimum damage to field crops;
- Proper compensation for all types of damages must be paid and the land should be brought back to its original form before they are handed back to the owners;
- The constructed labor camps should be provided with water supply and sanitation facilities. The workers should be apprised of hygienic practices;
- The transportation of heavy equipments should be done by avoiding agriculture land and using water ways as and where possible;
- The stores and equipment yards should be properly guarded so that all equipments remain safe; and
- The substation should be fully equipped with fire fighting equipments.

Finally, on proper examination it is observed that the project has been proposed to be implemented safely and in an environment friendly manner. So it is recommended that the project may be given Environmental Clearance to proceed with the works immediately.

Annex – 1
Terms of Reference (ToR) of Environmental Impact Assessment
(EIA) Study

1. Background of the Study

The demand for electricity is growing very quickly throughout the country for meeting industrial and household requirements. To cope with this high demand for power, new power plants are planned to be installed by the Government of Bangladesh (GoB) for generating more electricity. The generated power requires sufficient transmission facilities for evacuation as well as for linking the existing and future power plants. Dhaka being a mega city has a faster growing demand for power than elsewhere due to its rapid urbanization and industrialization process. The Power Grid Company of Bangladesh Ltd. (PGCB), therefore, is planning to supply more electricity to Dhaka City area from the upcoming Power Plants in Ashuganj area to fulfill the future demand. The PGCB has planned to construct a 400 kV power transmission line from Ashuganj to Bhulta and accordingly developed a Project named “Ashuganj – Bhulta 400 kV Transmission Line Project” for implementation.

Within the scope of the Project a 400 kV Double Circuit Power Transmission Line (T/L) from Ashuganj to Bhulta (located under Rupganj upazila of Narayanganj district) will be constructed. The proposed double circuit T/L will be used to transmit power from Ashuganj to Bhulta area as well as from Bhulta to Ashuganj area. In addition to the line, one 400/230kV, 3X520MVA Sub-Station will be constructed at Bhulta, where around 40 acres of land will be needed to acquire from the private land owners of that area. The Project will be implemented on Build Own Operate and Transfer (BOOT) basis.

According to the ‘Environment Conservation Act 1995’, ‘Environment Conservation Rules 1997’ and their amendments, the proposed Project falls under the ‘red category’ of projects, which requires both Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA). Therefore, the PGCB is mandated to conduct IEE and EIA studies with the help of capable consultants. In order to meet the legal obligation, the PGCB has to prepare the IEE Report for obtaining ‘site clearance’ and thereafter, the EIA Report for obtaining ‘environmental clearance’ from the Department of Environment (DoE).

In this context, the Center for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources, experienced in environmental, social impact assessment and resettlement planning, has been assigned by the PGCB to provide consultancy services in preparing an ‘Initial Environmental Examination Report’ as well as an ‘Environmental Impact Assessment Report’ for the proposed Ashuganj – Bhulta 400 kV Transmission Line Project.

2. Objectives of the Project

The main objective of the Ashuganj-Bhulta 400 kV T/L Project is to supply electricity from the upcoming Power Plants in Ashuganj area to Dhaka City via Bhulta area for increasing reliability of power supply to the Mega City. The specific objectives are:

- i. To evacuate power to be generated in the upcoming 2X450 MW Combined Cycle Power Plant (CCPP) at Ashuganj and deliver power to the load centre (Dhaka);
- ii. To supply more power through the Rampura 230/132 kV Sub-Station to meet the rapidly growing demand of the eastern region of Dhaka City;
- iii. To enhance the reliability of power supply to Dhaka City through the existing 230/132kV Rampura Substation and upcoming Ullon and Basundhara Sub-Station in the downstream as well and;
- iv. To create power evacuation facilities for the future generating plants at Ashuganj.

3. Scope of work of the Project

The scope of the Ashuganj-Bhulta 400 kV T/L Project is:

- i. Construction of Ashuganj to Bhulta 400kV Double Circuit T/L of around 70 km.; and
- ii. Construction of a 400/230kV, 3X520MVA Sub-Station at Bhulta.

4. Rationale of the Project

Considering the presence of the nodal point of natural gas distribution (by GTCL) and availability of gas with good pressure, a number of power plants are currently being implemented (e.g. 2X450 MV CCPP) as well as planned to be installed (223 MW CCPP) at Ashuganj by the Ashuganj Power Company Limited (APCL). It is a big challenge to evacuate this huge amount of power in the future to areas where demand for power is growing rapidly. The demand from Dhaka city is increasing faster than other parts of the country, therefore, to feed the growing demand necessary transmission line is required to be constructed between the generation and consumption points. After several case studies on load flow were collected by the PGCB, it has been found that a dedicated double circuit 400 kV line from Ashuganj to Bhulta and a 400/230kV, 3X520MVA Sub-Station at Bhulta would be the best means of evacuating the upcoming power that would be generated at Ashuganj area. Therefore, construction of a new 400/230kV substation at Bhulta and a double circuit 400 kV T/L from Ashuganj to Bhulta has been planned to be implemented by the PGCB.

5. Objectives of the EIA Study

The objectives of the EIA study are:

- I. To conduct Environmental Impact Assessment (EIA) study for the Ashuganj – Bhulta 400 kV T/L Project of PGCB; and
- II. To prepare EIA Report following the Guidelines and submit to DoE for obtaining ‘environmental clearance’ for the Project.

6. Scope of the EIA Study

The scope of the EIA study is stated below which includes the following:

- b. Conduct an environmental baseline survey and select environmental and social components likely to be impacted by the Project;
- c. Conduct detailed survey and impact analysis of specific environmental components (e.g. air, water, agriculture, plants, fisheries, socio-economic, etc.);
- d. Conduct public consultation to obtain people’s perceptions of the Project;
- e. Prepare a detailed Environmental Management Plan (EMP);
- f. Prepare an Environmental Impact Assessment (EIA) Report; and
- g. Assist the client in presenting the EIA Report to the DoE for obtaining ‘Environmental Clearance’.

7. Physical Components of the Project

The major components of the Project are as follows:

- i. Construction of a 70 km 400 kV Double Circuit Transmission Line from Ashuganj to Bhulta,
- ii. Construction of a 400/230kV, 3X520MVA Sub-Station at Bhulta on 20 acre of privately owned land,

iii. In-out of Ghorashal-Rampura 230kV line to Bhulta 400/230 kV Substation, and

iv. In-out of Haripur-Rampura 230kV line to Bhulta 400/230 kV Substation.

8. Study Area

The proposed project is located in Dhaka and Chittagong administrative divisions of Bangladesh. The power transmission line will start from Ashuganj (Brahmanbaria district) and end at Bhulta (Rupganj upazila of Narayanganj district). This line will cross Narsingdi Sadar upazila of Narsingdi district; Araihasar, Rupganj and Sonargaon upazilas of Narayanganj district; and Ashuganj, Brahmanbaria Sadar, Nabinagar and Banchharampur upazilas of Brahmanbaria district. **Table 1** presents the names of the districts, upazilas, unions and mouzas through which the transmission line will pass. The detailed locations of the IEE-EIA study areas are shown in **Map 1**.

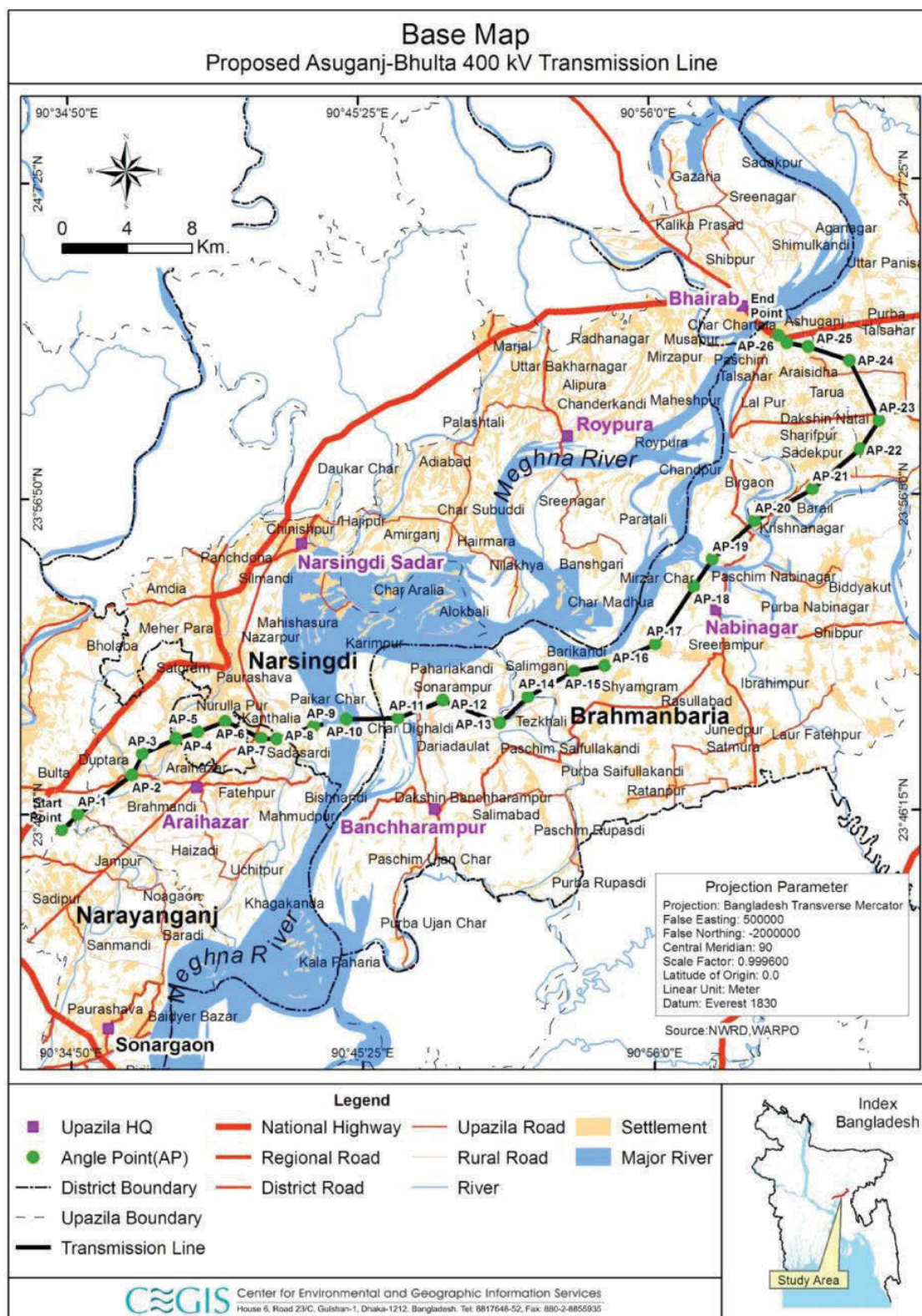
Table 1: Name of Administrative Areas within the RoW

Upazila	Union	Mauza
Narsingdi Sadar, Narsingdi	Karimpur	Char Line
	Char Dighaldi	Kholbandha
	Nurulla Pur	Algi (Kanda Para)
		Nurullahpur
	Paikar Char	Bara Khamar Char
		Nareshwardi
		Paikar Char
		Char Bhasania
		Khadimer Char
		Baniar Char
	Kanthalia	Daukandi
		Bara Maishadi
		Rahimdi
		Dogharia (Fazurkandi)
Araihasar, Narayanganj	Sadasardi	Nagardaukadi
	Duptara	Panchgaon
		Duptara
		Satyabhandi
	Sadasardi	Pathanerkandi
		Lakshmibardi
	Araihasar	Kamrangir Char
Rupganj, Narayanganj	Brahmandi	Binair Char
		Bhati Gobindi
		Darikandi
		Darikandi Chak
		Chhota Darikandi
		Datterkandi
	Golakandail	Gabtali Hat
Sonargaon, Narayanganj	Jampur	Kahena
Ashuganj, Brahmanbaria	Ashuganj	Sonarampur
		Jatrapur
		Baratala
		Baikunthapur
	Paschim Talsahar	Talsahar
		Andidil
Brahmanbaria Sadar, Brahmanbaria	Purba Talsahar	Poothai
	Uttar Natai	Chhota Brahmanbaria

Upazila	Union	Mauza
	Dakshin Natai	Bhultara
		Harankhola
		Narasingheswar
	Sadekpur	Damchail (Alakpur)
		Chilokut
		Sadekpur
Nabinagar, Brahmanbaria	Barail	Barail
		Jalsuka
		Gonsaipur
		Char Gonsaipur
		Radhanagar
	Krishnanagar	Krishnanagar
		Dakshin Lakshmipur
		Ashrafpur
		Sitarampur
		Daulatpur
	Paschim Nabinagar	Fatehpur
	Paurashava	Alamnagar
	Sreerampur	Gopalpur
	Shyamgram	Nasirabad
	Barikandi	Jafrabad
	Shyamgram	Sahabazpur
		Sreeghar
	Salimganj	Barail
		Nilakhi
	Barikandi	Thollakandi
Banchharampur, Brahmanbaria	Dariadaulat	Daria Daulat
	Tezkhali	Akanagar
		Bishnurampur
	Pahariakandi	Pahariakandi
	Sonarampur	Char Dariadaulat (D. Rampur)
		Sonarampur
		Char Seaton

Source: GIS Database, CEGIS, 2013

The transmission line has avoided major settlement areas and passes mostly over agricultural and fallow lands. A 100 meter wide Right of Way (RoW) covering a 40 meter buffer impact zone on each side (40m+40m) and 20 meter at the middle between the buffer zones have been defined as the General Impact Area (GIA), while the 20 meter at the middle of GIA has been defined as the Direct Impact Area (DIA) for the Project. In order to carry out the IEE study both the DIA and the GIA have been evaluated, while only the DIA will be considered for the EIA study.



Map 1: Base Map of Proposed Ashuganj – Bhulta 400 kV T/L Line Project

9. Methodology for EIA

The Environmental Impact Assessment (EIA) study will be conducted through the following steps (**Figure 1**).

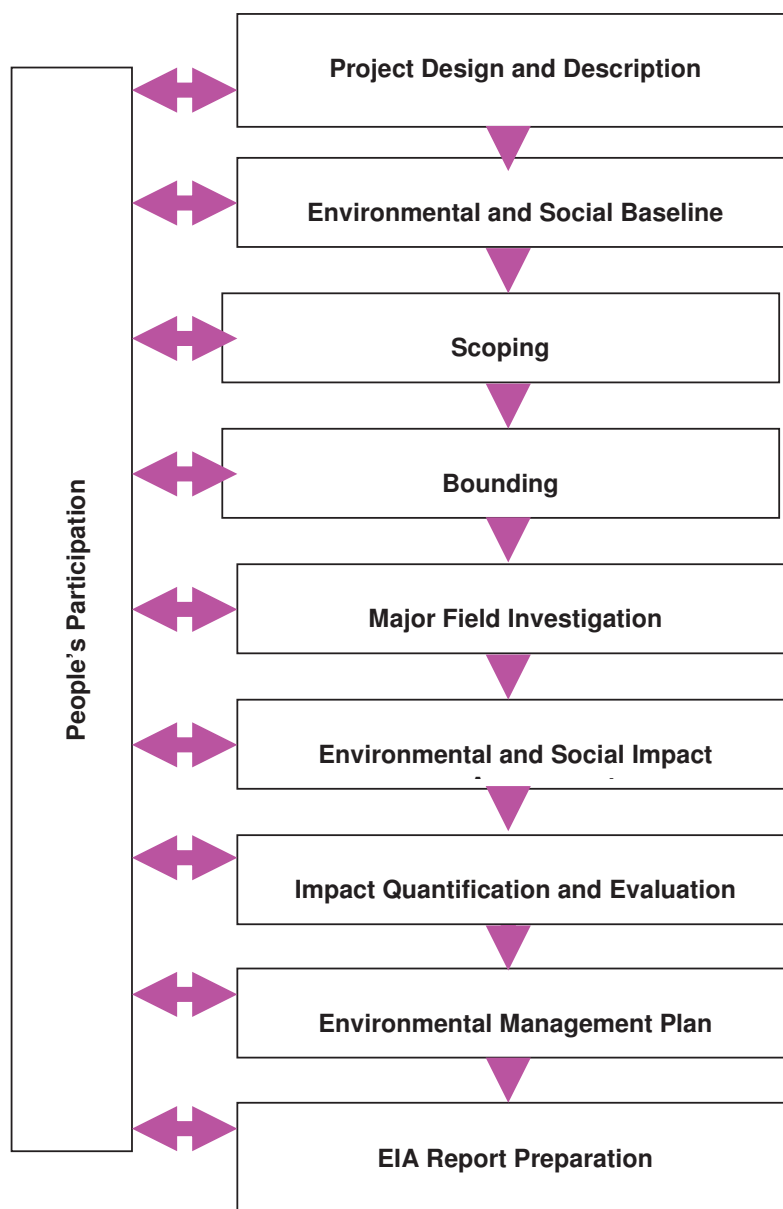


Figure 1: Steps of Environmental Impact Assessment (EIA)

Step-1: Project Design and Description

Detailed information on the proposed transmission line will be collected from the project proponents by the multi-disciplinary EIA team members to have a thorough understanding of the proposed interventions and their possible environmental consequences. This information will help in designing data collection programs.

Step-2: Environmental and Social Baseline

Environmental and social baseline condition of the project area will be established through a series of field visits, surveys and intensive consultation with local people. Detailed data will be collected on land resources, water resources, agriculture, fisheries, ecosystems and socio-economic condition. In addition to the professional inputs of the multi-disciplinary EIA team members, this will include intensive consultation with the stakeholders to obtain their perceptions on the proposed interventions and the possible impacts.

Step-3: Scoping

Important Environmental & Social Components (IESCs), likely to be impacted by the 400 kV transmission line, selected at the IEE stage will be revisited for finalizing their selection based on detailed information on the proposed interventions collected at step 1.

Step-4: Bounding

A bounding exercise will be carried out to delineate area likely to be impacted by the 400 kV transmission line.

Step-5: Major Field Investigation

At this stage, detailed investigation will be carried out to obtain information on the possible impact of the 400 kV transmission line on the IESCs.

Step-6: Assessment of Environmental Impacts

The future-without-project (FWOP) condition will be generated through trend analysis using information collected at step 5. The future-with-project (FWIP) condition will be predicted using professional judgment of the multi-disciplinary EIA team members based on information collected at the major field investigation stage and feedback received through intensive stakeholder consultation. Difference between the three scenarios i.e. pre construction, during construction and post construction conditions will be taken as impact of the proposed interventions.

Step-7: Evaluation of Impacts

Impact assessed on different IECs will be evaluated assigning score ranging from 1 to 10 for both positive (+) and negative (-) impacts considering magnitude, immediacy, reversibility and sustainability.

Step-8: Environmental Management Plan

The environmental management plan (EMP) will be prepared suggesting mitigation measures for minimizing the effect of the negative impacts, compensation plan for the negative impacts which cannot be mitigated, enhancement measures for increasing the benefits of the positive impacts, contingency plan for taking care of natural hazards and accidental events. An environmental monitoring plan will also be suggested in the EMP. Each component of the EMP will be divided into pre-construction, construction, operation and maintenance phases. Responsibilities of the institutions in the implementation of the EMP will be suggested to ensure efficient utilization of all the parties involved. Cost estimate

of each of the measure suggested under the mitigation plan, compensation plan, contingency plan and the monitoring plan at the pre- construction, construction, operation and maintenance phases will be prepared. The cost estimate should be included into the cost of the transmission line for economic and financial analysis.

Step-9: EIA Report Preparation

All the findings of EIA will be presented in Draft EIA Report. The report will be finalized by the addressing comments would be provided by the Client.

10. Duration of the Study:

Two months – From February to March, 2014.

11. List of Professionals:

1. Team Leader/ Environment Expert
2. Water Resource Expert
3. Socio- Economist
4. Ecologist
5. Environmental Law Specialist
6. Geologist/ Remote Sensing Specialist
7. Agriculture Specialist
8. Junior Professionals/Research Associates

12. Public Consultation:

During the course of preparation of the EIA, public consultation will be undertaken and necessary baseline environmental, socio- economic, biological and ecological information will be collected.

13. EIA Report Structure

The EIA report will be prepared following the DoE, JICA, ADB and World Bank guidelines in general. The following proposed Table of Contents (ToC) illustrates the major sections of the report and outlines the contents under each section.

14. Table of Contents (ToC)

EXECUTIVE SUMMARY:

The executive summary will include issues presented in a short and focused description of the project, environmental, ecological, biological and social setting, significant findings, major environmental, ecological, biological and social impacts on the proposed activities, recommended actions to mitigate/minimize potential negative impacts and suggested enhancement measures for the positive impacts and monitoring of ecological, biological and social performances.

1. INTRODUCTION

This section of the report shall provide the background and justification of the project and scope of the EIA report.

- 1.1 Background of the study
- 1.2 Study area
- 1.3 Objectives of the EIA
- 1.4 Scope of work
- 1.5 Limitations
- 1.6 The EIA team
- 1.7 Structure of the EIA report

2. ENVIRONMENTAL REGULATIONS AND GUIDELINES

This section shall include descriptions of the pertinent environmental policies and guidelines, rules and regulations. It shall also include rules and regulations on health safety, protection of ecologically sensitive areas, protection of endangered species, land acquisition, compensation, resettlement, as well as international rules and regulations related to the protection of the environment.

- 2.1 Overview
- 2.2 Procedure for obtaining environmental clearance
 - 2.2.1 Requirement for EIA report
 - 2.2.2 Procedure
- 2.3 Organizations related to enforcement of environmental standards
 - 2.3.1 Ministry of Environment and Forest (MoEF)
- 2.4 Relevant national policies and legislation relevant to the environment
 - 2.4.1 The Bangladesh Wildlife Preservation Order (1973; amended to Act in 1974)
 - 2.4.2 The National Forest Policy (1994)
- 2.5 Policy Related with Energy Development
 - 2.5.1 The Electricity Act, 1910
 - 2.5.2 The Power Policy, 1995
 - 2.5.3 The Energy Policy (1996)
 - 2.5.4 The Industrial Policy (1999)
- 2.6 Compliance with international requirements
 - 2.6.1 Rio Declaration
 - 2.6.2 Convention on Biological Diversity, (1992)
 - 2.6.3 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar (1971)
 - 2.6.4 United Nations Convention on the Law of the Sea, Montego Bay, (1982)
 - 2.6.5 Others (Conventions and Agreements)
- 2.7 Compliance with GoB EIA guidelines
- 2.8 Compliance with PGCB requirements

- 2.9 The Building Construction (Amendment) Act. 1990 and Building Construction Rules ' 1996
- 2.10 Land acquisition rules and regulations
- 2.11 Rules and policies in related fields

3. METHODOLOGY

This section will describe the approach and methodology followed to conduct the study

- 3.1 Overall approach
 - 3.1.1 Project design and description
 - 3.1.2 Environmental and social baseline
 - 3.1.3 Scoping
 - 3.1.4 Bounding
 - 3.1.5 Major Field investigation
 - 3.1.6 Impact assessment and possible computation
 - 3.1.7 Impact quantification and evaluation
 - 3.1.8 Environmental Management Plan
 - 3.1.9 EIA including RAP report preparation

4. DESCRIPTION OF THE PROJECT

This chapter will present a description of the proposed project interventions and cover relevant activities.

- 4.1 Major components of the project
- 4.2 Project location (location of the proposed power line and sub- station)
- 4.3 Physical features of the transmission line
- 4.4 Physical features of the substations
- 4.5 Component of the construction works
 - 4.5.1 Civil construction works
 - 4.5.2 Electrical works
 - 4.5.3 Testing and commissioning of equipment
- 4.6 Construction equipment
- 4.7 Work schedule

5. ANALYSIS OF SUITABILITY FOR ALTERNATIVE ROUTES

This will review the alternative route options available and discuss the comparative advantages and disadvantages.

- 5.1 Alignment selection factors
- 5.2 Alignment suitability analysis
- 5.3 Suitable alternative routes

6. ENVIRONMENTAL BASELINE CONDITION

This chapter will assemble and provide baseline data on the physical environment as well as social environment, sourced from secondary data as well as primary data obtained by the EIA team.

- 6.1 Water resources
 - 6.1.1 Climate
 - 6.1.2 Water level/flooding
 - 6.1.3 Air quality
 - 6.1.4 Ambient noise
 - 6.1.5 Water quality
 - 6.1.6 Natural hazards
- 6.2 Soil and agriculture
 - 6.2.1 Land resources
 - 6.2.2 Agricultural resources
- 6.3 Biological resources
 - 6.3.1 Terrestrial ecosystem
 - 6.3.2 Aquatic ecosystem
- 6.4 Socio- economic condition as a result of the transmission line
 - 6.4.1 Introduction
 - 6.4.2 Demographic features (including gender, literacy and age classification)
 - 6.4.3 Social baseline description (including occupation, employment, communication, water and sanitation, archeological sites, tribal people, diseases, communication etc)
 - 6.4.4 Land price situation
- 6.5 Socio- economic condition for proposed sub- stations
 - 6.5.1 Introduction
 - 6.5.2 Demographic features (including gender, literacy and age classification)
 - 6.5.3 Social baseline description (including occupation, employment, communication, water and sanitation, archeological sites, tribal people, diseases, communication etc).
 - 6.5.4 Land price situation

7. IMPORTANT ENVIRONMENTAL AND SOCIAL COMPONENTS

This will identify important environmental and social components (IESCs) which will be impacts likely to implement the proposed Ashuganj-Bhulta 400 kV TL project. The IESCs will be selected and discussed in this chapter with proper rationales.

8. IMPACT ANALYSIS

This will identify and assess positive and negative environmental impacts likely to result from the proposed project. Assessment of the impacts will be carried out at the pre-construction, construction and post-construction phases of the project.

- 8.1 Introduction
- 8.2 Selection of Important Environmental and Social Components (IESCs)
- 8.3 Potential environmental impacts (pre-construction, construction and post-construction phases)

9. ENVIRONMENTAL MANAGEMENT PLAN

This section will include an Environmental Management Plan (EMP). For negative impacts it will suggest mitigation measure and for positive impacts it will suggest enhancement measures.

- 9.1 Mitigation Plan
 - 9.1.1 Mitigation for impact on ambient air quality
 - 9.1.2 Mitigation for impact on interference with road crossing
 - 9.1.3 Mitigation for impact of construction wastes at tower and sub- stations sites
 - 9.1.4 Mitigation for storm water drainage congestion near substation sites
 - 9.1.5 Mitigation for impact on vegetation
 - 9.1.6 Mitigation for impact on plant species composition
 - 9.1.7 Mitigation for impact on habitat for wildlife
 - 9.1.8 Mitigation for impact of land sliding
 - 9.1.9 Mitigation for impact on crop production
 - 9.1.10 Mitigation for impact on natural fisheries
 - 9.1.11 Mitigation for impact on involuntary migration from Right of Way
 - 9.1.12 Mitigation for impact on land price
 - 9.1.13 Mitigation for impact on agricultural income
 - 9.1.14 Mitigation for impact on access to common property resources
 - 9.1.15 Mitigation for impact on human safety
- 9.2 Enhancement Plan
 - 9.2.1 Vegetation
 - 9.2.2 Agriculture
 - 9.2.3 Non- agricultural employment
 - 9.2.4 Agricultural income
 - 9.2.5 Urbanization
- 9.3 Contingency Plan
 - 9.3.1 Involuntary migration from right of way

- 9.3.2 Safety of workers
- 9.3.3 Human safety
- 9.4 Compensation Plan
- 9.5 Institutional requirements and Monitoring Plan.
- 9.6 Budgets for the Environmental Management Plan (EMP)

10. PUBLIC CONSULTATION AND DISCLOSURE

Consultation with interested parties, stakeholders and the general public (affected and non-affected) takes place and their views taken into account in the planning and execution of the project. A contract will be made and meeting/interviews and discussions set up with appropriate GOs, NGOs and local leaders and stakeholders.

- 10.1 Public consultation approach and methodology
- 10.2 People's perceptions
- 10.3 Major findings of Public Consultation

11. CONCLUSION AND RECOMENDATIONS

- 11.1 Conclusion
- 11.2 Recommendation.

(TABLES, FIGURES, ANNEXES, PHOTOGRAPHS)

Annex – 2
Base Information of GIA

Annex Table 2: Base information on GIA RoW of 400 kV Ashuganj-Bhulta T/L

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
Substation to AP - 01 Pakunda, Darikandi	<ul style="list-style-type: none"> ➤ Crossing of Gubtali to Asian Highway kutcha road Gubtaliar hat (Tatkar khal) crossing ➤ Rain Tree – 8 nos- 35 feet height ➤ Kadam Tree - 4 nos-27 feet height ➤ Mango Tree - 10 nos- 20 feet height ➤ Palm Tree- 3 nos- 30 feet height ➤ Chumbul Tree- 5 nos feet height ➤ Fallow- Fallow-Boro crops 	<ul style="list-style-type: none"> ➤ Crossing of Gubtali to Asian Highway kutcha road ➤ Tin made house- 1 ➤ Mango Tree- 5 nos- 20 feet height ➤ Supari Tree- 8 nos 25 feet height ➤ Mahogani Tree- 10 nos 30 feet height ➤ Bamboo Tree- 50 nos 35 feet height ➤ Banana Tree -5 nos 10 feet height ➤ Rain Tree – 13 nos 35 feet height ➤ Fallow- Fallow-Boro crops 	<ul style="list-style-type: none"> ➤ Crossing of Gubtali to Asian Highway kutcha road ➤ Tin made house - 1 ➤ Kadam Tree- 5 nos-27 feet height ➤ Mango Tree- 11 nos- 20 feet height ➤ Palm Tree- 5 nos-30 feet height ➤ Chumbul Tree- 8 nos feet height ➤ Rain Tree – 15 nos 35 feet height ➤ Chumbul Tree- 5 nos feet height ➤ Fallow- Fallow-Boro crops
Ap-01 to AP -02 Darikandi	<ul style="list-style-type: none"> ➤ Crossing of Dattar kandi to Asian highway brick soling road. ➤ Crossing of Kadamtali to Marichkandi brick soling road. ➤ Horgaon bazar to Gausia more pacca road ➤ 11 kv line crossing ➤ Settlement, Pacca building-1 ➤ Semi pucca- 10 ➤ Tin made house - 10 ➤ Brahmaputra river (by named brahmaputra khal) crossing ➤ Rain Tree – 12 nos 35 feet height 	<ul style="list-style-type: none"> ➤ Crossing of Dattar kandi to Asian highway brick soling road. ➤ Crossing of Kadamtali to Marichkandi brick soling road. ➤ Horgaon bazar to Gausia more pucca road ➤ 11 kv line crossing ➤ Tin made house - 3 ➤ Brahmaputra river (by named brahmaputra khal) crossing ➤ Mango Tree- Tree-5 nos- 20 feet height ➤ Supari Tree- 	<ul style="list-style-type: none"> ➤ Crossing of Dattar kandi to Asian highway brick soling road. ➤ Crossing of Kadamtali to Marichkandi brick soling road. ➤ Horgaon bazar to Gausia more pacca road ➤ 11 kv line crossing ➤ Settlement, Pacca building-1 ➤ Semi pucca- 5 ➤ Tin made house - 3 ➤ Shop tin-1 ➤ Brahmaputra river (by named brahmaputra khal) crossing

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Sonolu Tree 3 nos 20 feet height ➤ Kadam Tree-4 nos- 27 feet height ➤ Mango Tree- 15 nos- 20 feet height ➤ Palm Tree- 3 nos- 30 feet height ➤ Chumbul Tree- 5nos feet height ➤ Segun tree - 4 nos 35 feet height ➤ Supari Tree- 20 nos 25 feet height ➤ Mahogani Tree- 30 nos 30 feet height ➤ Bamboo Tree- 200 nos 35 feet height ➤ Wood apple Tree- 4nos 15 feet height ➤ Banana Tree -5 nos 10 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> Tree- 8 nos 25 feet height ➤ Mahogani Tree- 10 nos 30 feet height ➤ Bamboo Tree- 50 nos 35 feet height ➤ Banana Tree -5 nos 10 feet height ➤ Rain Tree – 13 nos 35 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> ➤ Segun tree - 4 nos 35 feet height ➤ Supari Tree- 20 nos 25 feet height ➤ height Sonolu tree 2 nos 20 feet height ➤ Mahogani Tree- 30 nos 30 feet height ➤ Bamboo Tree- 200 nos 35 feet height ➤ Wood apple Tree- 4nos 15 feet height ➤ Banana Tree -5 nos 10 feet height ➤ Rain Tree – 12 nos 35 feet height ➤ Kadam Tree-4 nos-27 feet height ➤ Mango Tree- 15 nos- 20 feet height ➤ Fallow- Fallow- Boro crops
Ap-02 to AP -03 Darikandi	<ul style="list-style-type: none"> ➤ Agriculture land ➤ Supari Tree- 20 nos 25 feet height ➤ Coconut Tree- 5 nos 30 feet height ➤ Mahogani Tree- 30 nos 30 feet height ➤ Bamboo Tree- 25 nos 30 feet height ➤ Banana Tree -5 nos 10 feet height ➤ Rain Tree – 7 nos 35 feet height ➤ Kadam Tree-6 nos- 27 feet height ➤ Mango Tree- 12 nos- 20 feet height ➤ Fallow- T Aman- Boro crops 	<ul style="list-style-type: none"> ➤ Agriculture land ➤ Banana Tree -7 nos 10 feet height ➤ Rain Tree – 5 nos 30 feet height ➤ Kadam Tree-2 nos-22 feet height ➤ Mango Tree- 6 nos- 15 feet height ➤ Fallow- T Aman- Boro crops 	<ul style="list-style-type: none"> ➤ Agriculture land ➤ pond- 1 ➤ Settlement, tin-1 ➤ Rain Tree – 9 nos 35 feet height ➤ Coconut Tree- 5 nos 30 feet height ➤ Mango Tree- 15 nos- 20 feet height ➤ Chumbul Tree- 4 nos feet height ➤ Supari Tree- 20 nos 25 feet height ➤ Mahogani Tree- 30 nos 30 feet height ➤ Fallow- T Aman-

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
Ap-03 to AP -04 Panchgaon, Kanthalia	<ul style="list-style-type: none"> ➤ Duptari bazar to Chotto satgram pacca road ➤ Settlement, Semi pucca- 2 ➤ Tin made house - 4 ➤ Supari Tree- 10 nos 25 feet height ➤ Mahogani Tree- 11 nos 30 feet height ➤ Bamboo Tree- 55 nos 35 feet height ➤ Assawath tree – 3 nos 40 feet height ➤ Banana Tree -10 nos 12 feet height ➤ Fallow- T Aman- Boro crops 	<ul style="list-style-type: none"> ➤ Duptari bazar to Chotto satgram pucca road ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 2 ➤ Supari Tree- 25 nos 25 feet height ➤ Mahogani Tree- 25 nos 30 feet height ➤ Bamboo Tree- 45 nos 30 feet height ➤ Banana Tree -20 nos 12 feet height ➤ Rain Tree – 26 nos 35 feet height ➤ Kadam Tree-6 nos-27 feet height ➤ Mango Tree- Tree-17 nos- 20 feet height ➤ Palm Tree- 3 nos-30 feet height ➤ Chumbul Tree- 5 nos feet height ➤ Fallow- T Aman- Boro crops 	<p>Boro crops</p> <ul style="list-style-type: none"> ➤ Duptari bazar to Chotto satgram pacca road ➤ Settlement, Pacca building-1 ➤ Semi pucca- 4 ➤ Tin made house - 7 ➤ Rain Tree – 20 nos 35 feet height ➤ Kadam Tree-6 nos-27 feet height ➤ Mango Tree- 22 nos- 20 feet height ➤ Palm Tree- 5 nos-30 feet height ➤ Chumbul Tree- 5nos feet height ➤ Supari Tree- 25 nos 25 feet height ➤ Mahogani Tree- 35 nos 30 feet height ➤ Bamboo Tree- 150 nos 35 feet height ➤ Banana Tree -20 nos 12 feet height ➤ Fallow- T Aman- Boro crops
Ap-04 to AP -05 Kanthalia	<ul style="list-style-type: none"> ➤ Kalagachia to Jalakandi pacca road ➤ Kanthalia to Abdullahkandi brick soling ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 1 ➤ Mango Tree- 24 nos- 20 feet height ➤ Chumbul Tree- 8 nos feet height ➤ Supari Tree- 15 nos 25 feet height 	<ul style="list-style-type: none"> ➤ Kalagachia to Jalakandi pucca road Settlement ➤ Kanthalia to Abdullahkandi brick soling ➤ Tin made house - 4 ➤ Rain Tree – 15 nos 35 feet height ➤ Mango Tree- 24 nos- 20 feet height ➤ Eucalyptus Tree- 	<ul style="list-style-type: none"> ➤ Kalagachia to Jalakandi pacca road ➤ Kanthalia to Abdullahkandi brick soling ➤ Settlement, Semi pucca- 2 ➤ Tin made house - 4 ➤ Rain Tree – 17 nos 35 feet height ➤ Mango Tree- 15 nos- 20 feet

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Mahogani Tree- 14 nos 30 feet height ➤ Bamboo Tree- 25 nos 30 feet height ➤ Banana Tree -15 nos 12 feet height ➤ Rain Tree – 15 nos 35 feet height ➤ Eucalyptus Tree- 10 nos 40 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> 8 nos 40 feet height ➤ Chumbul Tree- 8 nos feet height ➤ Supari Tree- 15 nos 25 feet height ➤ Mahogani Tree- 14 nos 30 feet height ➤ Bamboo Tree- 25 nos 30 feet height ➤ Banana Tree -15 nos 12 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> height ➤ Chumbul Tree- 5 nos 25 feet height ➤ Supari Tree- 20 nos 25 feet height ➤ Mahogani Tree- 30 nos 30 feet height ➤ Bamboo Tree- 40 nos 35 feet height ➤ Banana Tree -5 nos 10 feet height ➤ Eucalyptus Tree- 10 nos 40 feet height ➤ Fallow- T Aman-Boro crops
Ap-05 to AP -06 Mollar Char, Kanthalia	<ul style="list-style-type: none"> ➤ Kanthalia to Narsingdi pourashava pacca road ➤ Nuralpur to kanthalia brick soling road ➤ Settlement, Pacca building-1 ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 2 ➤ Eucalyptus Tree- 15 nos 40 feet height ➤ Banana Tree -11 nos 12 feet height ➤ Rain Tree – 14 nos 35 feet height ➤ Mahogani Tree- 14 nos 30 feet height ➤ Sonolu tree 3 nos 20 feet height ➤ Bamboo Tree- 35 nos 30 feet height ➤ Chumbul Tree- 4 nos 25 feet height ➤ Sirish Tree- 8 nos 35 feet height ➤ Mango Tree- 10 nos 20 feet height 	<ul style="list-style-type: none"> ➤ Kalagachia to Jalakandi pucca road ➤ Kanthalia to Abdullahkandi brick soling ➤ Settlement, Tin made house - 1 ➤ Rain Tree – 11 nos 35 feet height ➤ Mahogani Tree- 12 nos 30 feet height ➤ Bamboo Tree- 25 nos 30 feet height ➤ Chumbul Tree- 2 nos 25 feet height ➤ Sirish Tree- 10 nos 35 feet height ➤ Eucalyptus Tree- 4 nos 40 feet height ➤ Banana Tree -8 nos 12 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Kalagachia to Jalakandi pacca road ➤ Kanthalia to Abdullahkandi brick soling ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 3 ➤ Mango Tree- 10 nos 20 feet height ➤ Banana Tree -11 nos 12 feet height ➤ Rain Tree – 14 nos 35 feet height ➤ Mahogani Tree- 14 nos 30 feet height ➤ Bamboo Tree- 35 nos 30 feet height ➤ Chumbul Tree- 4 nos 25 feet height ➤ Domur tree 1 nos 14 feet height ➤ Sirish Tree- 8 nos

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Bot tree- 1 no 35 feet height ➤ Fallow- T Aman-Boro crops 		<ul style="list-style-type: none"> ➤ 35 feet height ➤ Fallow- T Aman-Boro crops
Ap-06 to AP -07 Mollar char, Kanthalia, Paharikandi	<ul style="list-style-type: none"> ➤ Araihasar chowrasta to Madovdi pouroshava pacca road ➤ Dewkandi to kanthalia brick soling road ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 3 ➤ 11 kv line crossing(two time/ both side of the road) ➤ Eucalyptus Tree- 15 nos 40 feet height ➤ Sirish Tree- 10 nos 35 feet height ➤ Mango Tree- 10 nos 20 feet height ➤ Chumbul Tree- 4 nos 25 feet height ➤ Rain Tree – 20 nos 35 feet height ➤ Sonolu tree 2 nos 20 feet height ➤ Coconut Tree- 5 nos 35 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Araihasar chowrasta to Madovdi pouroshava pucca road ➤ Dewkandi to kanthalia brick soling road ➤ Tin made house - 1 ➤ 11 kv line crossing(two time/ both side of the road) ➤ Chumbul Tree- 2 nos 25 feet height ➤ Sirish Tree- 10 nos 35 feet height ➤ Eucalyptus Tree- 4 nos 40 feet height ➤ Banana Tree -8 nos 12 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Araihasar chowrasta to Madovdi pouroshava pacca road ➤ Dewkandi to kanthalia brick soling road ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 2 ➤ 11 kv line crossing(two time/ both side of the road) ➤ Sirish Tree- 10 nos 35 feet height ➤ Sonolu tree 1 nos 20 feet height ➤ Mango Tree- 10 nos 20 feet height ➤ Chumbul Tree- 4 nos 25 feet height ➤ Rain Tree – 20 nos 35 feet height ➤ Fallow- T Aman-Boro crops
Ap-07 to AP -08 Kalagachha, Paikar char	<ul style="list-style-type: none"> ➤ Abdullah kandi to kanthalia pacca road ➤ Hoglekandia to sadasardi pacca road ➤ Bokkobadhy pacca road crossing ➤ Settlement, Semi pucca- 2 ➤ Tin made house - 4 ➤ Shop-1 ➤ Coconut Tree- 10 nos 20 Feet height ➤ RainTree – 12 nos 25 Feet height 	<ul style="list-style-type: none"> ➤ Abdullah kandi to kanthalia pucca road ➤ Hoglekandia to sadasardi pucca road ➤ Bokkobadhy pucca road crossing ➤ Coconut Tree- 5 nos 25 feet height ➤ Mango Tree- 3 nos 30 feet height ➤ RainTree Tree 4 	<ul style="list-style-type: none"> ➤ Abdullah kandi to kanthalia pacca road ➤ Hoglekandia to sadasardi pacca road ➤ Bokkobadhy pacca road crossing ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 3 ➤ Eucalyptus Tree- 8 nos 35 feet height

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Sirish Tree- 18 nos Feet height ➤ Eucalyptus Tree- 20 nos feet height ➤ Banana Tree 18 nos feet height ➤ Mahagani Tree 5 nos feet height ➤ Mango Tree- 6 nos feet height ➤ Jam Tree 3 nos feet height ➤ Koroi Tree- 5 nos feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> nos 30 feet height ➤ Banana Tree 5 nos 12 feet height ➤ Sirish Tree- 4 nos 30 feet height ➤ Eucalyptus Tree- 7 nos 35 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ RainTree- 9 nos 25 feet height ➤ Sirish Tree- 5 nos 25 feet height ➤ Eucalyptus Tree- 7 nos 30 feet height ➤ Mahagani Tree 3 nos 30 feet height ➤ Sojna Tree 4 nos 20 feet height ➤ Fallow- T Aman-Boro crops
Ap-08 to AP -09 Paikarchar, Char Bashini, Kalagachha	<ul style="list-style-type: none"> ➤ Gopaldi bazar to Meghna bazar pacca road crossing ➤ Balapur to kundodi to gopaldi brick soling road crossing ➤ Settlement, Tin sheet- 2 ➤ Textile/Cloth industry(small)-1 ➤ Eucalyptus Tree- 25 nos feet height ➤ RainTree Tree – 25 nos 30 feet height ➤ Sirish Tree -28 nos 25 feet height ➤ Coconut Tree 12 nos 30 feet height ➤ Mahagani Tree 15 nos 20 feet height ➤ Boroi Tree- 7 nos 11 feet height ➤ Kadom Tree 3 nos 25 feet height ➤ Chambul Tree 5 nos 20 feet height ➤ Banana Tree 7 nos 10 feet height ➤ Papaya Tree 5 nos feet height ➤ Bamboo Tree- 105 nos 35 feet height ➤ Mango Tree- 7 nos 16 feet height 	<ul style="list-style-type: none"> ➤ Gopaldi bazar to Meghna bazar pacca road crossing ➤ Balapur to kundodi to gopaldi brick soling road crossing ➤ Mango Tree- 7 nos 16 feet height ➤ Bamboo Tree- 10 nos feet height ➤ Coconut Tree 3 nos 22 feet height ➤ Sirish Tree 2 nos 25 feet height ➤ RainTree 5 nos 35 feet height ➤ Eucalyptus Tree- 6 nos 40 feet height ➤ Papaya Tree 2 nos 8 feet height ➤ Banana Tree 5 nos 12 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Gopaldi bazar to Meghna bazar pacca road crossing ➤ Balapur to kundodi to gopaldi brick soling road crossing ➤ Settlement, Semi pucca- 1 ➤ Tin made house - 3 ➤ Small Shop(tin)-1 ➤ Textile/ Cloth industry(small)-1 ➤ Jamrul Tree 3 nos 15 feet height ➤ Mango Tree- 5 nos 20 feet height ➤ Banana Tree nos 10 feet height ➤ Koroi Tree- 2 nos 30 feet height ➤ Sirish Tree- 6 nos 25feet height ➤ RainTree 7 nos 30 feet height ➤ Coconut Tree- 5 nos 30 feet height ➤ Mahagani Tree 8 nos 17 feet height

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	➤ Fallow- T Aman-Boro crops		➤ Fallow- T Aman-Boro crops
Ap-09 to AP -10 Paikarchar	<ul style="list-style-type: none"> ➤ The Meghna river crossing point (west side) ➤ Pitali Tree- 7 nos 15 feet height ➤ Borun Tree 5 nos 14 feet height ➤ Sirish Tree- 4 nos 20 feet height ➤ Chumbol Tree 3 nos 30 feet height ➤ Mango Tree- 5 nos 20 feet height ➤ Sisso Tree 4 nos 21feet height ➤ Koroi Tree- 2 nos 25 feet height ➤ Papaya Tree 4 nos 12 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ The Meghna river crossing point (west side) ➤ Pitali Tree- 8 nos 13 feet height ➤ Mango Tree- 2 nos 16 feet height ➤ Koroi Tree- 2 nos 25 feet height ➤ Jam Tree 1 nos 20 feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ The Meghna river crossing point (west side) ➤ Sisu Tree 3 nos 30 feet height ➤ Koroi Tree- 5 nos 35 feet height ➤ Banana Tree 7 nos 11 feet height ➤ Jam Tree 3 nos 15 feet height ➤ Barun Tree 4 nos 15 feet height ➤ Sirish Tree- 5 nos 20 feet height ➤ Fallow- T Aman-Boro crops
Ap-10 to AP -11 Dariadaulat, Kolbandha	<ul style="list-style-type: none"> ➤ Chumbol Tree 3 nos 30 feet height ➤ The Meghna river crossing point(east side) ➤ Khal (branch of Meghna river) crossing point ➤ Mango Tree- 5 nos 20 feet height ➤ Sisu Tree 4 nos 21feet height ➤ Koroi Tree- 2 nos 25 feet height ➤ The Meghna river crossing point(east side) ➤ Khal (branch of Meghna river) crossing point ➤ Fallow- T Aman-Boro crops ➤ Meghna River 	<ul style="list-style-type: none"> ➤ RainTree -7 nos 30 feet height ➤ Coconut Tree- 5 nos 30 feet height ➤ Mahagani Tree 8 nos 17 feet height ➤ The Meghna river crossing point (east side) ➤ Khal (branch of Meghna river) crossing point ➤ Meghna River ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Banana Tree 7 nos 11 feet height ➤ The Meghna river crossing point(east side) ➤ Khal (branch of Meghna river) crossing point ➤ Jam Tree 3 nos 15 feet height ➤ Barun Tree 4 nos 15 feet height ➤ Sirish Tree- 5 nos 20 feet height ➤ Fallow- T Aman-Boro crops ➤ Meghna River
Ap-11 to AP -12 Sonarampur, Dariadaulat	<ul style="list-style-type: none"> ➤ Sonarampur bazar to Morichakandi pacca road crossing ➤ Sonorampr to Linu miah bari 	<ul style="list-style-type: none"> ➤ Sonarampur bazar to Morichakandi pucca road crossing ➤ Sonorampr to 	<ul style="list-style-type: none"> ➤ Sonarampur bazar to Morichakandi pacca road crossing ➤ Sonorampr to

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	earth road crossing ➤ Kadamtali to Morichakandi brick soling road crossing ➤ Doldanga river crossing point ➤ 1 kv line crossing ➤ Settlement, semi pucca-4 ➤ Tin made house - 7 ➤ Bazar and hat-1 ➤ Shop-5 ➤ Rice mill-1 ➤ Eucalyptus Tree- Tree-12 nos 35 feet height ➤ Koroi Tree- Tree 7 nos 25 feet height ➤ Akashmoni Tree 25 nos 30 feet height ➤ Tatul Tree 8 nos 20 feet height ➤ Mango Tree- 11 nos 16 feet height ➤ Kanthal Tree 4 nos 15 feet height ➤ Coconut Tree- 5 nos 22 feet height ➤ Fallow- T Aman-Boro crops	Linu miah bari earth road crossing ➤ Kadamtali to Morichakandi brick soling road crossing ➤ Doldanga river crossing point ➤ 1 kv line crossing ➤ Settlement, Tin made house - 2 ➤ Eucalyptus Tree- 5 nos 24 feet height ➤ Akashmoni Tree 8 nos 25 feet height ➤ Tatul Tree 2 nos 20 feet height ➤ Mango Tree- 5 nos 20 feet height ➤ Kanthal Tree 2 nos 17 feet height ➤ Banana Tree 3 nos 13 feet height ➤ Koroi Tree- 5 nos 25 feet height ➤ Fallow- T Aman-Boro crops	Linu miah bari earth road crossing ➤ Kadamtali to Morichakandi brick soling road crossing ➤ Doldanga river crossing point ➤ 1 kv line crossing ➤ Settlement, pucca-1 ➤ Semi pucca-2 ➤ Tin made house - 2 ➤ Bazar and hat-1 ➤ Shop-8 ➤ Saw mill-1 ➤ Mango Tree- 7 nos 16 feet height ➤ Jam Tree 2 nos 12 feet height ➤ Kanthal Tree 4 nos 15 feet height ➤ Coconut Tree- 5 nos 30 feet height ➤ Banana Tree 12 nos 13 feet height ➤ Papaya Tree 3 nos 10 feet height ➤ Koroi Tree- 5 nos 25 feet height ➤ Fallow- T Aman-Boro crops
Ap-12 to AP -13 Pairakandi	➤ Sonarampur bazar to pairakandi to solimganj pucca road crossing ➤ 1 kv line crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 2 ➤ Bamboo Tree- 150 nos 40 feet height ➤ Chambul Tree 16 nos 35 feet height ➤ Mango Tree- 10	➤ Sonarampur bazar to pairakandi to solimganj pucca road crossing ➤ 1 kv line crossing ➤ Sirish Tree- 6 nos 30 feet height ➤ Koroi Tree- 5 nos 35 feet height ➤ Coconut Tree- 3 nos 32 feet	➤ Sonarampur bazar to pairakandi to solimganj pucca road crossing ➤ 1 kv line crossing ➤ Chambul Tree 6 nos 28 feet height ➤ Banana Tree 30 nos 10 feet height ➤ Mango Tree- nos

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	nos 18 feet height ➤ Coconut Tree- 8 nos 30 feet height ➤ Jum Tree 5 nos 20 feet height ➤ Akashmoni Tree 15 nos 35 feet height ➤ Pitali Tree- 6 nos 20 feet height ➤ Sirish Tree- 10 nos 35 feet height ➤ Koroi Tree- 11 nos 25 feet height ➤ T aush - T Aman-Boro crops	height ➤ Nim Tree 5 nos 13 feet height ➤ Bamboo Tree- 25 nos 35 feet height ➤ Banana Tree 4 nos 12 feet height ➤ T aush - T Aman-Boro crops	20 feet height ➤ Coconut Tree- 5 nos 25 feet height ➤ Akashmoni Tree 12 nos 35 feet height ➤ Sirish Tree- 7 nos 35 feet height ➤ Koroi Tree- 3 nos 30 feet height ➤ T aush - T Aman-Boro crops
Ap-13 to AP -14 Nilakhali, Tezkhali	➤ Titas river crossing point ➤ Settlement, tin-1 ➤ Koroi Tree- 3 nos 35 feet height ➤ Banana Tree 4 nos 12 feet height ➤ Papaya Tree-2 nos 10 feet height ➤ T aush - T Aman-Boro crops	➤ Titas river crossing point ➤ Koroi Tree- 2 nos 40 feet height ➤ Banana Tree 3 nos 12 feet height ➤ Papaya Tree 2 nos 11 feet height ➤ T Aush - T Aman-Boro crops	➤ Titas river crossing point ➤ Jum Tree 5 nos 20 feet height ➤ Akashmoni Tree 15 nos 35 feet height ➤ Pitali Tree- 6 nos 20 feet height ➤ Sirish Tree- 10 nos 35 feet height ➤ Koroi Tree- 11 nos 25 feet height ➤ T aush - T Aman-Boro crops
Ap-14 to AP -15 Sreeghar, Bishnorampur	➤ Dorikandi to Aganagar to salimganj pacca road crossing ➤ Settlement, pucca-1 ➤ Semi pucca-2 ➤ Tin made house - 1 ➤ Shop-1 ➤ Bamboo Tree- 150 nos 35 feet height ➤ Chambul Tree 16 nos 30 feet height ➤ Mango Tree- 10 nos 22 feet height ➤ Coconut Tree- 8 nos 25 feet height ➤ Jum Tree 5 nos 20 feet height ➤ Akashmoni Tree 15	➤ Dorikandi to Aganagar to salimganj pucca road crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 1 ➤ Sirish Tree- 6 nos 40 feet height ➤ Koroi Tree- 5 nos 35 feet height ➤ Coconut Tree- 3 nos 30 feet height ➤ Nim Tree 5 nos 17 feet height ➤ Bamboo Tree- 25 nos 35 feet	➤ Dorikandi to Aganagar to salimganj pacca road crossing ➤ Settlement, pucca-1 ➤ Semi pucca-1 ➤ Tin made house - 3 ➤ Shop-1 ➤ Chambul Tree 6 nos 22 feet height ➤ Banana Tree 30 nos 10 feet height ➤ Mango Tree- nos 20 feet height ➤ Coconut Tree- 5 nos 35 feet

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	nos 25 feet height ➤ Pitali Tree- 6 nos 15 feet height ➤ Sirish Tree- 10 nos 35 feet height ➤ Koroi Tree- 11 nos 30 feet height ➤ T aush - T Aman-Boro crops	height ➤ Banana Tree 4 nos 12 feet height ➤ T aush - T Aman-Boro crops	height ➤ Akashmoni Tree 12 nos 40 feet height ➤ Sirish Tree- 7 nos 35 feet height ➤ Koroi Tree- 3 nos 25 feet height ➤ Banana Tree 10 nos 10 feet height ➤ T aush - T Aman-Boro crops
Ap-15 to AP -16 Shyamgram, Nashirabad	➤ Debdar more to Maniknagar ghat pacca road crossing ➤ Maniknagar to gopalganj kacca road crossing ➤ Maniknagar khal crossing ➤ Settlement, pucca-1 ➤ Semi pucca-1 ➤ Tin made house - 5 ➤ Bamboo Tree- 150 nos 35 feet height ➤ Chambul Tree 16 nos 30 feet height ➤ Mango Tree- 10 nos 25 feet height ➤ Coconut Tree- 8 nos 35 feet height ➤ Jum Tree 5 nos 22 feet height ➤ Akashmoni Tree 15 nos 30 feet height ➤ Pitali Tree- 6 nos 18 feet height ➤ Sirish Tree- 10 nos 30 feet height ➤ Koroi Tree- 11 nos 26 feet height ➤ Fallow- T Aman-Boro crops	➤ Debdar more to Maniknagar ghat pucca road crossing ➤ Maniknagar to gopalganj kutcha road crossing ➤ Maniknagar khal crossing ➤ Sirish Tree- 6 nos 25 feet height ➤ Koroi Tree- 5 nos 30 feet height ➤ Coconut Tree- 3 nos 30 feet height ➤ Bamboo Tree- 25 nos 30 feet height ➤ Banana Tree 4 nos 12 feet height ➤ Fallow- T Aman-Boro crops	➤ Debdar more to Maniknagar ghat pacca road crossing ➤ Maniknagar to gopalganj kacca road crossing ➤ Maniknagar khal crossing ➤ Settlement, pucca-1 ➤ Semi pucca-1 ➤ Tin made house - 4 ➤ Banana Tree 30 nos 12 feet height ➤ Mango Tree- nos 20 feet height ➤ Coconut Tree- 5 nos 25 feet height ➤ Akashmoni Tree 12 nos 30 feet height ➤ Sirish Tree- 7 nos 35 feet height ➤ Koroi Tree- 3 nos 40 feet height ➤ Fallow- T Aman-Boro crops
➤ Ap-16 to AP -17 ➤ Shyamgram, Nashirabad	➤ Nasirabad to shahbajpur pacca road crossing ➤ Nasirabad to gopalganj pacca road crossing (two	➤ Nasirabad to shahbajpur pucca road crossing ➤ Nasirabad to gopalganj pucca	➤ Nasirabad to shahbajpur pacca road crossing ➤ Nasirabad to gopalganj pacca

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<p>times)</p> <ul style="list-style-type: none"> ➤ Gopalpur khal crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 12 ➤ 1 kv line crossing ➤ Eucalyptus Tree- 10 nos 35 feet height ➤ Mango Tree- 5 nos 25 feet height ➤ Banana Tree 10 nos 12 feet height ➤ Kanthal Tree 4 nos 20 feet height ➤ Jam Tree 2 nos 15 feet height ➤ Papaya Tree 4 nos 12 feet height ➤ Bamboo Tree- 30 nos 35 feet height ➤ Fallow- T Aman-Boro crops 	<p>road crossing(two time)</p> <ul style="list-style-type: none"> ➤ Gopalpur khal crossing ➤ Settlement, Tin made house - 4 ➤ 1 kv line crossing ➤ Eucalyptus Tree- 6 nos 35 feet height ➤ Mango Tree- 3 nos 20 feet height ➤ Banana Tree 4 nos 13 feet height ➤ Mahagani Tree 5 nos 25 feet height ➤ Sirish Tree- 4 nos 25 feet height ➤ Fallow- T Aman-Boro crops 	<p>road crossing(two time)</p> <ul style="list-style-type: none"> ➤ Gopalpur khal crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 8 ➤ 1 kv line crossing ➤ Mahagani Tree 15 nos 20 feet height ➤ Eucalyptus Tree- 8 nos 35 feet height ➤ Mango Tree- 5 nos 22 feet height ➤ Sirish Tree- 7 nos 30 feet height ➤ Chambul Tree 3 nos 35 feet height ➤ Fallow- T Aman-Boro crops
Ap-17 to AP -18 Gopalpur	<ul style="list-style-type: none"> ➤ Gopalpur to shaheb nagar kacca road crossing ➤ Settlement, Semi pucca-1 ➤ Tin made house - 5 ➤ Sagun Tree- 5 nos 40 feet height ➤ Sirish Tree- 6 nos 35 feet height ➤ Koroi Tree- 5 nos 32 feet height ➤ Boroi Tree- 5 nos 15 feet height ➤ Supari Tree- 5 nos 25 feet height ➤ Coconut Tree- 5 nos 28 feet height ➤ Tal Tree-8 nos 35 feet height ➤ Bamboo Tree- 50 nos 40 feet height ➤ Ipil Ipil Tree- 8 nos feet height ➤ Sisso Tree-5 nos 22 feet height 	<ul style="list-style-type: none"> ➤ Gopalpur to shaheb nagar kutcha road crossing ➤ Settlement, Tin made house - 2 ➤ Mango Tree- 3 nos feet height ➤ Segun Tree-3 nos feet height ➤ Koroi Tree- 2 nos feet height ➤ Sisso Tree- 2 nos feet height ➤ Sirish Tree- 3 nos feet height ➤ Boroi Tree- 5 nos feet height ➤ Fallow- T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Gopalpur to shaheb nagar kacca road crossing ➤ Settlement, Tin made house - 4 ➤ Supari Tree- 2 nos 20 feet height ➤ Sisso Tree- 3 nos 30 feet height ➤ Chumbul Tree- 8 nos 35 feet height ➤ Bamboo Tree- 15 nos 30 feet height ➤ Boroi Tree- 3 nos 20 feet height ➤ Mango Tree- 5 nos 15 feet height ➤ Fallow- T Aman-Boro crops

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Chumbul Tree- 8 nos 25 feet height ➤ Fallow- T Aman-Boro crops 		
Ap-18 to AP -19 Sitharampur, Nabinagar	<ul style="list-style-type: none"> ➤ Nabinagar to Darigaon pucca road crossing ➤ Nabinagar to fatapur pucca road crossing ➤ Montoli ghat to paschim fatapur/bish gaon kaccha road crossing ➤ Nabinagar to fatapur pucca road crossing ➤ Montali ghat(uttar) to Sitarampur kutcha road crossing ➤ Titas river crossing point ➤ Settlement, pucca-1 ➤ Semi pucca-4 ➤ Tin made house - 8 ➤ Boro Tree- 15 nos 12 feet height ➤ Koroi Tree- 5 nos 30 feet height ➤ Mango Tree- 8 nos 20 feet height ➤ Coconut Tree- 5 nos 25 feet height ➤ Eucalyptus Tree- 10 nos 35 feet height ➤ Fallow- Fallow-Boro crops 	<ul style="list-style-type: none"> ➤ Nabinagar to Darigaon pucca road crossing ➤ Nabinagar to fatapur pucca road crossing ➤ Montoli ghat to paschim fatapur/bish gaon kutcha road crossing ➤ Nabinagar to fatapur pucca road crossing ➤ Montali ghat (uttar) to Sitarampur kutcha road crossing ➤ Titas river crossing point ➤ Settlement, semi pucca-1 ➤ Tin made house - 1 ➤ Koroi Tree- 2 nos 30 feet height ➤ Mango Tree- 3 nos 16 feet height ➤ Coconut Tree- 2 nos 30 feet height ➤ Eucalyptus Tree- 2 nos 35 feet height ➤ Fallow- Fallow-Boro crops 	<ul style="list-style-type: none"> ➤ Nabinagar to Darigaon pucca road crossing ➤ Nabinagar to fatapur pucca road crossing ➤ Montoli ghat to paschim fatapur/bish gaon kutcha road crossing ➤ Nabinagar to fatapur pucca road crossing ➤ Montali ghat (uttar) to Sitarampur kacch road crossing ➤ Titas river crossing point ➤ Settlement, pucca-1 ➤ Semi pucca-4 ➤ Tin made house - 5 ➤ Supari Tree- 6 nos 20 feet height ➤ Boro Tree- 7 nos 15 feet height ➤ Mango Tree- 8 nos 22 feet height ➤ Koroi Tree- 2 nos 35 feet height ➤ Fallow- Fallow-Boro crops
Ap-19 to AP -20 Asrafpur, Krishnanagar	<ul style="list-style-type: none"> ➤ Sitarampur ghat to krishnagar ghat pucca road crossing ➤ Krishnagar ghat to char gonsaipur kacch road crossing ➤ Baluahati to 	<ul style="list-style-type: none"> ➤ Sitarampur ghat to krishnagar ghat pucca road crossing ➤ Krishnagar ghat to char gonsaipur kutcha road crossing ➤ Baluahati to 	<ul style="list-style-type: none"> ➤ Sitarampur ghat to krishnagar ghat pucca road crossing ➤ Krishnagar ghat to char gonsaipur kacch road crossing ➤ Baluahati to

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	krishnagar bazar/ghat kutcha road crossing ➤ Titas river crossing point ➤ Settlement, pucca-1 ➤ Semi pucca-6 ➤ Tin made house - 8 ➤ Eucalyptus Tree- 10 nos 30 feet height ➤ Mango Tree- 8 nos 20 feet height ➤ Koroi Tree- 12 nos 35 feet height ➤ Boroi Tree- 12 nos 15 feet height ➤ Pitali Tree- 8 nos 16 feet height ➤ Chumbul Tree- 5 nos 22 feet height ➤ Coconut Tree- 5 nos 20 feet height ➤ Fallow- Fallow-Boro crops	krishnagar bazar/ghat kutcha road crossing ➤ Titas river crossing point ➤ Tin made house - 1 ➤ Eucalyptus Tree- 8 nos 30 feet height ➤ Mango Tree- 3 nos 20 feet height ➤ Koroi Tree- 3 nos 30 feet height ➤ Boroi Tree- 8 nos 15 feet height ➤ Pitali Tree- 3 nos 20 feet height ➤ Mahagani Tree- 8 nos 22 feet height ➤ Fallow- Fallow-Boro crops	krishnagar bazar/ghat kacca road crossing ➤ Titas river crossing point ➤ Settlement, semi pucca-1 ➤ Tin made house - 4 ➤ Mahagani Tree- 10 nos 25 feet height ➤ Eucalyptus Tree- 5 nos 30 feet height ➤ Koroi Tree- 15 nos 30 feet height ➤ Coconut Tree- 3 nos 22 feet height ➤ Boroi Tree- 2 nos 16 feet height ➤ Fallow- Fallow-Boro crops
Ap-20 to AP -21 Char Gonsaipur, Gonsaipur,	➤ Char gonsaipur to barail kacca road crossing ➤ mollah hati to brahmanbaria kacca road crossing ➤ Gonsaipur to Jasuka kacca road crossing ➤ Settlement, pucca-1 ➤ Semi pucca-5 ➤ Tin made house - 30 ➤ Shop-2 ➤ 1 kv line crossing ➤ Mahagani Tree- 5 nos 20 feet height ➤ Boroi Tree- 8 nos 12 feet height ➤ Chumbul Tree- 3 nos 30 feet height ➤ Eucalyptus Tree- 15 nos 35 feet height	➤ Char gonsaipur to barail kutcha road crossing ➤ mollah hati to brahmanbaria kutcha road crossing ➤ Gonsaipur to Jasuka kacca road crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 9 ➤ 1 kv line crossing ➤ Shimul tree 2 nos feet height ➤ Mango Tree- 8 nos 15 feet height ➤ Chumbul Tree- 2 nos 25 feet height ➤ Koroi Tree- 5 nos 30 feet height ➤ Hijal Tree- 2 nos	➤ Char gonsaipur to barail kacca road crossing ➤ Mollah hati to brahmanbaria kacca road crossing ➤ Gonsaipur to Jasuka kacca road crossing ➤ Settlement, semi pucca-3 ➤ Tin made house - 33 ➤ Shop-1 ➤ 1 kv line crossing ➤ Hijal Tree- 8 nos 20 feet height ➤ Pitali Tree- 3 nos 14 feet height ➤ Bamboo Tree- 105 nos 35 feet height ➤ Sajna Tree- 5 nos 20feet height ➤ Coconut Tree- 8

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Coconut Tree- 5 nos 30 feet height ➤ Koroi Tree- 10 nos 32 feet height ➤ Shimul tree 8 nos feet height ➤ Sajna Tree- 3 nos 14 feet height ➤ Babla Tree- 5 nos 25 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> 20 feet height ➤ Pitali Tree- 3 nos 15 feet height ➤ Bamboo Tree- 15 nos 35 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> nos 30 feet height ➤ Papaya Tree-5 nos 12 feet height ➤ Supari Tree- 8 nos 25 feet height ➤ Fallow- Fallow- Boro crops
Ap-21 to AP -22 Sadekpur, Chilokut, Damchail,	<ul style="list-style-type: none"> ➤ Gash tolla more to Poyag board bazar kutcha road crossing ➤ Poyag board bazar to shal gaon kalishima bazar kacca road crossing ➤ Barail UP to Brahmanbaria pucca road crossing ➤ Settlement, pucca-2 ➤ Semi pucca-5 ➤ Tin made house - 4 ➤ Shop-1 ➤ Akashmoni Tree- 12 nos 24 feet height ➤ Boroi Tree- 13 nos 14 feet height ➤ Pitali Tree- 6 nos 15 feet height ➤ Sirish Tree- 5 nos 30 feet height ➤ Sajna Tree- 4 nos 20 feet height ➤ Supari Tree- 3 nos 25 feet height ➤ Mango Tree- 8 nos 15 feet height ➤ Chatim tree – 4 nos 20 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> ➤ Gash tolla more to Poyag board bazar kutcha road crossing ➤ Poyag board bazar to shal gaon kalishima bazar kutcha road crossing ➤ Barail UP to brahmanbaria pucca road crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 2 ➤ Akashmoni Tree- 7 nos 35 feet height ➤ Mango Tree- 5 nos 20 feet height ➤ Sirish Tree- 6 nos 30 feet height ➤ Boroi Tree- 7 nos 15 feet height ➤ Chatim tree – 2 nos 20 feet height ➤ Supari Tree- 2 nos 22 feet height ➤ Fallow- Fallow - Boro crops 	<ul style="list-style-type: none"> ➤ Gash tolla more to Poyag board bazar kutcha road crossing ➤ Poyag board bazar to shal gaon kalishima bazar kacca road crossing ➤ Barail UP to Brahmanbaria pucca road crossing ➤ Settlement, semi pucca-2 ➤ Tin made house - 5 ➤ Supari Tree- 15 nos 23 feet height ➤ Mango Tree- 12 nos 16 feet height ➤ Coconut Tree- 6 nos 30 feet height ➤ Sirish Tree- 8 nos 25 feet height ➤ Bamboo Tree- 5 nos 35 feet height ➤ Nim Tree- 2 nos 20 feet height ➤ Akashmoni Tree- 12 nos 35 feet height Chatim tree – 3 nos 20 feet height ➤ Mahagani Tree- 12 nos 25 feet

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
			height ➤ Banana Tree 8 nos feet 12 height ➤ Fallow- Fallow - Boro crops
Ap-22 to AP -23 Shalgaon, Natai, Poyaggram	<ul style="list-style-type: none"> ➤ Kalishima to Poyag board bazar pucca road crossing ➤ Gopat more to Daskin natai kacca road crossing ➤ Rail line crossing point (Ashuganj to Brahmanbaria) ➤ Settlement, pucca-4 ➤ Semi pucca-7 ➤ Tin made house - 12 ➤ Shop-2 ➤ Sirish Tree- 12 nos 25 feet height ➤ Pitali Tree- 6 nos 17 feet height ➤ Coconut Tree- 5 nos 30 feet height ➤ Mahogni 7 nos 20 feet height ➤ Nim 2 nos 18 feet height ➤ Bamboo Tree- 65 nos 40 feet height ➤ Boroi Tree- 12 nos 15 feet height ➤ Kanthal Tree- 8 nos 22 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> ➤ Kalishima to Poyag board bazar pucca road crossing ➤ Gopat more to Daskin natai kutcha road crossing ➤ Rail line crossing point (Ashuganj to Brahmanbaria) ➤ Settlement, semi pucca-2 ➤ Tin made house - 4 ➤ Boroi Tree- 7 nos 13 feet height ➤ Bamboo Tree- 30 nos 35 feet height ➤ Nim 2 nos 14 feet height ➤ Coconut Tree- 3 nos 30 feet height ➤ Sirish Tree- 4 nos 25 feet height ➤ Akashmoni Tree- 6 nos 30 feet height ➤ Supari Tree- 5 nos 25 feet height ➤ Mahagani Tree- 3 nos 30 feet height ➤ Fallow- Fallow- Boro crops 	<ul style="list-style-type: none"> ➤ Kalishima to Poyag board bazar pucca road crossing ➤ Gopat more to Daskin natai kacca road crossing ➤ Rail line crossing point (Ashuganj to Brahmanbaria) ➤ Settlement, pucca-2 ➤ Semi pucca-5 ➤ Tin made house - 11 ➤ Shop-1 ➤ Kanthal Tree- 5 nos 16 feet height ➤ Bamboo Tree- 60 nos 30 feet height ➤ Boroi Tree- 6 nos 16 feet height ➤ Coconut Tree- 8 nos 26 feet height ➤ Nim 2 nos 15 feet height ➤ Koro Tree- 8 nos 40 feet height ➤ Fallow- Fallow- Boro crops
Ap-23 to AP -24 Poothai, Andil, Chhoto Brahmanbaria, Talsahar	<ul style="list-style-type: none"> ➤ Talsahar to bott tall more pucca road crossing ➤ Ashuganj(Lalpur) to to Brahmanbaria(Bott tall) highway road 	<ul style="list-style-type: none"> ➤ Talsahar to bott tall more pucca road crossing ➤ Ashuganj (Lalpur) to to Brahmanbaria(Bott tall) highway 	<ul style="list-style-type: none"> ➤ Talsahar to bott tall more pucca road crossing ➤ Ashuganj(Lalpur) to to Brahmanbaria(Bott tall) highway

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> crossing ➤ 230/233 Kv line crossing ➤ Settlement, pucca-1 ➤ Semi pucca-4 ➤ Tin made house -6 ➤ Shop-1 ➤ Koroi Tree- 18 nos 30 feet height ➤ Kanthal Tree- 12 nos 20 feet height ➤ Mango Tree- 16 nos 25 feet height ➤ Payara 8 nos 16 feet height ➤ Akashmoni 15 nos 30 feet height ➤ Sajna Tree- 5 nos 20 feet height ➤ Bamboo Tree- 155 nos 40 feet height ➤ Chumbul Tree- 10 nos 45 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> road crossing ➤ 230/233 Kv line crossing ➤ Settlement, Tin sheet- 1 ➤ Sajna Tree- 2 nos 18 feet height ➤ Mango Tree- 6 nos 16 feet height ➤ Koroi Tree- 8 nos 35 feet height ➤ Payara Tree-2 nos 15 feet height ➤ Akashmoni 9 nos 35 feet height ➤ Jam 2 nos 20 feet height ➤ Boroi Tree- 8 nos 14 feet height ➤ Chumbul 6 nos 30 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> road crossing ➤ 230/233 Kv line crossing ➤ Settlement, Tin sheet- 2 ➤ Sirish Tree- 15 nos 35 feet height ➤ Boroi Tree- 8 nos 13 feet height ➤ Mango Tree- 8 nos 15 feet height ➤ Akashmoni 10 nos 30 feet height ➤ Bamboo Tree- 40 nos 40 feet height ➤ Koroi Tree- 8 nos 35 feet height ➤ Chumbul 8 nos 25 feet height ➤ T aush - T Aman-Boro crops
Ap-24 to AP -25 Talsahar, Paschim Talsahar, Andil	<ul style="list-style-type: none"> ➤ Talsahar to bott tall more pucca road crossing ➤ Ashuganj to to paschim talsahar bazar pucca road crossing ➤ Settlement, semi pucca-1 ➤ Tin made house -1 ➤ Boroi Tree- 20 nos 12 feet height ➤ Tatul 3 nos 26 feet height ➤ Mahogni 5 nos 30 feet height ➤ Koroi Tree- 8 nos 35 feet height ➤ Akasmoni Tree- 12 nos 35 feet height ➤ Sirish Tree- 7 nos 35 feet height ➤ Mango Tree- 8 nos 20 feet height ➤ Payara Tree- 7 nos 13 feet height 	<ul style="list-style-type: none"> ➤ Talsahar to bott tall more pucca road crossing ➤ Ashuganj to to paschim talsahar bazar pucca road crossing ➤ Boroi Tree- 5 nos 13 feet height ➤ Mahagani Tree- 4 nos 20 feet height ➤ Koroi Tree- 5 nos 35 feet height ➤ Akashmoni 8 nos 35 feet height ➤ Sirish Tree- 6 nos 40 feet height ➤ Mango Tree- 2 nos 20 feet height ➤ Payara 3 nos 11 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ Talsahar to bott tall more pucca road crossing ➤ Ashuganj to to paschim talsahar bazar pucca road crossing ➤ Settlement, semi pucca-1 ➤ Tin made house - 2 ➤ Mahagani Tree- 4 nos 22 feet height ➤ Koroi Tree- 3 nos 40 feet height ➤ Akashmoni 8 nos 35 feet height ➤ Mango Tree- 3 nos 22 feet height ➤ Boroi Tree- 12 nos 18 feet height ➤ Pitali Tree- 8 nos 15 feet height

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ T aush - T Aman-Boro crops 		<ul style="list-style-type: none"> ➤ Coconut Tree- 5 nos 25 feet height ➤ Kanthal 8 nos 20 feet height ➤ Bamboo Tree- 55 nos 40 feet height ➤ T aush - T Aman-Boro crops
Ap-25 to AP -26 Talsahar, Paschim Talsahar, Andil, Sonarumpur	<ul style="list-style-type: none"> ➤ 230/233 Kv line crossing ➤ Boroi Tree- 3 nos 15 feet height ➤ Mango Tree- 4 nos 22 feet height ➤ Pitali Tree- 4 nos 17 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ 230/233 Kv line crossing ➤ Mango Tree- 2 nos 20 feet height ➤ Boroi Tree- 2 nos 15 feet height ➤ Pitali Tree- 3 nos 16 feet height ➤ Papaya Tree- 2 nos 15 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> ➤ 230/233 Kv line crossing ➤ Boroi Tree- 5 nos 12 feet height ➤ Koroi Tree- 4 nos 35 feet height ➤ Cambul Tree-3 nos 35 feet height ➤ Papaya Tree- 4 nos 14 feet height ➤ T aush - T Aman-Boro crops
Ap-26 to Ashuganj Substation (proposed) Sonarumpur	<ul style="list-style-type: none"> ➤ Ashuganj to Brahmanbaria highway road crossing ➤ Sonarumpur to Ashuganj highway kucha road crossing ➤ Settlement, pucca-1 ➤ Semi pucca-2 ➤ Tin made house -4 ➤ Shop-1 ➤ Pond-2 ➤ 33 Kv, 11 Kv line crossing ➤ Koroi Tree- 2 nos 26 feet height ➤ Arjun Tree- 3 nos 23 feet height ➤ Mango Tree- 5 nos 16 feet height ➤ Boroi Tree- 5 nos 15 feet height ➤ Coconut Tree- 3 nos 25 feet height ➤ Sajna Tree- 2 nos 20 feet height 	<ul style="list-style-type: none"> ➤ Ashuganj to Brahmanbaria highway road crossing ➤ Sonarumpur to Ashuganj highway kutch road crossing ➤ Settlement, pucca-1 ➤ Semi pucca-2 ➤ Tin made house - 2 ➤ Pond-2 ➤ 33 Kv, 11 Kv line crossing ➤ Kanthal Tree- 3 nos 25 feet height ➤ Sirish Tree- 2 nos 35 feet height ➤ Boroi Tree- 3 nos 12 feet height ➤ Akasmoni Tree- 3 nos 30 feet height ➤ Eucalyptus Tree- 	<ul style="list-style-type: none"> ➤ Ashuganj to Brahmanbaria highway road crossing ➤ Sonarumpur to Ashuganj highway kucha road crossing ➤ Settlement, pucca-2 ➤ Semi pucca-4 ➤ Tin made house - 6 ➤ Shop-1 ➤ Pond-2 ➤ Hazi Auto rice mill-1 ➤ 33 Kv, 11 Kv line crossing ➤ Kadom 8 nos 30 feet height ➤ Sajna Tree- 3 nos 20 feet height ➤ Coconut Tree- 3 nos 30 feet height ➤ Pitali Tree- 4 nos

AP to AP (Mauza)	Description of 40m RoW at the left side	Description of 20m RoW at the middle	Description of 40m RoW at the right side
	<ul style="list-style-type: none"> ➤ Bilombi Tree- 3 nos 16 feet height ➤ Jam Tree- 3 nos 21 feet height ➤ Akashmoni Tree- 5 nos 30 feet height ➤ Eucalyptus Tree- 5 nos 35 feet height ➤ Payara 2 nos 10 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> 8 nos 35 feet height ➤ Karoi -5 nos 40 feet height ➤ T aush - T Aman-Boro crops 	<ul style="list-style-type: none"> 18 feet height ➤ Jam Tree- 3 nos 25 feet height ➤ Eucalyptus Tree- 5 nos 35 feet height ➤ T Aush - T Aman-Boro crops

Annex-3
Map (A3 Size)
