Environmental Impact Assessment

May 2016

Bangladesh: 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 October 2015 available on http://www.adb.org/projects/documents/ashuganj-400mw-ccpp-east-updated-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

^{o}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
$\mu g/m^3$	–	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

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Annexure

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 it's 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 CCPP) 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 it's 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 PM_{10} 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, NO_2 and SO_2 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 NO_2 (ii) Noise, (iii) Water pollution, (iv) Occupational health, and (v) Emergency/disaster impact.

6. Prediction and Evaluation of Impacts

As the proposed power plant will utilize Natural gas as fuel, the pollutants of potential concern will only Oxides of Nitrogen (NOx) during the operation period of the project. This pollutant has been examined to ensure the Bangladesh emission limit standard as well as IFC/WB, where appropriate, the required emission control techniques would be incorporated into the mitigation measures. The ground concentration of 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 558^0C to 90^0C. 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 m^3/sec of river water would be drawn from the intake of the proposed 400 MW CCPP project discharged at 7^0C 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 ONE: INTRODUCTION

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Power and energy are vital factors that determine the growth path of a developing country likes 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 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 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 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.Baria. 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 retiring 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: Bakhrabad 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 form 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).**

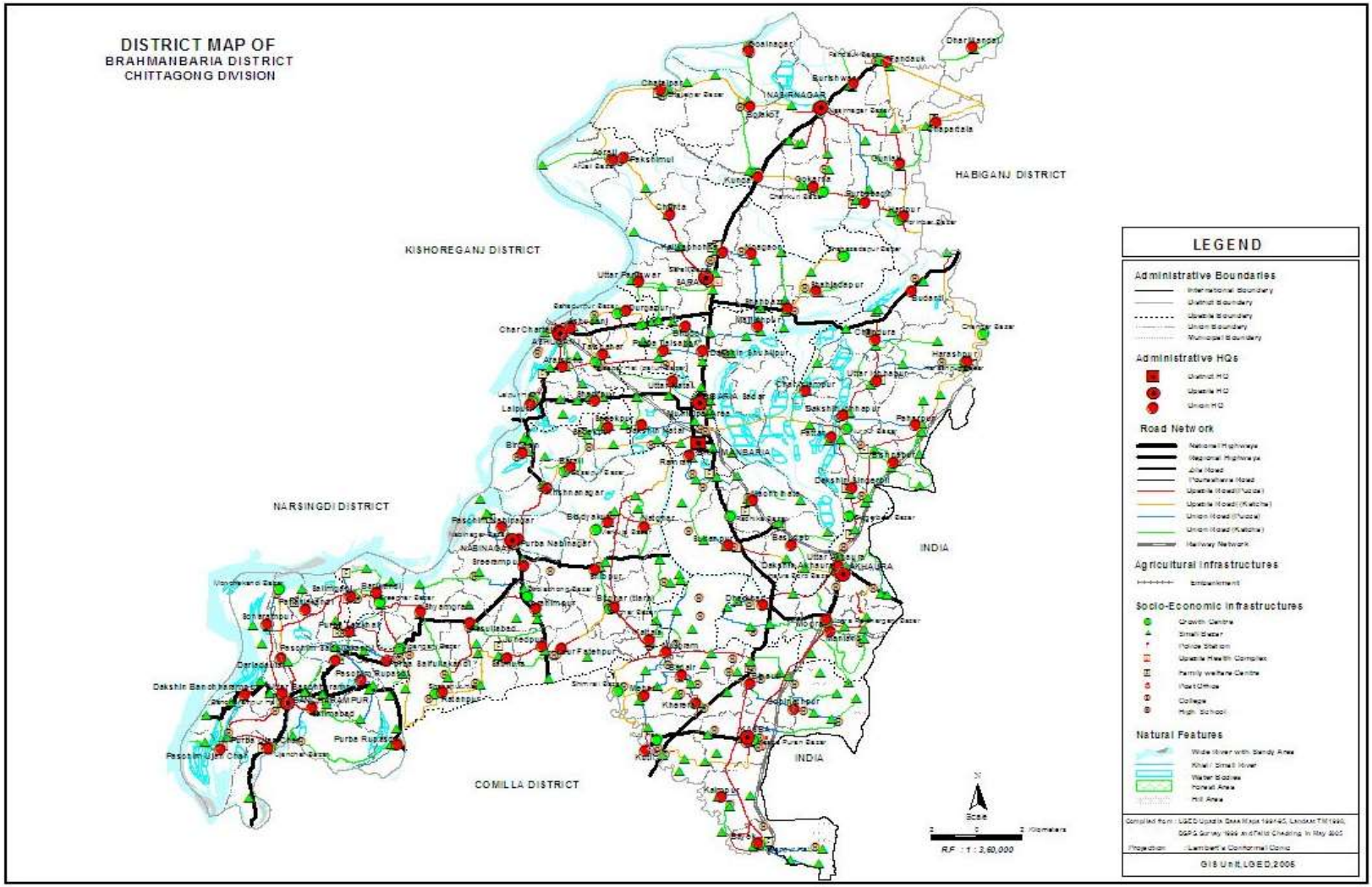


Figure: 2.1 (a) Brahmanbaria District Map

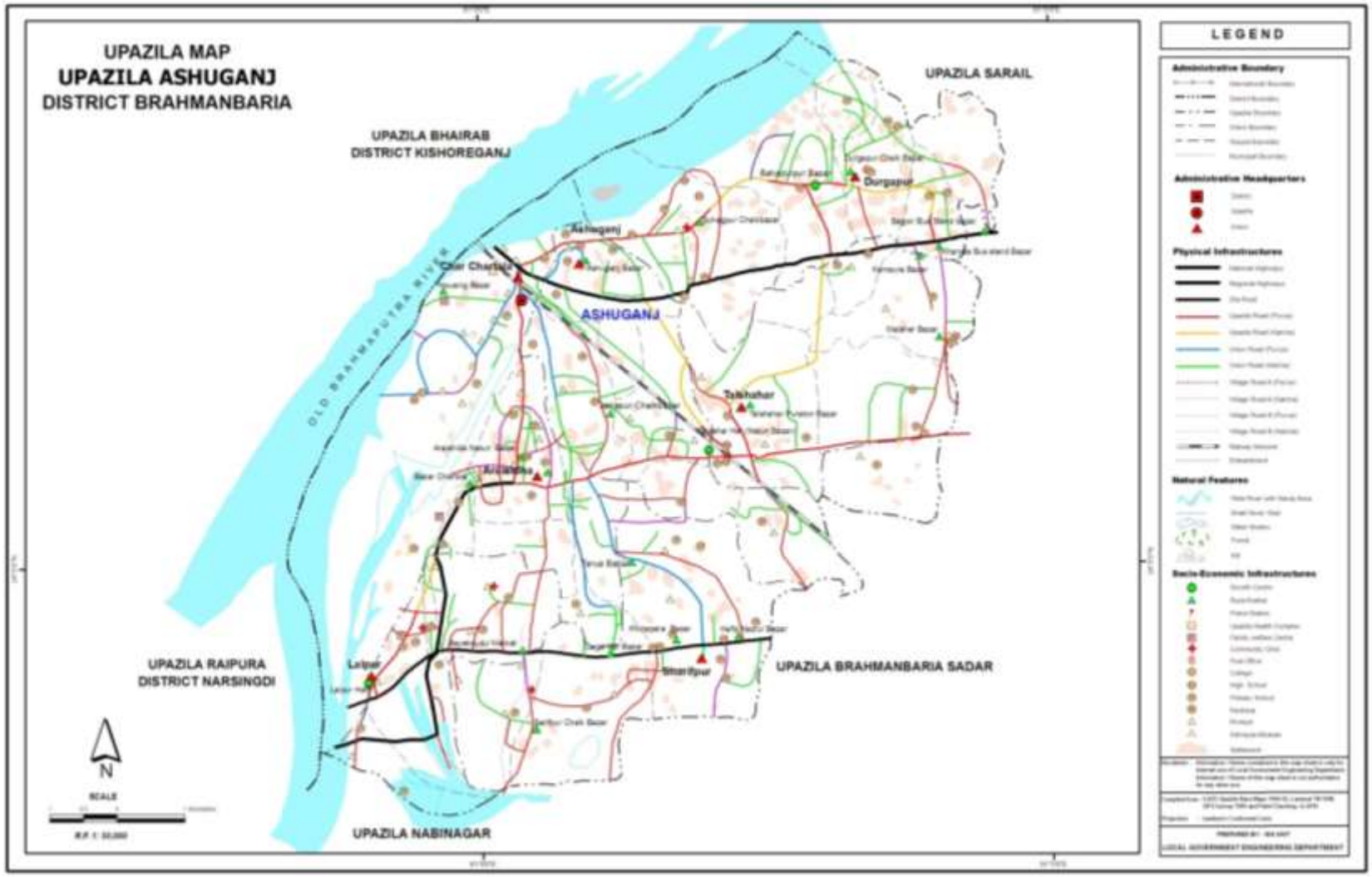


Figure: 2.1 (b) Ashuganj Upazila Map

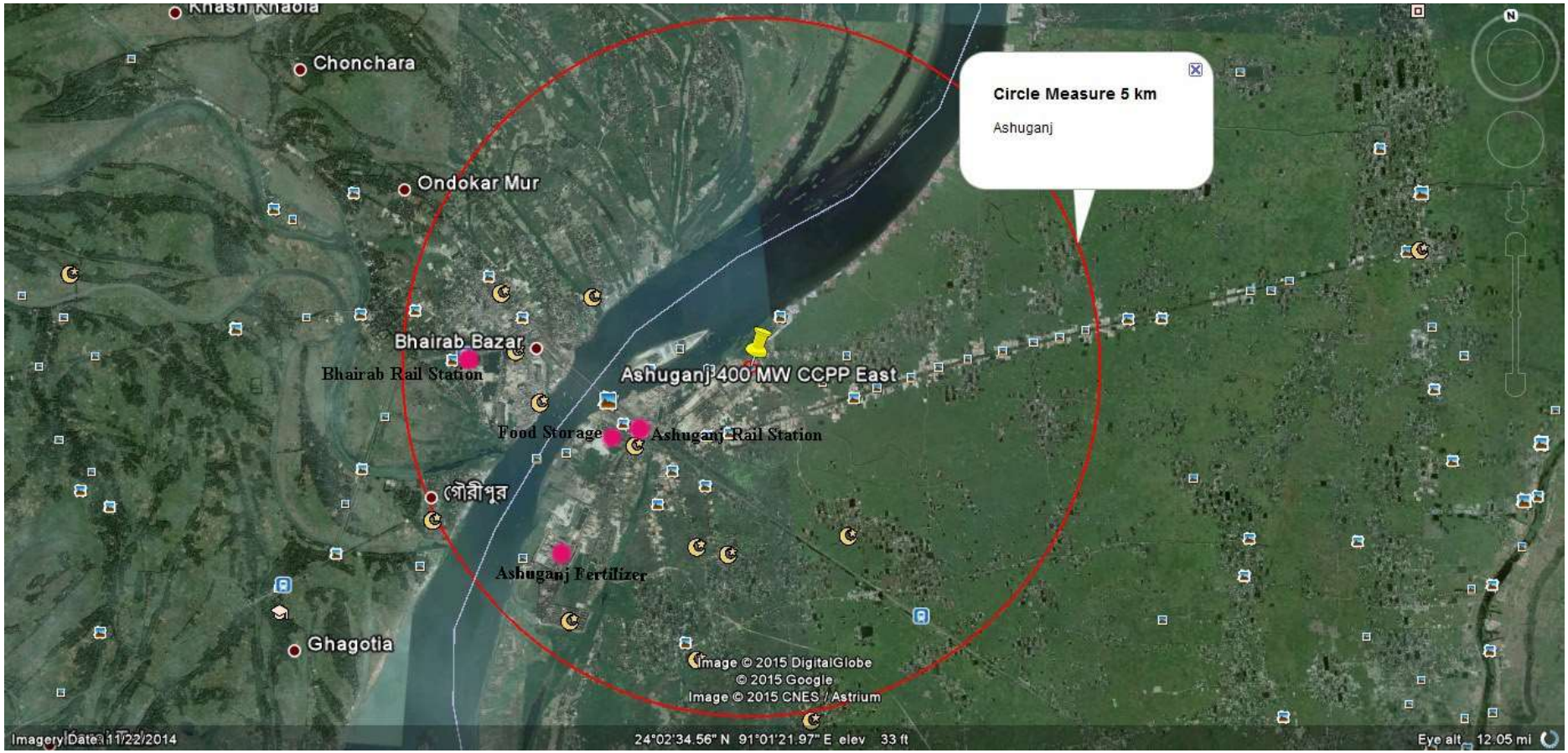


Figure: 2.1 (c) 5 km radius satellite map of the Proposed Project

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

Given the depleting indigenous gas resources in Bangladesh, the government instructed government entities not to build new gas fired power plants which will consume new gas. The total gas allocation by Petrobangla to APSCL is 230 million standard cubic feet per

day (MMSCFD), which can afford around 1,800MW of CCPP. The EIA assessed cumulative impact of 1,725MW power plants including the proposed 400MW. Future proposals for power plants in the complex need to seek additional gas allocation from Petrobangla, which are unlikely without new gas supplies being made available. Therefore, the impacts of the future proposals were not assessed in the EIA.

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 retire 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).**

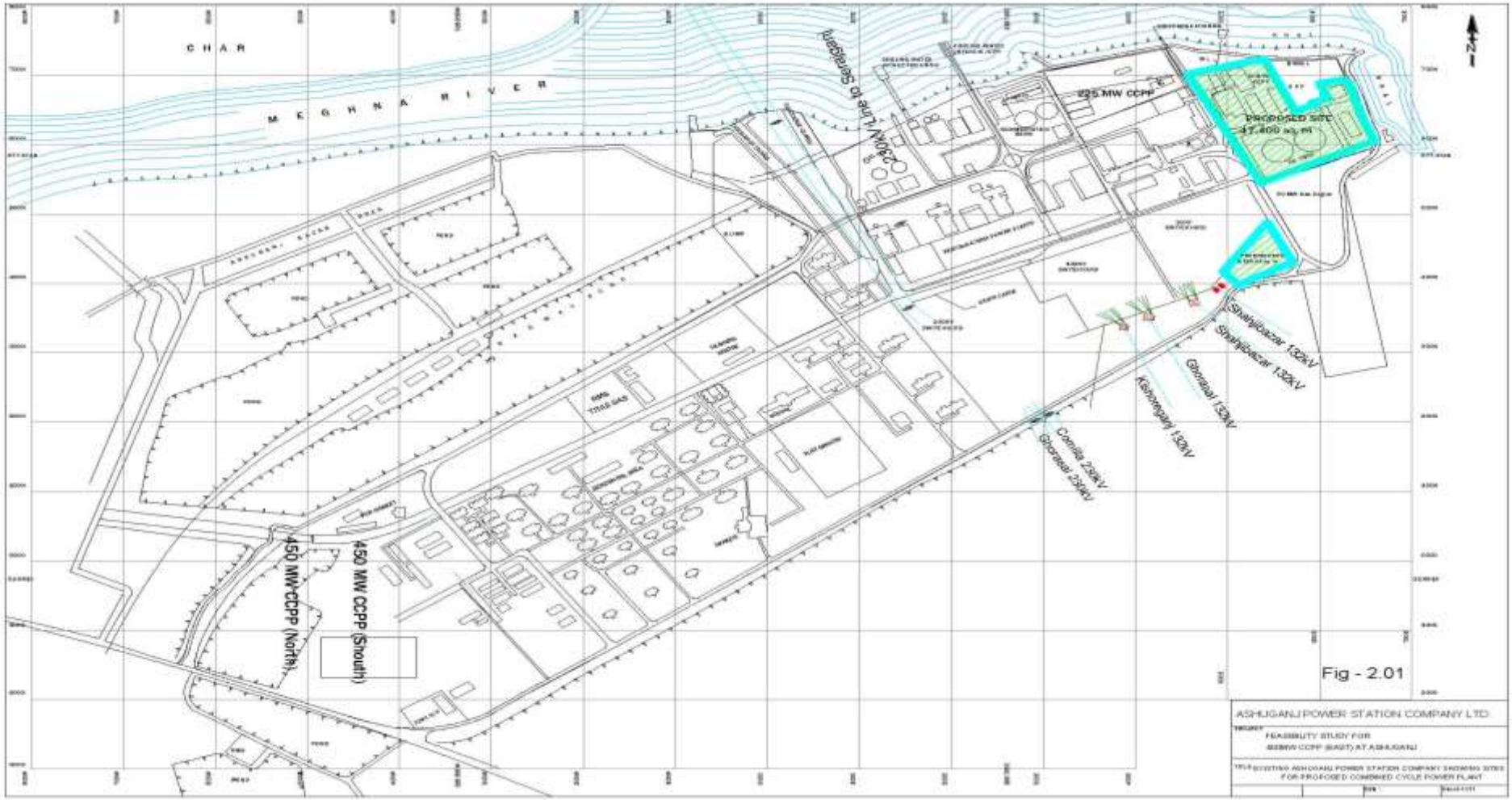


Figure 2.2(a): Existing Power plant beside the Proposed Project

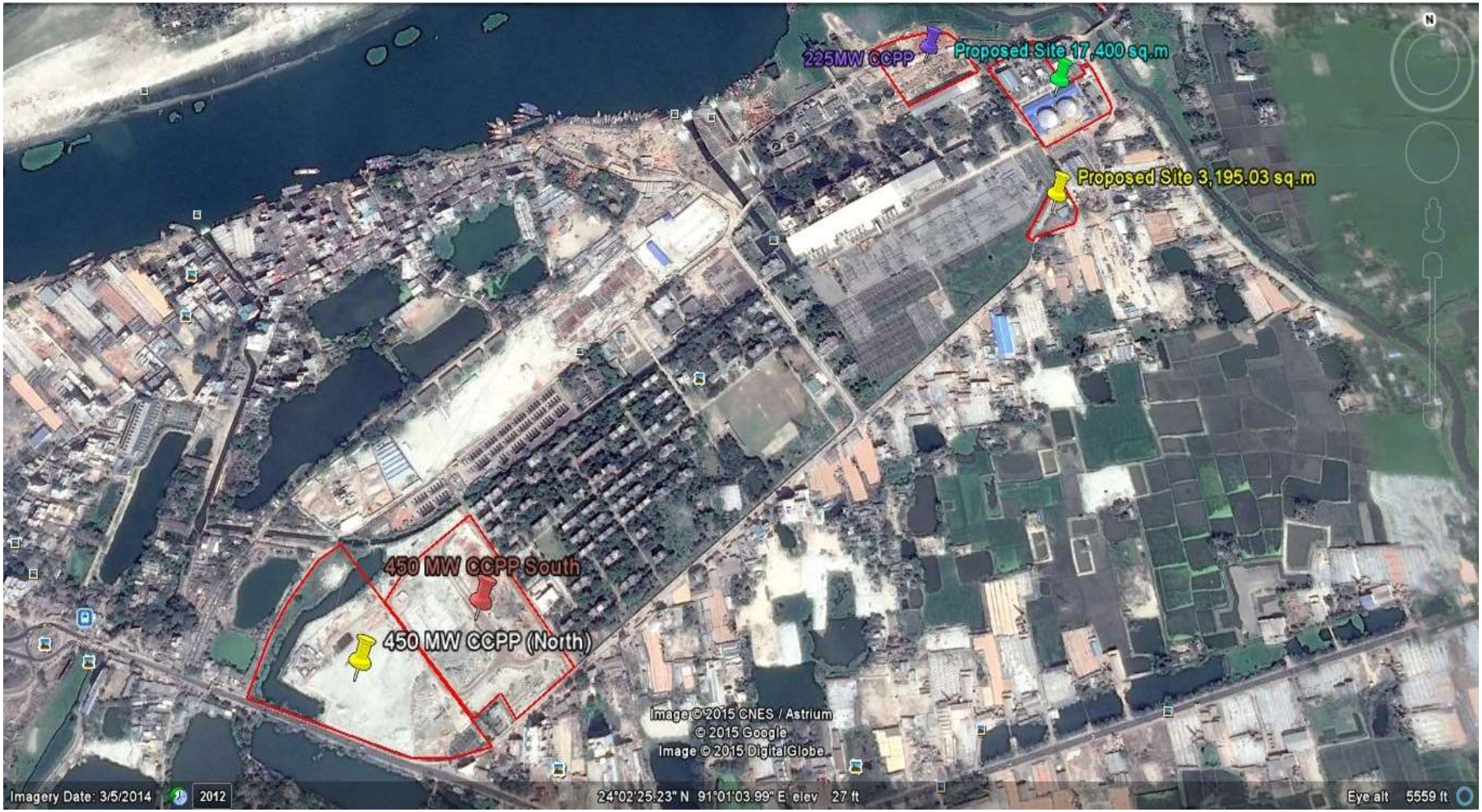


Figure 2.2(b): Satellite image of the existing power plants beside the proposed project

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. Condition survey of roads and bridges will be undertaken prior to start of works to provide a baseline to ensure roads and bridges used by construction traffic will be maintained in at least their current state during construction with any damage immediately repaired. The location map of the proposed project is shown in Fig 2.3.

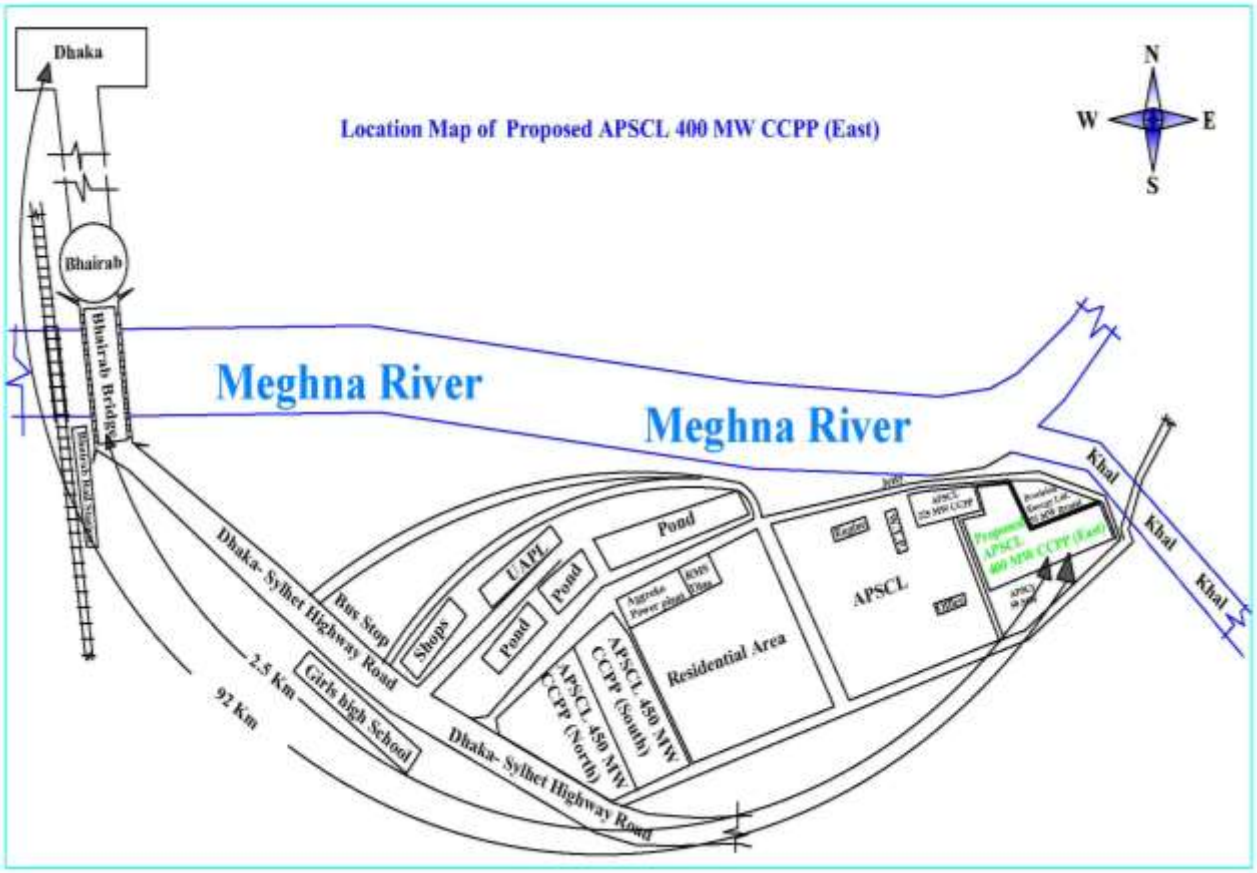


Figure 2.3: Location of the Proposed Project

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 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 (Annexture 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.

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 CO_2 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.

APSCL will coordinate with Power Grid Company of Bangladesh Ltd. (PGCB), EA of Ashuganj – Bhulta 400 kV transmission lines that the EIA of the transmission lines will be updated by PGCB to address the above gaps and that all transmission lines will follow

the EHS guidelines for Electric Power Transmission and Distribution, in particular stand-off distances of EMF.

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 (35ºc, 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 558^0C is selected to maximize energy input to heat recovery steam generator. Dry low NOx Burners, Water injection and catalytic removal system will be installed for limiting NOx emission. 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 587^0C, the maximum pressure and temperature of steam are considered to be 125 bar and 565^0C respectively, with corresponding steam output of 275,000 kg / hour. Care has to be taken to keep the exhaust gas temperature sufficiently above 115^0C 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 35^0C.

Gas turbine nominal output at 35ºC	:	250MW (ISO 288MW)
Exhaust gas temperature at base output	:	587ºC
Exhaust mass flow at base output	:	692kg/ sec
Steam pressure HP system	:	125 bar
Pinch point difference temperature	:	23ºC
Approach point difference temperature	:	16ºC
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. 565^0C 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	565ºC
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	45ºC

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 m^3 of water is required per second to flow through the condenser so as to allow no more than 7^0C 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 7^0C rise of temperature at the condenser discharge point, which is estimated to be 28,500 m^3/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 m^3/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 3^0C rise of temp. The minimum river discharge is 2050 m^3/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 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:ddwn 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. Annexure 17 gives the relevant environmental quality standards of Bangladesh.

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 3.4 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
Chloride	mg/L	150-600
Arsenic	mg/L	0.05
Residual chlorine	mg/L	0.2
Total Coliform	n/mL	0
Fecal Coliform	n/mL	0
Ammonia	mg/L	0.5
Nitrate	mg/L	10
Phosphate	mg/L	6

Source: ECR- Schedule 3

Table 3.3: Ambient Air Quality Standards

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

Source: ECR- Schedule 2 (Amended in 2005)

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

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

Table 3.4 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 3.5 WHO Ambient Air Quality Guidelines

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

Table 3.6 Noise Level Guidelines

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

Table 3.7 Emission Guidelines for Combustion Turbines (in mg/Nm^3)

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

3.5 ENVIRONMENTAL CLEARANCE

Formal 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.

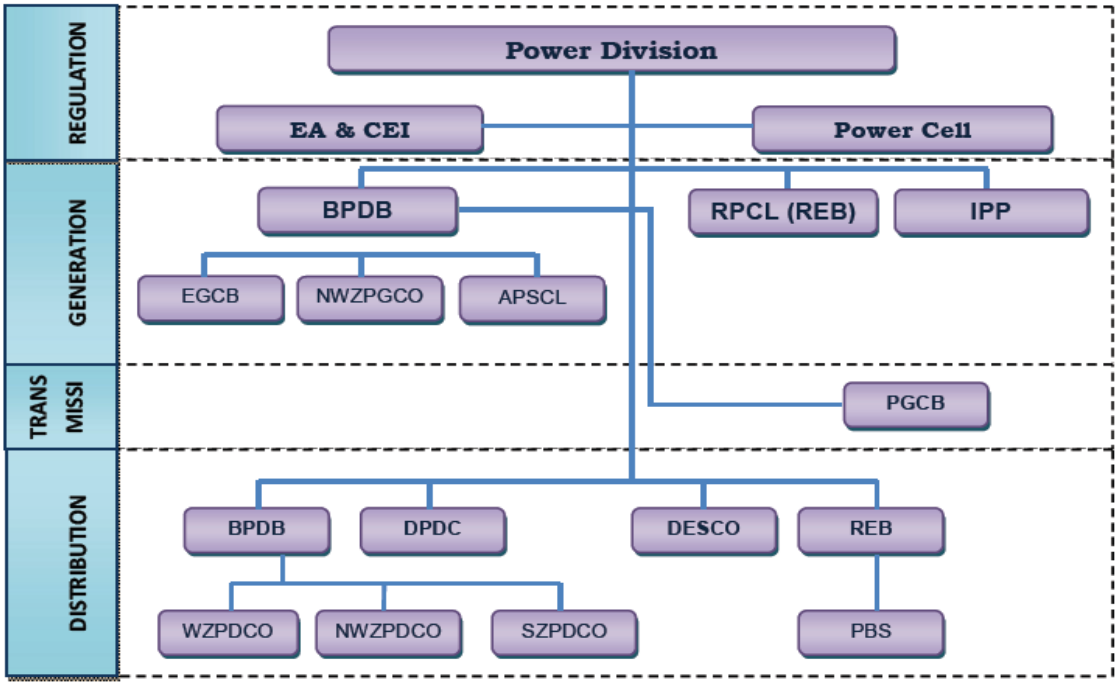
According to Bangladesh Power Development Board (BPDB) presently the installed capacity as on December 2013 in the power sector is 10,213.00 MW, whereas the derated generation capacity is 9,599.00 MW. According to a demand projection analysis, the peak electricity demand is 9,268 MW in 2014, 10,283 MW 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:


REGULATION
GENERATION
TRANS MISSI
DISTRIBUTION
Power Division
EA & CEI
Power Cell
BPDB
RPCL (REB)
IPP
EGCB
NWZPGCO
APSCL
PGCB
BPDB
DPDC
DESCO
REB
WZPDCO
NWZPDCO
SZPDCO
PBS

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 except 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 quality monitoring has been conducted at three different locations (24 Hour Basis). Bangladesh standard for NO_x is an annual average, but annual monitoring is not possible. For comparing with the IFC/WB standard for NO_x, additional monitoring was done on 12.10.2015 on the project site and in the east dormitory. 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 SO_2, 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 54 (1 hr)	110
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 48 (1 hr)	105
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 (SO_2).
5. Carbone Mono-Oxide (CO).
6. Fine Particulate Matter (PM2.5)

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. As the 450 MW project is situated very close to the proposed project, air quality data of that project can be used as reference to understand the air quality surrounding the current project. Data of air quality monitoring for one year of the 450 MW project is presented in Table 4.12 below:

Table 4.12 Ambient Air Quality Analysis of One Year of the APSCL 450 MW (South) Project

SN	*Sample Description*		Ambient Air Pollution Concentration in micro gram/cubic meter.				
		$PM_{2.5}$	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	24	24	24	24
	Unit						
03	Bangladesh (DoE) Standard for ambient Air	65	150	200	365	100	10000
04	International /World Bank Standard	75	150	NF	125	150	NF
05	Test result (Concentration present) in inside Ashuganj Power Complex area.						
	May, 2014	47	103	296	26	29	308
	June, 2014	31	54	181	18	22	142
	July, 2014	34	62	179	19	24	139
	August, 2014	49	134	290	27	39	360
	September, 2014	52	126	247	25	31	320
	October, 2014	44	119	266	27	36	290
	November, 2014	61	139	310	31	39	314
	December, 2014	63	141	307	29	36	294
	January, 2015	57	136	297	28	33	280
	February, 2015	51	123	312	30	34	256
	March, 2015	59	97	214	28	39	240
	April, 2015	55	108	291	27	36	232
	Annual average	50	112	266	26	33	265
Remarks			Pollution source from normal activities				

From the above analysis it has been observed that air quality surrounding the proposed project for the past year was satisfactory under both domestic and international standards except the parameter SPM. But the apparent exceeding of SPM level is supposedly due to the ongoing construction works around the entire Ashuganj Power Complex. Otherwise it can be said that the air pollution is low in the complex.

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

Adroit Environment Consultants Ltd, Mohammadpur, Dhaka-1207, Bangladesh

AECL LABORATORY ANALYSIS REPORT
AMBIENT AIR QUALITY TEST REPORT

Memo # AECL : 474
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.

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
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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 was completed and therefore the dust emission is now minimum and the EPC Contractor is also following the mitigation measures to reduce the SPM. This reduction is not due to the effect of the monsoon in action.

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 4.13.

Table 4.13: 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.

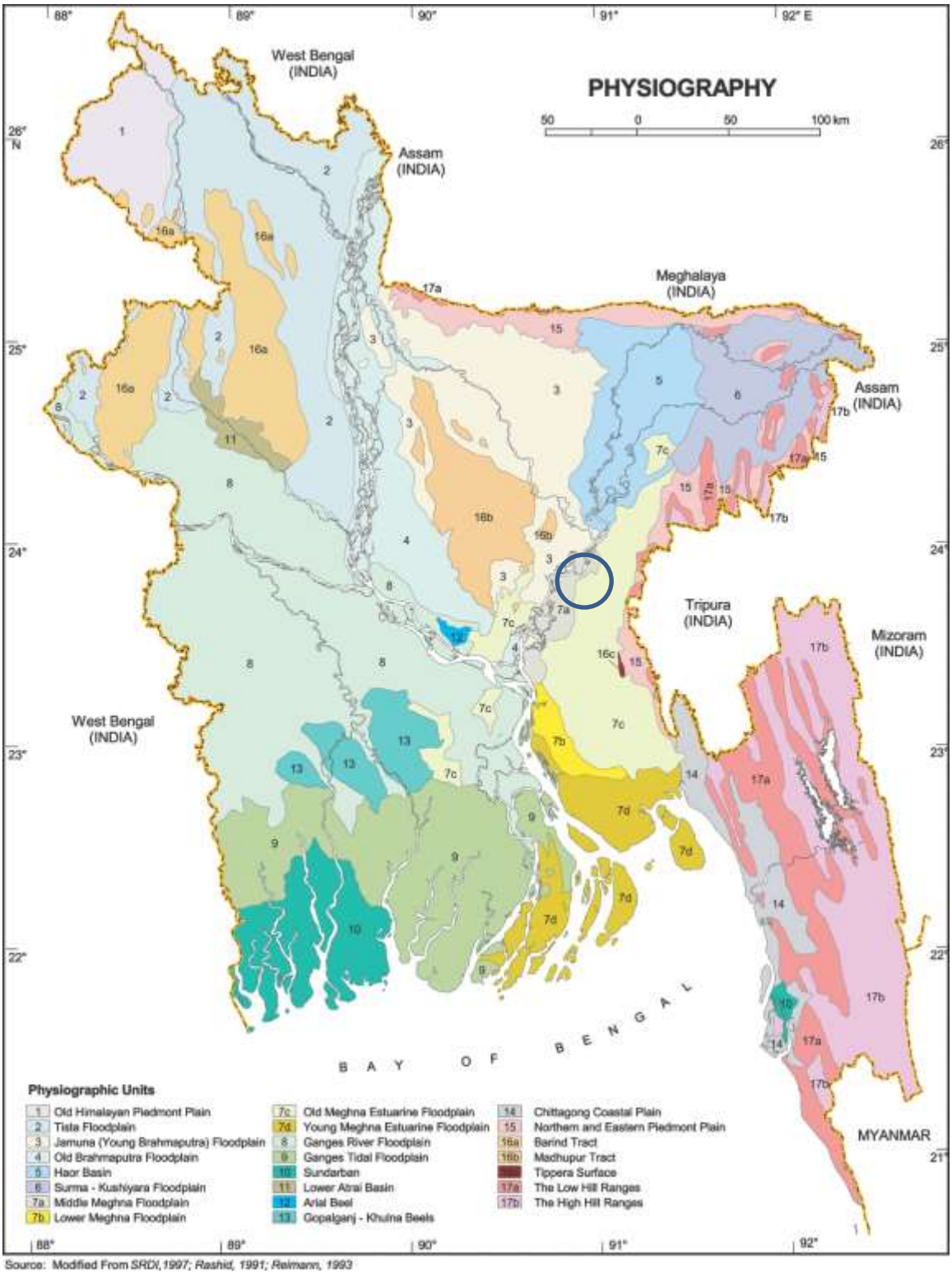
Figure 4.1: Air and Noise Monitoring Locations near the Project

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.



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

Fig. 4.2 Physiographic Map of Bangladesh

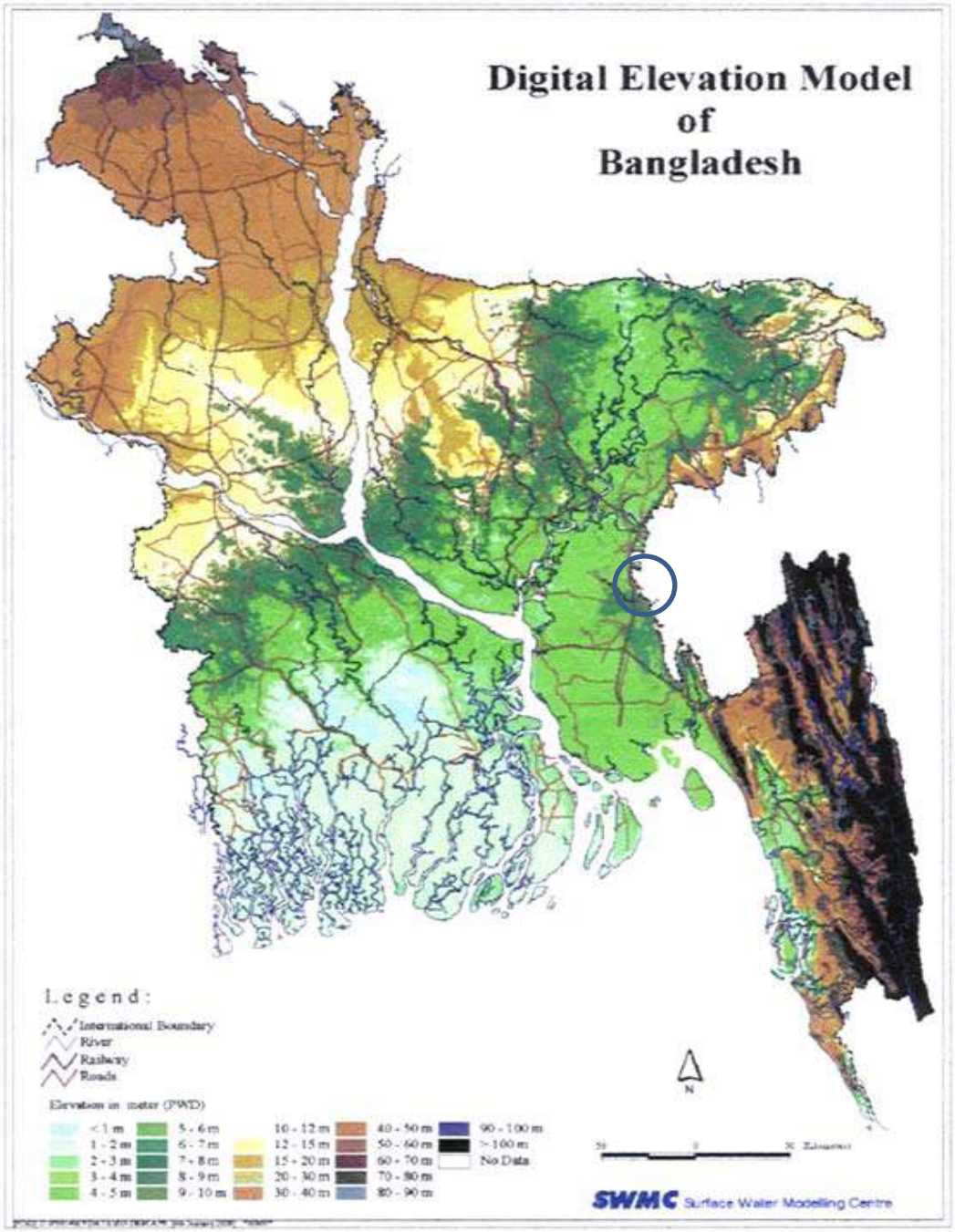


Fig. 4.3 Digital Elevation Model of Bangladesh

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**).

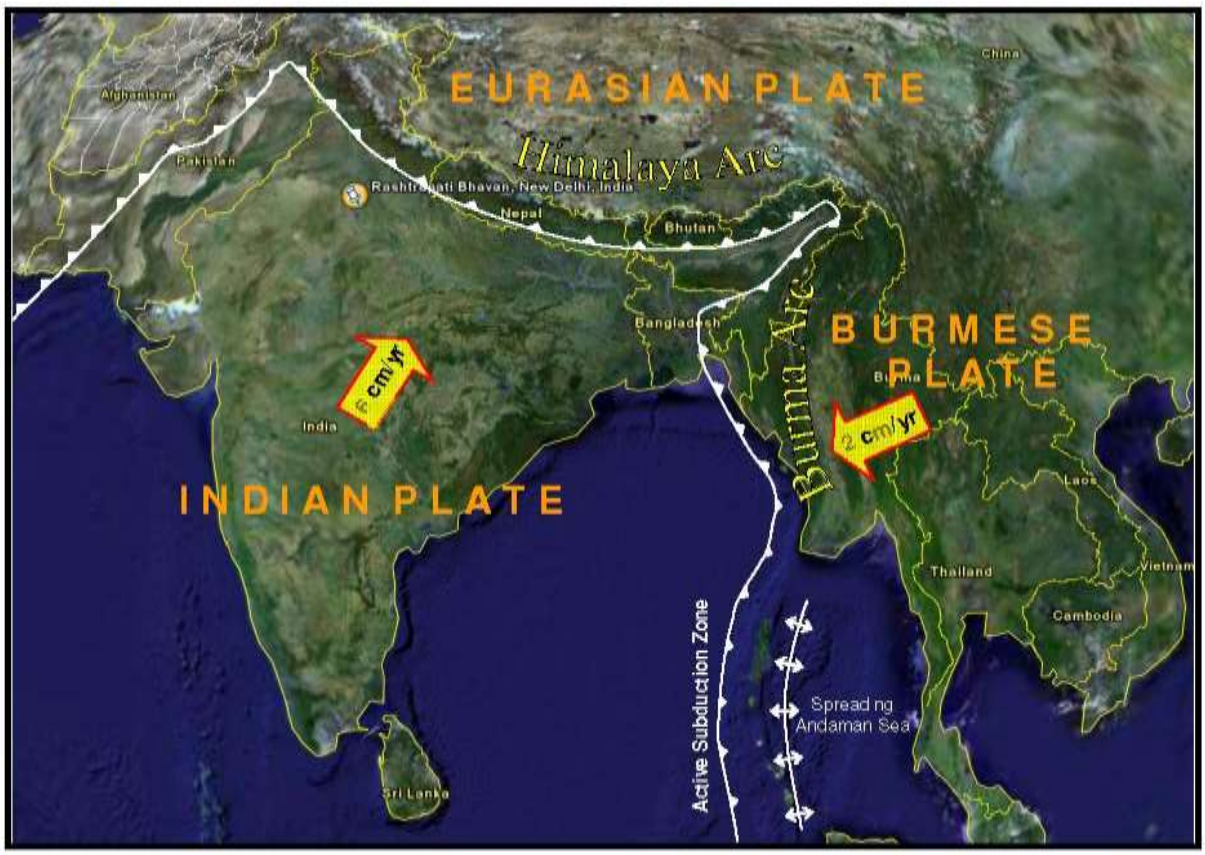


Fig. 4.4: Regional tectonic setup of Bangladesh with respect to plate configuration

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.

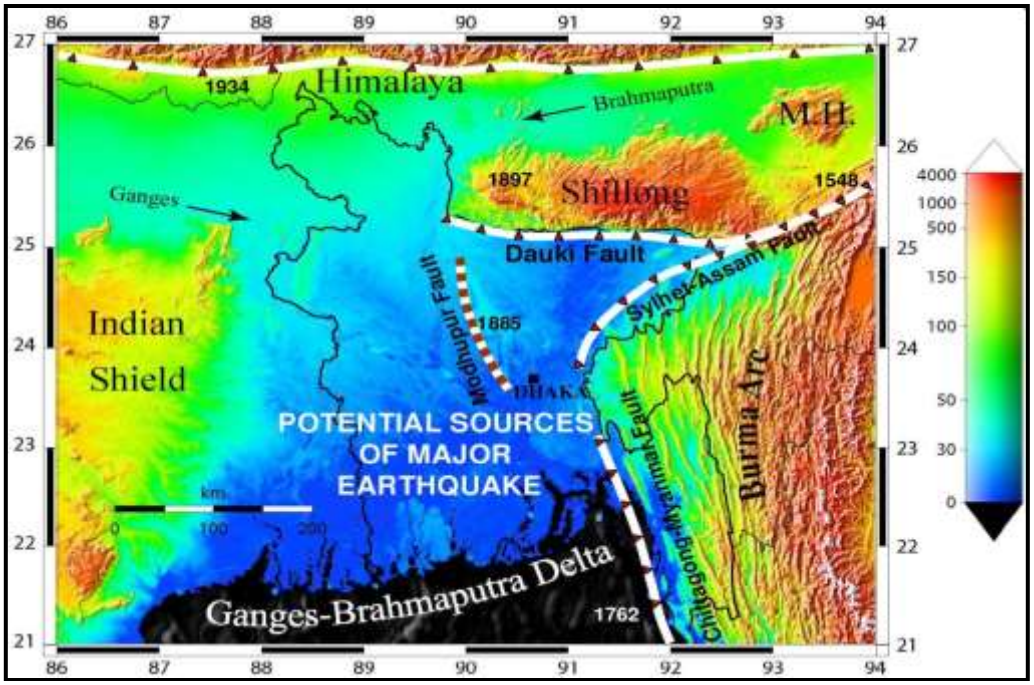


Fig. 4.5: Digital Elevation Model (DEM) of Bangladesh and surroundings showing geological faults – potential sources of major earthquakes in Bangladesh.

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.

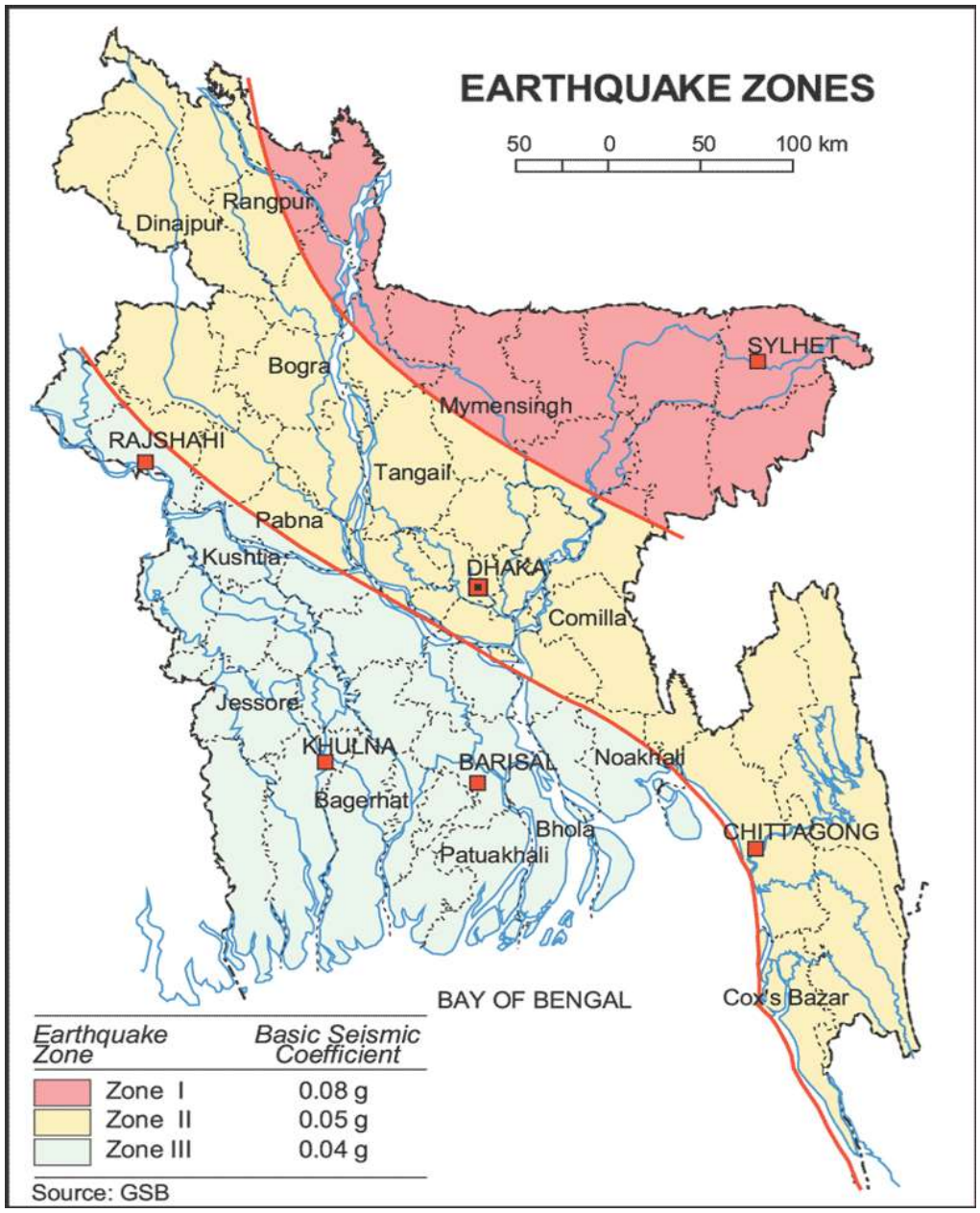


Fig 4.6 Earthquake Zoning Map of Bangladesh

Table 4.14 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

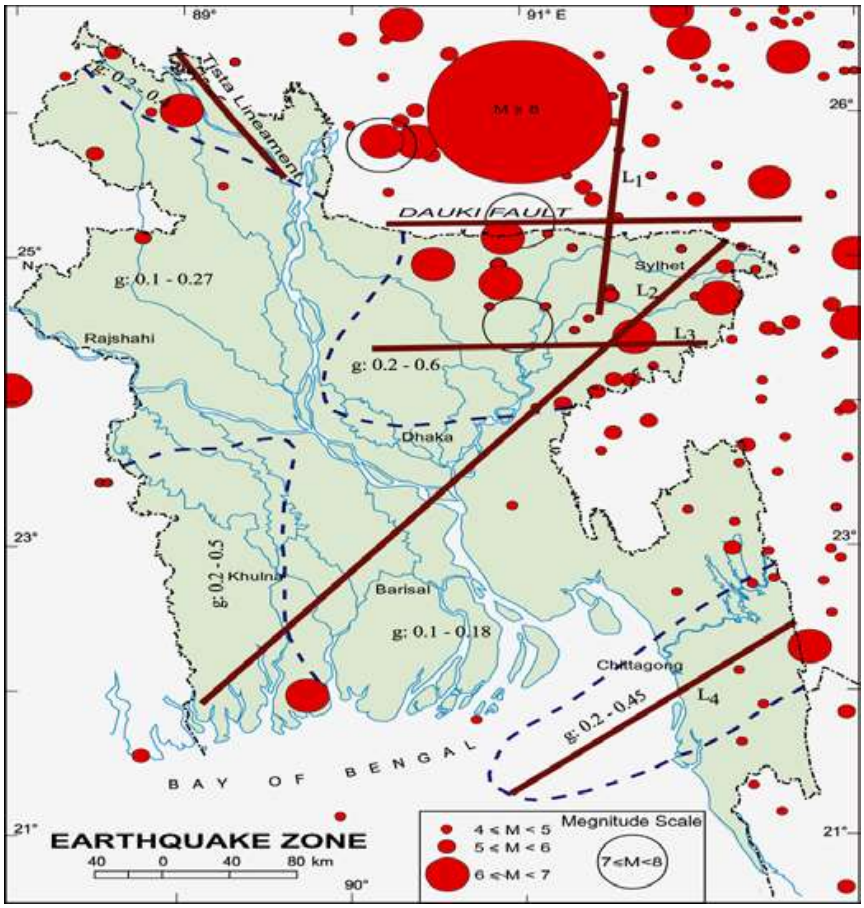


Fig. 4.7 Seismic Activity of Bangladesh

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 16558m^3/sec was measured on 9th September 2002; while the minimum discharge of 2050m^3/sec was recorded on 10th June, 1998. The water data collected from BWDB for the period from 1998 to 2006 is attached in **Table 4.15.**

Table 4.15: Flow at the Meghna River (m^3/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 4.16**). 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 inland surface water standards. BOD is on a high side for fishery. 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 4.16.

Table 4.16 Surface Water quality (limited parameters) of the River Meghna

Name of the Parameter	Concentration present	DoE (Bangladesh) Standard *	DoE Standards for Fishery	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	5 or more	NF	Azide modification
BOD_5	**7 mg/L**	50 mg/l	6 or less	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	6.5 – 8.5	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 Electrod
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 the 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 4.17.

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

Table 4.17: 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 $CaCO_3$)	**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	<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 4.18.

Table 4.18: 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. Project design should ensure that the impact on ecology is not detrimental to the current situation.

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 4.19.

Table 4.19 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 (^{o}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 4.20. 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 4.20 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 4.21. 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 4.21 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	*Pila globosa*	Gastropoda	Mesogastropoda	Pilidae	++	+	LC
Brotia snail	*Brotia costula*	Gastropoda	Mesogastropoda	Pilidae	+++	++	LC
Banded river snail	*Bellamya bengalensis*	Gastropoda	Prosobranchia	Viviparidae	++	+	LC
Fresh water mussel	*Parreysia corrugata*	Bivalvia	Unionoida	Unionidae	+	+	LC
Fresh water mussel	*Parreysia caerulea*	Bivalvia	Unionoida	Unionidae	++	+	LC
Fresh water mussel	*Lamellidense marginalis*	Bivalvia	Unionoida	Unionoidae	+++	++	NE
Fresh water mussel	*Lamellidense jenkinsianus*	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 4.22. We were not able to capture any single big fish. Names of fishes available at other seasons of the year are presented in table 4.23. 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 4.22 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	*Ompoc pabda*	+	NE
Golsha	*Mystus cavasius*	+	LC
Bele	*Glossogobius giuris*	+	LC
Tengra	*Mystus vittatus*	++	LC
Puti	*Puntius conchonius*	++	LC
Fali	*Notopterus notopterus*	+	LC
Kachki	*Corica suborna*	+	NE
Mola	*Amblypharyngodon mola*	+	LC
Kakila	*Xenentodon cancila*	+	LC
Chapila	*Gudusia chapra*	++	LC
Kholisha	*Colisha fasciatus*	++	NE
Chingri	*Macrobrachium eqidense*	+	NE
Shol	*Channa striatas*	+	NE
Taki	*Channa punctatus*	++	NE
Shing	*Heteropneustes fossilis*	+	LC
Koi	*Anabas testudineus*	+	DD
Mola	*Amblypharyngodon mola*	+	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 4.23 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	*Labeo rohita*	+	LC
Katla	*Catla catla*	+	NE
Kalibaush	*Labeo calbasu*	+	LC
Boal	*Wallago attu*	+	NT
Ayre	*Sperata aor*	+	LC
Bain	*Mastacembelus armatus*	+	LC
Chital	*Chitala chitala*	+	NT
Meni	*Badis badis*	+	LC
Batashi	*Neotropius atherinoides*	+	LC
Poa	*Otolithoides pama*	+	NE
Ilish	*Tenualosa ilisha*	+	LC
Fasha	*Setipinna phasa*	+	LC
Shilon	*Silonia silondia*	+	LC
Bacha	*Eutropiichthys murius*	+	LC
Bata	*Liza Persia*	+	NE
Chela	*Chela cachius*	+	LC
Gozar	*Channa marulius*	+	LC
Magur	*Clarius batrachus*	+	NE
Dari	*Scistura scaturigina*	+	NE
Kanpona	*Aplocheilus panchanx*)	+	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 4.24 and 4.25. Slightly higher number of phytoplanktons were recorded from the outlet water samples (Table 4.24). 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 4.24 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	-
Chrooccus	5	6.25
Gloeocapsa	2.75	-
Microcystis	4	7.5
Coelosphirum	1.25	1.25

Table 4.25 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 4.26 Avifauna observed near the surveyed river

English Name	Scientific Name	IUCN Status
Pond Heron	*Ardeola grayii*	LC
Little Cormorant	*Phalacrocorax niger*	LC
Black Kite	*Milvus migrans*	LC
Brahminy Kite	*Haliastur Indus*	LC
Red Vented Bulbul	*Picnonotus cafer*	NE
House Crow	*Corvus splendens*	LC
Tailor Bird	*Orthotomus sutorius*	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 4.27 List of aquatic vegetation seen in the visiting site

Common Name	Scientific Name	Intake point	Outfall point	IUCN Status
Water hyacinth	Echhornia crassipes	++	+	NE
Ipomea	Ipomea aquatica	+	+	NE
Helencha	*Alternanthera philoxeroides*	+	-	LC
Duckweed	Spirodela 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 28. These species should be conserved for ecological balance.

Table 4.28 List of vegetation (Herbs and Shrubs) grown near the visiting site

Local Name	Scientific Name	IUCN Status
Junka	*Sida cordata*	NE
Banmorich	*Croton bonplandianum*	NE
Fulkuri	*Ageratum conyzoides*	NE
Kanai	*Commelina erecta*	LC
Notey Shak	*Amaranthus viridis*	NE
Ban-palang	*Rumex dentatus*	NE
Durba	*Cynodon dactylon*	NE
Chanchi	*Alternanthera sessilis*	LC
Ghagra	*Xanthium indicum*	NE
Vat	*Clerodendrum viscosum*	NE
Kutus Kata	*Lantana camara*	NE
Verenda	*Ricinus communis*	NE
Kanta begun	*Solanum sisymbriifolium*	NE
Bish Katali	*Persicaria hydropiper*	LC
Nakful	*Synedrella nodiflora*	NE
Bara-Halkus	*Leucas cephalotes*	NE
Bondhoney	*Scoparia dulcis*	NE
Joshorilata	*Mikania cordata*	NE
Helencah	*Altenanthera philloxiroides*	NE
Sitki	*Phyllanthus reticulatus*	NE
Pichas-Ban	*Lippia aka*	NE
Ban-Ghagra	*Urena lobata*	NE
Lalverenda	*Jatropha glandulifera*	NE
Dhekia	*Christella dentata*	NE
Dhanighas	*Brachiaria reptans*	LC
Tridhara	*Tridax procumbens*	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 4.29 & 4.30.** 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 4.29, Table 4.30 and Table 4.31 respectively.**

Table 4.29 Population and demographic characteristics surrounding the project area (Zila, Upazilas and Paurashavas)

Sl	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 -	2398254	625484	271101	145,828	2594954	247166
	Male - Female	1205552	318579	136240	74,191	1320117	125621
		1192702	306905	134861	71,637	1274837	121545
5	Household Size						5.3
	-Rural	5.58	5.7	5.5	5.5	4.9	5.3
	-Urban	5.59	5.7	5.6	5.5	4.8	5.3
		5.52	5.7	5.3	5.3	5.0	
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	320	76	30	953	32
		97	34	-	-	147	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	4	1	-	-	4	1
	Paura Ward	39	12	-	-	39	12

Source: Population Census 2011

Table 4.30 Population and demographic characteristics surrounding the project area unions of Ashuganj and Bhairab Upazila

Ashuganj Upazla								
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 -Female	30282 16054 14228	15482 7740 7742	23555 12500 11055	26831 13691 13140	14201 7069 7132	17954 8971 8983	17523 8166 9357
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.4.31 Population and demographic characteristics surrounding the project area Pourashava Unions of Bhairab Upazilas

Sl	**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 - Female	93254 48764 44490	27306 13964 13342	23128 11411 11717	26906 13435 13471	29914 14674 15240	25567 12973 12594	21091 10400 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 4.32).

Table 4.32 Population of the Project Upazila

Upazila	Area (km_2)	Total Household (No)	Population (No)	Male (No)	Female (No)	Literacy 7+ (%)	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 Bramanbaria 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 4.33. The community is predominantly Muslim.

Table 4.33 Type of Religion of the sample households Bhairab Upazila

Upazila	Total H.H	Muslim	Hindu	Buddists	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 4.34).

Table 4.34 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 4.35 below shows the pattern of the ownership of residence.

Table 4.35 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 Chatals 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. 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. The tube wells of the Ashuganj Upazilla will not be affected by the discharge of wastewater from septic tank. Some local people at river side use river water for bathing.

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 4.38 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 4.36 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- 4.37 Access of sanitary Latrine as per households

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

Table 4.38 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%

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 4.39).

Table 4.39 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: 4.40 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%. Dakhshin 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 4.41 verifies this statement.

Table 4.41 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 4.42 & 4.43 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 4.42 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

Table 4.43 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 4.44.

Table 4.44 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 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
	Soil contamination			x		x		Demolishing of Unit 3 may cause soil contamination
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	x						No wildlife in the area; no impact

	passage							
	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.

* A buffer strip is an area of land maintained in permanent vegetation that helps to control air, soil and water quality, along with other environmental problems, dealing primarily on land that is used in agriculture. The proposed project does not have such lands for permanent vegetation. Few scattered tree plantation has been done. The plantation should make plantation fencing the project site.

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. Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor.

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 constriction 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.
-

<u>Handling and Mixing of Cement</u>

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 aliment; 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 plank.

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 laud 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 (toilets and bathrooms equipped with hand washing facilities, and separate facilities for man and women) should be provided and at the same time, proper and safe disposal of human waste (to septic tank) 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 toilets and bathrooms must be properly equipped including hand washing facilities and with separate facilities for men and women. Talks on sanitation will be held for workers to encourage cleanliness. 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 treates 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 necessaries. Harnesses and scaffold barriers for work at height will be provided. Segregation of pedestrians and traffic on-site will be segregated.

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

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 (SO_2), oxides of nitrogen (NO_X), carbon monoxide (CO) and Carbon dioxide (CO_2). CO_2 emissions cause greenhouse gas emission responsible for rise to global temperature.

Sulfur dioxide (SO_2) 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. Annexure 2 gives the natural gas specifications. The natural gas found in Bangladesh has no sulphur content and no hydrogen sulphide.

Nitrogen Oxides (NOx) emissions: Burning of fossil fuels at high temperature (above 1600^0C) generally produces two forms of nitrogen oxides-nitric oxide (NO) and nitrogen dioxides (NO_2); commonly referred to as nitrogen oxides (NOx). Since the gas turbine intakes excess air to the tune of 127% more than required for combustion, and if a fully premixed burner (dry low NOx burner DLN) is used there will be no NOx since the combustion temp is much less (2402^0F ≈ 1317^0C) in the case of such a turbines. The proportion of NOx and NO_2 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 NO_2. Once the NO enters the atmosphere, it reacts with oxygen in the air and oxidises to NO_2 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 (CO_2) emission: Emission of CO_2 is associated with global warming. CO_2 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 CO_2 and heat; At full capacity CO_2 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 CO_2 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**
CO_2 Emission, (t CO_2 / GWh)	342.1	355	39	**348-374**

*CCS-Carbon capture and storage

The CO_2 emission factor for Ashuganj 400 MW CCPP 342.1 tCO_2/GWh. Assuming 85% plant load factor, the total annual CO_2 emissions of Ashuganj 400 MW CCPP is estimated to be 1,018,910.64 tCO_2/year:

0.40 GW x 8760 hours/year x 0.85 = 2978.4 GWh/year
2978.4 GWh/year x 342.1 tCO_2/GWh=1,018,910.64 tCO_2/year

Particulates: As shown in Annexure 2, natural gas being used has no particulate matter content. Hence, no further analysis on particulates is needed. The previous stack emission result showed some PM emissions, this could be resulted due to the accidental mixing of stack emissions with the ambient air.

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 SO_2 would not be a concern in terms of emission. The NOx 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 NOx (DLN) burner with premix burning system which restricts the combustion temperature to 1316^0C which is much below the NOx forming temperature (1600^0C). The proposed power plant will produce 25 ppm NOx emission from the 289 MW turbine which will be within the IFC/WB emission limit of 51 mg/Nm3 (25ppm) with15% O2, for gas turbine power plants more than 50 MWth located in the degraded or non-degraded air shed. As per Bangladesh ECR 1997, the NOx emission standard of gas turbine power plant within 200-500 MW is 40ppm irrespective of O_2 content which is also higher than 25ppm.

For the emission standard, please check 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 NO_2 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 NO_2 emissions. The 65m stack height has been determined using good international industry practice as set out in the World Bank EHS Guidelines. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO_2 concentration contour has been analyzed with 500 m interval with a radius of 5000m from the point source. The NO_2 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 NO_2 concentration contour of 1 hour and annual average of maximum concentration have been analyzed. The maximum of 1 hour concentration of NO_2 (10-18 µg/m^3) 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/m^3 to 3 µg/m^3 uniformly surrounding the project within 4000m from the stack. The concentrations will be further below to 3 µg/m^3 beyond 4000m around the project. The maximum annual concentration of NO_2 has been detected as 0.50-0.60 µg/m^3 at 1000m to 5000m west to the project, whereas the concentration are below 0.50-0.10 µg/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 (10-18 µg/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 µg/m^3) for 1 hour concentration. The maximum annual concentration of NO_2 has been found 0.50-0.60 µg/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 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

Table 6.3 Predicted NOx Concentrations (ug/m^3)

Distance Downwind	
1-hour (ug/m^3)	
0-1500 meters all sides	10-18
1500-4000 meters all sides	3-10
Beyond 4000m all sides	<3
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)	
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 (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/m^3 = micrograms per cubic meter

The maximum 1-hour background NO_x level is about 54 ug/m^3. When adding the background level, the maximum 1-hour NO_x level when the project is in operation will be around 72 ug/m^3, which is within World Bank limit of 200 ug/m^3. As for the annual NO_x level, the annual average contribution from the project is not more than 0.60 ug/m^3. When adding the maximum annual background level of 26 ug/m^3, the annual NO_x level will be around 27 ug/m^3, which is below the World Bank limit of 40 ug/m^3.

Figure 6.1 and 6.2 are the emission contour maps of the proposed project at 1 hour and annual average of NO_2 concentration at 65m stack height:

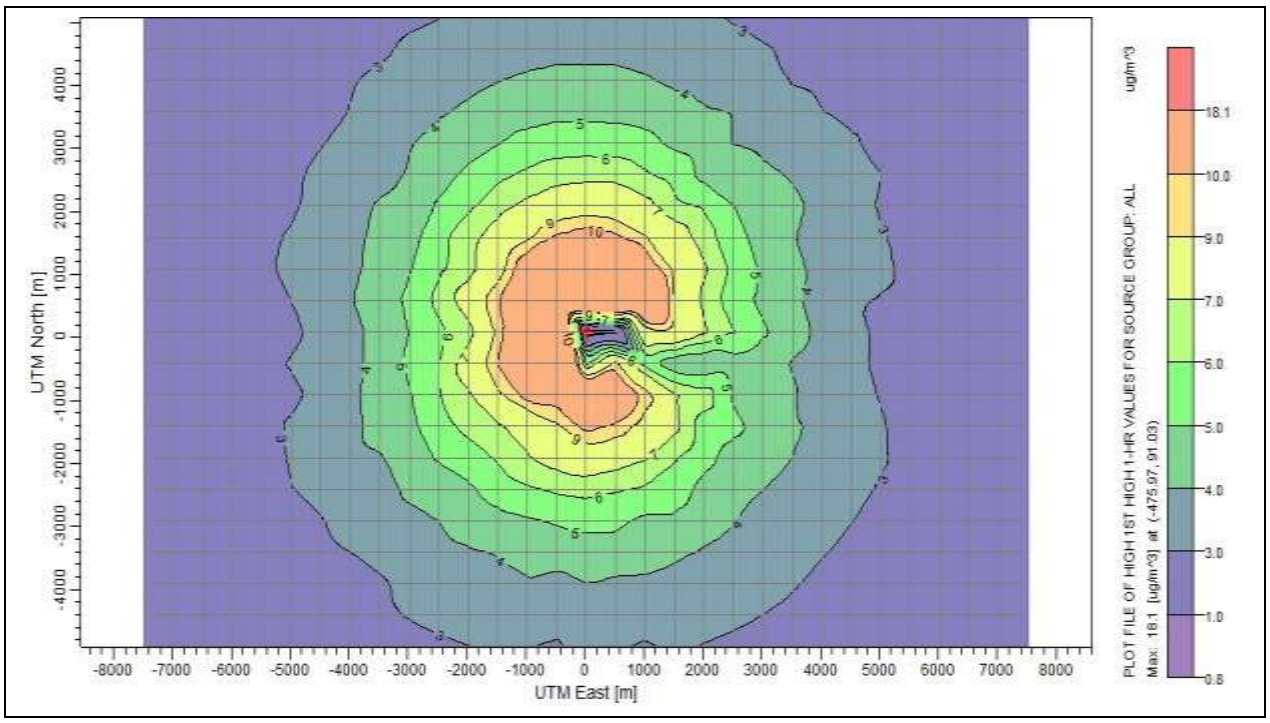


Figure 6.1: Emission contour map showing the NO_2 concentration (1 hour average)

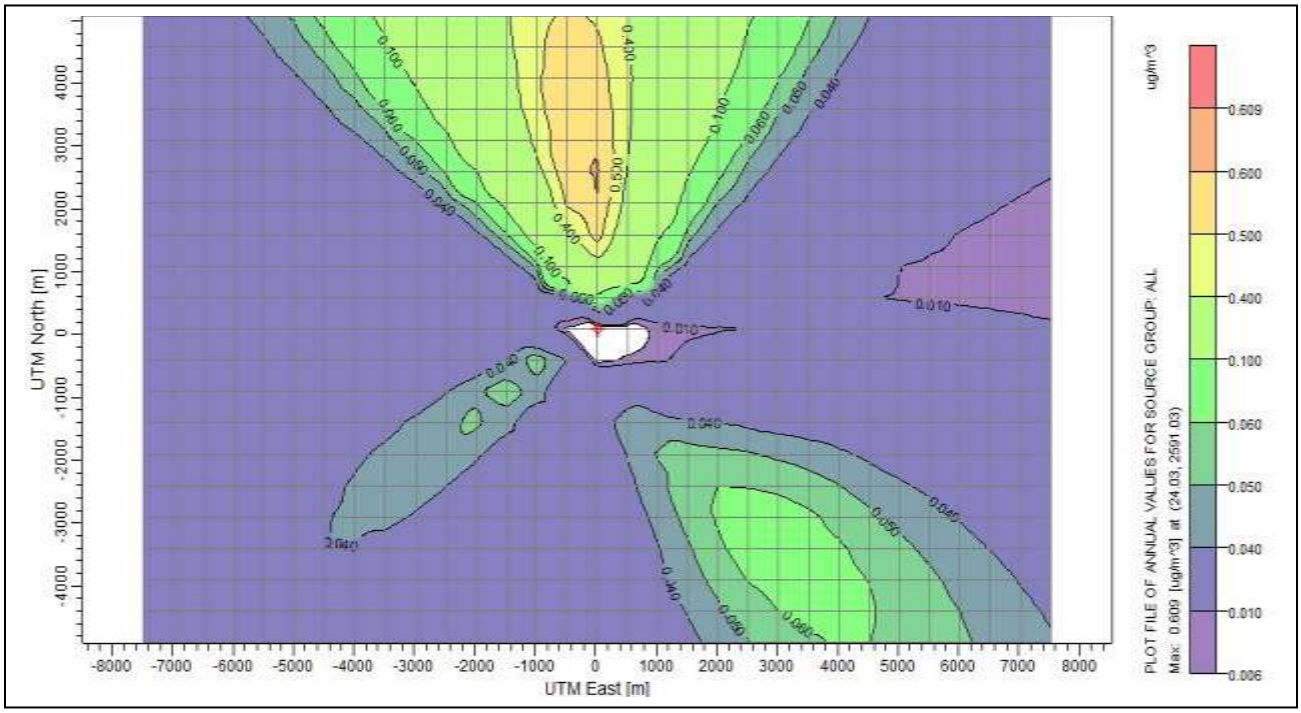


Figure 6.2: Emission contour map showing the NO_2 concentration (annual average)

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 NO_2 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 NO_2 concentration contour has been analyzed with 500 m interval with a radius of 5000m from the point source. The NO_2 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* (m3/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 (m3/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 (m3/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

* Old power plants were not considered when calculating the NO_2 emission rate due to the lack of data (NOx emission rate, velocity and flow rate). Only the newly built projects and proposed projects were considered in the cumulative impact assessment. APSCL confirms that the old generators will be replaced by these new projects step by step. Therefore, the old generators won't be in operation when the new ones are in place.

Dispersion Model results:

The NO_2 concentration contour of 1 hour and annual average of maximum concentration have been analyzed. The maximum of 1 hour concentration of NO_2 has been predicted below 100-153 µg/m^3 at a radius of 0-1000m around the project, whereas the concentrations are within 50-100 µg/m^3 from 1000-3000m around the project site and the concentrations are below 50 µg/m^3 has been predicted at further down beyond 400m radius. The maximum annual concentration of NO2 has been detected as 10-20 µg/m^3 at a radius up to of 3000m west to the project forming a pocket whereas the concentration are within 5-0.30 µg/m^3 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 NO_2 is 100-153 µg/m^3 at a radius of 0-1000m around the project which is within the IFC standard (200 µg/m^3) for 1 hour concentration. Since this is not an individual contribution to air shed and no other major NOx polluting sources exists within the air shed, the calculated concentration may be compared with the standard.

The maximum annual concentration of NO_2 has been found 10-20 µg/m^3 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 NOx Concentrations (ug/m^3)

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/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:

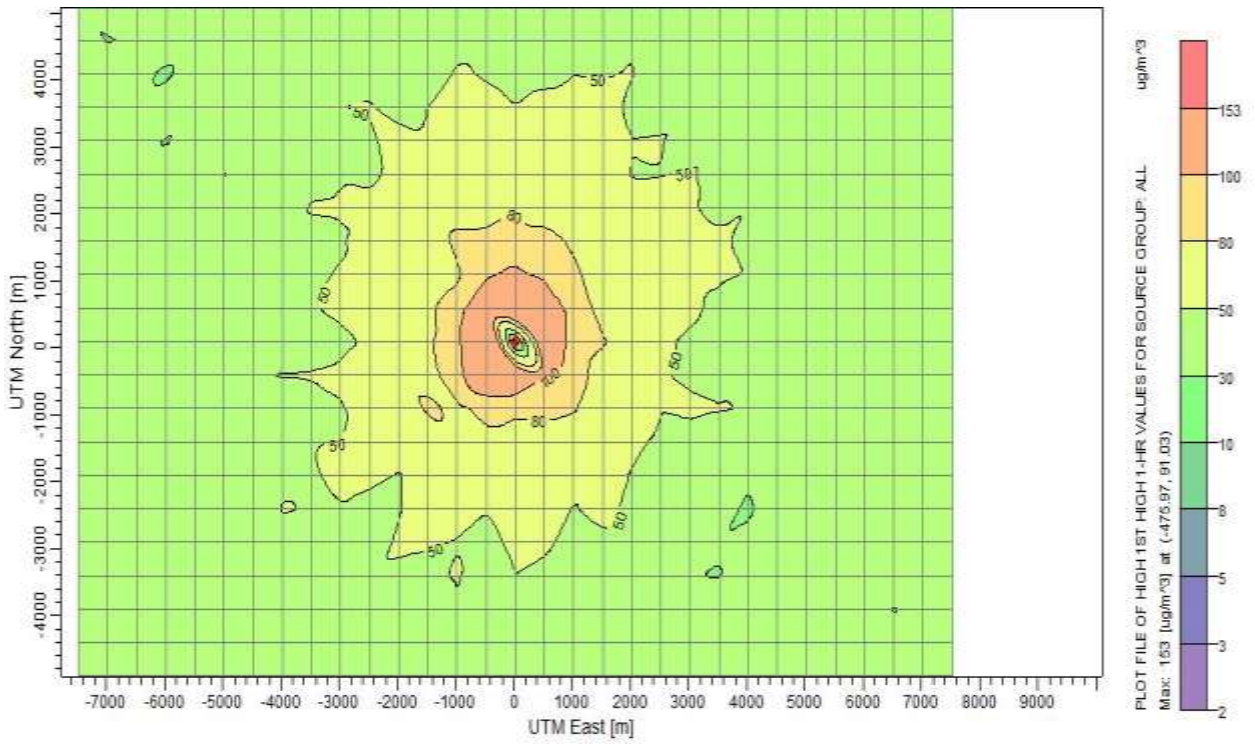


Figure 6.3: Emission contour map showing the NO_2 concentration (1 hour average) combined source

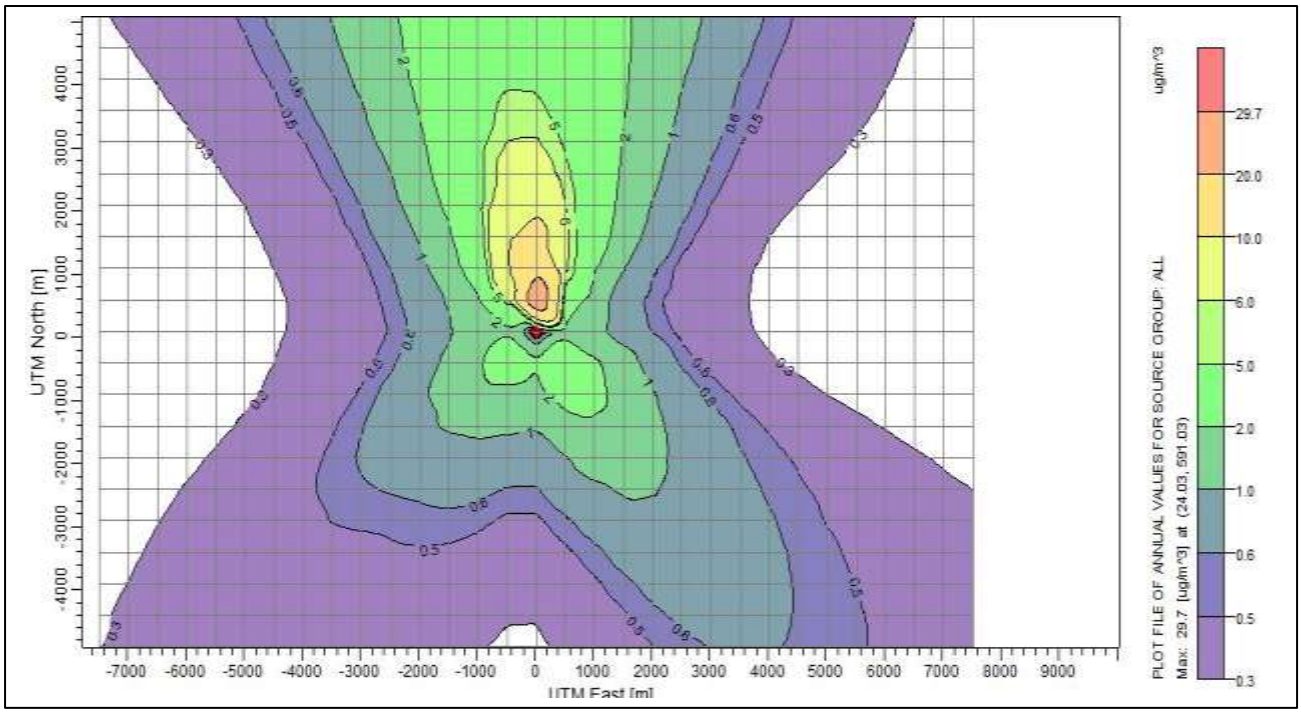


Figure 6.4: Emission contour map showing the NO_2 concentration (annual average) combined source

The modelling report has been attached in annexure 12(a). Moreover, for the well dispersion of the hot air from the generator, the proponent will construct a 65 m high stack from the ground level. The stack would be connected with a silencer to prevent the noise from the engine. The stack heights have been designed to facilitate undisturbed and free dispersion of the emitted air pollutants. Exhaust gas sample extraction facilities shall be installed for emission monitoring on each stack.

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. 0.5m^3/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.

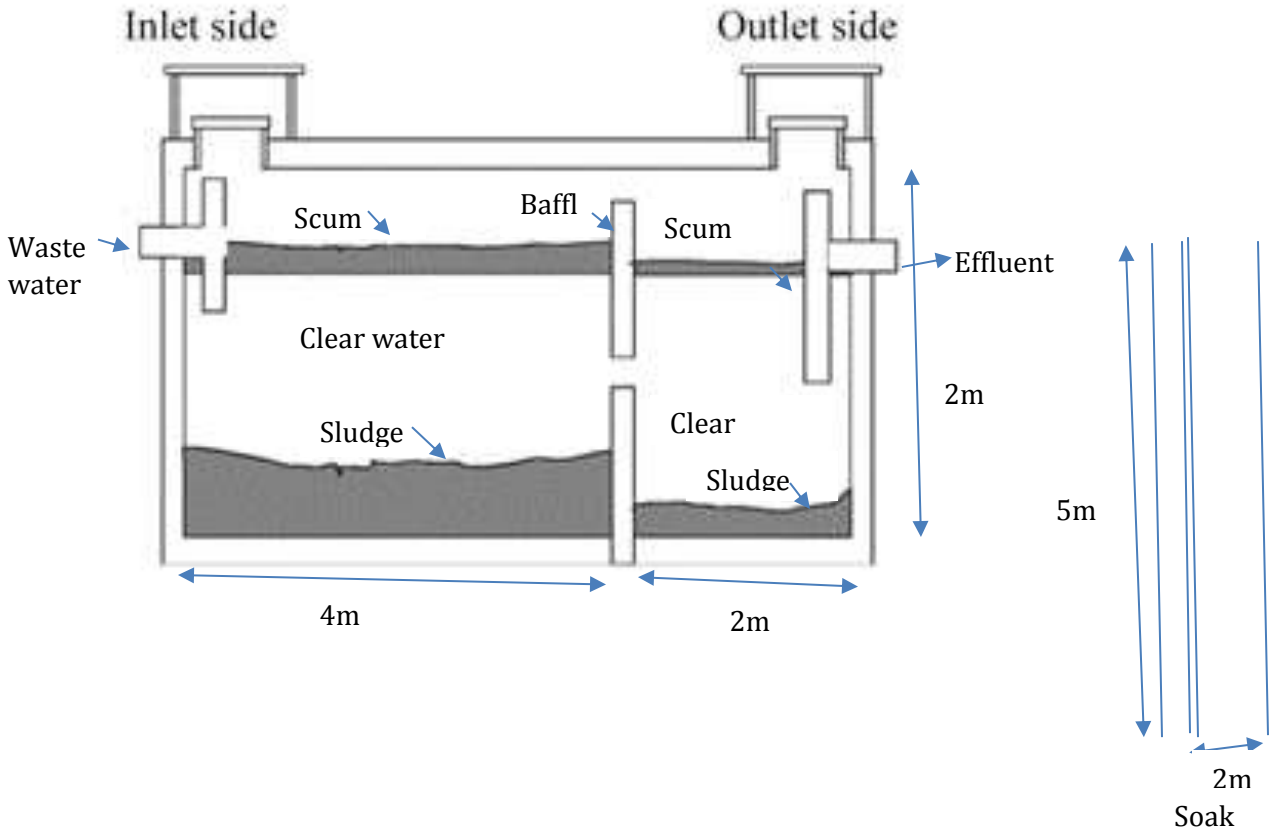


Fig. 6.5 Septic tank details

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 m^3/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 m^3/hour or 7.91 m^3/sec flow for the cooling process assuming a maximum rise of water temperature by 7^0C 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 56.4m^3/sec. The same volume will be discharged back to the river. The minimum river discharge is 2050m^3/sec at plant location is quite adequate for this. The average river temperature was recorded during the study period was 32.2^{0}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^{0}C) which discharges at 35^{0}C at the shortest discharge point D and 34.44^{0}C at the longest discharge point I.

It is estimated that over 56.4m^3/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 56.4m^3/sec water discharged at 34^{0}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 6.6 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.

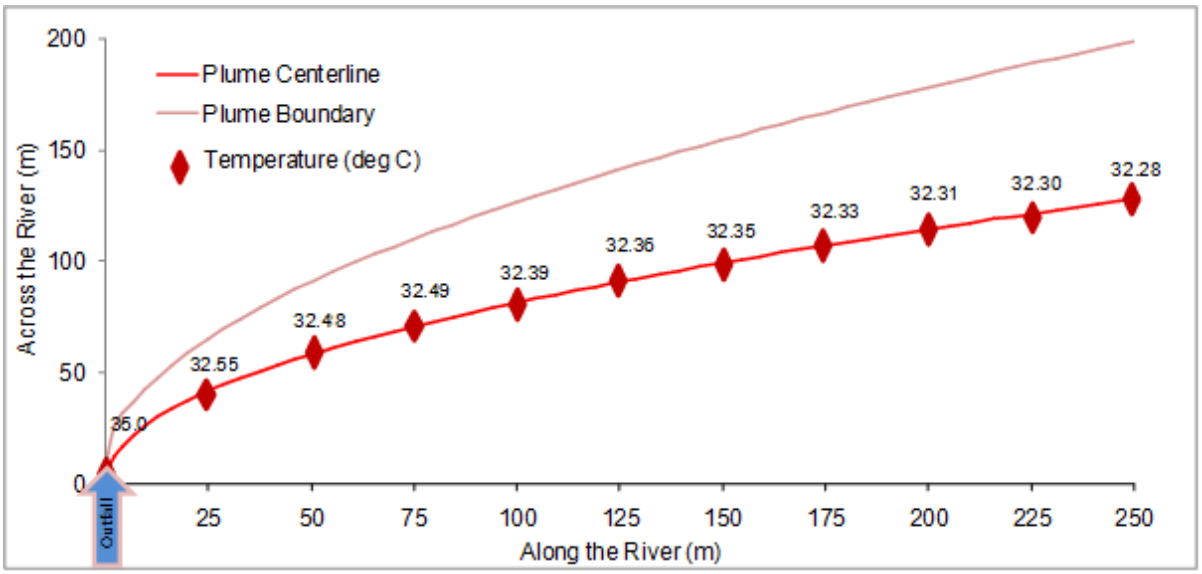


Figure 6.6 Thermal plume dispersion from upstream to dowstream

This result is confirmed that the increase of river water temperature around the discharge point do not exceeds 3^{O}C near the mixing zone boundary in the river. It will be reduced by 3^{0}C 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 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
Output Sound power level in dBA	29.37	24.48	19.58	14.69	9.79	04.79

Fig 6.7 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 EHS Guideline 2007	Residential, Institutional, educational	55	45
	Industrial, commercial	70	70
Bangladesh ECR, 1997	Mixed area	60	50
	Commercial	70	60
	Industrial	75	70

It is observed from the noise emission 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 ($\sum L = 10. \text{Log}_{10} (10^{L1/10} + 10^{L2/10})$ 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.

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).

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. The existing Unit 3 will be retired after the new 400 MW CCPP commissions. The staff working for existing Unit 2 can be shifted to work for the new 400 MW CCPP after proper training. 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 it's 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	▸ 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.	Dust—nuisance to surrounding communities of the proposed plant due to emission of dust during construction on the plant site Vehicle and equipment exhaust—Combustion exhaust from vehicles and construction can affect the ambient air quality of the Study Area	An increase in visible dust beyond the boundaries of the proposed power plant due to the activities undertaken at the plant site, or 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	▸ 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%	▸ 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	▸ 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	▸ Low NOx burner should be selected for turbine selection ▸ Proper stack height to be maintained.
Water Resources	An adverse impact on the water resources will be interpreted if it is established that the water consumed by the Project has directly affected the ability of the community to meet their water needs	The extraction of water for the power plant construction activities can affect the groundwater availability for the Study Area communities	▸ Availability of ground water to be studied ▸ Use surface water where possible ▸ Initiation of a water conservation program
Hazardous and Non-Hazardous Waste	Various types of wastes such as packing waste, metal scrap, and excess materials, air filters,	Material Safety Data Sheets (MSDS)	▸ Storage and handling of hazardous materials in accordance with international standards and appropriate to their

	oily rags, will be generated during the operation phase. The waste can be a health hazard and pollute waterways, if disposed improperly		hazard characteristics. ▸ All hazardous waste will be separated from other wastes ▸ Storage of fuels, chemicals and lubricants in bounded areas with impervious flooring and secondary containment of 110% capacity ▸ Availability of supporting information such as the MSDS ▸ A Hazardous Materials Register to be in place
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.	▸ 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	Non-ionizing radiation, Heat,	Proper monitoring for work place environment, health	• World Bank EHS guidelines on

& Safety of workers	Noise, Confined spaces, Electrical hazards, Fire and explosion hazards, Chemical hazards, Dust, sanitation, safe drinking water etc	& safety condition of the workers, PPE check, Fire drill and training of workers	Occupational H&S, Community H&S and Thermal Power will be followed. • Regular health check up of workers • Proper PPE should be provided to protect from the heat, electric shock and noise protection, • Regular awareness and training should be provided for fire safety & chemical hazard, • Safe drinking water should be provided

CHAPTER 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)	➢ 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	➢ 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

	➢ Making recommendations to the APSCL (PMU) regarding ESMP performance as part of an overall commitment to continuous improvement
Construction Contractor	➢ 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	➢ 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	➢ 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			
Pre-Decommissioning and Construction	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 and submit to ADB for approval. Undertake additional baseline studies for one year pre-construction to include: • Ambient air quality monitoring at sensitive receptors within the zone of maximum deposition. Notably 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	Before decommissioning and construction	A continuous daily visual inspection by trained staff of the contractor is needed. Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during decommissioning.	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.).	APSCL responsible for the management of the safe decommissioning of old plants. Basic training of persons employed to operate and maintain the monitoring system. 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

	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 Hazzi 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).							and site management practice.

	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. Detailed design to demonstrate: (i) emission standard of 51mg/m3 (25ppm) NOx will be met through adoption of dry low NOx burner (catalytic removal will be retrofitted if necessary following review of annual ambient air quality data) with dust filters on air intake to ensure no particulate or SO_2 emission, (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, (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, (v) structural engineering meets the applicable seismic design standards for location of the power plant, and (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 or explosion. 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. APSCL will develop a decommissioning plan for both Unit 3 (150 MW) and Unit 4 (150 MW) when getting permission from Government in the future. Finalize IEE for associated facilities including grievance redress mechanism and to address hazardous materials including SF6 and waste management. Prepare Construction Environment Management Plan incorporating site waste management plan and emergency response procedures, Construction Health and Safety Plan incorporating emergency response procedures, and Construction Traffic Management Plan.							
Air Quality: Dust emissions caused by construction	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction.	Before construction and during construction	Contractor should undertake daily inspections, with weekly inspections by environment officer, and	Implementation of Good Site management practices shall be the responsibility	APSCL Project Manager in collaboration with the	SPM, PM10, PM2.5, NO2, SO2 & CO.	Monthly reporting of summary results and submitted to	APSCL responsible for the management of the air

activities, construction vehicle movements, and transport of construction materials.	Emissions must be within prescribed limits of National Ambient Air Quality Standards. Mitigation practices including: • appropriate sitting and maintenance of stockpiles of materials so as to minimize dust blow (seek to achieve a distance of at least 500m from nearest sensitive receptors); • minimizing drop heights for material transfer activities such as unloading of materials; • construction phase to begin with construction of access roads; • roads will be kept damp via a water browser; • provide wheel wash for all vehicles leaving the project site; • do not permit any open burning on the project site; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site		monthly inspections by third party monitor. A continuous daily visual inspection by trained staff of the contractor is needed. Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. Measurements and analysis of different pollutants to be made on a continuous basis (at least monthly) by a third party consultant and the report to be submitted to the 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.	of all contractors on site under supervision of the APSCL nominated Project Manager.	Consultant's Site Manager & third party consultant		the APSCL and any other concerned authorities. (e.g. DOE, ADB, etc.).	quality monitoring system. Submission of monthly summary reports to DOE and any concerned authorities. Basic training of persons employed to operate and maintain the monitoring system. APSCL to ensure all contractors and subcontractor s working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.

	access; • sheeting of lorries transporting construction materials and soil; • enforcement of vehicle speed limits on nonmetal roads to <20 km/h. • no burning in open permitted and medical attention will be free of charge.							
Aquatic Environment: Construction of the intake structure and water discharge structure. Increased suspended sediment and pollutant loads, permanent loss and disturbance to aquatic flora and fauna.	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction. 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). The following measures will be taken: • Construction Method Statement to be produced by the Contractor;	During construction of intake and discharge structures	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Continuous daily visual Inspection by trained staff of the contractor. Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. During dredging and in-river works sediment discharge and surface water quality will be monitored (at least	Implemenation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the APSCL the Project Manager.	APSCL Project Director in collaboration with the Consultant's Site Manager & third party consultant.	Temp., pH, COD. BOD, TSS, TDS, DO, oil & grease etc.	Monthly reporting of summary results and submitted to the APSCL and any other concerned authorities. (e.g. DOE, ADB, etc.).	APSCL to ensure that all contractors and subcontractor s working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice. These mitigation Measures must be a condition of any construction contracts.

	• 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. • One year of water temperature monitoring data is collected before plant operation.		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.					
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	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction. 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	During construction	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly monitoring and	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's Site Manager & third party consultant..	Temp., PH, COD. BOD, TOC, DO, TSS, oil & grease etc.	Quarterly reporting of summary results and submitted to the APSCL and other concerned authority, e.g. DOE, ADB, etc., if required.	APSCL to ensure all contractors and subcontractor s working on site are aware of ESMP and all employees are given basic induction training on

contaminated soils.	be used to provide potable water for the construction workers (for standards see http://faolex.fao.org/docs/pdf/bgd19918.pdf). Mitigation activities will include the following: • no discharge of effluents into the river- all effluents shall be collected and removed off site for treatment by approved firms or disposed after proper treatment at site (records of effluent transfers to be maintained); • no discharge of surface water runoff direct into the river - development of a temporary site drainage plan which reduces flow velocity and sediment load by passing discharge through a sediment pond; regular testing of discharged water; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in		supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. River water sample should be collected monthly by a third party consultant from three locations, 500m upstream and downstream of works and at the works site-outfall, if preliminary monitoring campaign shows strong variations in water quality additional locations may be required					good construction and site management practices.

	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 • drainage must be adequately designed to include allowance for climate change Treatment of all wastewater must be consistent with the standards and measures in the EHS guidelines on wastewater and ambient water quality							

Noise: Increased noise in the project area as a result of the use of noisy machinery and increased vehicle movements.	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. And no unprotected ear should be exposed to a peak sound pressure level of more than 140 dB(C). The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85dB(A). Emissions at the site boundary and nearest sensitive receptors must be within prescribed limits of the EHS Noise Guidelines.	During construction	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. Monitoring of 24-hr noise levels to be made on a continuous basis (at least monthly) by a third party consultant at the site boundary and nearest sensitive receptors and the report to be submitted to the APSCL authority. Monitoring to be carried out on site and at the settlement and PDB high school and Hazzi Jolli high schools to the	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's Site Manager & third party consultant.	Noise complaints register to identify concerns. Check the noise level using noise measuring devices.	APSCL will produce a monthly log of valid complaints and actions taken. Monthly reporting of summary results and 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.

	Implementation of good site practices including: • provision of noise barrier around the project site to reduce off-site noise levels; enforcement of vehicle speed limits; • strict controls of vehicle routing; • diesel engine construction equipment to be fitted with silencers; • limited noisy construction activities at night; • prohibition of light vehicle movements at night; • use of protective hearing equipment for workers.		west, plus the APSCL dormitory to the east and the local settlement to the south of the project.					
Flora and Fauna Site Clearance-Vegetation removal and Habitat disturbance.	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction. • Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. • Specific mitigation	During construction.	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly inspection and	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.	Good conservation of floral wealth.	Quarterly reporting No. of floral species conserved or planted, if any.	APSCL to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on

	measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads.		supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.					good construction and Site management practices.
Soils and Hydrology: Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction. The potential impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented: • development of effective site drainage systems designed to include allowance for climate change; • restriction of access only to construction site areas; • disposal of waste materials unsuitable for reuse on-site, (e.g. for landfilling) at appropriately licensed sites; • provision of oil and suspended solid interceptors;	During construction.	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction. Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. Quarterly monitoring of drinking water in tube wells within 1km of a	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.	• site drainage. • access only to construction site areas. • waste materials. • oily waters. • drainage pathways. • potential spillage in Operational areas. Visual Inspection	Quarterly reporting of summary results submitted to the 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.

	• 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. 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 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		septic tank location by third party consultant to confirm that national drinking water standards are met.					

	of drinking water.							
Socio-Economic Environment: Positive impacts identified.	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction and Community Health and Safety. Public access to the site must be restricted. All activities related to the construction of the new plant will take place within the area belonging to APSCL, i.e. there will be no off-site activities or associated land acquisition during construction. Transmission lines & gas line will connect the new power plant to the existing substations and RMS. Ensure H&S measures per the EHS electric power and distribution guidelines and EHS onshore oil and gas development guidelines are incorporated The entire labor force will be daily commuters, thus	During construction.	Record local employment provided by the project. Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction. Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. Daily monitoring of drinking water provided to construction staff to confirm national drinking water standards are met.	APSCL Project management	APSCL Project Director in collaboration with the Consultant.	Workers satisfaction as measured by staff interviews and complaints reported. Visual Inspection	Quarterly reporting	Responsibility of APSCL.

	no worker housing or associated facilities will be erected on site during construction. If any off-site accommodation for the labor force needs to be developed the EIA and EMP should be updated accordingly. Legality of employees should be ensured. No forced or child labor (under age 18) to be employed. All employees to be legal. Regular talks on communicable diseases including HIV to be held for all workers. The contractors will be responsible for relevant temporary water/toilet facilities during construction and the need to provide appropriate services will be specified in their contracts. Provide adequate supplies of drinking water that is compliant with the national drinking water quality standards to all workers.							

	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. Regular talks on sanitation to be held for all workers to encourage cleanliness. Public access to the site must be restricted. Disease prevention and traffic safety measures should be adopted.							
Traffic and Transport: Disruption, noise and increased air pollution due to increased traffic, light loads and abnormal loads. Traffic Management Plan of the project is given	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction and Community Health and Safety. Standard good practice measures will be implemented as follows: • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of	During construction.	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. 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 management.	APSCL Project Director in collaboration with the Consultant.	Increased congestion Travel time (compared to reasonable daily commute) Visual Observation	Quarterly reporting of summary results submitted to the 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

as the Annexure-14(a).	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; • traffic management plan should include measures to minimize inconvenience to community. Ensure all roads and bridges used by construction traffic are maintained in at least their current state during construction with any damage immediately repaired. Condition survey of roads and bridges to be undertaken by third party consultant prior to start of works to provide a baseline for monitoring compliance.		Weekly inspection and supervision by APSCL is required to ensure the implementation of good site management practices by all contractors during construction. Quarterly monitoring of road and bridge condition by third party consultant to ensure maintenance being kept up.					management practices.

Archaeology: Potential chance finds of archaeological remains during construction.	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: • 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.	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Daily visual inspection is required by trained staff of the contractor to ensure the implementation of good management practices during construction. Weekly supervision of construction activities by APSCL is required to ensure the implementation of good site management practices by all contractors during construction.	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.
Natural Disasters Flash flooding.	Good engineering design will incorporate the following mitigation measures: • drainage system designed to direct flood water from main plant areas into the river and direct potentially	During construction.	Continuous daily visual inspection will be conducted by trained staff of the contractor. Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management practices by all	APSCL project management	APSCL Project Director in collaboration with the Consultant.	Visual observation	Quarterly reporting of summary results submitted to the APSCL and any other concerned authorities (e.g. DOE, ADB etc.), if	APSCL to ensure that all workers on site receive training in emergency preparedness and response procedures.

	contaminated waters through the oil interceptor.		contractors during construction. River water sample should be collected monthly by a third party consultant from three locations, 500m upstream and downstream of works and at the works site-outfall, if preliminary monitoring campaign shows strong variations in water quality additional locations may be required				required	
Solid Waste Management	Follow mitigation measures set out in this EIA and the EHS Guidelines on Construction and Waste Management. Good practice measures such as the following: (1) all waste taken off-site will be undertaken by a licensed contractor and APSCL will audit disposal procedure; (2) collection and segregation of wastes and safe storage; (3) recording of	During construction.	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Contractor to keep daily records of all waste transfers. Weekly monitoring by APSCL is required to ensure the implementation of good site management practices by all contractors during	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the 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.

	consignments for disposal; (4) prior agreement of standards for storage, management and disposal with relevant authorities; It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly disposal Contract. APSCL will plan a decommissioning plan for the disposal of old units.		construction.					
Occupational Health & Safety	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. Regular H&S training will be conducted for all construction staff, including training on good housekeeping, cleanup of debris and	During construction.	Contractor should undertake daily inspections, with weekly inspections by environment officer, and monthly inspections by third party monitor. Daily inspection is required to ensure the implementation of EHS Policies, plans and practices during construction. Weekly monitoring and supervision by APSCL is required to ensure the implementation of good site management	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.	Management procedures in place. Workers health and safety as measured by number of incidents.	Daily inspection 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 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

	spills, and working in confined spaces and at height. Measures include: • implementation of EHS procedures as a condition of contract all contractors and subcontractors; • clear definition of the EHS roles and responsibilities for all construction companies and staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection,		practices by all contractors during construction Record all fatalities, accidents and near misses that occur during construction work and implement corrective action to ensure such incidents are not repeated in future.					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.

	review and recording of EHS performance; • appointment of site nurse and provision of free on-site medical care for all construction staff; • pest and vector control; • maintenance of a high standard of housekeeping at all times; • provision of first aid equipment at easily accessible locations around the site; • H&S training including for confined spaces and working at height, planning with preparation of a H&S plan prior to work, drills, signage, first aid, etc.; • provision of harnesses and scaffold barriers for work at height, segregation of pedestrians and traffic on-site.							

Table 7.3: Identification of Impacts, Mitigation measures, Monitoring and Management during Operational period

Issue/Impact	Mitigation Measures	Implementation	Monitoring	Responsibility	Monitoring	Type and	Management

		Schedule		Implementation	Supervision	Indicators	Frequency of Reporting/ monitoring	and Training
Air Quality Emissions from stack are not expected to exceed standards. Ambient air quality affected by emissions from the power plant.	Implement mitigation as set out in the EIA and World Bank EHS Guidelines on Air Quality and Ambient Air Quality and Thermal Power to ensure that the emissions do not contribute to more than 25% of the air quality standards. Emissions standards to be achieved during operation are 51 mg/m3 or 25ppm NOx with zero particulates and SO_2. 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). APSCL will implement the mitigation measures suggested in the ESIA report. If ground level concentrations are found to be above the	Life time of plant operation. Life time of plant operation.	Automatic monitoring of stack emissions for NOx, SO_2, PM_{10} and $PM_{2.5}$ to be installed in the stacks. Annual stack emissions testing of NOx, SO_2, PM_{10} and PM2.5 by third party consultant. Continuous ambient air quality monitoring at sensitive receptors. Monitor and record annual gas consumption to calculate annual emissions of CO_2. Conduct continuous ambient air quality monitoring for NOx, SO_2, CO, PM10 & PM2.5 at four different locations (sensitive receptors) located within the zone of maximum deposition (about 1km east, west	The analyzer stations will be owned and operated by APSCL Third party monitoring	APSCL Top Management & EHS department APSCL Top Management & EHS department Third party inspection.	Stack emissions of NOx, SO_2, PM10 and PM2.5 concentration. Annual CO_2. Ambient air pollutants concentrations (at least PM10, PM2.5, NOx, SO_2, and CO).	Continuous Hourly data acquisition. Quarterly reporting to APSCL. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.). 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. Quarterly reporting by APSCL to Government and ADB etc. (or more frequently if required) highlighting key features and comparing

	National Ambient Air Quality Standards, options for further mitigation will need to be implemented. Catalytic removal to achieve a tighter emission standard will need to be retrofitted if necessary following review of continuous annual ambient air quality data. Continuous emission monitoring system will be installed.		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.					results with air quality standards and prediction in ESIA report
Aquatic Environment Discharge of process and cooling water.	Implement mitigation as set out in the EIA and World Bank EHS Guidelines on Wastewater and Ambient Water Quality and Thermal Power. All measures of waste and wastewater must be consistent with the standards and measures in the EHS guidelines. Effluent discharge of process water to meet standards set out in Table 5 of the EHS Guidelines on Thermal	Life time of the Plant	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. Install an automatic temperature gauge on the discharge point for	APSCL Project management. Third party monitoring supervised by the APSCL Management	APSCL management & EHS department.	Basic parameters as per the ECR 1997 pH, TSS, oil and grease, total residual chlorine, temperature Discharge temperature and seasonal river water temperature 500m upstream and	Monthly reports Prepared by APSCL or third party. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.). Once before	Records will be kept and compared on regular basis against Bangladesh and World Bank standards and impacts predicted in ESMP. APSCL to ensure that all employees are given basic

	Power. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Sanitary discharges to meet national wastewater treatment standards. Good site management practices including the following will be implemented: 1) proper treatment of contaminated water or cooling water before discharge to natural water body. 2) no disposal of solid wastes into the discharge structure; 3) regular maintenance of site drainage system to ensure efficient operation; 4) all discharges will comply with local and World Bank guidelines. • all fuel, oil and chemicals should be stored in bunded area 110% volume		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 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. Quarterly liaison with local fishermen regarding recent fishing catches and any concerns regarding thermal discharge and the impact on their livelihood.			downstream from outfall	operation and on an annual basis after operation of the power plant.	induction training on the requirements of the ESMP, good site management practices and H&S procedures.

	• regular training of all workers in spill response • provision of spill equipment at easily accessible locations around the site 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. An automatic temperature gauge on the discharge point for the power plant and on the three canal discharge points to measure the impact of this project and the contribution of the other power plants to the overall water temperature. Review detailed design to confirm EHS thermal power temperature parameters can be achieved in both winter and summer and review the inlet structure design to mitigate for fish entrainment.							

Noise Quality	Implement mitigation as set out in the EIA and EHS Guidelines on Noise and Thermal Power. Project detailed design ensures that no increase in noise levels by more than 3 dB when the standard is exceeded. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. And no unprotected ear should be exposed to a peak sound pressure level of more than 140 dB(C). The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reaches 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85dB(A). Emissions at the site boundary and nearest	Life time of the plant operation.	When the plant is fully operational, quarterly noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at sensitive noise receptors around the plant. Monitoring to be 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.	APSCL Project management. Third party monitoring supervised by the APSCL Management.	APSCL management & EHS department.	Power plant to comply with ESMP suggestions.	Monthly noise reports Prepared by APSCL or by third party. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	Should any complaints be received regarding noise, these will be logged and the APSCL EHS team will investigate the problem. APSCL to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and EHS procedures.

	sensitive receptors must be within prescribed limits of the EHS Noise Guidelines. Specific design mitigation measures to minimize noise impacts include: • gas turbines, steam turbine generators; air compressors, pumps and emergency diesel engines are enclosed in the Buildings with proper acoustic design; • provision of a noise barrier around the project site to minimize off-site noise levels.							
Flora and Fauna: Disturbance to habitats as a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: • restrict personnel and vehicle movements to access roads and within boundaries of site only; • control of noise during operation.	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	The visual effect of the power plant will be	Life time of the plant.	No monitoring is envisaged.	APSCL Project management	APSCL managemen	Improved visual image		Management to consider

Visual image of Power plant from surrounding areas.	improved through: • creation of landscaped boundary along the fence of the power plant. • Planting sufficient amount of trees around the project site				t & EHS department			the landscaped areas to maximize visual image and habitat creation. APSCL to manage and maintain proper landscaped areas.
Soil and Hydrology: Spillage of oils, chemicals or fuels on site.	Follow mitigation measures in EIA and World Bank EHS Guidelines on Hazardous Materials Management and Waste Management. Good site management measures as described in the ESMP, under aquatic environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation. No septic tank will be installed within 500m of a deep or shallow tube well used by the community for drinking water. Septic	Life time of the Plant	The APSCL authority will continuously monitor application of ESMP and good site management . 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.	APSCL Project management	APSCL managemen t & EHS department	Quality of bunds and drainage systems. Efficiency of operation.	Yearly report prepared by APSCL EHS department Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	APSCL to ensure all employees will receive related training.

	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 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. Septic systems should only be used for treatment of sanitary sewage, and are unsuitable for process wastewater treatment.							
Solid Waste	Follow mitigation measures in EIA and EHS Waste Management Guidelines. Good practice measures undertaken during the construction phase will be continued into the	Lifetime of the plant	Daily records of waste transfers to be kept. Continuous monitoring is required to ensure the implementation of good management practices during operation.	APSCL Project management	APSCL managemen t & EHS department	Efficient waste collection and disposal system should be done by either APSCL or Contractor	Quarterly reports jointly from O&M Division of 400 MW CCPP (East) from the EHS to	APSCL to ensure all employees are given basic induction training on good

	operation phase. It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly disposal contract. Records of all waste transfers to be maintained.					in place.	APSCL management. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.).	operation and site management practices.
Occupational Health and Safety, Risks and Hazards	Follow mitigation measures in EIA and EHS Occupational Health and Safety and Thermal Power Guidelines. Drinking Water provided to employees to meet drinking water standards. Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program. Use of warning signs near noisy environments and high temperature surfaces and provide personal protective equipment (PPE) as appropriate, including ear	Lifetime of the Plant	Regular on-site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management. Record all fatalities, accidents, near misses and occupational diseases that occur during operation and implement corrective action to ensure such incidents are not repeated in future. Quarterly health check of employees with respect to EMF exposure and other occupational hazards. Daily monitoring of drinking water provided to employees to confirm	APSCL Project management	APSCL management & EHS department.	Management procedures in place. Workers health and safety status, incidents, injuries, slip, trip, falls and near misses are properly documented .	Quarterly reports from the EHS to APSCL management. Reports are to be available to any of the concerning Authorities (DOE, ADB, etc.). .	APSCL to ensure that all employees are given basic induction training on EHS policies and procedures, Emergency Preparedness and Response Plan.

	muffs and insulated gloves and shoes. The stand mitigation that has been suggested in the ESMP report will be implemented and followed on site.		national drinking water standards are met.					
Repair and maintenance schedules for the turbines and cooling system	The gas turbine, steam turbine and cooling system require repair and maintenance schedules for the turbines and cooling system to maximize life cycle and operation efficiency.	Lifetime of the Plant	As per the manufacturer's schedule the gas turbine set needs timely minor, hot gas path and major inspection at specific time interval. The repair and maintenance of steam turbine and cooling water system will be done according to the manufacturer's recommendation and as required.	APSCL Project management	APSCL management & EHS department.		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.	APSCL to conduct the inspection with specialists as per schedule.
Risks associated	Follow the EHS Guidelines for Onshore	Lifetime of the plant	Regular inspection and maintenance of pipeline	APSCL Project management	APSCL managemen	Gas leakage	Quarterly reports from	APSCL to ensure that all

with the gas pipeline from the existing RMS station	Oil and Gas Development		system (e.g., leaks survey) Regular training and/or drills on safety, emergency and disaster preparedness will be conducted to workers		t & EHS department.		the EHS to APSCL managemen t.	employees are given basic induction training on EHS policies and procedures.

7.5 MONITORING PLANS AND SCHEDULES

7.5.1 During Construction Phase

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

Table 7.4 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	• 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)

Traffic Management Plan of this project)	• Deterioration of air quality from increased vehicular movement, affecting people in the surrounding areas	• Keeping vehicles under good condition, with regular checking of vehicle condition to ensure compliance with national standards	
	• Wind-blown dust from material (e.g., fine aggregate) storage areas	• Watering unpaved/dusty roads (at least twice a day; cost estimate provided) • Sprinkling and covering stockpiles • Covering top of trucks carrying materials to the site and carrying construction debris away from the site	
Construction activities, including operation of construction equipment	• Generation of noise from construction activities (general plant and access road construction), especially affecting the local resident	• Use of noise suppressors and mufflers in heavy equipment • Avoiding, as much as possible, construction equipment producing excessive noise during at night • Avoiding prolonged exposure to noise (produced by equipment) by workers • Creating a buffer zone between the neighbouring community and construction site	Contractor (Monitoring by APSCL);
	• Deterioration of air quality from wind-blown dust and possible use of equipment, such as stone (aggregate crushers)	• Not using equipment such as stone crushers at site, which produce significant amount of particulate matter • Keeping construction equipment and generators in good operating condition • Using equipment, especially generators with high levels of emission control. • Immediate use of construction spoils as filling materials • Immediate disposal/sale of excavated materials • Continuous watering of bare areas	
	• Generation of construction Waste	• Hauling of construction debris away from the site and their appropriate disposal in a designated disposal site	
	• Accidents	• Regular inspection and maintenance of equipment • Environmental health and safety briefing • Provision of protective gear	
	• Spills and leaks leading to soil and water contamination with hydrocarbon and PAHs	• Good house keeping • Proper handling of lubricating oil and fuel • Collection, proper treatment, and disposal of spills	
	• Employment of work/labour force	• Local people should be employed in the project activities as much as possible.	

7.5.2 Operation Phase

Most of the environmental parameters will experience beneficial effects during the operation phase of the power plant project. Efforts should be made to enhance these beneficial impacts, which may include incentives for proper growth of more projects in the area. The plant management authority of 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	• 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	• 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	• Inappropriate disposal of sewage causing environmental pollution • Generation of solid waste including sludge from demineralizer. • Possible water pollution	• Good housekeeping • Proper construction and maintenance of wastewater disposal system for the plant premises. • Ensuring proper storage, treatment, and disposal of all solid waste • Monitoring of effluent quality from treatment plant • Monitoring of river water quality and discharge water quality	APSCL
Occupational Health & Safety of workers	Non-ionizing radiation, Heat, Noise, Confined spaces, Electrical hazards, Fire and	• 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	APSCL

	explosion hazards, Chemical hazards, Dust, sanitation, safe drinking water etc	provided for fire safety & chemical hazard, • Safe drinking water should be provided	
Turbines and cooling system inspection	Machine performance may deteriorate with time.	• As per the manufacturer's schedule the gas turbine set needs timely minor, hot gas path and major inspection at specific time interval. 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 &	Frequency of training & orientation of	,,	,,

training of workers	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	NOx, SO2, PM10, PM2.5 and temperature	Continuous and annual
Ambient air quality	CO, NOx, PM10, PM2.5, SO2	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,	Number and Condition	Once in 6 months

Zooplankton, Vegetation etc.		
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,	30000.00	04	120,000.00

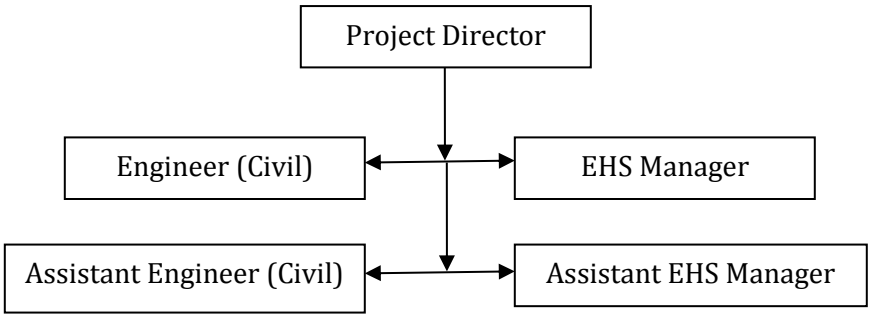
	COD, Total N, Total P			
Groundwater	pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe , Mn and Coliforms; Groundwater level	30000.00	02	60,000.00
Noise level	Noise at different locations	10000.00	12	120,000.00
River morphology	River cross-section	20000.00	01	20,000.00
Vegetation	Number 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

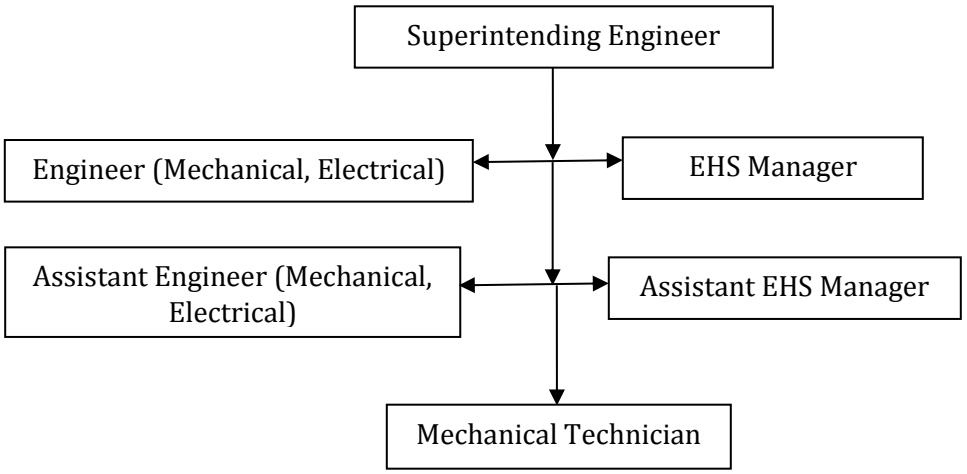
Item	**Number**	**unit cost (Taka)**	**Total cost per year (Taka)**
Safety and occupational health	02	200,000.00	400,000.00
Environmental management system	02	300,000.00	600,000.00
Total cost during operational phase			10,00,000.00

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 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.

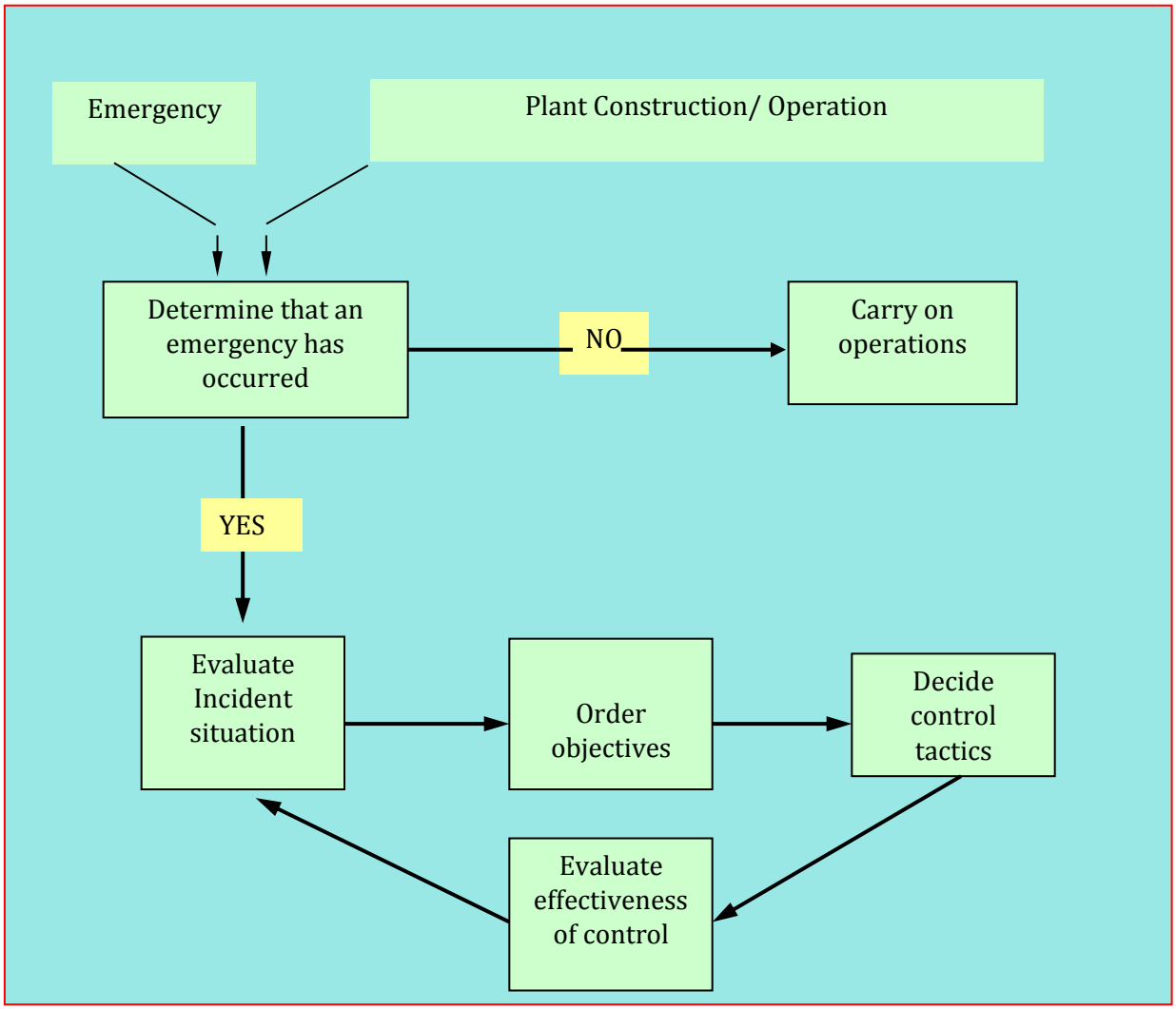


Figure 8.1: Illustrates an Example System Approach to Plant Construction & Operations.

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, CO_2 gas flooding systems, and portable extinguishers of CO_2 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 CO_2 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.

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 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 Bramman 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

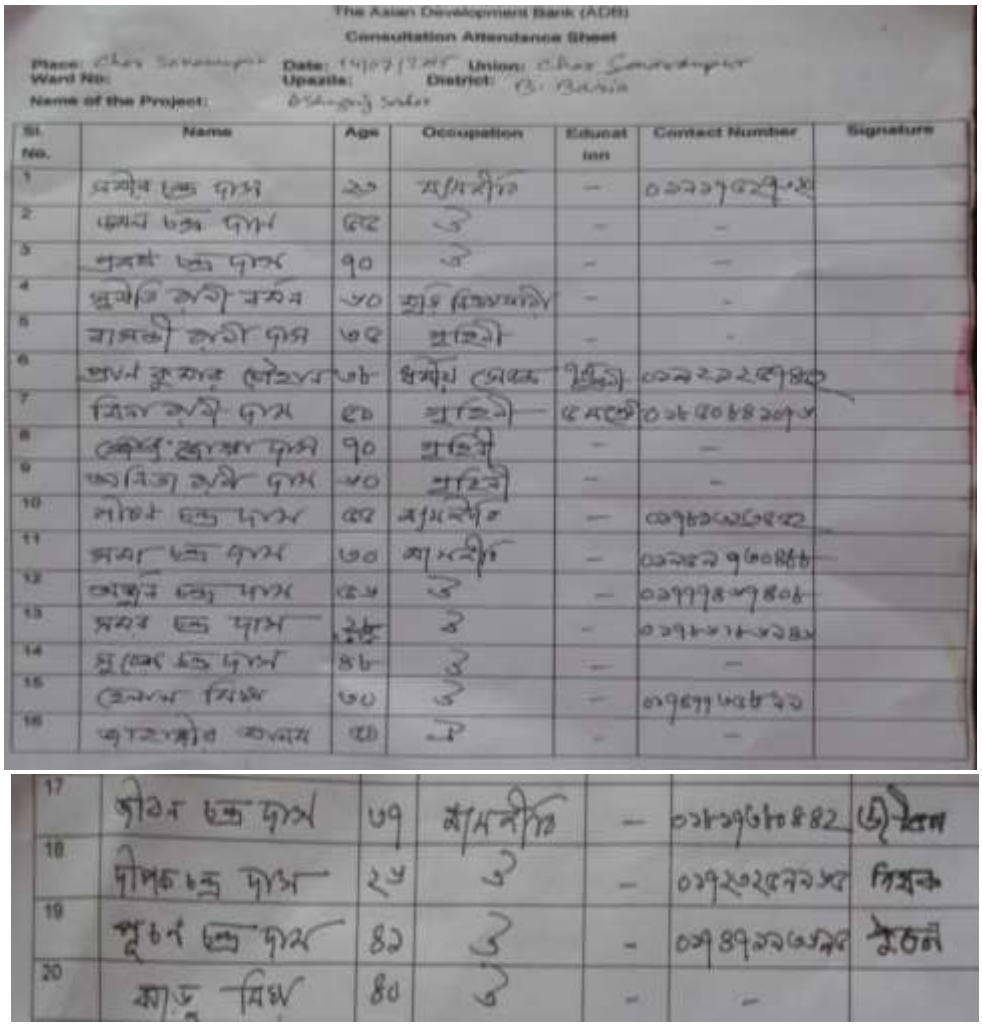
d) Local Fishermen:

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, including15 fishermen, 1 religious person, 4 women/house wife. Following is the participants list



The Asian Development Bank (ADB)

Consultation Attendance Sheet

Place: Char Sonarampur Date: 14/07/2015 Union: Char Sonarampur
Ward No: Upazila: District: B. Baria
Name of the Project: Dhanuj Sadar

Sl. No.	Name	Age	Occupation	Education	Contact Number	Signature
1	[illegible]	23	[illegible]	–	[illegible]	
2	[illegible]	62	ঐ	–	–	
3	[illegible]	90	ঐ	–	–	
4	[illegible]	70	[illegible]	–	–	
5	[illegible]	62	[illegible]	–	–	
6	[illegible]	38	[illegible]	[illegible]	[illegible]	
7	[illegible]	60	[illegible]	[illegible]	[illegible]	
8	[illegible]	90	[illegible]	–	–	
9	[illegible]	70	[illegible]	–	–	
10	[illegible]	62	[illegible]	–	[illegible]	
11	[illegible]	60	[illegible]	–	[illegible]	
12	[illegible]	54	ঐ	–	[illegible]	
13	[illegible]	28	ঐ	–	[illegible]	
14	[illegible]	48	ঐ	–	–	
15	[illegible]	70	ঐ	–	[illegible]	
16	[illegible]	60	ঐ	–	–	
17	[illegible]	69	[illegible]	–	[illegible]	[illegible]
18	[illegible]	24	ঐ	–	[illegible]	শিক্ষক
19	[illegible]	82	ঐ	–	[illegible]	[illegible]
20	[illegible]	80	ঐ	–	–	

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.

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	Executive Director	He said that the noise and heat

Rahman	(Engg.), APSCL	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 it's 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.

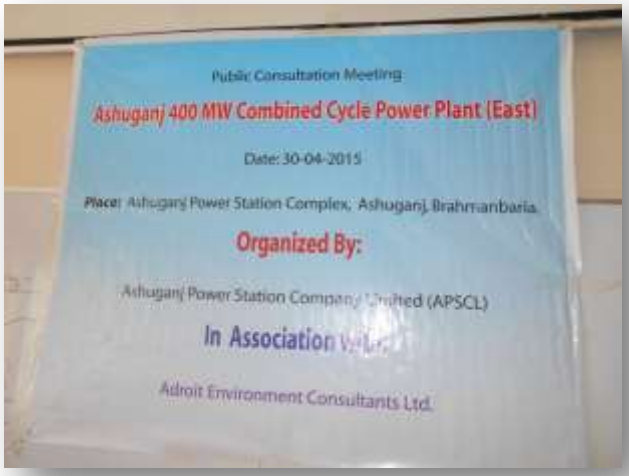
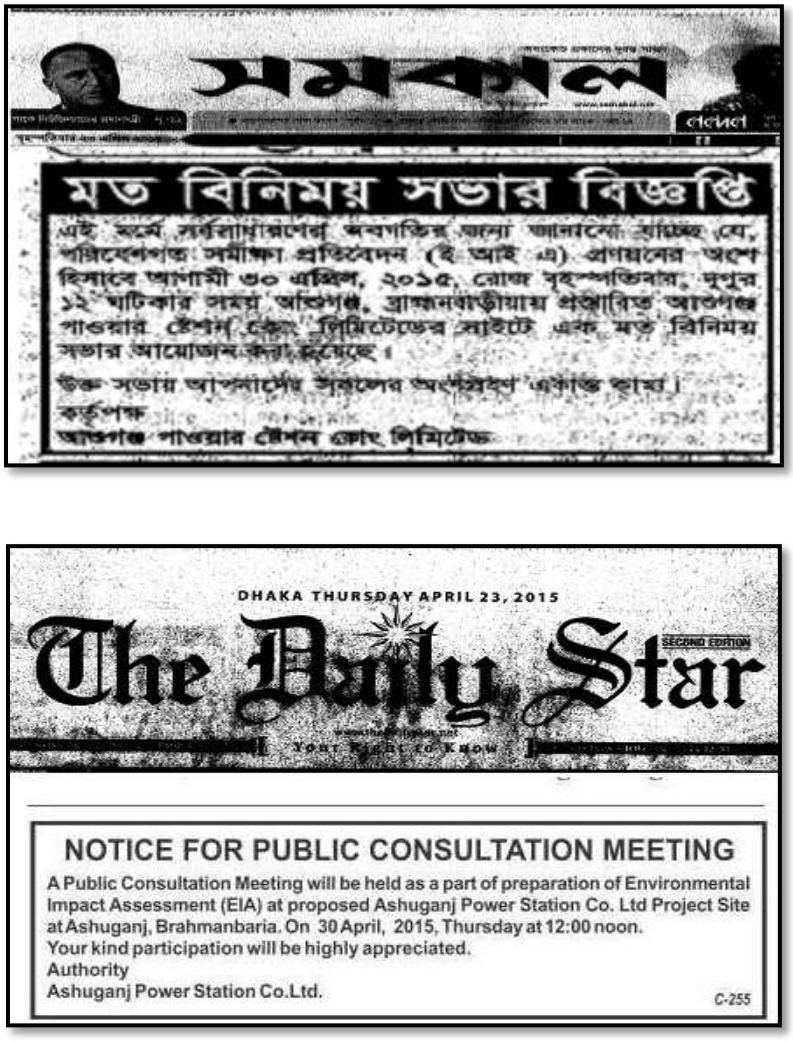


Figure 10.1(a): Photographs of Public Consultation at APSCL Office (1st time)

Figure 10.1(b): Photographs of Public Consultation at APSCL Auditorium (2nd time)



সমকাল

মত বিনিময় সভার বিজ্ঞপ্তি

এই মর্মে সর্বসাধারণের অবগতির জন্য জানানো যাচ্ছে যে, পরিবেশগত সমীক্ষা প্রতিবেদন (ই আই এ) প্রণয়নের অংশ হিসাবে আগামী ৩০ এপ্রিল, ২০১৫, রোজ বৃহস্পতিবার, দুপুর ১২ ঘটিকার সময় আশুগঞ্জ, ব্রাহ্মনবাড়ীয়ায় প্রস্তাবিত আশুগঞ্জ পাওয়ার স্টেশন কোং লিমিটেডের সাইটে এক মত বিনিময় সভার আয়োজন করা হয়েছে।

উক্ত সভায় আপনাদের সকলের অংশগ্রহণ একান্ত কাম্য।

কর্তৃপক্ষ
আশুগঞ্জ পাওয়ার স্টেশন কোং লিমিটেড

DHAKA THURSDAY APRIL 23, 2015

The Daily Star

SECOND EDITION

YOUR RIGHT TO KNOW

NOTICE FOR PUBLIC CONSULTATION MEETING

A Public Consultation Meeting will be held as a part of preparation of Environmental Impact Assessment (EIA) at proposed Ashuganj Power Station Co. Ltd Project Site at Ashuganj, Brahmanbaria. On 30 April, 2015, Thursday at 12:00 noon.
Your kind participation will be highly appreciated.
Authority
Ashuganj Power Station Co.Ltd.

C-255

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মতবিনিময় সভার বিজ্ঞপ্তি

Figure 10.2: Circular in the Newspaper

Figure 10.3: Interview with Local Fishermen of Ashuganj

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.

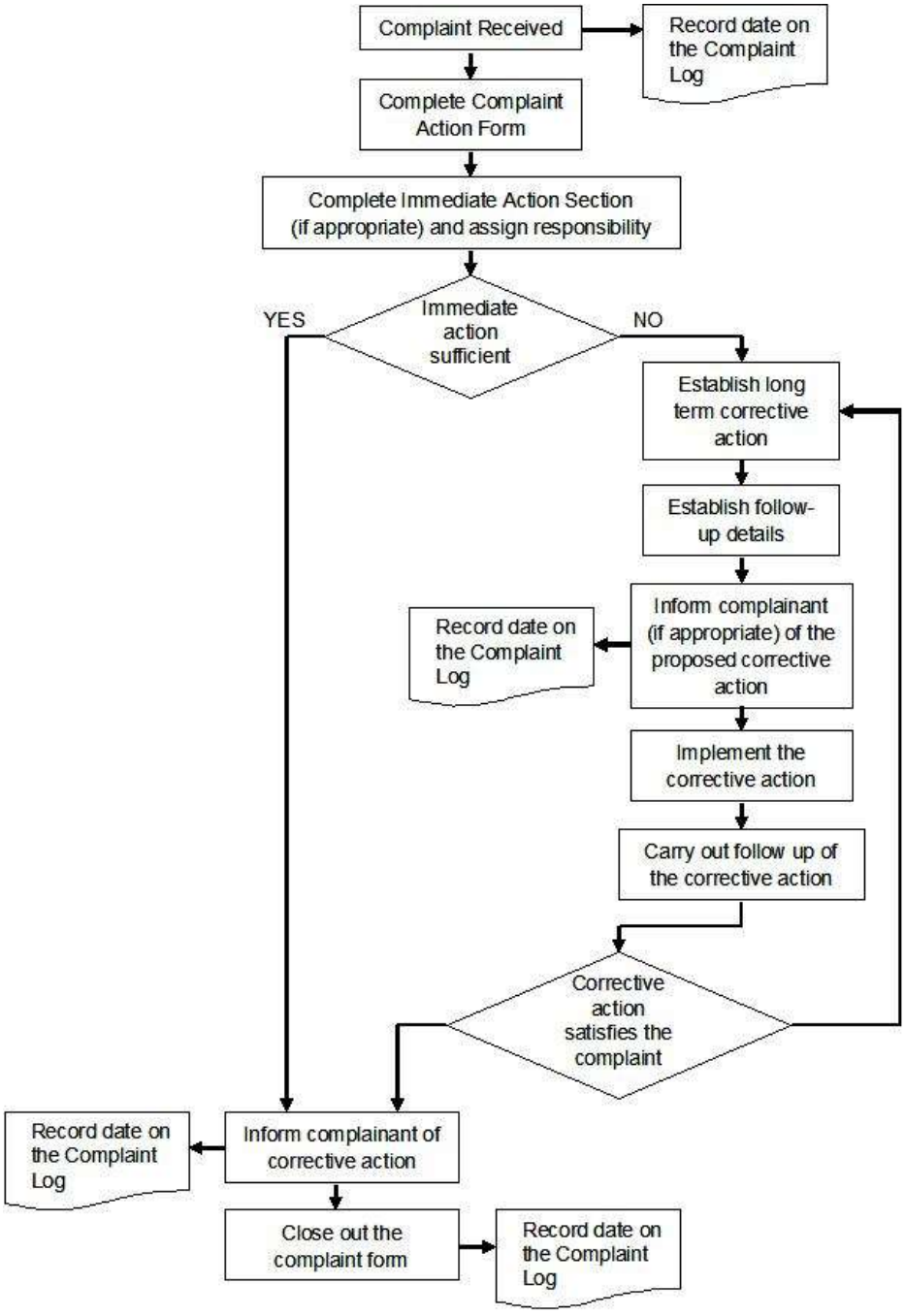
The Grievance Mechanism will be implemented during both the construction and operational period of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied 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 arbitrational tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law. However, the preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties.

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 NOx (DLN), water injection or Selective Catalytic Reduction (SCR) and the stack of nature 65 m height, as per the emission dispersion modeling, the NOx emission from all the stacks would be within the Bangladesh and WB/IFC standard.
Liquid Discharge: It is estimated that 7.91 m^3/sec of river water would be drawn from the intake of the proposed 400 MW CCPP project discharged at 7^0C rise in temperature at the condenser

discharge point, while the water will be discharged back to the river with less than 3^{o}C (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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