ASHUGANJ POWER STATION COMPANY LTD

[AN ENTERPRISE OF BANGLADESH POWER DEVELOPMENT BOARD)

DETAILED FEASIBILITY STUDY AND ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR ASHUGANJ 450MW COMBINED CYCLE POWER PLANT (SOUTH) AT ASHUGANJ EXISTING POWER STATION SITE

ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT

ATLANTA ENTERPRISE LIMITED

in association with

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ABBREVIATIONS

APSCL	-	Ashuganj Power Station Company Ltd
AoI	-	Area of Influence
AEL	-	Atlanta Enterprise Limited
BPDB	-	Bangladesh Power Development Board
CCPP	-	Combined Cycle Power Plant
DoE	-	Department of Environment
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
FGD	-	Focus Group Discussion
GoB	-	Government of Bangladesh
GDP	-	Gross Domestic Product
IEE	-	Initial Environmental Examination
IEC	-	Important Environmental Component
KII	-	Key Informants Interview
MoFE	-	Ministry of Forest and Environment
PRA	-	Participatory Rural Appraisal
RRA	-	Rapid Rural Appraisal
DO	-	Dissolved Oxygen

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EXECUTIVE SUMMARY

Bangladesh is running with acute shortage of power generation capacity and addition of generation capacity through implementation of proposed Ashuganj 450 MW CCPP South at APSCL premises is considered essential to cope with the consumers' demand and to provide reliable power in Dhaka and adjoining areas.

This Environmental Impact Assessment has been prepared as part of the feasibility study for Ashuganj 450 MW Combined Cycle Power Plant South project proposed for construction at Ashuganj Power Station Complex owned by Ashuganj Power station Company Limited (APSCL). The project proponent is the APSCL of the Ministry of Energy and Power. The objective of the study is to help APSCL prepare a power generation project suitable for GoB financing. The Project aims to improve power supply by replacing the old unreliable power plants resulting in reducing load shedding and ensuring stable power supply.

This EIA study based on field investigations, coordination with APSCL, requirement of law Department of Environment (DoE), and stakeholder consultations. This report covers the description of existing environmental conditions, assessment of environmental impacts of the power station operation, recommended mitigation measures and environmental monitoring. The environmental impact was considered for activities during pre-construction, construction and operation phases of the Project to satisfy the Department of Environment that it meets with the requirement of law.

As power projects are identified as having the potential for environmental impact, the Bangladesh Department of the Environment (DoE) has categorized them as being the "Red Category" of industrial processes. As such, an Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) are required. However, the Director General of DOE has exempted IEE and allowed the project proponent to go for EIA for which the project proponent prepared this report through AEL.

The EIA has identified various potential impacts and recommended suitable mitigation measures together with a monitoring program. The potential negative environmental impacts are temporary and relatively minor and will occur during construction as well as in operational stages of the proposed project.

Again the proposed plant is of advanced design with dry low Nox (DLN) burner with premix burning system which restrict the combustion temperature to $1317^{O}C$ which is much below the Nox forming temperature ($1600^{O}C$). Thus possibility of Nox formation is minimal.

Since the new plant will be of single gas turbine and of advance design noise and vibration pollution will be less in companion with the existing power stations.

The total quantity of water withdrawal will be about $56.67m^3$/sec by all the units including the proposed 150MW CCPP & 450MW CCPP and the 450MW CCPP South. This water will be discharged back to the river with a temperature rise of $7^{O}C$ i.e. with discharge temp of $37.54^{O}C$. This discharge will not have any tangible effect on entire river water ($2050m^3$/sec). Since the proposed 150MW CCPP will discharge $3.34m^3$/sec water at $7^{O}C$ above the temp of river water about 250m upstream of the common intake, the temp of water at intake will be $30.54^{O}C$ instead of $30^{O}C$.

However, after immediate vicinity of the discharge point due to instant mixing with equal volume of river water with temp 30^{O}C the temp will be 34.04^{O}C which is much below the limit of 40^{O}C set for the by DoE.

There is a permanent jetty at the river bank in APSCL Complex provided with crane of capacity 200ton plus 50ton auxiliary. But this crane require major rehabilitation. After rehabilitation of the crane and with help of some other cranes of appropriate capacity any larger unit can be unloaded. But transportation to the proposed site of Ashuganj 450MW CCPP South is difficult even incase of smaller units since there are no free space to make even temporary road to carry heavy equipment across existing power station premises. The existing railway line and the internal roads could not be extended to the new site because of various obstacles all ready built as different components of the power station. Investigation was made to find out a suitable location at river side near the proposed site. But the immediate nearest riverfront is already occupied by a market and other installation. Further investigation was done to build a temporary jetty at the old ferry ghat about one and a half km away from the site for unloading the equipment and carry the same to the site by lowbuoy carriers. The approach road from old ferry ghat to proposed site was also investigated and found suitable for the purpose.

Since the power plant will be within the APSCLs premises, no new requisition of land is required so there will be no question of resettlement.

On the other hand, the project will promote significant economic benefits resulting from project operation. Implementation of the proposed mitigation measures and the monitoring program will reduce the impacts to significant levels.

At the time of construction, the contractor will implement the mitigation measures identified in the EIA, while project consultants will conduct regular monitoring to ensure contractor's compliance with applicable provisions of the EMP. The project consultant will assist the APSCL in preparing contractual documents such as bidding documents; bills of quantity and other contractual obligations of the contractor clearly identify environmental responsibilities and describe penalties for non-compliance. The local people expressed support for immediate implementation of the project, as they clearly realized the project benefit during the consultations.

Finally, the Project will result in positive environmental and economic beneficial impacts and will have minor negative impacts during construction period which will be carefully monitored and adequately mitigated. The completion of this EIA fully meets the GoB standards. After completion of the project, a post project evaluation would be useful for sustainability and ensuring environmental safeguards of the project.

Conclusions

The EIA has identified various potential impacts and recommended suitable mitigation measures together with a monitoring program. The potential negative environmental impacts are temporary and relatively minor and will occur during construction as well as in operational stages of the proposed project.

Since the new plant will be of single gas turbine and of advance design noise and vibration pollution will be less than those by the existing ones.

There will be no water pollution except rising of temp to 37.04^{O}C against river water temp of 30^{O}C.

Major transportation will be by river and unloading will be done at a temporary Jetty at the ferry ghat which is only about one and a half a kilometer from away the project site. So, no tangible impact on road network is envisaged.

Since the power plant will be within the APSCL complex no new requisition of land is requested. So there will be no question of settlement of inhabitants.

Thus it is seen that negative impacts of the project on environment as well as on society are negligible.

On the other hand, the project will promote significant economic benefits resulting from project operation. Implementation of the proposed mitigation measures and the monitoring program will reduce the impacts to significant levels.

During construction, the contractor will implement the mitigation measures identified in the EIA, while project consultants will conduct regular monitoring to ensure contractor's compliance with applicable provisions of the EMP. The project consultant will also assist the APSCL in preparing contractual documents so that bidding documents; bills of quantity and other contractual obligations of the contractor clearly identify environmental responsibilities and describe penalties for non-compliance. The local communities expressed support for immediate implementation of the project, during the consultations as they clearly realized the project benefit.

Finally, the Project will result in positive environmental and economically beneficial impacts and will have minor negative impacts during construction period which will be carefully monitored and adequately mitigated. The completion of this EIA fully meets the GoB standards. After completion of the project, a post project evaluation would be useful for sustainability and ensuring environmental safeguards of the project.

Recommendation

In light of the above, the project proponent, M/s APSCL may be allowed to go ahead with the implementation of the Project.

CHAPTER – 1

1. INTRODUCTION

1.1 Overview

This Environmental Impact Assessment (EIA) has been prepared as part of the feasibility study for Ashuganj 450 MW Combined Cycle Power Plant South project proposed for construction at Ashuganj Power Station Complex owned by Ashuganj Power station Company Limited (APSCL). The project proponent is the APSCL of the Ministry of Power, Energy and Mineral Resources. The objective of the study is to help APSCL prepare a power generation project suitable for GoB financing. The Project aims to improve power supply by replacing the old unreliable units in succession resulting in reducing load shedding and ensuring stable power supply.

This EIA study has been based on field investigations, coordination with APSCL, requirement of law of Department of Environment (DoE), and stakeholder consultations. This report covers the description of existing environmental conditions, assessment of environmental impacts of the power station operation, recommended mitigation measures and environmental monitoring plan. The environmental impact was considered for activities during pre-construction, construction and operation phases of the project to satisfy the Department of Environment that it meets with the requirement of law.

1.2 Background

To alleviate poverty in the face of resource limitations and high population density, Bangladesh requires an economic growth rate of 6-7% p.a. to provide employment to its rapidly growing labor force that cannot be absorbed by agriculture. In order to achieve this growth rate, availability of a reasonably priced and reliable source of electricity is a prerequisite. Starting from a small base, the power sector in Bangladesh has grown significantly. The installed generation capacity has increased to 5202 MW (BPDB annual report 2008) in the utility service (as of June 2008) from a meager 88 MW in 1960. Electricity generation grew at about 7% p.a. during last ten years, compared with average annual GDP growth rate of about 5.5%. Notwithstanding the progress made to date, Bangladesh's per capita electricity generation of 170 kWh p.a. is still among the lowest in the world. About 35% of the population has access to electricity, which is also low compared to many developing countries.

Currently there is acute shortage of generation capacity in the country and addition of generation capacity is, therefore, considered essential to cope with the consumers' demand and to provide reliable power in and around Ashuganj and to the national grid of Bangladesh as a whole. As per latest assessment, there is a generation shortfall in the country to the order of as compared to peak power demand estimated for 2009. This will continue to widen as the progress in hand and progress of implementation is much behind the forecast for future years up to 2014. In order to overcome this situation, Bangladesh Power Development Board (BPDB) has been considering various options of electric power sources development.

Ashuganj Power Station Company Ltd. (APSCL) is the second largest power station in Bangladesh. The installed capacity by its 8 units is 724 MW and present de-rated capacity is 678MW. Recently a 55MW IPP and 50MW GT Power Plants have been commissioned. In addition to that further 2 (two) total 85MW quick rental power plant have already been commissioned by this time. All these units are of gas operated reciprocating engines. Thus

total capacity comes 914. Ashuganj Power Station fulfills about 15% of power requirements of the country. It is situated near Titas Gas Field and on the left bank of the river Meghna. So it is the most favorable place for power station because of availability of natural resources for power generation. For this purpose about 311 acre lands at the 1 kilometer north-east away from the Bhairab Railway Bridge was acquired. In the same year with the financial assistance of German Government the establishment work of two units each of 64 MW (Unit 1 & Unit 2) started. These two units were commissioned in July 1970. To face the growing requirements for power in the country- Government of Bangladesh decided to setup another two units (Unit 3 & Unit 4) each of 150 MW capacities in Ashuganj. IDA, KfW (Germany), ADB, Kuwait and OPEC provided the financial assistance for this project. After the implementation of Unit 3 & 4 started, the government found that another unit of 150 MW can be established from the savings out of funds provided by the donors. The work for installation of Unit 3 & 4 was started in 1984 and Unit 5 in 1985. Unit 3, Unit 4 and Unit 5 were commissioned in December 1986, May 1987 and March 1988 respectively. During the planning for installation of Unit 3 & 4 it was decided to install a Combined Cycle Power Plant by financial assistance of British Government. Accordingly, works of 90MW Ashuganj combined cycle project [gas turbine unit GT1 of 56 MW capacity and one steam turbine unit of capacity 34 MW (with waste heat recovery boiler)] had been started; and these were commissioned in 1982 and 1984 respectively. A second gas turbine GT2 of 56MW capacity was installed and commissioned in 1986 bringing the capacity up to 146 MW.

The combined cycle power plant, the GT-2 and 2x64MW units have been operating for many years and their condition has deteriorated much, with resultant deterioration of performance. The design and models are out-dated and no more in production. So, procurement of spares has been difficult in the recent years. Therefore, APSCL recently has decided to replace these power plants with a new 450MW combined cycle plant. Further APSCL decided to increase the over all production capacity and Ashuganj 450MW CCPP booth has been envisaged.

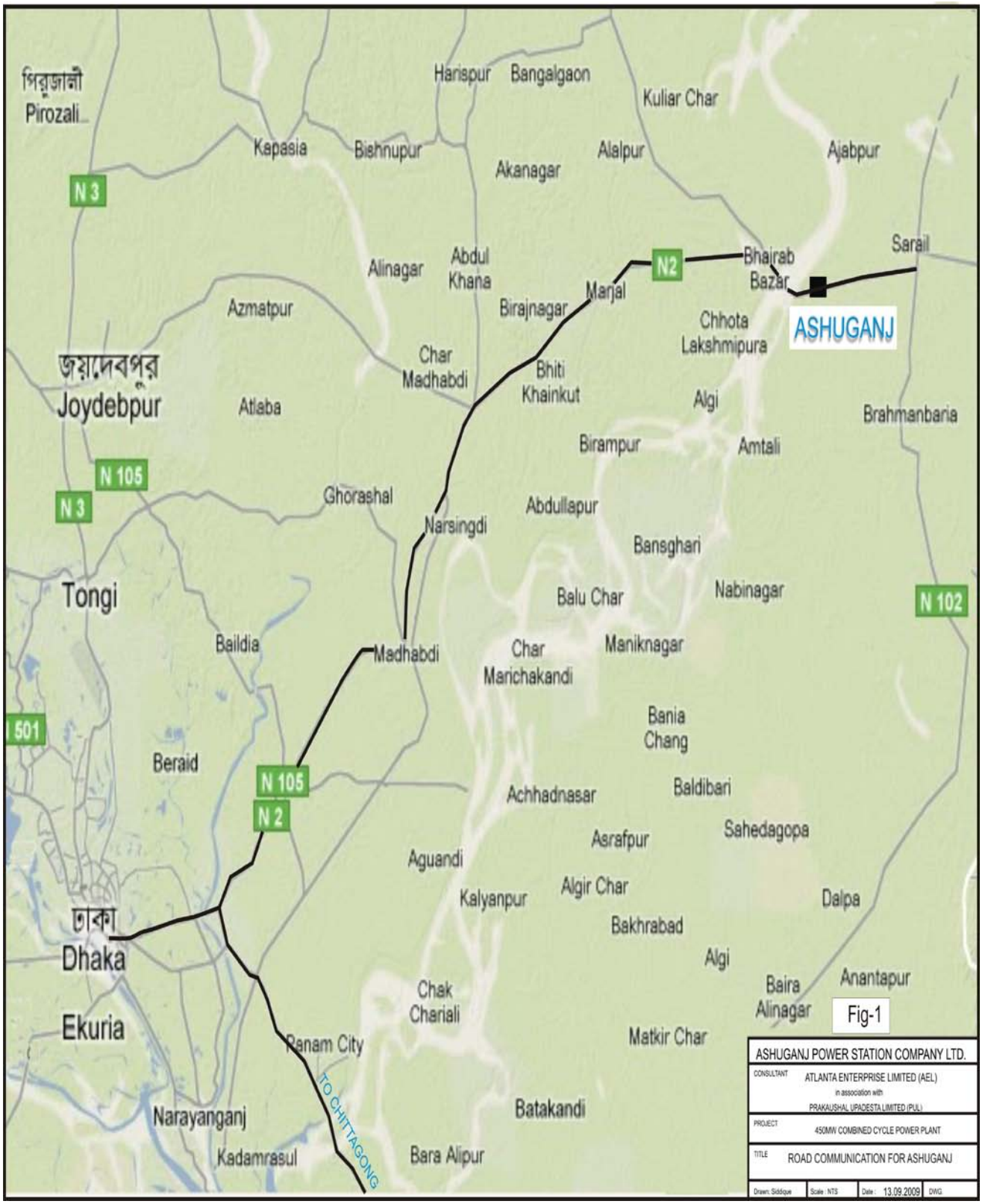
1.3 Objectives of the Project

It is already mentioned that in the foregoing paragraph that Ashuganj power station comprised of 2x64MW steam units, 90MW CCPP (56MW GT+34MW ST), 56MW GT & 3X50MW steam units. The smallest steam units, the CCPP & the GT have already out lived but till they are in service resulting most in efficient outcome. Thus a 150MW & 450MW CCPP were envisaged to be built as replacement. Further APSCL considered it necessary to extend this capability. So they decided to install Ashuganj 450MW CCPP beside the already decided 450MW CCPP.

1.3.1 The Site and Gas Pipe Line

APSCL is approximately 75 km North East of Dhaka City (Fig-1). The proposed Ashuganj 450 MW Combined Cycle Power Plant south will be located beside the already decided 450MW CCPP in the existing Ashuganj Power station premises on the left bank of the River Meghna (Fig-4.1). The combined cycle power plants will be installed in APSCL's vacant land located at the Southwest extremity of the APSCL complex (site-4). A map of the project site is furnished at Figure-3.1. It is intended that gas turbine unit will be fired continuously with natural gas. It is anticipated that gas will be supplied by Titas Gas Transmission and Distribution Co.

Figure – 1: Location Map of Ashuganj Power Station Company Limited (APSCL)



1.4 Need for Environmental and Social Impact Assessment Study

As power projects are identified as having the potential for environmental impact, the Bangladesh Department of the Environment (DoE) has categorized them as being the "Red Category" of industrial processes. As such, an Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) are required. However, the Director General of DoE can exempt IEE and allow the project proponent to go for EIA. The Managing Director of APSCL accordingly made an application to the Director General, DoE, vide Memo No. APSCL/MD/ Project-450MW/2011/536 dated 17-04-11 requesting the approval of the Terms of Reference for EIA and exemption from IEE. The Director General kindly exempted IEE & approved the Terms of Reference requests vide no. DoE/Clearance/5080/2010/116 dated 25-05-2011

1.5 Scope of Services for the EIA and SIA Study

This Environmental Impact Assessment (EIA) is a part of the feasibility study for the proposed Ashuganj450 MW Combined Cycle Power Plant (South). The objective of the study is to help APSCL prepare a power generation project suitable for GoB financing. The study is to verify the impact of the proposed project on environment and on people

The Terms of Reference (ToR) for the consultants are, but not limited to the following:

1. TERMS OF REFERENCE (TOR)

1.1 APSCL intend to build the Ashuganj 450MW Combined Cycle Power Plant South adjacent to the 450MW Combined Cycle Power Plant the feasibility study of which has already been done or any suitable site within the APSCL premises.

1.2 The consultant prepare recommendation for its future use.

1.3 The Consultant will study and determine the best technological option, plant arrangement and maximum unit capacity on the available place and prevalent situation.

1.4 The consultant will study the fuel availability for the entire life of the plant.

1.5 The consultant will prepare specification for Gas turbine, HRSG, generator, steam turbine, all pertinent appurtenance, electrical and mechanical auxiliary equipments, electrical equipment for power evacuation, water treatment plant and construction or utilization of existing circulating pump station.

1.6 The consultant will study the existing intake and discharge channel of circulating water system considering the navigability of the river and will prepare recommendations in this regard.

1.7 The consultant will prepare detail cost estimate including detail cost breakdown mentioning foreign and local cost components along with list of equipment and bill of quantities of for the proposed plant.

1.8 The consultant will prepare detail project implementation schedule and tentative disbursement schedule and carry out financial analysis.

1.9 The consultant will analyze detail project risks and will prepare proposal to mitigate it.

1.10 The consultant will prepare detail Project Feasibility Report and will submit the report to the Managing Director, APSCL on the basis of the above studies & investigation that should include all relevant features of site, site investigations, site layouts; design criteria, conceptual design of the plant, plant performance, specifications, quantity of materials; item wise cost estimate both in local & foreign currency; project implementation plan, construction schedule, budget; financial analysis, benefit/cost ratio, training program etc.

1.11 The work will be completed within one month with effect from the written instruction to go ahead with the work.

1.12 The draft Feasibility Study Report will be submitted at the end of third week with effect from the date of instruction to go ahead with the work, and the final Feasibility Study Report will be submitted within one week of receiving the comments of approval.

1.13 The consultant will carryout Environment Impact Assessment Study which shall cover the following items:

1) Policy, legal and administrative framework
2) Project description
3) Baseline data
4) Environmental Impact Assessment and Mitigation
5) Environmental Management Plan
6) Analysis of alternatives
7) Recommended Environmental Protection Measures, Environmental Management Plan and Environmental Monitoring Plan
8) Prepare a Social Impact Assessment
9) The consultants are to conduct detailed environmental study; to assess the biophysical and socio-environmental impact; to prepare report on Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) and to obtain environmental clearance/ permission from the Department of Environment (DoE) for the implementation of the above projects.

12 Reporting

- An inception report shall be provided within one month of placing the contract with the consultant
- A brief interim report will be submitted every fortnight.
- Draft Feasibility Report shall be submitted at the end of third week from the effective date of contract.
- Final Feasibility Report shall be submitted within 7 days after incorporation of necessary comments of the APSCL.

1.6 Methodology

A team of multidisciplinary specialists has been employed to prepare the EIA Report. Both secondary and primary data were used in the preparation of the EIA Report.

The EIA study has been conducted and the present report prepared based on the information provided by APSCL as well as all possible secondary information and data collected from all relevant sources and from the field through observation, primary data collection, public consultation, survey and certain degree of field validation.

During this process, the following steps have been followed:

(i) A map of the area surrounding the proposed Ashuganj 450MW Combined Cycle Power Plant Project has been prepared. This is furnished at Fig-1. Keeping the CC power plant in the centre, two imaginary circles have been drawn with 1 km and 5 km radii. These areas are the basis for collecting relevant information and data needed for EIA Study. Four (4) field enumerators have been engaged for carrying out extensive survey in the designated area and for collecting relevant data as per designed Questionnaire Formats. While the field survey was gaining momentum, several Focus Group Discussions (FGD) were held comprising the members of the public, representing different professions, NGOs and CBOs. In these FGD meetings, the participants were listed and their opinion/comments were recorded in well designed Formats. Finally, all these data have been entered into a computer to form a data base and analyzed.

(ii) Review the already conducted EIA for completed projects and identify areas to focus during the EIA;

(iii) Collection of information relating to the study from BPDB, APSCL and other organizations;

(iv) Detailed understanding of the scope of the assignment, activities involved and for the intervention areas and their surrounding environment;

(v) Engage resource persons / field staff keeping in mind the limited time available for the assignment, arrange mobilization and necessary orientation;

(vi) Collect all possible data on the environmental, social and natural resource components and parameters of necessity;

(vii) Collection and review of pertinent reports and other references. *This particularly included DoE EIA Guidelines for industries 1997, Environmental policies, strategies and acts.*

(viii) Meet concerned agencies and gather information from various government and other agencies of concern *(Local Union Councils, Upazilla Councils, BPDB, DOE, BWDB, etc);*

(ix) Develop and utilize different information gathering tools, as necessary or deemed appropriate;

(x) Undertake field visits and field surveys including public hearing process;

(xi) Conduct a representative survey using prepared questionnaire covering a wide cross-section of people in the study area;

(xii) Collect samples, as necessary (air, water, noise) from predetermined points and areas within the study area and analyze relevant parameters;

(xiii) Identification of environmental, biological and social impacts and evaluation of their significance and consequences;

(xiv) Consult the people / stakeholders in the intervention areas through a public consultation process;

(xv) Presentation of an outline of a management plan for future to handle the environmental and social management issues;

(xvi) Prepare the draft EIA and SIA report;

(xvii) Receive feedback on the draft and obtain quality check; and

(xviii) Prepare the Final EIA and SIA Report incorporating the observations from APSCL and DoE and submit the same to APSCL.

In the process of preparing the EIA, EIA Guidelines of DoE for industries have been specially consulted and considered.

1.7 Report Structure

The Final Report is prepared meeting the requirements of APSCL as well as the Bangladesh DoE. The outline of the report structure is given below:

- Chapter-1 presents the "introduction" which will deal with the "background" and other aspects of the study.
- Chapter-2 covers the "legislative and regulatory aspects" applicable to developments of this type of project in Bangladesh. It describes briefly the Regulatory Framework, Environmental Policy, Energy and Power Policies, Environmental Legislation, Environmental standards, Environmental Clearance Requirements.
- Chapter-3 of the report covers the "project description".
- Chapter-4 describes the "environmental baseline".

  The following aspects are covered in this Chapter:

  - Topography and Land Use
  - Geology and Soils
  - Climate
  - Natural Hazards
  - Water Resources
  - Air Quality
  - Noise
  - Ecological Baseline

- Chapter-5 describes the "socio-economic survey".
- Chapter-6 covers the "environmental impacts and mitigation".
- Chapter-7 describes the "environmental management and monitoring plan".
- Chapter-8 deals with "public consultation".
- Chapter- 9 deals with "conclusions and recommendations"

1.8 Acknowledgement

AEL has prepared this EIA Report on behalf of APSCL.

The Project proponent had been extremely positive in providing necessary information and documents and also in providing necessary guidance during undertaking of the study and preparation of the report. The Consultant gratefully acknowledges the help, advice and information provided by the Ashuganj Power Station Company Limited (APSCL), Bangladesh Power Development Board (BPDB), as well as the support and interest shown by local people, government and non-government organizations.

CHAPTER – 2
LEGISLATIVE AND REGULATORY ASPECT

2.1 INTRODUCTION

In Bangladesh, development projects are governed directly or indirectly by some type of legal and/or institutional requirements. Assessment of policy, strategy and regulatory issues are extremely important for any project proponent or developer before they physically execute a Program or Plan. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary. The following sections review the relevant National Legislative, Regulatory and Policy Requirements along with some international ones.

Accordingly, APSCL will conduct its operations in compliance with local, national and international legislations. The proposed project will be conducted in accordance with Bangladesh Legislation or International Agreements to which Bangladesh is a party.

2.2 REGULATORY FRAMEWORK

2.2.1 Environmental Agencies

There are a number of agencies relevant to the environmental considerations / concerns in Bangladesh. Following sub-sections present a precise description of such organizations.

- **Ministry of Environment and Forest (MoEF)**

The Ministry of Environment and Forest (MoEF) is the key government institution in Bangladesh for matters relating to national environmental policy and regulatory issues. Realizing the ever-increasing importance of environmental issues, the MoEF was established in 1989 and is presently a permanent member of the Executive Committee of the National Economic Council. This group is the major decision-making body for economic policy and is also responsible for approving public investment projects. The MoEF oversees the activities of the following agencies:

- Department of Environment (DoE);
- Department of Forest (DoF);
- Forest Industries Development Corporation;
- Bangladesh Forest Research Institute and Institute of Forestry;
- Forestry Division of the Bangladesh Agricultural Research Council and
- National Herbarium.

Of the above agencies precise description of the first two departments including other pertinent ones are presented below as considered relevant.

- **Department of Environment (DoE)**

The Department of Environment (DoE), established in 1989 under the jurisdiction of the MoEF, is the executing agency for planning and implementing environmental issues including, but not limited to, the following activities:

- Reviewing environmental impact assessments and issuing environmental clearance where appropriate;
- Implementing environmental monitoring programs and enforcement measures;
- Developing and maintaining environmental data bases, and
- Coordinating international events with the MoEF (e.g., representing Bangladesh in international seminars, workshops, etc).

The DoE is headed by a Director General (DG) who is supported by a team of Directors, Deputy Directors, Assistant Directors, Engineers, and other technical staff (e.g., chemists and laboratory technicians). The DoE has regional offices in Sylhet; Rajshahi; Khulna and Barisal, monitoring stations and several laboratories.

- **Department of Forest (DoF)**

The Department of Forest (DoF), under the Ministry of Environment and Forest, is responsible for protection and management of the Reserve Forests; National Parks; Sanctuaries in the country. The department manpower extends down to Union levels in areas where reserve forest exists. Officers of the DoF are responsible for protection of wildlife in these forest areas.

- **Ministry of Land - Land Reform and Land Acquisition Directorate**

The Ministry of Land (MoL) manages revenue generation for Government-owned land (called khas), excluding agency-owned lands controlled by the Bangladesh Water Development Board (BWDB), Roads & Highways, etc. The MoL controls open water bodies (rivers, beels, haors) above a specified size, except for those that were transferred to the Ministry of Fisheries and Livestock under the new fisheries management policy. The MoL must approve the process where the government acquires private land on behalf of a private development program.

- **Ministry of Water Resources and Flood Control - Bangladesh Water Development Board (BWDB)**

The Ministry of Water Resources and Flood Control is responsible for the water management program of the country. This includes preparation and implementation of water master plans, flood control measures, surface and ground water hydrology data-collection, modeling, monitoring and planning irrigation projects. The executing agency is the Bangladesh Water Development Board (BWDB).

- **Ministry of Fisheries and Livestock - Directorate of Fisheries**

The Directorate of Fisheries, under the Ministry of Fisheries and Livestock, is responsible for managing the fish seed farms in each district. It is also responsible for managing 152 open water bodies under the new fisheries management policy which includes open rivers, depressed basins (haors), oxbow lakes (baors) and other large inland permanent water bodies (beels).

- **Ministry of Power, Energy and Mineral Resources**

The Ministry of Power, Energy and Mineral Resources is the apex body with responsibility for exploration, production and marketing of all forms of primary energy sources. These primary energy sources encompass natural gas, petroleum, coal and peat. This Ministry also deals with all issues related to the generation, transmission, distribution and sales of electricity.

- **The Bangladesh Power Development Board**

The Bangladesh Power Development Board (BPDB) is under the jurisdiction of the Ministry of Power, Energy and Mineral Resources. It is mainly responsible for generation, transmission and distribution of electricity in the country. The Bangladesh Power Development Board is the holding company of PGCB, APSCL and other bodies except REB and PBSs dealing with generation, transmission and distribution of electricity.

2.3 ENVIRONMENTAL POLICY

2.3.1 Introduction

Bangladesh National Environmental Policy has become a priority consideration for any development intervention.

2.3.2 National Environmental Policy

Bangladesh National Environmental Policy of 1992 sets out the basic framework for environmental action together with a set of broad sector guidelines. The Environment Policy provides the broader framework of sustainable development in the country. It also states that all major undertakings, which will have a bearing on the environment, (including setting up of an industrial establishment) must undertake an IEE / EIA before they initiate the project.

The Environment Policy delineates the Department of Environment (DoE) as the approving agency for all such IEE / EIAs to be undertaken in the country.

Policies of fifteen sectors are described in the Policy. Under the Energy and Fuel sector, the use of fuel that has the least environmental impact is encouraged. Conservation of fossil fuel and the need for conducting EIAs before implementation of projects for fuel and mineral resources is stressed in the policy.

The Environmental Action Plan Section of the Policy, under sub-section ‘Fuel and Energy’, suggests that:

- In the rural areas the use of gas, coal, kerosene and petrol as fuel will be expanded, so that fuel wood, agricultural residues, and cow dung is conserved. This will help use of agricultural residues, and cow dung etc. as manure; and
- Appropriate measures will be taken to ensure that extraction; distribution and use of natural resources such as oil, gas, coal, peat etc. do not adversely affect air, water, land, the hydrological balance and the ecosystem.

"Forest, Wildlife and Biodiversity" section requires:

- Conserve Wildlife and Biodiversity, strengthen related research and help dissemination and exchange of knowledge in these areas; and
- Conserve and develop wetlands and protection of migratory birds.

2.3.3 National Environmental Management Action Plan

The National Environmental Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statement set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements for a period between 1995 and 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; and
- Improvement in the quality of life of the people.

One of the key issues in NEMAP regarding the energy sector has been that “energy conservation awareness is generally low throughout the country”.

2.3.4 National Conservation Strategy

National Conservation Strategy 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.

2.3.5 Fifth Five Years Plan

This is the last Five-Year Plan of the country. Presently there is no such Plan except a Three Year Rolling Plan instead. However, the Plan has a lot of relevance in the present context and expresses the planning notion of the Government while considering environmental and related issues and their integration in national planning.

The last Five-Year Plan was formally published in March 1998 and had a separate chapter devoting to ‘environment and sustainable development’. The chapter talks about major environmental issues of the country, areas of special concern, cleaning up of hot spot pollution areas, public and private sector cooperation and tools to achieve that, Government - NGO cooperation, financial and disaster management.

The Fifth Five Year Plan in its section, ‘Oil, gas and natural resources’ sets out, among others, the following relevant objectives:

- Conduct geological and geophysical surveys in order to explore and discover new indigenous energy resources; and
- Meet most of increased demand for commercial energy through the development of indigenous gas.

As part of the policies and strategies under the same section, the following are noteworthy:

- Conservation and economic use of natural gas will be promoted;
- In order to accelerate development activities, efforts will be made to gradually involve the private sector in exploration, production, transportation and sale of oil and gas;

- Environmental Impact Assessments will be made mandatory for energy development projects; and
- Geological and geophysical activities will be geared up.

2.4 ENERGY AND POWER POLICIES

The National Energy Policy provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources and environmentally sound sustainable energy development Programs. The Policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology.

One of the objectives regarding environment is “to ensure environmentally sound sustainable energy development Programs causing minimum damage to the environment".

Seven specific policy recommendations are listed in the policy. Of those, the following three are relevant to the present project:

- Environmental impact assessment should be made mandatory and should constitute an integral part of any new energy development project;
- Use of economically viable environment friendly technology is to be promoted; and
- Public awareness is to be promoted regarding environmental conservation.

2.5 ENVIRONMENTAL LEGISLATION

2.5.1 Introduction

A considerable amount of legislation has been established in Bangladesh: to protect environmental health; to control environmental pollution, and to conserves natural resources.

2.5.2 The Environmental Conservation Act, 1995

The Bangladesh Environment Conservation Act of 1995 (ECA ’95) is currently the main legislation relating to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. It has repealed the Environment Pollution Control Ordinance of 1977.

The main objectives of ECA ’95 are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/ initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities’ discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;

- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

Before any new project can go ahead, as stipulated under the rules, the project promoter must obtain Environmental Clearance from the Director General. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of 5 years imprisonment or a maximum fine of Tk.100, 000 or both. The Department of Environment (DoE) executes the Act under the leadership of the Director General (DG).

2.5.3 Bangladesh Environment Conservation Act (Amendment 2000)

This Act focuses on: (1) ascertaining responsibility for compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

2.5.4 Bangladesh Environment Conservation Act (Amendment 2002)

This Act elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale, production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

2.5.5 Bangladesh Electricity Act. 1910 & Regulations

This act provide the permission to National Electricity Board (at present BPDB) or any licensee of the Government to lay down or place electricity supply lines within the area of supply. The Act provide such permission subject to payment of compensation to the affected person due to removal of structure, standing trees or any other objects for extending aerial lines. Provision under this law requires that this authority shall be subject to intimation to the local authority or to the owner.

Under provision of the Electricity Act. 1910 nothing shall be deemed to authorize or empower a licensee to place any aerial line along or across any street, railway, tramway, canal or waterway unless and until the Govt. has communicated to him a general approval in writing of the methods of construction which he proposes to adopt.

2.5.6 Dhaka Electricity Supply Authority Act. 1990

This Act was promulgated with the purpose of establishing Dhaka Electric Supply Authority for proper management of power supply to the greater Dhaka district. Under this Act a separate management organization DESA was established and considered as ‘Licensee” under Electricity Act. 1910. Under this Act DESA will perform all duties and exercise all powers of a licensee.

2.5.7 Petroleum Act (1974)

This Act provides the statutory framework for the exploration, development, exploitation, production, processing, refining and marketing of petroleum in Bangladesh. The following may summarize the Act:

- The Act enables legislation that allows the Bangladesh Government to enter into all aspects of petroleum exploration, development and exploitation, processing, refining and marketing.

In addition, the Government is authorized to enter into petroleum agreement(s) with any person for the purpose of petroleum operations;

- The Bangladesh Oil, Gas and Mineral Corporation (BOGMC) is designated as the authority to exercise the rights and powers of the Government under the Act; and
- The Act repeals the Regulation of Mines, Oil fields and Mineral Development (Government Control) Act 1948 and the 1974 Petroleum Ordinance Act.

The Act sets out the duties of persons engaged in petroleum operations, namely:

- "To ensure that such petroleum operations are carried out in a proper manner and in accordance with good oil field practices;
- To carry out petroleum operations in any area in a manner that does not interfere with navigation, fishing and conservation of resources of the sea and sea-bed; and
- To consider factors related to the ecology and environment."

Provisions of this Act set out certain details related to environment and safety:

"In particular, and without prejudice to the generality of the foregoing provision, a person engaged in any petroleum operations shall, in carrying out such operations in any area:

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

2.5.8 East Bengal Protection and Conservation of Fish Act (1950)

The East-Bengal Protection and Fish Conservation Act of 1950, as amended by the Protection and Conservation of Fish (Amendment) Ordinance of 1982 and the Protection and Conservation of Fish (Amendment) Act of 1995, provide provisions for the protection and conservation of fish in inland waters of Bangladesh. This is relatively unspecific and simply provides a means by which the Government may introduce rules to protect those inland waters not in private ownership.

This is framework legislation with rule making powers. Among others, some of these rules may:

- Prohibit the destruction of, or any attempt to destroy, fish by the poisoning of water or the depletion of fisheries by pollution, by trade effluent or otherwise.

2.5.9 The Protection and Conservation of Fish Rules (1985)

These are a set of rules in line with the overall objectives of the Fish Act. The Rule requires that "no person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters". The Rule further states - "No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters".

2.5.10 Environment Conservation Rules (1997)

These are the first set of rules, promulgated under the Environment Conservation Act of 1995 (so far there have been three amendments to this set of rules - February and August 2002 and April 2003). The Environment Conservation Rules of 1997 has provided categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects.

Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) the requirement for and procedures to obtain environmental clearance, and (iii) the requirement for IEE / EIAs according to categories of industrial and other development interventions.

The Rules are not explicit for various oil and gas exploration interventions. Rather, this is covered under the broader heading of “exploration, extraction and distribution of mineral resources” under the Red Category Projects.

The proposed project, according to the DoE, falls under the Red category of the Environmental Conservation Rules, 1997. Exploration of some of the mineral resources, including hydrocarbons, should not be treated as a Red Category activity, as the environmental issues involved due to such exploration are often moderate and the physical activities of exploration in the field are very temporary and in general do not cause a significant impact.

2.6 ENVIRONMENTAL STANDARDS

2.6.1 Introduction

The appropriate national environmental standards are applied under the Environmental Conservation Rules 1997

2.6.2 National Environment Quality Standards

At present there are environmental standards in operation in Bangladesh also promulgated under the Environment Conservation Rules of 1997. There are standards prescribed for varying water sources, ambient air, noise, odor, industrial effluent and emission discharges, vehicular emissions, etc.

The Bangladesh standards intend to impose restrictions on the volume and concentrations of wastewater / solid waste / gaseous emissions, 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, oxides of nitrogen and in some cases volatile organic compounds and other substances.

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

The standards, commonly known as Environmental Quality Standards (EQS), are legally binding. There is a separate schedule on industry specific standards, other than the general industrial emission and effluent standards. This schedule covers a wide range of industries – fertilizer, tannery, integrated textile, food, cement, etc.

For reference, the Bangladesh standards for ambient air, noise, odor, sewage, industrial effluent and industrial emission are furnished hereinafter as six separate Tables, Table-2.1 to Table-2.6. These are all in an authentic translation from original Bengali citing the specific source.

Table-2.1
Bangladesh Standards for Ambient Air Quality
(All values in micrograms per cubic meters)

Sl	Area	Suspended Particulate Matters (SPM)	Sulfur Dioxide (SO_2)	Carbon Monoxide CO)	Oxides of Nitrogen (NOx)
Ka	Industrial and mixed	500	120	5000	100
Kha	Commercial and mixed	400	100	5000	100
Ga	Residential and rural	200	80	2000	80
Gha	Sensitive	100	30	1000	30

Source : Schedule-2, Rule 12, Environment Conservation Rules of 1997 (Page 3123, Bangladesh Gazette, 28 August 1997) (Own authentic translation from original Bengali).

Note :
1. Sensitive area includes national monuments, health resorts, hospitals, archaeological sites, educational institutions and other government designated areas (if any).
2. Any industrial unit located not in a designated industrial area will not discharge such pollutants, which may contribute to exceed the ambient air quality above in the surrounding areas of category 'Ga' and 'Gha'.
3. Suspended particulate matters mean airborne particles of diameter of 10 micron or less.

Table-2.2
Bangladesh Standards for Noise

Sl	Area Category	Standards Values (all values in dBA)	
		Day	Night
Ka	Silent zone	45	30
Kha	Residential area	50	40
Ga	Mixed area (basically residential and together used for commercial and industrial purposes)	60	50
Gha	Commercial area	70	60
Umma	Industrial area	75	70

Source : Schedule 4, Rule-12, Environment Conservation Rules, 1997. (Page 3127B Bangladesh Gazette, 28 August 1997) own authentic translation from original Bengali

Note :
1. Daytime is reckoned as the time between 6 a.m. to 9 p.m.
2. Night time is reckoned as the time between 9 p.m. to 6 a.m.
3. Silent zones are areas up to a radius of 100 meter around hospitals, educational institutions or special establishments declared or to be declared as such by the Government. Use of vehicular horn, other signals and loudspeakers is prohibited in silent zones.

Table-2.3
Bangladesh Standards for Odor

Parameters	Unit	Values
Acetaldehyde	PPM	0.5-5
Ammonia	PPM	1-5
Hydrogen Sulfide	PPM	0.02-0.2
Methyl Disulfide	PPM	0.009-0.1
Methyl Mercaptan	PPM	0.02-0.2
Methyl Sulfide	PPM	0.01-0.2
Styrene	PPM	0.4-2.0
Trimethylamine	PPM	0.005-0.07

Source: Schedule –8, Rule-12, Environment Conservation Rules, 1997. (Page 3130, Bangladesh Gazette, 28 August 1997) own authentic translation from original Bengali

Note ***:*** 1. Regulatory standards at emission/discharge outlets (apply to those outlets which are higher than 5 meters) :

Q = 0.108 x He2 cm

Where Q – gas emission rate (Nm3/hour)

He – effective height of the outlet (m)

Cm – above mentioned standard (ppm)

2. Where there is a range given for a parameter, the lower value will be used for warning and the higher value for initiation of legal procedure or punitive measures.

Table-2.4
Bangladesh Standards for Sewage Discharge

Parameters	Unit	Values
BOD	mg/l	40
Nitrate	mg/l	250
Phosphate	mg/l	35
Suspended Solids (SS)	mg/l	100
Temperature	^{o}C	30
Coliforms	number/100ml	1000

Source : Schedule- 9, Rule-13, Environment Conservation Rules, 1997. (Page-3131 of the Bangladesh Gazette of 28 August 1997) (Own authentic translation from original Bengali)

Note :
1. These standards are applicable for discharge into surface and inland water bodies.
2. Chlorination is to be done before final discharge.

Table-2.5
Bangladesh Standards for Industrial and Project Effluent

Sl. No.	Parameters	Unit	Discharge To		
			Inland Surface Water	Public Sewer to Secondary Treatment Plant	Irrigable Land
1	Ammonical nitrogen (as elementary N)	mg/l	50	75	75
2	Ammonia (as free ammonia)	mg/l	5	5	15
3	Arsenic (as As)	mg/l	0.2	0.05	0.2
4	BOD_5 at 20^oC	mg/l	50	250	100
5	Boron	mg/l	2	2	2
6	Cadmium (as Cd)	mg/l	0.05	0.5	0.5
7	Chloride	mg/l	600	600	600
8	Chromium (as total Cr)	mg/l	0.5	1.0	1.0
9	COD	mg/l	200	400	400
10	Chromium (as hexavalent Cr)	mg/l	0.1	1.0	1.0
11	Copper (as Cu)	mg/l	0.5	3.0	3.0
12	Dissolved oxygen (DO)	mg/l	4.5-8	4.5-8	4.5-8
13	Electro-conductivity (EC)	µsiemens/cm	1200	1200	1200
14	Total dissolved solids	mg/l	2100	2100	2100
15	Flouride (as F)	mg/l	2	15	10
16	Sulfide (as S)	mg/l	1	2	2
17	Iron (as Fe)	mg/l	2	2	2
18	Total kjeldahl nitrogen (as N)	mg/l	100	100	100
19	Lead (as Pb)	mg/l	0.1	1	0.1
20	Manganese (as Mn)	mg/l	5	5	5
21	Mercury (as Hg)	mg/l	0.01	0.01	0.01
22	Nickel (as Ni)	mg/l	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/l	10.0	Not yet set	10
24	Oil and grease	mg/l	10	20	10
25	Phenolic compounds (as C_6H_5OH)	mg/l	1.0	5	1
26	Dissolved phosphorus (as P)	mg/l	8	8	15
27	Radioactive substance	(to be specified by Bangladesh Atomic Energy Commission)			
28	PH		6-9	6-9	6-9
29	Selenium (as Se)	mg/l	0.05	0.05	0.05
30	Zinc (as Zn)	mg/l	5	10	10
31	Total dissolved solids	mg/l	2100	2100	2100
32	Temperature	^oC (summer) ^oC (winter)	40 45	40 45	40 45
33	Suspended solids	mg/l	150	500	200
34	Cyanide	mg/l	0.1	2.0	0.2

Source: Schedule –10, Rule-13, Environment Conservation Rules, 1997 (Page 3132 - 3134 of the Bangladesh Gazette of 28 August 1997) (Own authentic translation from original Bengali).

Note: These standards will be applicable for all industries other than those which are specified under 'industrial sector specific standards'. These standards will have to be complied from the moment of trial production in case of industries and from the moment of the very beginning in case of projects. These standards will have to be met at any point of time and any sampling. In case of need for ambient environment condition, these standards may be made stringent. Inland surface water will include drains, ponds, tanks, water bodies, ditches, canals, rivers, streams and estuaries. Public sewer means leading to full fledged joint treatment facility comprising primary and secondary treatment. Land for irrigation means organized irrigation of selected crops on adequate land determined on the basis of quantum and characteristics of waster. If any discharge is made into public sewer or on land which does not meet the respective definitions in notes 5 and 6 above, then the inland surface water standards will apply.

Table-2.6:
Bangladesh Standards for Industrial and Project Emissions

Sl	Parameters	Values (in mg/Nm^3)
1	Particulates (ka) Power station of capacity of 200 MW or more (kha) Power station of capacity of less than 200 MW	 150 350
2	Chlorine	150
3	Hydrochloric acid vapor and mist	350
4	Total fluoride (as F)	25
5	Sulfuric acid mist	50
6	Lead particulates	50
7	Mercury particulates	10
8	Sulfur dioxide (ka) Sulfuric acid production (DCDA* process) (kha) Sulfuric acid production (SCSA* process) (* DCDA : Double conversion, double absorption, SCSA : Single conversion single absorption) Lowest height of stack for sulfur dioxide dispersion : (ka) Coal based power plant 500 MW or more 200 MW – 500 MW Less than 200 MW (kha) Boiler Steam per hour – up to 15 tons Steam per hour – more than 15 tons (Q = SO_2 emission in kg/hour)	kg/ton acid 4 100 275 m 220m $14(Q)^{0.3}$ 11m $14(Q)^{0.3}$
9	Oxides of nitrogen (ka) Nitric acid production (kha) Gas based power stations 500 MW or more 200 – 500 MW Less than 200 MW (Ga) Metallurgical oven	 3 kg/ton acid 50 ppm 50 ppm 40 ppm 30 ppm 200 ppm
10	Kiln soot and dust (ka) Blast furnace (kha) Brick kiln (Ga) Coke oven (Gha) Lime kiln	Mg/Nm^3 500 1000 500 250

Source: Schedule-11, Rule-13, Environment Conservation Rules, 1997 (Page 3135, 3136, Bangladesh Gazette, 28 August 1997) (Own authentic translation from original Bengali).

2.6.3 World Bank Standards

World Bank or International Finance Corporation (IFC) investment agreements for power plants normally require that the project Sponsors design and operate with due regard for environmental, health and safety aspects. To assist in this process, the World Bank has produced a series of guidelines concerning the industries and pollutants most often encountered during Bank lending operations.

It is important to note that these standards are applied in conjunction with those of the host country and that compliance with national environmental stipulations is a pre-requisite for World Bank funding approval.

The guidelines in the World Bank Group's Pollution Prevention and Abatement Handbook-Part III, dated September, 1998 were used for both atmospheric emissions and liquid effluents.

2.7 ENVIRONMENTAL CLEARANCE REQUIREMENTS

2.7.1 National Environmental Clearance

For most proponents, planning an industrial project or projects of various natures in Bangladesh is currently mandatory to obtain an "environmental clearance" from the Department of Environment.

The first step for the project proponent is to complete an application form, which may be obtained from the appropriate DoE Divisional Office. The application form with a cover letter is then addressed to Director / Deputy Director of the respective Divisional Office of the Department of Environment as prescribed in the Environmental Conservation Rules of 1997. The application should include a feasibility study report of the project, IEE / EIA, NOC's of local authorities, a mitigation plan for minimizing the impact of environmental pollution and a Treasury Chalan of requisite fees (this will depend on the amount of investment by the project proponent). The DoE authority reserves the right to request additional information and supporting documents for the proposed project.

As per the Environment Conservation Rules of 1997, the DoE divisional authority issues environmental site clearance within 60 working days or the refusal letter with appropriate reasons for such a refusal. The clearance issued is valid for a one-year period, which requires being renewed 30 days prior to the expiry date. For projects requiring both site clearance and environmental clearance (like in the present case), a two-tier system is applied (actually this is a three tier system) as after one obtains the site clearance, they need to apply again at an appropriate time along with the EIA. Once the EIA is approved (this approval is actually the second tier), then the proponent applies for the Environmental Clearance.

This may be quite a lengthy process if DoE uses the full extent of the time limits. The rules however provide the Director General a discretionary authority to grant `Environmental Clearance' to an applicant exempting the requirement of site / location clearance, provided he considers it appropriate.

The Environmental Conservation Rules of 1997 ensures the right of the aggrieved to appeal against the Notice Order or Decision to the appellate authority. The appeal should be made to the appellate authority with the clear justification and the attested copy of the specific Notice Order / Decision of the respective DoE office against which the appeal is to be made. Moreover, the prescribed fee is to be paid through treasury Chalan and the relevant papers for the appeal are required to be placed.

The focus of the environment conservation rules in terms of environmental clearance and EIA lies with the classification of industries and certain projects into four groups; Green, Orange-A, Orange-B and Red based on their pollution or environment damage potential.

Green List Industries / projects are considered relatively pollution-free and therefore do not require an environmental clearance from the DoE and consequently no environmental study.

Orange List Industries / projects fall into two categories, Category-A and Category- B. Category- A industries are required to submit general information, a feasibility report, a process flow diagram and schematic diagrams of waste treatment facilities along with their application for obtaining DoE environmental clearance. Category-B industries / projects are required to submit an Initial Environmental Examination (IEE) report, along with their application and the information and papers specified for Category- A industries / projects.

Red List Industries / projects, according to the Rules, are those which may cause 'significant adverse' environmental impacts and are therefore required to submit an EIA Report. However they require obtaining an initial site clearance on the basis of an IEE Report, and subsequently submitting an EIA Report for obtaining environmental clearance along with other necessary papers, like the feasibility study report and no objections from local authorities.

CHAPTER – 3
PROJECT DESCRIPTION

3.1 Background

In Bangladesh, there is acute shortage of 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 gas turbine power plants with highbred energy efficient 450MW CCPP. The proposed Ashuganj 450MW Combined Cycle Power Plant (South) will be addition to further enhance the capability of APSCL and thereby the nationahood. The proposed power plant (Ashuganj 450MW CCPP (South) located beside the already decided additional Combined Cycle Power Plant (450MW) within the premises of APSCL at the bank of the River Meghna. It is to note that, the Combined Cycle Power Plant will be installed in APSCL's vacant land; therefore, no new land acquisition is required. The case is same with the Ashuganj 450MW CCPP (south). It is intended that all the unit(s) will be fired continuously on natural gas.

3.2 Project Objectives

The purpose of the already decided power plant was to replace old power plants situated in the Ashuganj Power station complex which are very old and uneconomic to operate. The addition of Ashuganj 450MW CCPP (south) will further increase the capability of APSCL as well as serve better their commercial objective. The generated power will be transmitted to the national grid system to cater for the existing market. It is expected that this power plant will help to sustain the business of APSCL as well as continue to meet the power demand of greater Comilla area and Bangladesh at large through the existing network.

The objective of the study is to investigate into the feasibility of establishing such a Combined Cycle Power Plant at one of the designated sites (Fig-5.01 of FS Report Volume-1) at the premises of Ashuganj Power Station Company Ltd. It was necessary to collect physical dimension based on which, layout and configuration of the proposed combined cycle power plant could be determined suiting to the available land at the given sites.

3.3 Existing Power Plants at Ashuganj

The Ashuganj 724 MW power plant established by BPDB in the period steam 1970-1988 in phases. Out of the landmass available in APSCL premises a portion of land adjacent to 146MW CCPP has already been allotted to a private 50MW rental diesel power plant as an emergency. Further a 50MW Gas Operated Diesel Power Plant has already been installed by APSCL at site no 2. Beside, further 190MW rental power stations have already been commissioned in and around APSCL premises. But this rental power plants will cease to operate after three years.

Thus the original power station of APSCL at Ashuganj consists of two units of 64MW steam power plant + 3 units of 150MW steam power plant + 1units of 90MW (56+34) combined cycle power plant+1 additional unit of 56MW gas turbine. The power is generated at 11kV & 15.75kV by different machines and is stepped up to 132 kV and 230kV and thereby connected to the national grid system. Except the 3×150MW steam power plants all are very old.

Recently a 150MW CCPP & a 450MW CCPP have been planned to install within the APSCL premise but yet to be installed. The out put of 150MW CCPP were planned to connect to the existing Substation while that of 450MW was to be connected to a new 230kV Switchyard planned with the proposed 450MW CCPP.

All the power plants are fuelled by natural gas through respective feeder lines, metering stations from the main gas transmission line belonging to Titas Gas Transmission and Distribution Company Ltd.

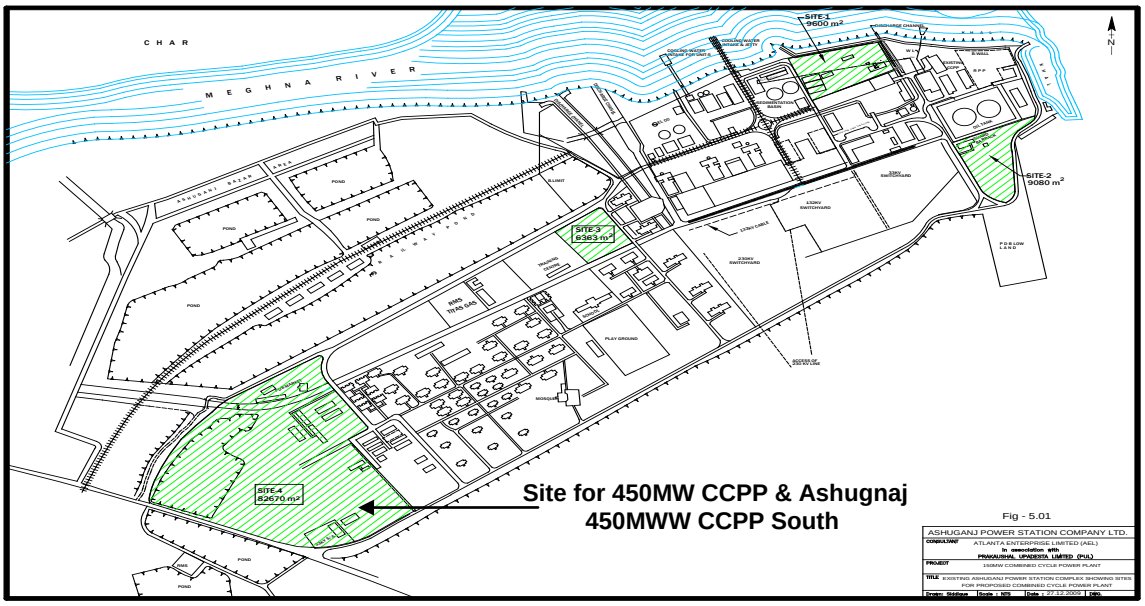
The existing power plants are consuming gas at the rate of 12.82SCF/kWh by 146MW CCPP, 11.37SCF/kWh by 2x64MW steam power plant and 9.72SCF/kWh by 3x150MW steam power plants. Thus if all the units run at 90% plant factor the total daily gas consumption will be 165.60MMSCFD against a total generation of 15.638mkWh/day. The total now a day gas consumption including the rental ones comes to 229.5MMSCF at 90% Plant Factor with corresponding energy generation of 21.34SCF/kWh. But when the existing 147MW CCPP & 2x64MW Steam unit will be replaced and the rental power stations tenures will expire after three years and the proposed 150MW CCPP, 450MW CCPP & Ashuganj 450MW CCPP South come to operation, the total generation capacity will be 1550MW and corresponding generation will be 33.48MkW/day against the total gas consumption will be 261.36MMSCFD at 90% Plant Factor. So the additional gas requirement will be 31.86MMSCFD with incremental energy generation of 12.14MkW/day.

There are two s/s switchyard 132kV and 230kV. The 132 kV substation built with the 2x64MW power station was commissioned in 1970 and the 230kV was built later on, with the 3x150MW power plant. It is located very close to the south side of the power plant (Fig-5.06 of FS report Volume-1). The132kV a double bus sub-station with bus bar conductor 450mm^2 TAl rated 1000A. (1)There are in all 22 bays in the 132kV switchyard out of which 5 bays are connected to power plants (GT-1&2 and ST unit of CCPP); (2) two bays are connected to 2x150MVA 230/132kV auto-transformers; (3) the rest 12 bays are used for catering for load through outgoing 3-double circuit 132kV transmission lines, 132/33kV and 132/6.6kV transformers; (4) two bays have been earmarked for a 50MW rental power station at Ashuganj and one newly built line from Shahjibazar rental power station; (5) one bay position remains spare which is unequipped (Fig-5.13). The 230kV switchyard is also a double bus system with 2x500mm2 copper comductor having estimated capacity of 2000A (Fig-5.11) of FS report of Volume–1). With the completion of 450MW CC Power Plant a new 230kV switchyard has already been proposed to be built and interconnected with the 230kV switchyard. The new switchyard will be extended to evacuate the output of the Ashugnnj 450MW CCPP (South) without any adversaries.

3.4 The Proposed Project

The main thrust of this study was to study and find out the feasibility of the setting up the Ashuganj 450MW CCPP South can be accommodated on APSCL's own land at Ashuganj and elsewhere within the premises of APSCL. Therefore, the Ashuganj site was investigated (Figure 3.1). Details of investigations are described in Chapter – 5 of Feasibility Report.

Figure 3.1 Ashuganj Power Station Complex



The Site

Ashuganj located on the left bank of the Meghna River about 75 km Northeast to Dhaka is connected by railway & motor way (Fig-5.02, Chapter-5 of FS report Volume-1) with Dhaka. There also exists good waterways connection of the site with seaports of Chittagong and Mongla. There is 724MW thermal power plant, and a large 230 kV and a 132 kV substation exist here already. Adjacent to the site of the existing CCPP a 50MW rental gas base power plant has already been commissioned. Further APSCL has already commissioned a 50MW gas based diesel power plant at site no-2. Beside rental power stations with total capacity 190MW have been commissioned within and very adjacent to APSCL complex.

Available Land

The total original APSCL's land was 311 acres of which a considerable portion has been already utilized and large portion of balance land is available scattered in different sites was found to be occupied by already built power plants and pertinent installation almost in the middle, leaving rest of the land unfavorably oriented in. The site considered for this plant (Ashuganj 450MW CCPP South) is at site no. 4 adjacent to already planned 450MW CCPP. The total area available at site 4 is about 82.670m^2. This can accommodate 2 (two) 450MW Power Plants of 1:1:1 configuration.

The information collected from the manufacturers enabled the Consultants to make out various alternative layouts for various capacities and configurations.

3.4.1 Plant/unit sizes

The power plants in Bangladesh are interconnected and the total present power demand of Bangladesh is estimated to be more than 5200 MW.

Such a system can accommodate a maximum unit size of 500MW. Considering the total output of the combined cycle power plant to be 450 MW under site conditions (35ºc, 1.013 bar, 98%RH) and of 1:1:1 configuration of the plant is quite compatible.

3.4.3 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 450 MW power plant with 1:1:1 configuration was investigated with one 334MW (ISO rated) gas turbine, a heat recovery boiler and a 150MW steam turbo-generator.

3.4.4 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 NO_x Burners, Water injection and/or catalytic removal system is envisaged for limiting NO_x (Chapter – 6 of Feasibility Report).

3.4.5 Type of Boiler

Considering ease of operation and maintenance, ease of handling during transportation, ease of erection and simplicity of construction, a vertical module forced circulation double pressure reheat 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^OC, the maximum steam temperature is considered to the limit to 529^0C

3.4.6 Type of Steam Turbine

The steam turbine is to be a double flow, double pressure or mixed pressure type depending on the steam cycle utilized. Dual pressure turbine can be operated at high efficiency than single pressure type, but the construction of turbines and control system becomes more complicated.

Manufacturers of steam turbine have their own standard designed turbines. Therefore utilization of such standard designed turbine seems the most economical solution.

3.4.6.1 Steam Cycle

In this size of the heat recovery boiler, dual pressure steam cycles are usually adopted. From the viewpoint of thermal efficiency, the dual-pressure steam cycle is preferred even with relatively higher capital cost than the single pressure system.

To minimize initial investment and to simplify the system, reheating/regenerative condensing turbine with a dual pressure steam cycle is to be utilized.

3.4.6.2 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

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.

The following Table-3.1 shows the major features of the systems in case of 55 MW steam turbine based on a rough estimate.

Table-3.1
Comparison of Different Cooling Systems

		Open cycle	Closed cycle wet type C/T	Closed cycle dry type C/T
Circulating water	t/hr	23,000	25,300	25,000
External supply water	t/hr	23,000	2530	Negligible
Discharge water	t/hr	23,000	2530	Negligible
Initial cost	%	100	200	600
Operating and maintenance cost	%	100	120	150

3.4.7 Control of the Combined Cycle Power Plant

A state of the art micro computer based distributed control system will be applied for smooth operation of high technology gas turbine, heat recovery boiler and the steam turbine for optimum operation.

The variable pressure operation of the steam turbine unit is to be employed so as to afford flexible operation and improve the turbine efficiency at partial load.

3.4.8 Hydrological Conditions

The hydrological data of the Meghna River were collected from Surface Water Processing Branch of Bangladesh Water Development Board (BPDB), for the years 1985 to 2008.

River water discharge readings recorded during the period from 1988 to 2006 shows minimum discharge of 2050M^3/sec occurring in November, 1998 while a maximum discharge of 16558m^3/sec occurred in August, 2002. Availability of water is considered adequate for once through cooling of the Steam Turbine. The temperature is seen to vary from 15.66^{0}C to 30^{0}C during the period from 1988 to 2006.

3.4.9 Sub-soil Conditions

For ascertaining the sub-soil conditions of the site, three soil borings upto 24m have been carried out. The results show that suitable pile foundations will have to be adopted for the major equipment of the CC Power Plant Project.

3.4.10 Seismic Conditions

Bangladesh and northeast India have historically been in the active seismic zone. According to Bangladesh Building Code, Bangladesh has been divided into three seismic zones i.e zone 1, zone 2 and zone 3, Ashuganj power station site is situated under zone 3. Seismic coefficient for zone 3 is 0.25.

3.4.11 Water Supply

From the steam rate of the 150MW ST unit of the 450MW CCPP and assumed rise of cooling water temperature by 7^0C, it was calculated that about 23,000 tons of cooling water per hour or about 6.4m^3(ton)/sec flow is required for once through cooling. The total water withdrawal by the existing and new plants amount to 50m^3/sec. the same volume will be discharged back to the river with 7^OC rise of temp i.e. at 37.54^OC. The minimum river discharge of 2050m^3 /sec at plant location is quite adequate for this. The temperature of river water was recorded to be 30^OC. But the temp of river at intake will be 30.54^OC due to discharge of proposed 150MW CCPP 250m upstream of the intake. If the 150MW CCPP, 450MW CCPP, 3x150MW Steam Units and Ashuganj 450MW CCPP South runs simultaneously, the water requirement will be about 56.67m^3/sec.

It is concluded that the available river water is sufficient for the entire power station including the proposed plants, and cooling tower is not required.

It is estimated that over 56.67m^3/sec of river water would be drawn from the intake point by all the plants together and impact of 56.67m^3 water discharged per second at 37.54^oC 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 be 34.04^OC. At the long and down the river the temperature will reduce to almost river water temperature.

In aquatic system, both the present and proposed industrial developments will also be considered. Where possible, the positioning of such developments will be taken into account when establishing the placement of the inlet and outlet systems from the proposed project.

Surface and ground water protection systems will also be included in the design of the power plant. Adequate measures will be employed in order to prevent leakage of substances such as fuel oil and lubricants. All storage will be sealed and dyked appropriately.

3.4.12 Fuel Supply

Fuel for the gas turbine unit of the proposed combined cycle power plant is natural gas which is indigenously available in Bangladesh. Total lifetime requirement of gas is estimated to be about 438.13BSCF at 70% plant factor. The quality of natural gas fuel for gas turbine are as shown below:

Table-3.3
Composition of Natural Gas

	% Mole	**% Wt**
Methane	96.464	90.882
Ethane	1.914	3.380
Propane	0.254	0.657
i-Butane	0.262	0.894
n-Butane	0.100	0.340
i-Pentane	0.030	0.127
n-Pentane	0.013	0.053
Hexane	0.040	0.200
Heptane+	0.342	2.407
Nitrogen	0.477	0.785
CO_2	0.106	0.274
Total	**100**	**100**

Ashuganj Power Station had started producing electricity since 1970 with 2x64 MW steam thermal power plants based on indigenous natural gas. There were, two oil tanks with 10000 tones capacity each, but never used for the power station. All the subsequent plants also were based on natural gas fuel.

Currently Bangladesh is passing through a difficult time with regard to gas supply. Gas production and transmission system has not been expanded for the last eight years to match with the growth in demand. Even in this crisis Ashuganj Power Station has been enjoying a very good supply because of proximity to gas field and exclusive line of supply. Petrobangla, the state organization for oil, gas and mineral resources development has ensured that Ashuganj will enjoy its present quota of 150 MMSCFD i.e. about 4.25 million cubic meter per day. A marginal increase is possible even now, if the Government desires in view of additional quantity of proven gas reserve.

Government has stressed upon efficient use of fuel (energy) resources of the country and that is why APSCL has decided to convert its older plants to be replaced by efficient combined cycle power plants. With about 56.4% efficiency it needs only about 7.145SCF of gas per KWh generated as compared to 12.82 SCF by existing 146MW CCPP & 11.94SCF by existing 2x64MW units.

The total now a day gas consumption including the rental ones comes to 229.5MMSCF at 90% Plant Factor with corresponding energy generation of 21.3MkWh/day. But when the existing 147MW CCPP & 2x64MW Steam unit will be replaced and the rental power stations' tenures will expire after three years and the proposed 150MW CCPP, 450MW CCPP & Ashuganj 450MW CCPP South come to operation, the total generation capacity will be 1550MW and corresponding generation will be 33.48MkW/day against the total gas consumption will be 261.36MMSCFD at 90% Plant Factor. So the additional gas requirement will be 31.86MMSCFD with incremental energy generation of 12.14MkWh/day.

The existing Titas gas RMS situated in Ashuganj Power Station Complex is receiving gas supply at a pressure of 1000psi (present pressure is 700 – 800psi) through a 10" dia pipe from the valve station. In the Titas RMS the gas pressure is regulated and three different pipe lines are in use to supply gas to the power station complex. The 450MW (3×150) 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 90MW CCPP (56MW GT1 + 34MW ST) and the 2nd unit of GT 56MW receives gas at a pressure of 500psi (present pressure 330psi) through an 8" dia pipe (Fig.-5.08 of FS report Volume -1).

The existing Titas Gas RMS for APSCL shall have to be extended and a new 10'' dia about 600m long gas pipe line shall be installed along with gas supply system for GT unit at Site-4 (Fig-6.12 of FS report Volume-1). Another new 10''dia about 600m long pipe line shall be installed along with gas supply system for Ashuganj 450MW CCPP South.

3.4.14 Transportation

There is a permanent jetty at the river bank in APSCL Complex provided with crane of capacity 200ton plus 50ton auxiliary. But this crane require major rehabilitation. After rehabilitation of the crane and with help of some other cranes of appropriate capacity any larger unit can be unloaded. But transportation to the proposed site of 450MW is difficult even incase of smaller units since there are no free space to make even temporary road to carry heavy equipment across existing power station premises. The existing railway line and the internal roads could not be extended to the new site because of various obstacles all ready built as different components of the power station. Investigation was made to find out a suitable location at river side near the proposed site. But the immediate nearest riverfront is already occupied by a market and other installation. Further investigation was done to

build a temporary jetty at the old ferry ghat about one and a half km away from the site for unloading the equipment and carry the same to the site by lowbuoy carriers. The approach road from old ferry ghat to proposed site was also investigated and found suitable for the purpose.

3.4.15 Evacuation of Power from the proposed Ashuganj 450MW CCPP South

In the feasibility study report of the first 450MW CCPP project it was proposed to bifurcate the existing double circuit single Mallard conductor line to Ghorasal to turn-in and turn-out to the proposed 230kV substation at the power plant project site. The Ashuganj part of the line was proposed to be used as the inter-connector between the two substations. But the capacity of this part of the line will be very much insufficient to the requirement of power transfer from the power plant substation connecting to two 450MW CCPPs. It is now proposed that one set of double circuit underground 230kV cable of sufficient capacity may be laid on the other side of the road under a walk-way to interconnect the two substations, so that maximum power transfer from the power plant sub-station to the existing APSCL 230kV sub-station as well as occupation of the APSCL land on the road side is ensured. The inter-connection of the Ghorasal 230kV line will also be done by another set of double circuit 230kV underground cables laying along the same route and terminating to a new terminal structure installed inside the boundary wall of the APSCL 230kV substation. The cost of the proposed cables will be much higher than the cost shown in the first 450MW CCPP project for the two double-circuit interconnections on 4-circuit towers and hence the additional cost shall be provided in the project. It is proposed to keep two cables in each project.

3.4.16 Project Implementation Schedule

Project Implementation schedule is based on realistic assumptions. It is estimated that a period of 36 months will be needed to complete the project, counting from the date of issuance of EOI document for short-listing of project consultants. It is shown that implementation of the plant (450MW CCPP) as a whole will take 24 months including testing & commissioning.

3.5 Analysis of Project Design Alternatives

3.5.1 Selection of Type

That a combined cycle power plant was an obvious choice as the terms of reference so required, but then several other technological options have been investigated to verify its justification.

The capacity of the new power station to be installed within the framework of the project is 450 MW at the site rating. For this range of capacity, one of three types of power plants is ordinarily selected, namely, steam turbine, gas turbine and combined cycle. Generators driven by diesel engines burning natural gas are limited by capacity up to about 10MW. Due to unit size constraint of gas fuel diesel engine, the same may not be brought into this comparison. During selection of technology and size from among these types, the existing land, available fuels, cooling water availability, construction cost and time, operating cost, grid system availability, etc. should be taken into consideration.

A comparison of the types of generating plants is summarized in Table 3.5 below:

TABLE 3.5
COMPARISON OF GENERATING FACILITIES BY TYPE

Sl	Item	Steam Power Plant	Gas Turbine Plant	Combined Cycle Plant	Remarks
1.	Construction cost	100%	40%	70%	
2.	Thermal efficiency	37%	35%	55%	
3.	O&M cost				
	a. Fixed	100%	67%	87.6%	
	b. Variable	100%	160%	124%	
4.	Lube oil cost	Moderate	Negligible	Moderate	
5.	Construction period	60 months	18 months	36 months	
6.	Life period *	25 years	15 years	20 years	World Bank
7.	Required cooling water	100%	Negligible	33%	
8.	Civil work quantity	100%	20%	40%	
9.	Auxiliary power consumption (% of rated output)	100% (7.7)	25% (1.9)	50% (4.0)	

* World Bank Study, 1991

Notes: 1 All based on natural gas as fuel.
2 Gas burning diesel engine operated with approx. 10% of fuel oil
3 All based on 450 MW unit size.

3.5.2 Merits of Combined Cycle Power Plant

Gas turbines are most suited for peaking duty and also have the capacity to run at continuous base load. Thus, when married to a Rankine cycle steam, its flexible characteristic is transmitted to this hybrid machine. At base load duties, thermal efficiency of 50% and above as compared to 37% for steam power plants and 35% for gas turbine power plant can be achieved.

The advantages of combined-cycle technology can be summarized as follows:

a) lower capital cost than other fossil fuel power alternatives.
b) the short lead time for construction plus modular installation permits adapting capacity additions to fit uncertain load growth;
c) capital costs are relatively firm because of the short lead time.
d) the high efficiency results in lower fuel consumption with resultant minimum environmental pollution per kWh produced, and conservation of primary energy
e) the smaller number of operation and maintenance personnel than conventional steam plants reduces the O&M cost.
f) Less CO_2 emission per kWh generation.

It is concluded on the basis of above facts and findings, that combined cycle is the best option for the proposed power plant at APSCL premises.

3.5.3 Alternatives from Environmental Consideration

The following three alternatives were considered from the point of view of environmental consideration and with respect to different fuel use, namely, gas, oil and coal. Comparative analysis against the proposed alternatives is presented in **Table – 3.6 below**.

Table – 3.6
Comparison of Different Alternatives

Sl	Environmental Element	Original Proposal (Gas fired comb. Cycle)	Alternative 1 (Oil fired steam)	Alternative 2 (Coal fired steam)	Remarks
1	Air Pollution	M	M	H	
2	CO_2 emission	L	M	H	
2	Waste Water	L	H	H	
3	Noise Pollution	H	M	M	
4	Resettlement	L	M	H	Minimum land for gas fired plant
5	Space for Construction	L	M	H	Minimum space for gas fired plant
6	Time for construction	L	H	H	
7	Surface water contamination	L	L	L	
8	Soil contamination	L	M	M	
9	Terrestrial Flora	L	L	M	
10	Acquatic flora	L	L	L	
11	Fishery	L	L	L	
	Overall Evaluation	Good	Medium	Poor	

Note: L – Low impact; M – Medium Impact; H – Hig

CHAPTER – 4
BASLINE CONDITION

4.1 Baseline Condition

4.1.1 Introduction

Environmental baseline is considered by examining the existing environment of the project site against which potential impacts from development activities of the project both during implementation and in operation phases can be compared. Further, the objective of establishing the baseline for important environmental components (IECs) such as, water, air, noise, is influenced by the project intervention.

The following sections describe the existing physical components of the project area. These include topography, land use, geology and soil, climate, natural hazards, water resources, ecological resources, ambient air quality and ambient noise level. The study area covers the APSCL and the immediate surrounding extended area of about 5 km radius, considered as “Area of Influence (AoI)”.

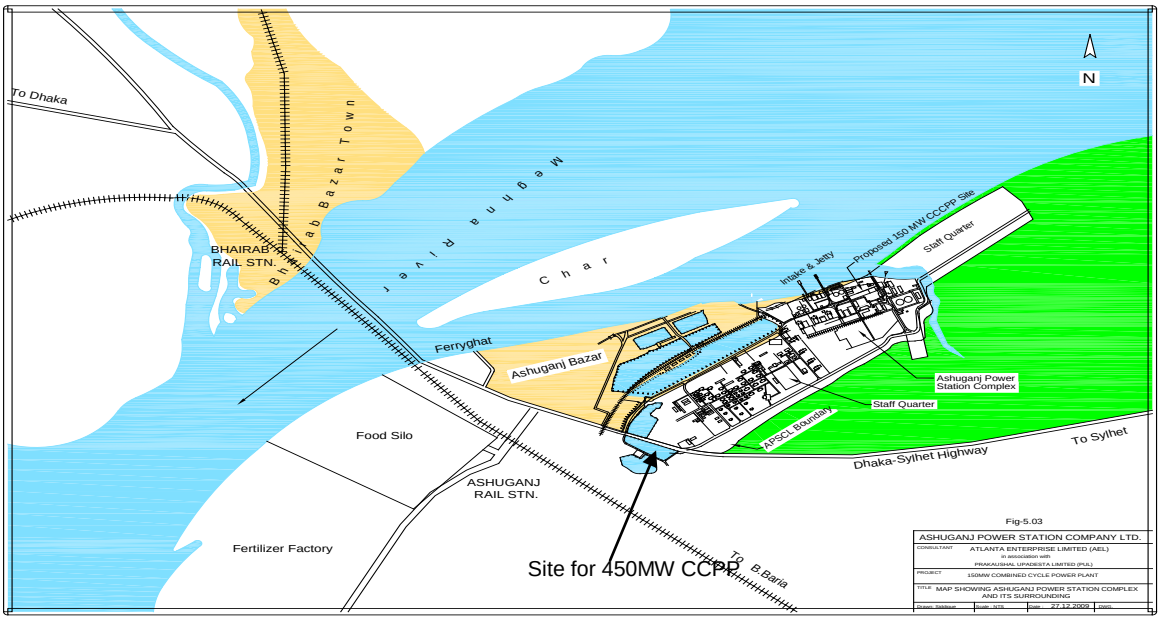
4.1.2 Topography and Land Use

4.1.2.1 Topography

The proposed power plant is located on the south bank of river Meghna within the APSCL complex Fig 4.1. The site is situated on the Meghna flood plain. The general topography indicates that the areas most susceptible to flooding are the Meghna floodplains.

The general project area is a vast, low-lying alluvial plain, sloping gently to the south and south-west. A depression extends northeast from the Dhaka area following the Meghna floodplain and broadens out in the Sylhet depression. Within this area, elevations are less than 6m above mean sea level.

Figure – 4.1: Location of Ashuganj Power Station Company Limited (APSCL)



4.1.2.2 Land Use

The site is located in the industrial belt along the river Meghna. Commercial shops, restaurants on Dhaka-Sylhet highway are situated north-east of Meghna Bridge. The area on the north-west side of the APSCL is mainly used as river landing site for paddy business, stone, sand bricks and breaking yard.

The land use pattern in the area is of mixed type having industrial, commercial and residential uses. Erratic development of housing and industries, imprudent alignment of roads and commercial places and some pockets of good agricultural land are common features of the existing topography surrounding the project area.

4.1.3 Geology and Soils

Geology of Bangladesh is generally dominated by poorly consolidated sediments deposit over the past 10,000 to 15,000 years (Holocene age). The geology of the study area consists of Quaternary deltaic sediments, which have been strongly influenced by tectonic movements on deep-seated faults. The area lies on a tectonic block, which has been uplifted relative to the surrounding areas. The soil profile of the study area consists of about 12m thick clay deposit followed by sand, clay and progressively coarser sand as depth increases.

In terms of crop production, the soils of Bangladesh can be categorized into three main classes; floodplain, terrace and hill soils. Soils are mainly grey loamy on the ridges and gray to dark gray clayey in the basins. Gray sands to loamy sands with compact silty topsoils occupy areas of the old Brahmaputra Char.floodplain or alluvial soils. In adjoining southern part soil mainly comprises sandy barns and sandy clay barns and tends to be gray to dark gray in poorly-drained basins and brown on higher and better drained land.

4.1.4 Climate

The climate of the region is dominated by the influence of the Himalayan mountain ranges and the monsoonal systems in the Bay of Bengal. The climate is sub-tropical with summer, monsoon and winter seasons. Rainfall is monsoonal, inter-monsoonal or cyclonic in origin.

The maximum annual rainfalls in the area as recorded was 4127mm in the year 1952 and minimum yearly rainfall is 1439mm in year 1989 with peak rainfalls occurring in July and August (Table -4.1).

Furthermore, from mid November to February is the coolest and driest period; April to May is the hottest period with periodic heavy thunderstorms: June to mid September is the most rainy and humid period and mid September to early November is a transitional period with decreasing rainfall, often with association of thunder but with relatively high temperature and humidity (Table 4.1 to Table 4.6).

TABLE 4.1

MONTHLY & YEARLY TOTAL RAINFAL MILLIMETER AT COMILLA

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual
1948	0	194	43	293	240	619	1045	347	388	219	14	0	3402
1949	0	0	112	494	665	884	747	661	294	148	0	0	4005
1950	0	19	26	28	257	****	266	530	183	297	258	0	****
1951	0	0	23	212	200	539	857	596	401	427	55	0	3310
1952	10	0	18	471	541	899	644	419	570	422	133	0	4127
1953	****	2	29	20	****	661	612	370	493	147	****	42	****
1954	6	****	70	****	****	979	389	376	264	****	0	0	****
1955	****	0	88	69	302	270	663	329	246	55	148	0	****
1956	8	3	74	94	227	803	423	387	444	****	23	0	****
1957	52	57	8	69	125	374	384	154	366	42	0	1	1632
1958	3	91	44	118	240	233	251	771	239	255	5	0	2250
1959	37	66	153	108	270	336	396	581	207	311	0	0	2465
1960	0	0	35	****	353	373	591	334	454	153	62	0	****
1961	1	12	21	116	182	639	382	577	114	134	0	0	2178
1962	12	12	5	189	237	446	456	230	98	231	0	****	****
1964	20	30	29	121	343	544	816	540	428	533	28	0	3432
1965	0	0	14	0	53	717	595	810	329	49	99	14	2680
1966	14	****	29	****	127	641	315	****	540	348	28	58	****
1967	****	****	****	191	186	****	****	295	443	272	****	0	****
1968	0	****	45	****	****	524	498	442	185	****	10	****	****
1969	0	0	57	237	41	782	559	****	366	26	27	0	****
1970	20	9	63	****	****	129	546	240	37	284	74	****	****
1971	****	10	****	****	****	****	291	307	****	166	57	****	****
1972	0	0	****	117	252	369	206	385	69	57	1	0	****
1973	10	30	53	72	445	489	****	138	127	198	160	0	****
1974	0	0	84	234	****	488	763	271	442	150	65	0	****
1975	0	43	6	84	194	259	516	143	258	182	128	0	1813
1976	0	10	49	44	266	521	517	435	17	96	10	0	1965
1977	0	78	7	359	392	417	435	116	149	132	35	5	2125
1979	7	8	35	20	26	173	167	486	344	157	29	9	1461
1980	0	41	50	82	429	195	472	428	219	175	0	2	2093
1981	16	13	101	470	383	315	511	250	112	0	0	27	2198
1982	0	12	7	232	358	593	219	519	194	19	32	0	2185
1983	14	25	98	93	290	195	396	518	403	221	17	16	2286
1984	12	5	0	98	635	428	391	449	233	186	0	2	2439
1985	3	6	75	151	301	264	208	345	266	22	0	0	1641
1986	5	0	2	231	242	165	389	244	369	208	137	0	1992
1987	0	0	45	212	117	****	429	350	354	156	58	13	****
1988	0	17	33	10	470	379	415	423	216	227	59	0	2249
1989	0	18	18	70	183	342	332	77	239	160	0	0	1439
1990	0	21	179	228	331	333	303	252	227	239	71	27	2211
1991	11	50	229	270	439	331	394	409	377	240	50	114	2914
1992	0	63	0	10	154	298	259	128	128	197	2	1	1240
1993	1	129	81	174	642	506	540	287	245	219	40	0	2864
1994	10	11	124	150	185	431	116	245	91	20	1	0	1384
1995	0	29	12	114	318	329	529	452	124	48	147	0	2102
1996	12	0	114	102	449	392	308	146	178	322	12	1	2036
1997	8	11	117	160	199	350	664	270	277	47	1	30	2134
1998	27	54	109	249	342	100	854	336	281	48	118	0	2518
1999	0	0	2	7	229	350	892	371	365	292	43	0	2551
2000	45	52	121	212	554	295	182	319	106	155	3	0	2044
2001	0	13	6	54	300	590	184	312	258	161	72	0	1950
2002	29	0	72	91	344	316	766	223	129	83	83	0	2136
2003	2	50	128	132	141	673	290	131	97	129	3	49	1825
2004	0	4	6	175	186	654	311	183	686	218	1	0	2424
2005	6	2	249	157	193	259	403	410	395	349	0	1	2424
2006	0	0	0	117	607	402	151	226	300	94	1	0	1898
2007	0	20	21	179	153	548	654	221	339	280	82	0	2497
2008	30	11	26	34	282	330	457	375	247	265	0	0	2057
Note	:**** means data missing												

TABLE 4.2

MONTHLY & YEARLY AVERAGE HUMIDITY IN % AT COMILLA

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1948	71	70	68	75	81	87	95	96	90	83	77	73	80
1949	69	63	70	80	85	88	88	87	87	85	80	78	80
1950	79	77	70	77	77	88	87	91	84	87	84	83	82
1951	78	75	74	85	86	87	87	86	85	88	85	82	83
1952	83	74	72	79	83	87	88	86	89	86	86	82	82
1953	81	78	82	72	78	87	89	86	86	84	83	84	82
1954	78	78	73	83	85	91	89	91	87	88	86	85	84
1955	79	62	69	72	81	86	88	87	85	83	81	75	79
1956	79	66	72	72	84	87	84	85	84	81	79	77	79
1957	77	73	61	67	78	84	85	84	85	81	75	75	77
1958	75	72	63	75	82	84	84	86	85	85	77	77	78
1959	75	73	79	78	82	86	85	86	87	86	77	75	80
1960	70	68	74	69	76	84	88	85	87	80	76	75	77
1961	74	67	71	74	79	85	84	86	84	82	77	74	78
1962	69	67	58	74	79	87	86	87	85	80	78	80	77
1964	72	71	71	82	86	93	93	91	89	85	81	80	82
1965	74	69	72	76	83	89	96	95	86	82	79	78	81
1966	77	67	67	78	85	94	92	93	89	84	84	86	83
1967	***	76	80	74	83	84	86	85	86	81	72	71	79
1968	69	75	67	78	78	88	87	88	86	82	79	***	79
1969	74	69	78	77	78	87	87	90	84	80	75	73	79
1970	85	70	69	90	92	93	93	86	86	85	90	***	85
1971	84	88	85	***	83	85	89	89	85	84	79	***	85
1972	***	***	65	72	77	82	82	84	78	72	67	63	74
1973	60	60	64	72	79	83	81	81	83	79	78	75	74
1974	69	58	69	76	76	82	88	82	81	79	72	67	74
1975	62	62	57	69	75	79	84	81	82	81	71	62	72
1976	60	64	67	70	77	85	85	85	78	76	70	62	73
1977	63	60	68	78	78	83	85	85	84	84	81	76	77
1979	68	67	70	75	75	80	85	85	85	81	78	80	77
1980	72	73	75	77	79	83	84	85	85	82	75	74	78
1981	72	72	73	81	80	82	86	83	85	79	74	74	78
1982	69	71	69	81	78	87	85	85	85	81	78	74	78
1983	73	69	80	79	81	84	84	84	85	84	78	78	79
1984	75	69	73	77	83	84	85	85	83	82	75	75	78
1985	75	74	80	80	81	85	85	84	85	80	76	75	80
1986	76	71	72	80	79	83	85	83	87	84	82	76	79
1987	76	74	77	82	78	85	89	86	86	81	79	78	80
1988	75	77	79	81	83	85	86	87	85	82	80	80	81
1989	75	74	73	81	82	86	88	84	88	88	80	76	81
1990	80	78	81	84	83	88	90	86	87	86	83	80	83
1991	79	79	80	83	88	90	88	86	90	88	84	81	84
1992	83	80	82	80	82	85	89	86	88	86	83	80	83
1993	78	77	78	83	85	87	88	89	88	87	83	79	83
1994	80	79	83	82	84	88	86	87	86	85	83	76	83
1995	75	79	73	83	84	89	90	89	88	86	87	82	83
1996	80	77	82	84	82	84	86	87	85	83	81	78	82
1997	75	74	81	81	82	85	87	85	85	81	81	83	81
1998	83	77	77	83	84	84	89	87	84	83	81	79	82
1999	76	76	77	80	83	86	87	87	86	85	78	77	81
2000	78	75	79	82	83	85	84	84	85	86	81	77	81
2001	73	76	73	77	83	87	85	83	85	85	85	81	81
2002	78	71	75	81	83	85	88	85	82	82	81	80	80
2003	80	73	77	81	80	87	83	82	85	85	78	81	81
2004	82	74	79	83	78	85	85	83	86	79	77	77	80
2005	77	76	82	79	79	84	85	87	85	84	80	76	81
2006	78	79	72	78	79	85	85	83	84	83	80	78	80
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

Note: : **** means missing data

4.1.4.1 Temperature

In general, cool seasons coincide with the period of lowest rainfall. Temperature data for last fifty years is given in **Table-4.3** and **Table-4.4** show the monthly average maximum and minimum temperature at Comila for the period 1948-2008. During this period monthly maximum average temperature of 36^{O}C degree Celsius was observed in April, 1960 whereas monthly average minimum temperature was 9.8^{O}C degree Celsius in January, 1962. The monthly maximum temperature **(Table – 4.5)** was 41.8^{O} degree Celsius in April 1960 and that of minimum **(Table – 4.6)** was 6^{O} degree Celsius in January, 1993 & 1995.

TABLE 4.3

MONTHLY AVERAGE MAX. TEMPERATURE AT COMILLA

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual
1948	26.6	27.9	32	32.9	31.8	32.2	30.3	31.1	31.4	30.8	28.4	26.6	30.2
1949	26.8	28.4	33	30.5	31	30.8	30.5	30.6	31.4	32	29.4	25.9	30
1950	27.1	27	32.2	33.2	33.2	30.1	30	28.1	31.2	29.1	26.7	24.3	29.4
1951	23.5	27	30.1	30.8	31.3	29.8	29.4	30.3	30.4	29.2	26.9	25.2	28.7
1952	23.8	27.2	28.5	30.9	30.7	30.8	29.9	30.4	29.6	29.7	27.4	24.1	28.6
1953	23.1	27.1	29.7	32.3	32.1	31.2	30.5	31.6	31.5	30.8	28.4	29.1	29.8
1954	25.3	30.4	33.4	33.5	33.2	29.4	30.3	31.1	32.4	31.1	28.6	26.5	30.4
1955	26.5	29.3	33.1	33.8	32.9	31.3	29.8	30.5	32	31.2	28.9	26.2	30.5
1956	26.5	29	32.4	34.9	32	29.7	31.2	31.2	31.2	32.1	29.5	27	30.6
1957	25.8	26.9	32.3	35.4	33.4	31.7	30.8	32	32	31.5	29.7	27.4	30.7
1958	28.2	27.8	33.8	34.6	32.8	32.8	31.9	31.1	32.3	31.7	30.4	27.1	31.2
1959	25.9	27.1	31.5	33.2	32.5	31.2	31.2	31.1	30.6	30.3	28.7	26.9	30
1960	26.4	31.1	31.9	36	34.3	31.6	30	31.8	31.3	31.1	28.5	27.4	30.9
1961	26.5	26.4	32.7	34.3	33.1	31.5	31.4	31.2	31.6	31.5	28.9	25.7	30.4
1962	25.6	28.7	33.8	33.6	33	31.3	32.3	31.5	32.7	30.8	29.2	26.9	30.8
1964	24.8	28.9	33	32.5	32.6	31.2	29.7	31.4	31.9	30.7	29.2	27.2	30.3
1965	26.2	28.4	31.3	33.7	33.4	31.4	30.9	30.1	31.4	31.4	29.9	26.6	30.4
1966	25.8	30.8	33.1	35.2	35.1	30.5	31.1	30.6	31.2	30.3	29.3	25	30.7
1969	25.1	29.5	32.3	33.2	34.1	30.6	30.6	29.9	31.7	31.8	29.7	27.2	30.5
1970	25.5	28.8	31.5	33.4	33.3	31.8	30.7	31.4	31.5	30.2	29.1	****	****
1971	25.5	28.1	32.7	****	33.4	31.4	30.1	30.1	31.8	30.4	29.1	****	****
1972	****	****	32.6	32.6	33.1	31.6	32	30.6	32.6	32.5	30.4	27.4	****
1973	26.3	29.4	31.2	33.3	31.1	30.8	31.6	31.1	30.5	31	28	24.7	29.9
1974	24.5	27.8	31	31.2	31.9	30.7	28.7	30.4	30.5	31.6	30.3	25.3	29.5
1975	25.3	28.5	32.7	32.3	32.3	31.3	29.5	31.2	30.4	30.5	27.6	25.4	29.8
1976	25.3	27.8	31.1	32.6	31.6	29.7	30	30	31	30.3	29.6	25.9	29.6
1977	24.7	27.4	31.2	29	30.3	29.7	30.3	31	31.8	30.4	28.8	26.1	29.2
1979	26.5	26.6	30.8	33.3	34	32.8	30.8	30.9	31	30.9	30.4	25.8	30.3
1980	25	26.9	30.5	33.1	31.3	30.9	30.7	30.8	31	30.4	30	26.9	29.8
1981	25	26.4	29.4	28.7	30.4	30.6	29.2	31.3	31.8	31.7	30.2	25.5	29.2
1982	26.3	27	29.8	31.3	33.6	30.2	31.3	30.5	31.4	31.4	28.1	25.8	29.7
1983	****	28.3	29.9	31.2	31.7	31.8	31.5	31.2	31.6	31.1	30.2	25.7	****
1984	24.8	26.8	32.6	33.5	30.9	31.7	30.3	31.4	31	31.7	30	27.1	30.2
1985	26.1	27.9	31.3	32.5	32.2	32.3	30.5	31.8	31.6	32.2	29.7	27.6	30.5
1986	25.8	28.5	32.9	31.8	32.9	33	31.3	32.5	31.3	31	29.5	27	30.6
1987	26.2	28.7	30.7	31.7	33.7	32.3	30.5	30.9	31.4	32.1	29.8	27.1	30.4
1988	26.4	28.7	30.8	32.7	31.8	31.2	30.7	30.6	31.7	31.6	29.8	27.1	30.3
1989	24.2	27.5	31.4	32.2	33.6	31.7	31	32.1	31.3	30.2	29.1	26.4	30.1
1990	25.9	28.3	28.2	31	32.4	31.7	30.6	32.3	31.8	30.3	30.4	26.7	30
1991	24.4	28.2	32.2	32.7	30.9	30.6	31.6	31.7	30.6	30.9	27.9	25.6	29.8
1992	24.2	25.4	30.7	33.8	33	32.9	31.6	32.8	32.3	32.1	30.1	26.3	30.4
1993	25.5	28.2	29.9	32.4	31.2	31.2	31	31	31.4	31.6	29.4	27.2	30
1994	26	26	30.4	32.5	33.1	31.6	32.1	31.9	32.3	31.9	29.7	27.1	30.4
1995	24.9	27.1	31.8	33.3	33.1	31.8	30.8	31.9	31.7	32.2	28.7	26.8	30.3
1996	25.2	28.4	31.4	32.5	33.4	32	31.5	30.9	32.8	31.4	29.9	27.4	30.6
1997	24.8	26.5	30.9	29.9	33.1	31.8	31.2	32.1	31.4	31.1	30	24.7	29.8
1998	22.7	27.3	28.8	31.4	32.3	32.9	30.3	30.6	32.2	32.6	30.5	27.4	29.9
1999	26.3	29.5	31.9	34.2	32	31.5	30.9	30.9	31.2	31.3	30.1	27.6	30.6
2000	25.5	25.9	30	32.2	31.9	32.1	32	32	32.2	31.8	30	27.1	30.2
2001	25.1	28.7	31.7	33.8	31.6	30.9	32	33	32.4	32.2	29.2	26.4	30.6
2002	25.8	28.5	31.2	31.6	32.2	32	31.2	31.9	33.2	31.8	29.2	26.7	30.4
2003	23	27.8	29.5	33	33.5	30.7	32.1	32.8	32.6	31.8	29.7	26.4	30.2
2004	24	27.8	30.8	31.5	34	32	31.5	32.5	30.8	30.8	29.4	27.2	30.2
2005	24.8	28.5	30.4	33.5	33	33.3	31.8	31.5	32.4	31.2	29.3	27.6	30.6
2006	25.5	30.1	31.9	33.2	33	32.5	32	32.9	31.9	32	29	26.9	30.9
2007	24.4	26.9	30.1	31.9	33.6	31.8	30.7	32.2	31.6	31.4	29	25.8	29.9
2008	24.8	25.9	30.5	33.4	33.7	31.6	30.9	31.7	32.6	30.8	29.7	26.5	30.2

Note: ****means data missing.

Source: Bangladesh Meteorological Department (BMD)

TABLE 4.4

MONTHLY AVERAGE MIN. TEMPERATURE AT COMILLAH

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual
1948	13.3	16	18.9	21.7	24.2	25.3	25.4	25.3	24.9	22.5	18.6	13.2	20.8
1949	12.5	14.7	20.7	21.9	24.3	26	25.3	25.4	25.3	24.4	17.4	11	20.7
1950	12.4	14	18.9	23.4	25	25.6	25.1	24.8	26.1	23.8	18.3	13.3	20.9
1951	12.5	14.1	20.6	22.7	23.8	25.4	24.9	25.6	25.5	24.3	19.2	15	21.1
1952	13.4	14.6	18.4	22.7	24.9	25.6	25.2	25.4	25.2	24.3	19.6	13.8	21.1
1953	11.9	15.7	21.8	23.5	24.2	24.9	25.5	25.5	25.5	23.5	15.7	18.1	21.3
1954	11.9	17.3	19.2	24.6	25.3	24.6	23.8	24.5	25.3	22.7	17.2	14.7	20.9
1955	12.2	12.7	19.8	21.2	25	25.4	25.1	24.7	25.2	24.3	18.6	12.7	20.6
1956	12.1	12.7	20.3	22.5	24.7	24.8	24.9	25.1	24.4	23.5	18.8	13	20.6
1957	12.9	14.1	17.2	23.2	25.1	24.8	25.4	25.4	25.3	22.4	16.4	12.8	20.4
1958	13.2	14.6	18.9	23.9	25.5	25.7	25.5	25.4	25.3	24.1	19.3	14.2	21.3
1959	13	14	19.1	23.7	24.2	25.5	25.4	25.2	24.8	23.5	17.3	13.6	20.8
1960	10.9	14.5	18	24.2	25.7	25.8	25.2	25.5	24.3	23.5	18	14.3	20.8
1961	13.3	13.9	22.3	23.7	25	25.1	25.3	25.4	24.7	23.3	17	11.1	20.8
1962	9.8	14.6	17.8	24	22.1	23.8	24.6	22.6	25.1	22.9	17.1	12.6	19.8
1964	12	15.4	21	23	23.5	24.2	24	25	25.3	24	19.3	14	20.9
1965	12.2	13.6	17.9	22.7	24.9	24.6	24.7	24.9	25.2	23.6	18.6	15.2	20.7
1966	13.8	16	19.3	23.6	24.9	24.9	25.3	25.4	24.8	22.3	19.7	14.1	21.2
1969	10.2	13.5	20.2	22.9	24.4	24.7	24.8	24.6	24.7	23.5	20.9	16.5	20.9
1970	14.6	15.6	20.1	23.9	25.8	26.1	25.9	25.9	25.9	24	20.8	****	****
1971	12.8	14.1	17.3	****	24.8	24.9	24.8	24.4	25	23.8	17.6	****	****
1972	****	****	21.8	23.7	26.2	25.5	26.4	25.1	26	24.3	19.4	12.3	****
1973	11.8	16.1	17.6	23.6	23.8	25	25.5	24.8	24.6	23.6	19	14.2	20.8
1974	11.9	13.3	19.7	22.9	24	24.8	24.9	25.3	24.9	24.8	21.7	14.3	21
1975	12.1	15.6	19.9	23.6	24.8	24.8	24.8	25.4	25.1	24.8	19.3	13.2	21.1
1976	11.7	15.9	20.5	23.4	24.2	24.7	25.2	24.9	25.2	22.9	19.9	12	20.9
1977	11.6	14.2	21.1	21.7	23.5	24.8	25.8	25.6	25.1	22.2	19.5	13.4	20.7
1979	12.6	13.9	19.1	23.3	25.6	25.7	25.9	25.8	25.4	22.9	19.6	15	21.2
1980	12.5	15.6	20.8	24.2	22.7	25.5	25.3	25.4	25.4	23	16.7	13.5	20.9
1981	12.5	15.4	18.5	21.5	23.3	25	24.9	25.6	25.5	22.7	17.1	13	20.4
1982	11.4	15.3	17.6	21.7	24.4	25.2	25.6	25.2	25.2	22.9	17.6	12	20.3
1983	11.9	15.2	20.8	22.6	23.9	25.7	26	25.2	25.7	23.7	19.5	12.8	21.1
1984	11.6	13.7	19.4	23	24.8	25.2	25.3	25.1	24.5	23.7	17.4	12.6	20.5
1985	12.9	14.7	21.6	23.9	23.9	25.3	25	25.6	24.9	22.9	16.9	13.8	20.9
1986	12.5	15.1	19.1	21.9	22.6	25.6	25.3	25.3	24.8	23	19.6	14.3	20.8
1987	12.7	15.8	19.6	22.8	24.5	26.4	25.7	25.9	25.5	23.7	19.8	14.2	21.4
1988	13	15.7	19.7	23.5	24.3	25.4	25.7	25.8	25.8	23.5	19.5	15.4	21.4
1989	10.9	16.1	19.2	23.6	25	25.2	25.4	25.4	25.2	23.6	16.3	11.4	20.6
1990	12.6	17.1	18.1	21.4	24.3	25.3	25	25.2	24.6	22.4	19.6	13.8	20.8
1991	11.8	16.4	20	22.8	23	24.9	25.3	25.3	25	23.9	16.7	12.6	20.6
1992	11.9	14.6	21.5	23.9	22.9	25	25.1	25.4	25	23.1	17.8	11.1	20.6
1993	10.9	16.1	18.2	21.2	23.4	25.6	25.6	25.5	24.9	23.5	18.6	13.1	20.6
1994	12.7	14.1	20.5	22.1	24.9	25.5	25.4	25.1	24.8	22.4	17.8	10.9	20.5
1995	10	14.6	17.9	22.3	24.6	24.6	25.6	25.6	25.4	23.9	19.9	12.8	20.6
1996	11.8	14.8	21.3	23.3	24.2	25.1	25.7	25.2	25.3	22.2	17.4	13.7	20.8
1997	11.2	14.5	19.8	19.5	23.2	24.3	24.8	25.1	24.3	21.8	18.4	13.4	20
1998	11.7	15.2	17.4	21.3	24.3	26.3	25.2	25.8	25.7	24.9	20.7	14.4	21.1
1999	12.6	16.2	20.6	24.7	24.6	25.4	25.5	25.6	25.1	24.3	18.9	14.3	21.5
2000	12.6	15.3	19.9	23	24.1	25.6	25.7	25.7	25.3	23.8	18	11.8	20.9
2001	10.9	15.9	19.1	23	23.9	25.3	25.5	26	25.4	24.2	19.8	12.8	21
2002	13.4	15.2	18.9	22.1	23.5	25.5	25.5	25.5	25.1	22.9	18.8	13.9	20.9
2003	10.9	15.8	18.2	23.1	23.8	24.9	25.8	25.6	25	24	16.3	13.9	20.6
2004	12.8	14.8	20.9	22.3	25	24.9	25.5	25.3	25.1	23.1	17.2	14.5	21
2005	12.4	16.4	21.1	22.6	23.5	26.1	25.5	25.4	25.3	24.1	18.1	14	21.2
2006	12.1	18.4	20.1	22.9	24.4	25.6	25.7	25.6	25.1	24.1	19	13.3	21.4
2007	11.1	15.9	18.1	22.7	24.8	25.2	25.3	26.1	25.4	23.3	20	14.3	21
2008	13.2	14	20.4	22.9	23.9	25.2	25.5	25.5	25.2	23.2	18.3	15.8	21.1

Note: ****means data missing.

Source: Bangladesh Meteorological Department (BMD)

TABLE 4.5

MONTHLY & YEARLY MAXIMUM TEMPERATURE IN DEG.CEL AT COMILLAH

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annua	l Month
1948	29.9	32.4	36.1	36.5	35.2	34.3	33.9	33.2	33.9	33.8	31.1	28.8	36.5	4
1949	29.2	33.5	36.9	34.3	34.4	33.3	33.3	33.3	35.8	34.2	32.3	30.1	36.9	3
1950	29.4	31.6	35.6	37.4	36.7	33	33.6	30.5	33.3	32.1	29.9	28.6	37.4	4
1951	27.2	31.7	35.2	36.7	33.4	32.8	32.3	33.3	32.7	32.2	30.5	27.9	36.7	4
1952	27.6	33.8	32.3	37.5	33.4	34.4	32.7	34.4	31.8	33.1	32.2	26.7	37.5	4
1953	26.1	32.8	35.6	34.4	36.7	34.4	34.4	34	33.9	32.3	30.2	32.2	36.7	5
1954	28.8	33.8	36.6	36.7	36.4	34.6	33.1	34.4	35.5	33.8	34.3	29.4	36.7	4
1955	30.6	33.2	36.9	36.5	36.6	33.7	31.4	33.6	37.7	34.8	32.1	29.4	37.7	9
1956	29.4	33.9	35.4	39.2	34.9	33.8	33.7	34.6	35.9	34.6	32.1	29.4	39.2	4
1957	28.9	31.1	36.1	38.5	36.7	34.6	33.3	35	34.5	33.7	30.6	29.2	38.5	4
1958	30.9	31	37.9	38.9	35.9	35.9	34.4	33.9	34.9	35	32.2	30	38.9	4
1959	28.9	29.4	36.1	36.7	34.6	37.1	33.9	35.6	34.4	36.7	32.8	30.6	37.1	6
1960	31.7	33.9	35.6	41.8	38.3	35	34.4	34.4	34.4	34.4	30	32.2	41.8	4
1961	30	32.8	35	38.3	37.2	36.1	34.4	33.9	35	33.3	31.1	28.3	38.3	4
1962	28.9	32.8	36.9	36.9	36.1	34.4	36.7	33.5	35.6	33.3	31.1	28.9	36.9	3
1964	28.9	33.3	36.7	34.4	35.6	33.3	33.9	34.7	35.6	33.9	32.2	29.4	36.7	3
1965	28.9	31.1	35	36.7	35.6	35	33.9	35	33.7	33.3	31.9	29.4	36.7	4
1966	27.8	33.9	36.7	36.7	37.2	35	33.9	33.3	33.3	34.4	30.6	27.8	37.2	5
1969	28.3	33.3	36.1	36.7	36.7	33.9	34.4	33.9	35	34.4	33.9	29.4	36.7	4
1970	27.8	31.7	36.7	35.2	36.1	34.4	35	33.9	35.6	33.9	32.8	****	****	**
1971	28.9	31.7	36.1	****	35	34.3	33.3	32.2	33.9	33.3	31.7	****	****	**
1972	****	****	36.2	35.3	35.2	35.6	35.6	34.2	35.3	34.4	33.3	31.7	****	**
1973	31.7	32.8	36.5	35.6	34.4	34.7	35	33.6	33.9	33.9	31.7	27.8	36.5	3
1974	26.7	32.2	35.3	34.4	37.5	33.9	30.6	33.1	33.3	34.2	32.8	26.9	37.5	5
1975	27.5	31.9	36.1	37.2	35	33.9	31.7	34.4	33.9	32.8	31.1	28.3	37.2	4
1976	28.3	32.2	35.3	35	36.1	33.3	32.2	33.3	33.3	32.2	33.3	28.3	36.1	5
1977	27.8	30.6	33.9	32.2	35.6	33.1	33.3	33.3	34.4	32.5	30.6	29.4	35.6	5
1979	28.8	32.2	35	36.1	39.4	35.2	33.9	35	34.4	32.8	32.2	30	39.4	5
1980	27.2	30.6	33.9	36.1	35	33.9	33.9	34.4	33.3	33.1	32.8	28.6	36.1	4
1981	27.7	31.7	31.7	31.9	32.8	33.9	32.8	36	35	33.5	31.6	29.1	36	8
1982	31	29.5	34.5	34.4	37	35	34.5	33.5	35	34	33	28.5	37	5
1983	****	31	32.3	34	35.5	36	35	34.2	34.8	34.7	32.5	28.5	****	**
1984	28	31.5	35	38	34.2	36.2	34.5	36	33.5	33.5	32	31.5	38	4
1985	30.2	32	35	34.7	35.4	36	35	35	35	35.2	33	29.8	36	6
1986	29.8	30.5	36	34	36.6	36	34	37	34	33.5	33	28.5	37	8
1987	29.6	32.2	34	35.1	37	34.5	33.4	34	34	34.2	32.2	32	37	5
1988	28.5	31.5	34	35.2	34.5	35	35	34.1	36	34	32	29.6	36	9
1989	27	30.5	34	34.2	36	35.7	34.5	34	33.5	33.5	31.5	29.5	36	5
1990	28.8	30.5	34.1	32.6	35	34	33	36	35	33.5	33	28.8	36	8
1991	28.5	32.4	35.8	36.8	32.7	34	34.6	36	34.7	34.5	29.8	29.5	36.8	4
1992	28.5	27.5	33.5	37.2	36	35.5	36.5	36	35	35	34.8	28.2	37.2	4
1993	29.5	30	33.5	36	34.5	34	34	33	35	35	31.2	29	36	4
1994	29	30	32.3	36.5	35	35	35	35	34.5	34	32.6	29.3	36.5	4
1995	30	30	36	35.6	35.5	35.5	33.6	34.3	34.8	34.2	33	29.8	36	3
1996	28.5	31.5	34.4	36.5	36.2	35	34.8	34.8	37	35	33	30.2	37	9
1997	27.8	30	32.8	33	36.2	34	34.2	36.8	33.8	34	32.8	29	36.8	8
1998	27	30	31.5	34	36.7	35.6	34.2	34.5	35.7	35.5	33.5	29.5	36.7	5
1999	29	34	34.6	36	36.5	35.4	34.2	34.2	34	34	33	30.5	36.5	5
2000	29.2	28.5	34	34	36.3	35	35.1	35.5	34.8	34.5	33	28.6	36.3	5
2001	28.5	32.5	34.5	36	35	35	35	35	35.6	34.2	32.2	28.4	36	4
2002	28.5	32.5	34.2	34.2	35.8	34.5	33.8	35	36.5	35.1	32.8	29.8	36.5	9
2003	29.4	31	32.5	35	36	37	35.2	35.6	34.4	34.6	31.8	30.3	37	6
2004	27.8	30.7	33.5	35	37.2	36	35	35	34	35.4	31.6	30.2	37.2	5
2005	28.6	32.3	32.8	36.4	35.4	35.8	34.8	34.8	34.8	34.4	32.2	30.8	36.4	4
2006	28.8	32.4	35.2	37.3	36.7	35.8	35.4	34.8	34.8	34.2	32.4	29.8	37.3	4
2007	27.7	30	34.5	34.5	36.4	35.6	34.6	35.6	34.8	35.4	31.5	28.2	36.4	5
2008	28	30.4	32.4	36.6	36.7	35.5	34.4	36.2	35.4	34.4	32.5	30.3	36.7	5

Note: *** means data missing.

TABLE 4.6

MONTHLY & YEARLY MINIMUM TEMPERATURE IN DEG.CEL

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual	Month
1948	10.7	11.8	13.1	18.7	21	22.7	24.3	24.3	23.4	18.4	15.5	10	10	12
1949	10.4	9	13.3	19.1	19.6	23.4	24.3	22.8	23.3	21.4	12	8.4	8.4	12
1950	10	7.8	11.9	17.2	21.7	23.3	24.3	21.4	24.4	21.9	12.9	10.2	7.8	2
1951	8.9	9.6	15.7	20	20.2	21.1	21.1	23.2	23.7	20.6	15	12.2	8.9	1
1952	10.7	12.2	14.4	19.2	20.4	23.2	21.7	24.4	23.6	22	13.9	10.6	10.6	12
1953	8.3	10	17.2	19.4	20.6	21.9	24	24.4	23.8	20	13.9	13.3	8.3	1
1954	6.7	8.3	12.8	18.9	19.3	21.1	21.1	22.8	23.3	20.6	12.2	10.6	6.7	1
1955	7.4	9.2	15	15.6	18.2	22.8	23.6	19.9	24.2	20	16.1	9.4	7.4	1
1956	9.4	9.4	17.2	19.2	21.1	22.3	23.8	23.8	21.6	20.4	16.1	11	9.4	1
1957	10.4	9.9	12.1	18.9	18.3	21.6	23.8	23.7	22.1	17.8	13.8	10.1	9.9	2
1958	10.3	9.8	14.8	16.8	19.9	21.4	24.3	24.4	23.2	20.3	16	10.6	9.8	2
1959	8.3	10.4	10.4	19.3	21	21.6	23.2	23.3	23.8	21	15	10.6	8.3	1
1960	8.2	9.9	15.4	21.2	22	23.2	23.9	24.4	18.3	19.4	13.9	10.6	8.2	1
1961	10	8.2	18.2	18.9	19.9	22.2	22.8	21.7	22.2	20.6	11.7	9.3	8.2	2
1962	7.2	10.4	13.9	18.9	17.2	15.6	22.8	15.6	23.3	19.3	13.2	9.9	7.2	1
1964	7.7	9.9	14.3	18.8	20.4	21	16.6	22.8	21.1	21.6	15.4	7.2	7.2	12
1965	8.8	10.4	13.2	18.2	18.3	22.1	22.7	23.2	23.1	21.1	15.7	11.8	8.8	1
1966	11.1	12.2	14.3	18.8	17.7	21.7	23.2	23.2	22.7	20.4	16.1	10.4	10.4	12
1969	6.6	7.1	15.4	16.6	21.6	22.7	22.7	22.7	22.7	22.1	12.7	14.3	6.6	1
1970	9.9	10.6	16.7	18.9	21.7	24.4	23.9	24.4	24.6	21.7	16.1	****	9.9	1
1971	9.4	10	12.2	****	17.8	23.9	23.9	23.3	23.3	18.9	12.8	****	9.4	1
1972	****	****	15.6	19.2	23.3	22.2	24.2	23.9	24.4	20.6	16.7	8.9	8.9	12
1973	8.3	11.1	12.2	19.4	21.1	22.8	24.2	21.4	22.2	20.6	12.2	11.1	8.3	1
1974	9.6	8.9	15	17.5	20	21.1	23.3	22.8	22.8	21.1	19.4	11.9	8.9	2
1975	10	11.7	15	18.9	20.6	20.6	22.8	22.8	22.8	23.3	15.6	10.6	10	1
1976	8.9	11.1	12.8	20.6	20	21.7	23.9	22.8	23.3	18.9	16.1	10	8.9	1
1977	7.8	8.1	15	18.9	18.9	22.2	24.4	24.4	23.3	19.7	16.7	10	7.8	1
1979	8.6	11.1	12.2	18.8	20.6	20.6	23.9	23.9	23.3	20	15	11.4	8.6	1
1980	10	10.6	16.1	20	18.3	24.4	24.4	24.4	23.9	18.3	11.1	10.3	10	1
1981	9.4	11.1	14.4	17.8	19.4	22.7	24.2	24.4	23.9	18.9	12.2	10	9.4	1
1982	8.8	11.7	12.2	18.3	20.5	23.3	23.8	24.4	21.4	18.9	12.2	11	8.8	1
1983	9.4	7.8	15	18.3	17.5	20	23.9	22.9	23.9	19.4	15.6	8.2	7.8	2
1984	8.9	10.4	12.3	18.9	20.3	19.4	23.8	23.3	22.2	21.1	15.3	8.6	8.6	12
1985	10	12.3	16.9	20	19.4	22.2	23.8	23.3	22.8	18.3	12.7	10.4	10	1
1986	10	11.9	11.1	18.3	18.9	23.3	23.3	22.9	21.4	20.6	15	11.5	10	1
1987	9.4	10.4	16.1	19.2	18.5	24.2	25	23.6	23	20	15.5	10.5	9.4	1
1988	10	11.5	14.8	19	20.9	23.4	24.2	24	24.2	20.6	17	12.8	10	1
1989	7.6	11	13.4	19.5	21.4	22	24.5	24.5	24	20.5	13.5	9	7.6	1
1990	7.5	14.5	13	16.5	20.5	23	24	24	22.5	17	13.5	12	7.5	1
1991	8.4	13.5	13.6	18.5	20	22.4	24.5	23.5	23	20.5	11.8	9	8.4	1
1992	9	12	17	18.5	18.5	21.5	24	24	23.5	18.2	13.3	9	9	1
1993	6	12.7	14.8	17.5	20	23	23	24.8	23.8	19.5	15	11.4	6	1
1994	10.5	11	14	18.3	21	23	23.5	24	22.5	19.5	13.8	8.2	8.2	12
1995	6	10.5	13.8	16	21	22.4	23	22.6	24	21	14.2	10	6	1
1996	9	10.2	14	19	19.8	21.8	23.3	24	24	20.5	12.6	10.5	9	1
1997	8	9.5	17	15.4	20	22	23	23.5	21.2	18	14.6	9.6	8	1
1998	7.3	10.5	12.6	16.4	20.2	23.3	23	24.5	24	21.6	17.5	10.7	7.3	1
1999	10	11.6	15.5	19.6	21.8	22.5	24.2	24.3	24	22.5	14.6	11.3	10	1
2000	8.6	11.6	15.5	19.6	19.5	24	24.2	23.1	23.6	20.5	13.7	10	8.6	1
2001	7.5	11.3	15	19.5	20.3	23.6	24.6	24.5	24	22.4	15.4	11	7.5	1
2002	9.8	10.6	15	17	20.5	23.5	24	23.8	24	18.5	14.8	10	9.8	1
2003	6.8	13.8	12	17.8	20.4	21.6	24.5	24.4	23.8	21.4	11.8	10.4	6.8	1
2004	8.5	9.5	14.8	18.4	18.8	22	22	24.4	23	21.2	15.2	7.8	7.8	12
2005	9	10.5	16.5	19.3	18.8	22.7	24	24.2	23.4	21.5	14.4	9.8	9	1
2006	8.9	13.8	15	18.5	20.6	21.6	24.4	23.6	23	21.2	13	10.6	8.9	1
2007	8.3	12.5	13.5	16.6	21.5	22.7	23	24	24	19.4	17.5	10.8	8.3	1
2008	10.5	8.5	15.6	18.2	20.7	22.6	24	24.5	22.6	18.8	14.5	12.2	8.5	2

Note: *** means data missing.

Source: Bangladesh Meteorological Department (BMD)

4.1.4.2 Wind Speed and Direction

Data about wind speed and direction for the period from 1948 to 2008 as collected from Meteorological Department are attached hereto **Table-4.7**.

The data indicates that the maximum wind speed recorded as 80 & 96 knots in the month of March & June, 1979 respectively followed by 88 knots in the month of April, 1954 and 80 knots in the month of June, 1980. The prevailing wind direction is South and South-east in most part of the year.

TABLE 4.7
MONTHLY & YEARLY MAXIMUM WIND SPEED KTS & DIRECTION IN DEGREE AT COMILLA

Year	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm
1948	5	13	3	7	13	12	7	23	12	9	18	12	9	13	3	9	13	3	9	18	3	9	13	12	9	13	12	9	13	12	7	36	12	5	36	12
1949	7	18	3	12	19	12	6	18	0	24	36	3	16	18	12	17	21	12	20	18	12	16	17	3	14	18	12	12	2	0	12	12	3	8	28	12
1950	9	19	3	9	36	12	14	18	12	18	18	12	19	14	3	18	18	12	14	18	12	10	13	12	12	18	12	12	36	3	5	18	12	4	27	3
1951	4	36	3	9	18	3	14	5	3	24	18	12	14	18	3	16	9	12	17	13	3	16	18	12	16	13	12	14	13	12	7	13	12	4	18	3
1952	10	13	12	14	18	3	17	18	12	18	18	3	16	31	3	16	18	12	16	13	3	14	13	12	14	18	12	9	18	3	9	31	12	6	5	12
1953	7	36	3	9	18	12	50	18	0	9	13	12	9	13	6	9	13	12	9	13	3	9	13	12	9	13	0	9	9	0	2	36	12	2	36	12
1954	20	36	3	9	13	12	9	13	12	88	18	0	8	18	6	8	18	3	9	18	12	9	13	0	5	18	12	5	5	3	2	36	3	3	36	3
1955	3	36	3	6	31	6	9	18	12	9	13	18	9	18	6	9	18	6	9	18	6	9	16	12	9	13	18	7	13	18	9	13	3	3	13	6
1956	20	18	3	5	4	6	50	18	6	7	18	12	9	13	18	28	13	18	17	13	0	9	18	12	12	18	12	3	13	12	3	18	3	2	18	6
1957	13	20	3	13	13	3	9	13	3	51	8	3	24	18	18	9	18	12	14	18	12	16	18	12	10	31	12	2	36	6	0	0	18	1	18	6
1958	2	18	6	2	13	12	3	18	3	17	18	12	21	18	12	17	18	3	13	18	12	9	18	12	5	18	18	9	13	3	0	0	18	0	0	18
1959	0	0	18	2	18	12	14	36	18	7	18	12	15	18	6	9	18	6	18	18	0	14	18	18	9	18	18	3	18	6	0	0	18	0	0	18
1960	6	36	6	11	18	6	60	36	6	19	18	3	60	18	3	19	13	12	25	18	12	91	30	3	19	13	6	31	36	0	9	5	6	9	5	6
1961	9	27	12	19	18	18	31	18	6	19	18	3	40	18	0	43	9	6	19	13	0	19	13	6	13	13	6	13	27	12	9	36	6	13	36	6
1962	19	36	6	13	18	6	13	18	12	13	5	0	19	36	0	13	18	12	13	18	18	13	18	0	19	9	0	9	36	18	5	36	6	5	36	6
1964	6	31	6	13	34	12	9	13	12	15	36	0	19	36	0	13	18	6	19	13	18	13	18	12	13	13	3	15	18	3	5	36	6	5	36	0
1965	0	0	18	9	34	18	9	31	18	19	18	12	31	18	12	19	18	12	9	18	12	9	18	6	9	18	18	53	1	6	5	5	3	9	36	3
1966	9	13	6	5	23	6	13	18	12	13	18	6	13	18	3	19	31	18	9	13	18	13	18	18	13	27	6	25	36	3	5	31	6	9	36	12
1967	**	**	**	5	18	18	9	5	3	19	13	12	19	18	18	9	18	12	18	18	6	13	18	3	19	13	6	9	13	0	5	31	6	5	31	12
1968	9	18	12	5	18	6	13	18	18	26	36	12	19	18	18	19	18	12	19	18	18	9	18	12	9	18	18	13	31	12	5	31	6	**	**	**
1969	5	31	6	5	18	6	9	18	9	35	18	9	15	18	0	9	13	3	9	18	12	9	18	12	13	13	12	5	31	6	5	31	6	5	31	6
1970	7	36	6	9	23	18	9	13	6	9	18	18	9	18	3	9	18	12	9	18	18	5	18	12	9	18	6	9	13	3	19	36	3	**	**	**
1971	9	36	18	5	36	12	5	18	12	**	**	**	5	23	12	15	18	0	9	13	6	13	13	12	25	13	12	9	5	12	13	5	6	**	**	**
1972	**	**	**	**	**	**	22	18	12	34	18	9	25	18	9	25	18	6	25	23	6	20	18	12	9	23	6	18	18	9	9	36	9	10	36	6
1973	10	31	9	13	34	6	15	9	6	35	18	6	20	36	3	15	13	3	17	18	6	17	13	6	17	13	9	20	18	6	19	9	12	25	5	12
1974	10	36	6	9	23	6	20	18	9	25	18	6	25	36	9	40	27	0	18	18	6	20	9	0	19	5	9	10	18	9	18	5	6	16	5	6
1975	15	36	6	15	31	6	15	23	12	30	18	12	30	18	9	53	18	6	20	23	12	20	13	6	15	18	6	12	18	9	7	31	3	7	36	6
1976	15	36	6	12	20	6	20	18	12	30	18	9	20	27	9	20	18	12	25	18	9	21	18	9	21	18	9	15	18	9	12	36	6	12	31	9
1977	15	18	9	15	18	9	25	18	12	35	18	12	30	18	9	30	18	6	36	13	12	15	13	6	17	18	15	11	18	6	12	18	6	10	31	9
1979	24	31	12	15	36	6	80	18	0	15	13	6	75	23	9	96	9	9	72	18	15	18	23	6	14	18	6	16	36	6	15	31	6	21	30	12
1980	12	36	6	15	36	12	15	31	18	22	18	12	25	36	0	80	18	0	72	31	0	20	13	15	12	18	9	15	13	12	7	36	6	7	31	9
1981	10	36	6	10	5	3	15	13	9	20	18	12	12	18	12	15	27	12	15	18	9	20	13	18	10	18	12	9	18	12	5	36	6	25	18	3
1982	5	36	9	9	36	21	18	36	6	20	18	12	20	18	6	9	18	9	15	18	0	18	18	21	15	18	9	12	27	15	5	36	6	8	18	9
1983	8	31	18	8	18	6	9	23	12	9	18	3	9	18	12	9	18	15	9	13	3	9	18	15	9	18	3	9	13	6	9	9	6	9	36	0

Year	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm
1984	15	27	9	15	36	6	13	18	0	20	18	21	30	31	3	25	18	12	18	18	18	21	9	21	18	18	21	12	18	6	9	36	6	22	18	9
1985	9	31	6	8	18	9	9	18	9	9	18	6	9	18	15	18	27	6	16	18	12	28	18	0	10	18	6	10	13	9	5	36	9	5	31	9
1986	8	36	6	6	27	9	10	31	21	16	16	9	16	27	12	15	18	12	19	18	12	15	13	15	12	18	9	15	36	12	10	23	18	6	36	9
1987	8	27	9	12	34	9	15	23	15	20	31	3	16	36	0	16	18	9	15	18	6	20	18	6	12	18	9	9	2	21	4	36	12	8	18	12
1988	5	36	3	12	31	18	15	18	0	17	18	6	20	18	12	20	18	6	20	18	21	17	18	3	15	18	18	14	18	12	17	18	0	5	36	6
1989	6	31	9	19	23	9	15	29	12	25	18	12	25	18	15	25	18	9	18	10	15	12	18	6	23	4	12	20	23	9	5	18	6	7	36	6
1990	6	18	9	15	31	15	25	5	0	25	27	21	20	9	15	12	18	9	15	18	6	10	18	9	15	18	9	20	13	12	10	31	12	12	36	3
1991	6	4	6	12	36	6	12	13	21	55	5	18	18	18	9	24	23	9	14	18	6	12	18	15	27	4	12	15	13	0	9	9	21	9	36	3
1992	6	27	6	16	18	15	15	18	12	20	18	6	21	18	6	22	23	9	20	13	6	31	30	0	21	80	0	10	9	12	9	2	9	8	36	9
1993	8	27	9	15	18	9	15	4	6	18	4	12	35	18	9	20	23	18	18	18	9	12	18	6	20	18	3	9	13	6	15	27	6	7	36	9
1994	9	36	18	12	36	6	20	18	9	15	31	18	22	18	9	15	18	3	15	13	9	16	18	6	16	18	0	14	23	12	6	36	9	5	36	6
1995	14	36	9	15	18	12	20	36	9	20	32	15	20	18	3	16	18	12	15	13	15	15	18	9	9	18	18	6	9	0	12	13	6	6	36	9
1996	7	34	9	15	18	18	16	18	12	16	18	15	25	36	15	27	27	9	15	18	9	13	18	9	8	9	6	20	18	0	8	36	6	7	36	6
1997	6	27	9	12	36	0	15	36	21	10	17	21	25	36	15	12	13	3	12	18	12	15	18	21	31	36	0	5	36	9	5	36	6	7	34	9
1998	10	36	0	10	18	12	15	18	9	15	18	12	16	18	21	12	18	9	12	18	9	12	18	6	14	18	15	14	18	6	15	5	15	5	34	6
1999	5	36	9	8	36	6	12	18	6	18	31	9	15	18	18	15	18	9	12	18	15	15	23	6	8	18	9	6	13	9	7	36	9	4	36	9
2000	6	18	12	8	36	6	15	18	9	18	18	6	27	18	18	12	18	18	10	18	9	10	18	9	17	18	6	16	18	9	4	9	9	5	36	6
2001	8	36	0	14	18	9	12	18	6	15	18	12	15	18	9	12	18	15	10	18	9	10	18	12	8	18	12	8	5	0	5	34	6	5	36	9
2002	5	36	12	6	36	3	24	31	18	15	36	0	15	22	9	16	18	9	12	18	15	15	18	9	8	18	6	6	18	15	7	13	21	6	36	9
2003	12	34	12	15	36	18	20	18	21	20	36	21	15	27	18	16	18	3	12	18	15	8	18	9	10	18	9	12	18	3	6	36	18	6	31	6
2004	8	31	6	12	18	6	20	18	6	20	18	12	18	18	6	16	22	12	18	18	6	14	18	12	12	13	12	20	18	18	10	36	6	6	36	6
2005	15	31	9	15	18	9	15	5	9	15	22	18	15	5	9	15	18	3	14	18	9	14	18	12	12	18	15	10	18	12	8	36	9	9	31	9
2006	10	34	9	16	18	6	14	31	9	15	18	6	16	18	18	17	18	21	14	18	9	8	18	9	8	18	6	5	21	12	5	36	12	4	31	6
2007	6	29	9	7	18	6	8	31	6	15	21	15	18	27	15	10	18	9	10	18	15	9	18	12	8	23	6	15	7	18	25	18	0	5	36	6
2008	6	36	15	20	9	12	16	23	18	11	5	12	12	18	9	13	18	9	12	18	9	11	16	9	8	18	12	21	18	3	4	36	9	4	36	6
Note : **=missing data ; 0= calm ; Original Dir.=Dr*10																																				

4.1.5 Natural Hazards

4.1.5.2 Introduction

Bangladesh can be regarded as susceptible to natural calamities. This is due to its unique combination of physiographic, morphological and other natural features, which have lead to the direct loss of life and physical property on a massive scale. The natural calamities are floods, cyclones and storm surges, and earthquakes. Each of these natural hazards is discussed below.

Flooding

Flood is a common phenomenon in Bangladesh. Every year certain area of Bangladesh is subjected to flooding. The major cause of flood is monsoon rainfall runoff from upstream catchments. More than 90 percent of runoff is from outside Bangladesh.

It has been observed that the land used by the existing Ashuganj Power Plant and its electrical distribution system have never been exposed to flood water. The land-based project buildings will be located at the same approximate elevation as the existing electrical distribution system.

Cyclones

Bangladesh is also cyclone prone. The country experiences, at times, catastrophic cyclones that cause immense loss of life and property. However, cyclones usually decay rapidly after coming into contact with land and such losses are largely confined to coastal regions. Since the project area is far from the coastal belt, the likely impact of cyclones will be relatively small and it will not be necessary to implement specific contingencies for such an event.

Earthquakes

Bangladesh and northeast Indian states have long been one of the seismically active regions of the world, and they have experienced numerous large earthquakes during the past 200 years at an average rate of one in every 30 years.

The catastrophic earthquakes of 1762 and 1782 are believed to have been partially responsible for the diversion of the Old Brahmaputra River from the west of Mymensingh to the present Jamuna Channel and the diversion of the Ganges River from its main Arial Khan distributary to the present Padma channel. Since 1860 over 20 shallow and intermediate major earthquake epicentres have been recorded in Bangladesh and surrounding area.

Bangladesh has been classified as falling into three seismic zones with zone -III (0.25) the most severe and zone-I (Z = 0.075) the least, where Z is called zone coefficient. The project area falls into Zone-II. As a result, the land buildings and land based structures for this project should be designed to withstand maximum lateral load of 25% of gravity load.

4.1.6 Water Resources

4.1.6.1 Surface Water Resources in and around the project

The nearby surface water source of the proposed site for the power plant is the river Meghna. The river Meghna, on the downstream joins the river Padma near Chandpur. The river Meghna is one of the three major river systems in Bangladesh.

4.1.6.1.1 Water Flow of the Meghna Rivers

The flow of Meghna rivesr 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 2004 is attached in **Table – 4.8**.

Table- 4.8 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

4.1.6.1.2 River Water Quality at and around the project

The existing water quality of the Meghna river at the upstream is relatively good **(Table: 4.9).** Ashuganj Fertilizer Complex is situated about 2km downstream of Ashuganj Power Station. 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.

Water quality data for some parameters have been analyzed during July 2009 and are presented in **Table-4.9** below: The water quality parameters investigated are within the Bangladesh standards. It may be pointed out that the cooling water discharge shall be similar in composition to that of the water abstracted from the Meghna River.

Table 4.9 Water Quality of the Meghna River

Surface Water Quality Test Report

Sl. No.	Parameter	Concentration present	DoE (Bangladesh) Standard for Inland surface water
01	BODS 20^{0}C	3.1 mg/l	50 mg/l
02	DO	6.6 mg/l	4.5-8.0 mg/l
03	SS	32 mg/l	150 mg/l
04	COD	10 mg/l	200 mg/l

05	Nitrogen at nitrate	8.0 mg/l	10.0 mg/l
06	Chloride	3.0 mg/l	600 mg/l
07	TDS	62 mg/l	2100 mg/l
08	Conductivity	132 μS/cm	1200 μS/cm
09	Manganese total	0.13 mg/l	5 mg/l
10	Sulfate	0.2 mg/l	-
11	Iron	0.1 mg/l	2 mg/l
12	Silica	32 mg/l	-
13	Oil & grease	3.5 mg/l	10 mg/l
14	PH	6.8 mg/l	6.0-9.0
15	Phosphate	0.5 mg/l	-
16	Temperature	30^0C	40^0C
17	Turbidity	65 JTU	-

Date: 16 July 2009

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More data on the Meghna river along with other three rivers the Buriganga, the Sitalakhya and the Jamuna for the year 1997 have been collected from DoE and are presented in **Table 4.10** below**:** These pre-project surface water quality data can be used to assess the future trend of the river water quality.

Table 4.10
Water Quality Data for four rivers (Meghna, Buriganga, Sitalakhya, and Jamuna)

River	Meghna	Buriganga	Sitalkhya	Jamuna
Parameters				
EC, Micro-S/cm	166	200	230	140
PH	7.1	7.3	7.1	7.02
Chloride, mg/l	5.0	25	15	14
T. Alkalinity, mg/l	40	130	82	68
DO, mg/l	6.5	3.0	6.2	7.2
BOD. mg/l	3.2	12	2.5	2.0

Source: DoE

The data shows that pH value of the river water is in neutral range, which means that there is no discharge of excessive acidic or alkaline effluent into the river systems. EC, Chloride, alkalinity, values are within the acceptable limit as mentioned in EQS of Bangladesh.

Dissolved Oxygen (DO) value, which is the primary criteria of surface water body to determine the freshness, remains above 4.0 mg/l (4.0 mg/l being the minimum level for any aquatic lives). BOD value is also within allowable limit for Meghna River.

4.1.6.2 Ground Water

The groundwater storage reservoir has three divisions:

- An upper silty clay cover of less than 20m thicknesses, along the borders of the NCR. The maximum thickness ranges from 50 to 100 m.
- A middle composite aquifer of fine to very fine sands, varying in thickness from 30 to 60m along the border of the NCR. The centre of the region, the aquifer is less than 10m thick. Although it is a good aquifer, its irrigation development potential is poor, because its sands are too fine for slotted well screens and for providing high discharge rate. However, it is used as a source of supply for HTWs and MOSTIS.

- The lowest aquifer, the main aquifer consists of medium, medium-to-fine or medium-to-coarse sand with layers of clay and silt extending to 30-60m. The coarser-grained structure of this aquifer is suitable for large-scale groundwater development with screened wells. Most tube wells within the main aquifer are less than 150 m deep.

For all uses of water, apart from cooling purpose, the possibility of using ground water abstracted from boreholes may be considered.

Water aquifers are present beneath the vast majority of Bangladesh, which are being recharged by the major river systems and by infiltration of rainwater. Most ground water is available within 5 m of the surface. This level fluctuates seasonally, approaching the ground surface over most of the country during the months July to September.

It is found that local ground water represents a stable source of water for various activities including irrigation (both shallow and deep tube wells), domestic purposes (hand pumps) and industrial applications (deep tube wells).

The local groundwater level is lowered to approximately 6m below ground level during the dry seasons, with levels returning to their normal position before the end of the monsoon. This fall in ground levels is an entirely natural process that arises because of the hydrological link with the river.

4.1.7 Air Quality

4.1.7.1 Introduction

Air quality standards prescribe pollutant levels (REF: DoE, 1997) that cannot be legally exceeded during a specific time period in a geographical area. The emissions of air pollutants therefore need to be controlled so that the ground level concentrations (GLCs) for these pollutants do not exceed the ambient air quality.

4.1.7.2 Local Air Quality

The local area may be classified as a mixed industrial areas defined and found from survey. Air quality, based on analysis carried out by sampling at site on 20th June 2011 shows the $PM_{2.5}$, PM_{10}, SPM, SO_2 & NO_x concentrations in the ambient air is far below the allowable limit. The weather was sunny. Since the wind direction was from the south-east to north-west corner and still has reasonable buffer/assimilation capacity to adsorb air pollutants to a certain extent. Therefore, these are within the prescribed limit of the National Air Quality Standards. The analysis report is furnished below in Table-4.11. The table includes the pollutants by the existing power stations including the 146MW CCPP & 2x64MW steam power plant 3x150MW Steam Power Plant, 50MW Power Plant and 190MW IPP. Since the proposed 450MW CCPP will be the replacement of existing 146MW CCPP & 2x64MW steam power plant and the units will be of advanced design, atmospheric pollution will be less than those generated by the existing power plants and so will be the cumulative pollution. Further the IPPs will case to operate when Ashuganj 450MW (South) will come into operation. So, the data obtained by sampling can be accepted as baseline data for proposed Ashuganj 450MW CCPP South.

It is discussed in section 3.3 that existing power station altogether generating 14.3mkWh/day burning 70.664MMSCFD gas including the 146MW CCPP's share of 39.227MMSCFD & 31.437MMSCFD of gas for the share of the 2x64MW steam plant. The survey report reflects the pollutants contributed by burning 165.60MMSCF gas/day.

The proposed 450MW CCPP running at 90% Plant Factor burn 69.45MMSCFD gas. Thus by replacing old the146MW CCPP & 2x64MW steam power plant by new 450MW CCPP will consume almost similar amount of gas. Thus the total gas burning will be reduced. So, when the old 146MW CCPP & 2x64MW steam power plant will be replaced by the new 450MW CCPP the pollutants will be reduced unless deterioration of the other units. Thus the base line data emanated from sampling can be accepted as base line data as if the old 146MW CCPP & 2x64MW steam power plant has already been replaced by the proposed 450MW CCPP. By the same way when the Ashuganj 450MW CCPP South will come into operation, the IPP (190MW) will cease to operate. So the data can be consumed base line data for Ashuganj 450MW CCPP South. The results shown in Table 4.11 & 4.12 outcome of sampling when the existing power plants as well as all the rental power plants are in operation.

Table 4.11 AMBIENT AIR QUALITY TEST REPORT

Location: Proposed Ashuganj 450MW Combined Cycle Power Plant South Project, Ashuganj.

Sampling Date: 20-06-2011

Sl.	Sample Location	Ambient air pollution concentration in micro gram/cubic meter				
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NO_x
01	Propose project area	59	79	191	22.10	36.79
	Duration	480	480	480	480	480
	DoE (Bangladesh) standard for Industries area	65	150	200	80	100
	Analysis Method	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochhelser

Source: Field Survey 16th Nov 2009

Note:
1. $PM_{2.5}$ – Fine particulate sampler.
2. PM_{10} – Respirable Dust Content
3. SPM – Suspended Particulate Matter
4. NO_x – Oxides of Nitrogen
5. SO_2 – Sulphur Di-oxide

4.1.8 Noise

Existing ambient noise levels in the vicinity of the proposed power plant was monitored using a noise level meter. The monitoring was carried out on 20 June 2011, in the proximity of the proposed CC power plant. The sample locations were selected based on factors such as: sensitivity to noise and proximity to the project site. Noise monitoring data are shown in Table-4.12 below. The data includes the noise due to all the existing plants including the existing 146MW CCPP & 2x64MW steam power plant and the 3x150MW power plants as well as the 50MW gas operated diesel power plants and 190MW IPP. Since the proposed 450MW CCPP will be the replacement of existing 146MW CCPP & 2x64MW steam power plant and the units will be of advanced design, noise and vibration will be less than those generated by the existing power plants and so will be the cumulative noise and vibration. So, the data obtained by sampling can be considered as representing the data as if the 146MW CCPP & 2x64MW steam power plant has already been replaced with the proposed 450MW CCPP and can be accepted as baseline data for proposed Ashuganj 450MW CCPP South.

Table- 4.12 Ambient Noise Quality Analysis
Sampling date: 20-06-2011

Sl	Location	Site condition	Result (dBa)
			Day time
01	Project west-north corner	Propose project	57.33
02	Project north-east corner	Propose project	56.11
03	Project south-east corner	Propose project	58.23
04	Project west-south corner	Propose project	60.09
Bangladesh (DoE) standard for industrial area			75

Source: Field Survey 16th Nov 2009

Data in the Table show that the existing noise level in proposed area (industrial zone) is within the range of Bangladesh Environmental Quality Standard for industrial zone.

4.2 Ecological Baseline

4.2.1 Background

This section of the report deals with flora and fauna of the project area. The consultant made ecological assessment of existing flora and fauna within the study area. The study area is rich in plant and faunal diversity. The ecological setting of the project is mostly wetland, homestead and roadside vegetation, etc. This report is prepared on the basis of field trip, available published and unpublished information.

4.2.2 Ecological and Conservation Designations

4.2.2.1 Overview

The Bangladesh Wildlife (Preservation) Order, 1973, promulgated under Presidential Order No.23 has been enacted and amended in two phases as the Bangladesh Wildlife (Preservation) Amendment Act. This provides for the establishment of national parks, wildlife sanctuaries, game reserves, and private game reserves. Each of these designations is briefly described below:

4.2.2.2 National Parks

A National Park is defined in Bangladesh as “a comparatively large area of outstanding scenic or natural beauty, in which the protection of wildlife and preservation of the scenery, flora and fauna in their natural state is the primary objective, and to which the public may be allowed access for recreation, education and research”. Activities prohibited in the country’s National Parks include hunting, trapping, felling, destroying or burning plants or trees, cultivation, mining or pollution of waterways.

National Parks does not exist in the Area of Influence (AoI) of the project.

4.2.2.3 Wildlife Sanctuaries

In Bangladesh, Wildlife Sanctuaries represent an area closed to hunting and maintained as an undisturbed breeding ground. Such sites are primarily for the protection of wildlife including all natural resources such as vegetation, soil and water. Under Article 23, Wildlife Sanctuaries are assigned a greater degree of protection than National Parks in Bangladesh although the restrictions on activities are broadly similar. Such establishments are also not available in the AoI.

4.2.2.4 Game Reserves

These represent an area in which wildlife is protected to enable populations of important species to increase. Here the capture of wild animal is prohibited although hunting and shooting may be allowed on a permit basis. The proposed project site is not situated in or near any reserve forest.

4.2.2.5 Private Game Reserves

A private game reserve is an area of land set aside by the owner to broadly fulfill the same purpose as any other game reserve. The owner who shall exercise all the powers of an officer under this Act establishes such areas following application.
The proposed project site is not situated in such reserves.

4.2.2.6 Reserve Forest

The Forest Act, 1927, 1994 enables the government to declare any forest or waste land to be reserved for protected forest. Most activities are generally prohibited in reserve forests although certain actions such as the removal of forest produce may be permitted under license in protected forest. Prohibited activities include enlargement of clearings, cultivation and quarrying etc. The proposed project site is not situated in or near any reserve forest.

4.2.2.7 Other Designations

Bangladesh is also party to the Convention concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), which it accepted on 3 August 1983.

The Sunderbans mangrove forests, Naluar Haor represent the areas in Bangladesh to represent World Heritage Sites/ Ramsar Sites. These sites are located in other districts of Bangladesh and far away from the project AoI.

4.2.2.8 Ecological and Conservation Designations in the Project Area

Figure 4.1 shows the location of the project area in relation to the country's forests and protected areas. The map illustrates that no protected habitats or reserve forests occur within 50 km of the site. It is, therefore, concluded that these areas are outside of the project's AoI.

4.2.3 Terrestrial and Aquatic Ecology

4.2.3.1 Terrestrial Flora

There is no natural forest in the project site as industrial and commercial establishments dominate the area. There is no forestland in this area; the composition of plant community was low growing and herbaceous vegetation as well as other flora.

Homestead Vegetation

Homestead vegetation has a positive effect on improvement in soil moisture through shading and mulching process. Trees growing at homesteads also ensure easy access to the fuel wood, fodder and other products. Thus, it reduces the pressure on forestlands.

A large number of multipurpose trees (fruit, timber, fodder, medicine) are grown in the project area. The most common among them are Am *(Mangifera indica)*, Kanthal- (*Artocarpus heterophyllus*), Lebu- (Citrus sp.), Kola (Musa sp.) Korai- (Albizia procera), Jam- (Syzygium cumini), Kul- (Zizyphus sp.) etc.

Roadside vegetation

Most of the 10-15 families of the plant species are present in the study area. These are: Gramineae, Leguminosae, Moraceae, Myrtaceae, Cyperaceae, Euphorbiaceae, Rutaceae, Solanaceae, Labiatae, Rubiaceae,Malvaceae, Compositae, etc. The most common roadside plantation trees are Sisso-(Dalbergia sissoo, Mahogoney-(Sweitonia mahagoni) Katanote-(Amaranthus spinosus), Apang-(Achyranthus aspera), Chorekanta-(Chrysopogon aciculatus), Jagadumur-(Ficus glomoreta), Swetadrun-(Leacus lavendulifolia), Tulsi- (Ocimum sanctum), Titbegun-(Solanum indicum), Benna-(Veteveria zizanioides), Bot-(Ficus benghalensis) etc.

Figure 4.2: The location of the project area in relation to the country's forests and protected areas

4.2.3.2 Terrestrial Fauna

A number of species were observed in the AoI including many common birds typical of the open countryside such as the roller Coracais benghalensis, and the bee eaters Meliops supercilious, and meliops orientals ,crow, parakeet, eagle, *shalik*, sparrow etc. Besides this avian species, the habitats are likely to have variety of reptile, mammals and invertebrates. No record of wild animals and endangered species are found in the project area.

No wild mammal species were observed during the visit to site and site survey. Mammals typical of cultivated rural habitats of this type are likely to include the Indian fox *lepis Migrocollis*, and rodent species such as brown and black rat. Indian gerbil and sand-colored rat. Other species, in particular the more endangered species are almost certainly absent due to the lack of suitable natural habitat.

Bird species were observed at the site included the parish kite *Milvus migrans*, the house crow *corvus splendens* and the Brahmani kite. All of these species are typical inhabitants of urban fringe and are considered common on both a local and regional level. A few waders were seen feeding in areas of standing water adjacent to the site. These included little egret and black wing stilt, both of which are extremely common in the deltaic regions of Bangladesh.

A few reptiles were observed, including common skink *Mabuya carinata*, smooth water snake *Enhydris, and wall gecko gekko gecko*. All of these are common within the study area. Anecdotal evidence suggests that cobra occur in the study area but not at site. As the site is inundated for much of the area, it is a particularly suitable habitat for amphibians, however none were observed during the site visit.

As already mentioned, the site is typical of much of the study area, and its lack of natural habitats makes it highly unlikely that of the endangered fauna of the area is present.

4.2.3.3 Aquatic Flora

Wetland flora plays a vital role for biodiversity conservation. The wetland habitat characterized by anaerobic conditions, which inhabits normal plant growth. The project area supports two types of wetland e.g., (a) Permanent wetland and (b) Seasonal wetland. The permanent wetland includes rivers and perennial water bodies. The permanent wetland provides refuge and shelter for the most of the aquatic flora. The seasonal wetland serves as the cultivated land.

Kalmilata (Ipomoea reprans), Shapla (Nymphaea lotus), Helencha (Altemathera philoxeroides) and Kuchuripana (Eihhcormia crassipes) are the main aquatic flora in the project area.

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4.2.3.4 Aquatic Fauna

The main aquatic fauna in this area are different types of fishes. A few ponds that remain almost dry in the summer season in this area are used for natural cultivation of seasonal fresh water fishing. The fresh water fishes are carp (Rui, Katal, Mrigel, Ghania, Kalibaus etc.). The stretch of the river Meghna provides a habitat for a wide variety of fishes and shellfish species, which include carp, catfish (Boal, Pangas, Shilong, Bacha etc.) and live fish (Koi, Singh, Magur etc.). Tortoise, Frogs, Water Snakes etc. are other aquatic found in the Beels around the project area. **Table 4.13** presents' available fish species in the Meghna river.and in the Beel areas.

A large number of aquatic fauna was observed in the project area. Many are totally dependent on wetlands (beels, river, ponds) and species are partially dependent on

wetlands. There are little available aquatic habitats for faunal species. Wetlands are intensively exploited and the habitat is highly disturbed. Despite this, some species have adapted to the altered environment, and others have even flourished.

Among the amphibians the skipper frog (*Rana cyanophyctis*) is common-being found in most of the wetland habitats and has been the most successful in adapting to the altered environment. The common roof turtle (*Kachuga tecta*) and the flat-shelled spotted turtle (*Lissemys punctata*) are the most common of the reptiles. These freshwater turtle species face problems of migration during summer when water levels are inadequate.

The common aquatic snakes include the checkered keelbaek (*Xenochrophis piscator*) and the smooth water snake (*Enhydris enhydris*). The common lizards found within the project AoI comprise the common skink (*Mabuya carinata*) and the garden lizard (*Calotes versicolor*).

Among other species that once were common but now are only occasionally seen are the monitor lizards (*Varanus bengalensis and V. flavescens*). These species prefer a habitat with or near water.

Aquatic and water-dependent birds have been severely affected by habitat alteration. Wetland degradation has left virtually no sheltered place for waterfowl to roost or nest. Herons, egrets, bitterns and ducks have been intensely affected by habitat alteration.

Wetland dependent birds like kingfishers and other birds of prey have little scope for adoption. Sonic species (mostly piscivores) have moved to areas more favorable to their needs.

The freshwater dolphin (*Platanista gangetica)* are seen rarely in the Meghna during the monsoon season.

Table – 4.13: Fish Species in the Meghna River and in Ponds.

Local Name	Scientific Name
Katal	Catla catla
Rui	Labeo rohita
Jat puti	Puntius sophore
Boal	Wallago attn
Chital	Macrognathus aculeatus
Shol	Chpisoma garna
Ghawra	Lepidocephalus guntca
Bata	Labeo bata
Raik	Cirrhinns reba
Tit puti	Puntius ticto
Mola	Amblypharngodon mola
Kakila	Xenentodon cancila
Pabda	Ompok pabda
Tengra	Mystus tengra
Ayre	Mystus aor
Baila	Glosso GOB ins giuris
Kajuli	Aila coila
Kachki	Corica soborna
Name chanda	Chanda ramma
Lal chanda	Chanda ranga
Foli	Notopterns notopternsnotoptrns chital
Tara Baim	Mastacembelus panchus
Gochi baim	Mastacembleus armatus
Shal baim	Chanda puncttus
Taki	Channa striatus

CHAPTER – 5
SOCIAL AND ECONOMIC ENVIRONMENT

5.1 INTRODUCTION

The project area designated for the construction of 450MW CCPP is a part of Ashuganj Upazila under Brahmanbaria district and Bhairab upazila under Kisoreganj district. The main objective of the proposed study is to construct 450MW combined cycle power plant to meet the growing demand of BPDB's power system. The report of the SIA study is as follows.

This section discusses socio economic condition of the project area. Both primary and secondary sources data are utilized for understanding of the socio economic condition of the project area.

5.2. SOCIO ECONOMIC SURVEY

For collecting latest social information, four skilled Investigators under the guidance of a Sociologist were engaged in constructing primary data using structured questionnaire, a copy of which is attached hereto at Annexure – 3

5.3 METHODOLOGY

For benchmark socio economic analysis, a survey was carried out on both the banks of the river Meghna. This has been done on the basis of Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA). One FGD meeting was held at Upazila level and 5 Focus Group discussions (FGD) were organized in the union level with about 100 stakeholders of different social strata representing the project area. There was a checklist and structured questionnaire for discussion in the FGD, Key Informants Interview (KII), for primary and secondary data collection. The union/ pourashava were selected on the basis of strategic location and distance. In the west bank of the river 2 FGD were organized and 3 FGD were organized from the east bank of the river Meghna. One FGD from the project union within one km radius, two from 2 to 3 km radius and two from 4 to 5 km radius. In addition to that Ashuganj and Bhairab Upazila government officers, Local government public representatives and KII were taken. As secondary sources, Bangladesh Bureau of Statistics (BBS),Upazila, Union and Pourashava records, Banglapedia, concerned books and periodicals were consulted. The socio economic information has been taken from both upstream and downstream areas of the river Meghna. The survey area is roughly of 5 km radius around the proposed Ashuganj CCPP project site.

Considering the Union/Pourashava coverage, a total of- 7 unions/Pourashava are in the project site around five km radius of which, on the east bank 4 are in Ashuganj. viz.Char Charchartala, Ashuganj, Araishida, Durgapur(Dakshin Panisar) and 2 unions and one Pourashava are in Bhairab Upazila, These are Bhairab Pourashava, Srinagar (part of previous Sadekpur) and Simulkandi. Structured questionnaires and Checklist were used for data collection. Socio economic, environmental, demographic questions were included in the structured questionnaires.

5.4 SOCIO ECONOMIC CONDITION OF THE STUDY AREA

The project area is an industrial site beside and adjacent to the Dhaka Sylhet highway and locates in the eastern bank of mighty 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 rest 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 Upazla of B.Baria district. 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 Ashugnj. 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.Within1km 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..

5.5. 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 5.1 & 5.2.** 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 -5.1 and Table 5.2. and Table 5.3** respectively.

Table 5.1: 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 - Male - Female	2398254 1205552 1192702	625484 318579 306905	271101 136240 134861	-145,828 -74,191 -71,637	2594954 1320117 1274837	**247166** **125621** **121545**
5	Household Size -Rural -Urban	 5.58 5.59 5.52	 5.7 5.7 5.7	 5.5 5.6 5.3	 5.5 5.5 5.3	 4.9 4.8 5.0	**5.3** **5.3** **5.3**
6	Literacy Rate % (7 years+) -Male -Female	 39.46 42.26 36.69	 44.3 46.2 42.4	 32.9 36.2 29.7	 46.2 47.7 42.7	 38.3 41.3 35.1	 **40.7** **44.8** **36.6**
7	Sex Ratio	101	104	101	104	104	**103**
8	Total Mouza/ Mohallah	1024 97	320 34	76 -	30 -	953 147	**32** **26**
9	Total Village	1331	375	140	38	1794	**84**
10	Total Union	98	21	9	7	105	**6**
11	Total Upazila	8	1	1	1	13	**1**
12	**Pourashava** **Paura Ward**	**4** **39**	**1** **12**	**-** **-**	**-** **-**	**4** **39**	**1** **12**

Source: Population Census 2001, Community series, Zila:B.Baria and Kishoreganj, BBS, August, 2006

Table 5.2: 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 2001, Community series, Zila: B.Baria, BBS, January, 2007 and National Series, Vlume-2, Union Statics, March 2007

Table 5.3: 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 % (7 years +)**	**53.57**	**23.54**	**32.85**	**-32.23**	**33.75**	**37.14**	**35.26**

Source: Population Census 2001, Community series, Kisshoreganj, BBS, February, 2007

5.5.1. Population

As per Population Census 2001, population and other relevant information are as follows (Table 5.4).

Table 5.4 Popultion of the Project Upazila

Upazila	Area (km^2)	Total Household (No)	Population (No)	Male (No)	Female (No)	Literacy7+ (%)	Population 18+ (No)
Ashuganj	67.59	26709	1,45.828	74,191	71,637	46.2	72,332
Bhairab	139.32	46,634	2,47,166	1,25,621	1,21,545	40.7	1,24,941

The above Table shows that there are (103.5) males compared to 100 females. Sex Ratio (2001, BBS) in the Dhaka district is 109.5. But the ratio is different in the urban area, namely, 121.9 and the same in the rural area it is 103.6.

Family Size: average family size in district (Census, 2001) is, In the district of Kishoreganj hh size is 4.9 and in Bramanbaria is 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 sq km.

5.6 Findings of Socio-Economic Survey

Following findings have been obtained from the socio economic survey. Data is mainly from secondary sources but some data have been collected from FGD meeting and KII based on PRA and RRA method. The secondary sources are Union Parishad, Upazila Parishad and BBS. And some records are collected from concerned key stakeholders viz associations and public representatives.

5.6.1 Religion

Religious feature of the manpower are presented in Table 5.5. The community is predominantly Muslim.

Table 5.5 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::BBS, community series, Kisoreganj and B.Baria census 2001

From the above Upazila 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.

5.6.2 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 5.6).

Table 5.6 Land holdings and Ownership of Land at Ashuganj Upazila

	Ashuganj	Bhairab Upazila
Agricultural Land in decimal	(%) 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% have 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.

5.6.3 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-7 below shows the pattern of the ownership of residence.

5.6.4 Access to Health Facilities

There are government Health complex in both the Upazilas. Two government hospitals are giving services, one owned by Ashuganj power plant and another is owned by Zia Fertilizer factory in Asuganj Upazla. 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 poors 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 viz 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.

5.6.5 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.

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-9.2 and 9.3 above shows the sanitation coverage in Ashuganj and Bhairab Upazila. Sanitary latrine coverage was 44.89% of the households in Ashuganj and 39.74 % holds in Bhairab upazila.. But present situation has been drastically improved. Asshuganj is at present under 100% and Bhairab is under 90% sanitation coverage.

5.6.6 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 5.7).

Table 5.7: 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

5.6.7 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(Census2001), 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 Ashugnj upazila the literacy rate for both sex 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: 5.8 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 2001

The above Table 5.8 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.

5.6.8 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 5.9 verifies this statement.

Table 5.9 Electricity Facility

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

SourceBBS, 2001 census

However all the unions are under rural electrification program in both the upazilas.

Details of Social Environment are provided in Volume 3

CHAPTER –6
ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

6.1 Environmental Impacts Identification

Chapter 3 (Project description) identified the major activities associated with project phases. Each phase of the project has the potential to impact on the physical, biological and socio-economic environments of the Project areas. This chapter assesses the potential impacts that may arise from various project activities and identifies suitable measures to mitigate or avoid the potential adverse impacts identified and, where possible, to enhance potential beneficial impacts.

The Ashuganj 450MW Combined Cycle Power Plant Project is an energy conversion process in which chemical energy in gas fuel is converted to thermal energy and successively to mechanical and electrical as final output. In the process it liberates heat and combustion product such as gases like CO_2, NO_x, SOx, CO, etc. to surrounding atmosphere. During construction it may have impact on the locality. The study was to identify these adverse impacts, and suggest mitigation measures to reduce these if not eliminated.

Accordingly, an environmental baseline survey was conducted in the project areas to identify the environmental parameters likely to be affected by the project implementation. All the major environmental parameters covering ecological, physico-chemical and human interest related aspects were considered in identifying the affected areas at different stages of the project cycle. A checklist of the screened environmental parameters is prepared as shown in **Table-6.1**. Anticipated environmental impacts due to plant location, construction and operation of the proposed power plant have been identified and shown in the Table. This Table of comprehensive lists of environmental parameters, their consequences and impacts are very useful in designing various activities of the proposed plant in an environmental friendly manner. The magnitudes of environmental impacts are classified as none, minor, moderate and major in the checklists. In order to distinguish the short and long-term impacts, both the construction and operational phases are considered separately in the checklist. It can be seen from the checklist that the major environmental components that will be adversely affected by the project activities are Air quality and noise pollution**.** Socioeconomic environment is considered to be affected positively of the project activities would create job opportunity for the local people and the area will be more developed and commercial activities will be increased in the locality. All these impacts will contribute to improve the quality of life of the local community. Mitigation measures of the adversely affected parameters are discussed in the subsequent sections.

6.1.1 Identification of SEIs (Significant Environmental Issues) for the Construction of the Proposed Project.

Significant Environmental Issues (SEIs), are the issues that require detailed and in-depth further investigation. The various baseline significant environmental components (or IEC) have been discussed in Chapter-4. Evaluation of impact of the project on the environment is addressed and mitigation measure as required, are recommended in this Section of the report. Environmental parameters likely to be affected by the Project are tabulated in Table-6.1 and SEIs in Table-6.2.

TABLE 6.1: Environmental Parameters Likely to be affected by the Project

Environmental Parameters	Environmental Examination				
	Positive Impact	No Impact	Adverse or Negative Impact		
			Low	Moderate	Severe
1. Ecological					
Fisheries				X	
Aquatic weeds		X			
Eutrophication		X			
Wetland		X			
Forest / plants		X			
Animals		X			
Species diversity		X			
Endangered species		X			
2. Physico-chemical					
Erosion & siltation		X			
Flooding		X			
Drainage congestion		X			
Air pollution					X
Noise pollution and Vibration					X
Solid waste			X		
Water pollution			X		

Table 6.2: Identification of SEIs (Significant Environmental Issues) of the Project

	Environmental Parameters	**Magnitude of Impacts**			**Type of impact**				**Temporal extent**		**Spatial extent**		**Mitigability**		**SEIs**
		Severe/ good	Moderate	Low	Direct	Indirect	Induced	Cumulative	Long term	Short term	Widespread	Local	Fully	Partially	
	Ecological														
1	Fisheries		X				X		X			X			
2	Aquatic weeds														
4	Wetlands														
6	Animals														
7	Species diversity														
8	Endangered species														
	Physic-Chemical														
9	Erosion & siltation														
10	Flooding														
11	Drainage congestion			X			X			X		X	X		
12	Air pollution	X			X			X	X		X			X	X
13	Noise pollution and Vibration	X			X			X	X			X		X	X
14	Solid waste			X	X					X		X	X		
15	Water pollution			X	X			X	X			X	X		

6.1.2 Socio-Economic Impact

Table-6.3 and **Table 6.4** below reveals the results of the survey with regard to the impact of the proposed power plant. A good number of the respondents (52.54%) provided positive answers regarding the installation of the project. These people showed their response by stating that they were ready to cooperate with APSCL for implementation of the project.

Table 6.3 Impact of Proposed Combined Cycle Power Plant at Ashuganj

Area (Upazilla Basis)	Total Response	No of Positive Response	% [+ve]	No of Negative Response	% [-ve]	Zero impacts	No comments
Ashuganj Upazila	13	6	46.15	1	7.69	4	2
Ashuganj Union	8	5	62.5	2	25	-	1
Arashida union	7	5	71.43	0	0	2	-
Dakshin panishar(Durgapur)	5	3	60	2	40	-	-
Bhairab Upazila	13	4	30.77	1	7.69	5	3
Simul kandi	7	4	57.14	0	0	1	2
Srinagar(part of Ex Sadekpur Union)	6	4	66.67	0	0	2	-
Total	59	31	52.54%	6	10.17%	14(23.73%)	8(13.56%)

Table 6.4 Impact of Proposed Combined Cycle Power Plant at Ashuganj of different Aspects

Sl	Types of the Affects	Advantages	Disadvantages	No Impacts
1	Agriculture	1. Existing irrigation facilities will be continued. Presently a portion of water used of plant cooling system are diverted to a reservoir then it is diverted to paddy field through link canal 2. More power supply may enhance more irrigation facilities and more crop		
2	Fish		1. Discharging of hot water and digging of artificial canal damages breeding natural fish varieties viz Taky etc of Ashuganj union. But the impact is minimum	
3	Livestock			No impact.
4	Bird		1. Because of deforestation, urbanization and sound pollution birds leave from the plant site area.	
5	Animal		1. Due to urbanization, wide movement people and vehicle, sound and deforestation. They are moving to other areas	
6	Forestry		Due to rapid urbanization, of the project area and grid line, plants, herbs and bushes have been reduced in the plant side area but its impact is limited	
7	Income	Expansion of business, more electric connection income will be increased because of employment generation and in migration.		
8	Employment	Employment will be Increased in the area due to industrialization, influx of professionals, workers, employment resulting growing demands goods and services.		
9	Movement of Local People		Short time impact will occur on movement of local people due to increased movement of goods, instrument and vehicle and in migration workers in construction of plant.	
10	Tourism	The plant location strategically is in a very important place. The natural beauty of this upper Meghna attracts everyone. So in migration of professional, employee visitors and workers may be influenced by the expansion of tourism, river excursion etc.		
11	Business	Here exists a lots chatal (Boiler based rice husking mills) runs by electricity and also Bhairab bazaar and Ashuganj are very developed, Moreover, some ice factory is available in the area for exporting haor's fishes and marketed into the capital city and other areas of the country.		
12	Industry	Different industry will be developed in future. At present shoe, factory, tannery, ice factory, fish processing, fertilizer factory, rice husking mills etc are prevailing in the area.		
13	Housing	Naturally project area is beautiful and a place of business and well communicated with other areas of the		

		country. The area will be developed as a satellite city in near future. Some housing society and real state business organization have been working in the area In addition to that the region is being developed rapidly. At present few multistoried buildings have been constructed in the project area.		
14	Archeological and historical site			No negative impact on the archeological sites. Sound and temperature effect is at minimum. There is no archeological and historical site adjacent to the plant site
`15	Health		Negative impact on health due to in migration relating STD and waterborne diseases	

Overall impact of the project is positive .Now farmers are benefited during boro cultivation. Plant authority pumps the water from river for its cooling system. Then it is diverted to reservoir and used by the farmer. Existing Irrigation facilities will be continued. Presently a portion of water used for plant cooling system is diverted to a reservoir. Then it is diverted to paddy field trough a link canal. Normal costing of irrigation water is Tk.1500/biga by the diesel machine. But the plant discharge water is being supplied at the rate of Tk.200.00 per biga to the farmer. This is a direct benefit of the project. However, addition of the 450MW CCPP will not affect this system.

6.2 Evaluation and Mitigation of Impacts

Environmental impacts are identified and predicted for both positive and negative impacts in terms of ecological, physico-chemical and socioeconomic parameters. Evaluation of impacts and possible mitigation measures are described in this section mentioning the sources and characteristics of impacts. Status of residual impacts is also discussed.

6.2.1 Impact due to Project Location

It was earlier mentioned that the proposed 450MW CC Power Plant at Ashuganj would be located in their own land lying at southwest extremity of the APSCL complex. The site is partially vacant requiring land development. Some redundant structures will be demolished before starting construction. If the existing environmental situation is considered as baseline condition, there would be no significant adverse impacts due to project location. Since the site is at the southwest extremity of APSCL complex landscape will follow the existing APSCL architectural suit and adequate buffer zone can be developed around the site.

6.2.1.1 Human settlement

As the site is owned by APSCL no acquisition of fresh land is required and no settlement would be displaced. Some unused materials on the site will be shifted to suitable location when the construction of the Power Plant will start.

6.2.1.2 Changes in landscape

Sources of Impacts

Due consideration will be given in designing the project infrastructure to avoid visual intrusion. A visual intrusion to the local people may be created by the project if the plant buildings are designed without considering the local landscape. The proposed power plant will not change the existing local landscape of the area as it will be constructed following the architectural pattern followed earlier.

Mitigation Measures

The 450MW CC Power Plant will have modern architectural view and that will not create any significant visual intrusion from any direction.

Residual Impacts

These will be no considerable change in landscape. However, the residual impact on change in landscape would be very insignificant provided the above mitigation measures are implemented.

6.2.1.3 Inadequate buffer zones

Source of Impacts

Buffer zones are the spaces that provide natural environmental protection from damage by external events. In context to the local area, there will be no such buffer zones if industrial plants are built close to each other. Buffer zone can provide wind-breakers, erosion control, sediment traps, sound insulation and visual screening. Lack of plantation and vegetated spaces will create inadequacy of buffer zone required for environmental protection. However, a moderate buffer zone can be developed around the site.

Mitigation Measures

APSCL would try to keep some open space within the plant premises that can be developed as a buffer zone. Tree plantation of various species in all possible open spaces within the plant premises would render the view as a green belt. Trees and plants release oxygen and carbon dioxide is consumed in the process of photosynthesis. This phenomenon contributes in cleaning the air. Some trees also absorb the toxic gases and particulate. Circulation would be such as to provide the air intake on the riverfront and exhaust gas emitting at a velocity of 20m/sec through a stack of or above 50m height will be carried away and dispersed by the wind.

Residual Impacts

Residual impact would almost be negligible provided the mitigation measures are undertaken properly.

6.2.2 Adverse Impacts during Construction

Several activities will be performed during construction period of the proposed power plant. The occurrence of environmental hazards is very common in all types of construction works. These hazards may include air pollution, noise pollution and vibration, spreading of diseases and accident.

6.2.2.1 Air pollution

Source of Impacts

The area is predominated by sandy-clay soils. Sometimes sandy soil can pollute the air during heavy wind. It is anticipated that the air would be polluted with dust and sand particles for the movement of light and heavy transport vehicles and during piling work. This air pollution may create some breathing problems to the workers. Very few people live near the site except power station staffs.

Mitigation Measures

To reduce air pollution in site, attempt is normally made to complete the construction of infrastructures within the wet season. Due to high rainfall in this period, air and soil remain wet and dust particles cannot spread easily. If construction work is continued during dry period, dust control arrangement by sprinkler shall be placed.

Residual Impacts

Residual impacts will be very low as water will be sprayed on the dry exposed places of the project site.

6.2.2.2 Water Pollution

During the construction period water pollution i.e. thermal pollution is being contributed by the existing plant. The total discharge of the existing plant is about 43.534m^3(ton)/sec with average discharge temp of 37.54^{O}C. After instant mixing with equal volume/mass of water the temp will be 34.04 after immediate vicinity of the discharge point. At the long end down the river the temperature of river water will negligible i.e. 30.13^{O}C.

6.2.2.3 Noise Pollution and vibration affect

Noise and vibration are generated from various construction activities such as piling of foundation, crushing of stones and bricks and installation of machines and equipment, etc. In addition, working conversation of the labor force also enhances the noise pollution. The noise pollution and vibration create disturbance to the workers of the adjacent establishments and surrounding people involved in various activities as well as nearby staff quarter people.

Mitigation Measures

Generation of noise pollution and vibration are an integral component of any construction work that cannot be avoided completely. However, it is possible to take certain measures to reduce the extent to an acceptable level. Appropriate precautions and skilled operation of machines and equipment would contribute to reduce the nuisance. Precaution like selection of proper working period considering the comfortable time of the people working and living around should be followed for construction work. The construction work normally starts at about 8.00 am and continues until 6.00 pm at the plant site. Working beyond this period may create sound hazards to the local people and hence the above work period shall be enforced.

Residual Impacts

Residual impact is within the acceptable limit while the above mitigation measures are being undertaken.

6.2.2.4 Spreading diseases

Source of Impacts

It is not unlikely that diseases may be spread among the construction workers as most of them are illiterate and their level of knowledge on health and hygiene is very low. They are not aware of water pollution, healthy accommodation and food poisoning. Moreover, due to high concentration of labor force during construction, unhygienic condition may be created in the vicinity and thereby the same may lead to transmission of various diseases. Thus, the worker may suffer from various diseases such as diarrhoea, dysentery and skin infections. These diseases can spread from one worker to another and to the people living in the area.

Mitigation Measures

During construction phase, all of the impacts are reversible including spreading of diseases among the workers and the people working and living nearby. Moreover, the impacts are of short duration. In order to reduce or avoid the spreading of diseases, it is suggested that arrangement for good quality drinking water, hygienic sanitation and accommodation facilities for the staff and the workers shall be made. Frequent medical check-up would also be helpful in controlling the spreading of diseases. Emergency medical services and adequate first aid facilities should always be available at the site during construction period.

Residual Impacts

Residual impacts of spreading diseases can be avoided or reduced to a minimum level provided the suggested mitigation measures are undertaken and properly implemented.

6.2.2.5 Accidents

Sources of Impacts

Adequate precautionary measures will be undertaken at the project site to avoid any accident. However, accident is unexpected and it may occur any time during construction work and cause loss of lives and properties.

Mitigation Measures

A high level of precautions shall be undertaken that would reduce the occurrence of accidents remarkably. Adequate first aid facilities and emergency contacts to the adjacent health complexes and other emergency services will help to save the lives from accidents.

Residual Impacts

Residual impacts of accidents can be reduced to a minimum level provided the suggested mitigation measures are undertaken and properly implemented.

6.2.3 Impacts during Operation Stage

6.2.3.1 Air pollution

Source of Impacts

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.

Gaseous pollutants to the atmosphere

The major pollutants of potential concern are sulfur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO). Carbon dioxide (CO_2) emissions cause greenhouse effect giving rise to global temperature.

Sulfur dioxide (SO_2) emission: The emissions of sulfur dioxide are dependent on the sulfur content of the gas. There is no sulphur in the gas to be used as may be seen from the analysis of natural gas. Therefore, there would be no sulphur dioxide emission from the plant.

Nitrogen Oxides (NO_x) emissions: Burning of fossil fuels at high temperature (above 1600^OC) generally produces two forms of nitrogen oxides-nitric oxide (NO) and nitrogen dioxides (NO_2); commonly referred to as nitrogen oxides (NO_x). Since the gas turbine intakes excess air to the tune of 127% more than required for combustion, and if a fully premixed burner (dry low Nox burner DLN) is used there will be no Nox since the combustion temp is much less ($2402^OF \approx 1317^OC$) 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 oxides to NO_2 with passage of time. The health hazards due to nitrogen dioxide is far greater than that of nitrogen mono-oxides. For this project we have studied the implication of Ashuganj 450MW CCPP South by calculating the amount of NO_x likely to be produced by the 334 MW Gas Turbine associated with the CCPP.

Again the proposed plant is of advanced design with dry low Nox (DLN) burner with premix burning system which restricts the combustion temperature to 1316^OC which is much below the Nox forming temperature (1600^OC). Thus possibility of Nox formation is minimal.

However, Calculation shows, on the basis of 15 per cent dry O_2, if the situation happens so. Dry low NOx (DLN) burner will produce 9 ppmv of Nox equivalent to 15.38gm/sec, water injection method produce 25ppmv equivalent to 42.72gm/sec, while a dual fuel burner is used the Nox emission due to liquid fuel amounts to 75ppmv (maximum) equivalent to 128.17gm/sec from the 450MW CCPP. Based on the appropriate design of burner, dry low Nox (DLN), water injection or Selective Catalytic Reduction (SCR) and the stack of nature 40m height, using the results of this hypothetical exercise the ground level concentrations of NO_x at various downwind distances such as 100m to 20 Km have been calculated. The results are presented below in Table 6.6. The Table is based on the theoretical calculated, emission for 450MW CCPP with existing emission of the power station including the existing

146MW CCPP & 2x64MW steam plants. From this table, it is seen that the concentration levels at various distances are within the allowable limit of DoE. The actual concentration will be lesser since baseline concentration will be lesser due to retirement of the existing 146MW CCPP and 2x64MW steam units. However, addition of 150MW CCPP and additional 450MW CCPP may increase the concentration but still will be less than the present concentration.

Table – 6.6

NO_x concentration level at various distances from the plant

Downwind distance (Km)	Concentration of NO_x with dry low Nox burner μ g/m^3	Concentration of Nox with water inject method mg/m^3	Concentration of Nox with liquid fuel mg/m^3	Allowable limit of NO_x as per Bangladesh standard mg/m^3
1	2	3	4	5
0.10	41.17	41.17	41.17	100
0.20	41.17	41.17	41.17	100
0.50	41.86	43.10	46.96	100
1.0	46.00	54.75	81.94	100
1.1347	46.21	55.17	83.17	100
2.0	44.59	50.68	69.69	100
5.0	42.04	43.57	48.38	100
10.0	41.43	41.89	43.33	100
20.0	41.24	41.37	41.78	100

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 with its present quantum will not have much impact on global warming.

Carbon dioxides emission of Ashuganj 450 MW CCCP (South) is given below.

Carbon Dioxide Emission of 450MW CCPP

Based on conversion efficiencies, gas composition and other information collected from the manufacturers of gas turbines and combined cycle power plants in the capacity range, carbon dioxide emissions were calculated. The maximum amount of CO_2 to be released at maximum combustion/generation rate by the CC 450MW proposed power plant is shown below:

Maximum C.C capacity	-	446.56MW
Maximum G.T. capacity	-	ISO 334MW, Field 296MW
Heat rate	-	7.145SCF/kWh
Maximum quantity of natural gas consumed per hour @ 296MW (Field condition)	-	2.894MMCF

Combustion Products per Second of 334MW G.T. (ISO)

(2.0896 Mole gas + 4.492 Mole O_2 + 16.8997 Mole N_2 27.313 Mole Air + 2.802 Mole H_2O =2.29984 Mole CO_2 + 4.3888 Mole H_2O + 16.9 Mole N_2 + 27.312 Mole Air + 2.5964 Mole H_2O) per sec.

1. CO_2 emission/sec

   2.29984 Mole per second = 2.2998×44 lb/sec

2. CO_2 emission/hour

   Emission per hour ≈ 2.2998×44×3600
   = 364288.32 lb
   = 165285 kg

3. Energy generated per hour by CCPP rated 446.56MW (at field condition) = 446.560 kWh

4. **CO_2 emission/kWh** = $\frac{165285 kg/hr}{446560 kWh/hr}$
   = 0.371kg per kWh

Particulate

Since natural gas available in Bangladesh would be used as fuel for the proposed combined cycle power plant and the gas contains literally no dust, there shall be no significant concentration of particulate in the exhaust gas. Any particulate in the exhaust gases is likely to be dust drawn in through the air intakes. Proper filters and appropriate maintenance of the filters on the air intake will prevent this problem and will be carried out as part of the maintenance schedule. Stack sampling of GT is proposed on an annual frequency.

Mitigation Measures

The proposed power plant would be of latest design with an optimum efficiency of combined cycle. Hence there will be less CO_2 emission per unit of energy (kWh) generated.

Natural gas would be used as fuel and gas available in Bangladesh contains little amount of impurities (0.276 per cent nitrogen). There would be literally no SO_2 emission. NO_x will be mostly inhibited by appropriate measure in the system design

Residual Impacts

Residual impacts of air pollution can be reduced to a minimum level provided the suggested mitigation measures are undertaken and properly implemented.

6.2.3.2 Water pollution

6.2.3.2.1 Source of Impacts

Both the construction and the operation phases of the power plant require raw water supplies. The typical water requirements for a combined cycle power plant are:

- Fuel system - operating water for fuel oil separators
- Lubricating oils system - operating water for lubricating oils separators
- Cooling water - make-up water for boiler and for condenser cooling in steam turbine unit of CC power plant
- Heat recovery system - make-up water for steam and for hot water circuits
- Oily water treatment system - back-flushing water for treatment unit
- Service water - plant washing water, toilets and showers
- Air Inlet System - flushing water for air filter aleaning

Water will be drawn from the Meghna river, adequate mixing zone will be employed ensuring that temperature stratification does not result from the power plant, thus reducing / preventing negative impacts on the river water.

6.2.3.2.2 Impact on River Water by Proposed Combined Cycle Power Plant

From the steam rate of the 150MW ST of Ashuganj 450MW CCPP South and assumed rise of cooling water temperature by $7^{O}C$, it was calculated that about 23,000 tons of cooling water per hour or about 6.4m3(ton)/sec flow is required for once through cooling. The total water withdrawal by the existing and new plants amount to 56.4m3/sec. the same volume will be discharged back to the river with $7^{O}C$ rise of temp i.e. at $37.54^{O}C$. The minimum river discharge of 2050m3 /sec at plant location is quite adequate for this. The temperature of river water was recorded to be $30^{O}C$. But the temp of river water of intake will $30.54^{O}C$ due to discharge of proposed 150MW CCPP 250m upstream of the intake.

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 2 (two) 450MW CCPPs and impact of $56.4m^3$ water discharged per second at $37.54^{o}C$ 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 be $34.04^{O}C$. At the long and down the river the temperature will reduce to almost initial river water temperature.

In aquatic system, both the present and proposed industrial developments will also be considered. Where possible, the positioning of such developments will be taken into account when establishing the placement of the inlet and outlet systems from the proposed project.

Surface and ground water protection systems will also be included in the design of the power plant. Adequate measures will be employed in order to prevent leakage of substances such as fuel oil and lubricants. All storage will be sealed and dyked appropriately.

Results of preliminary analysis furnished in the following table (Table 6.5) shows that there is a change in temperature of river water due to discharge of condenser outlet water into the river. Condenser outlet water mixed with river water; initially a turbulence mixing occurs, then affected by the flow rate of river. Assuming complete mixing occurring with equal volume of water due to initial turbulence, the resultant temperature would be $34.04^{0}C$. This temperature

is 4.84°C higher than that of the river water temp (30°C) will be achieved actually down a long length of the river without any significant temp change.

Table – 6.5
Heat Analysis of Cooling Water Discharge

$H = \rho C_p V T$

Where
V=Qt
Q=flow, m^3/sec
T= temperature
H= Heat
ρ density
C_p = specific heat
t=time=1 sec

Year	River flow (m^3/s)	Withdrawal of water by other units m^3/sec	Withdrawal for condenser of this units/m^3/sec	Total withdrawal	River water Temp at the intake OCC	Condenser outlet °C	Heat of water to be withdrawn 127.64KJ/kg x Col 5 (10^3 KJ)	Condenser water Heat 156.89KJ/kg x Col 4 (10^3KJ)	Heat of mixed water (Col 8 + Col 9) (10^3KJ)	Temp of equal volume Turbulence Mix (°C) (Col 5 + Col 6)/ 2	Temp of river water after complete mixing
1	2	3	4	5	6	7	8	9	10	11	12
1998	2050	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.13
2000	3197	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.09
2001	3135	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.09
2002	4448	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.06
2003	2938	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.09
2004	3742	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.07
2005	3658	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.08
2006	4230	50	6.67	56.67	30.54	37.54	7233	1,031.44	8264	34.04	30.06

In aquatic system, both the present and proposed industrial developments will also be considered. Where possible, the positioning of such developments will be taken into account when establishing the placement of the inlet and outlet systems from the proposed project.

Surface and ground water protection systems will also be included in the design of the power plant. Adequate measures will be employed in order to prevent leakage of substances such as fuel oil and lubricants. All storage will be sealed and dyked appropriately.

Mitigation Measures

Care will be taken in the design of water system for the CC 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 modeling will be required during detailed design stage to ascertain exact temperature of condenser outlet water mixing with the river water, so that other water users will not be affected.

Residual Impacts

The residual impacts are within the expected limits if above mitigation measures will be undertaken.

6.2.3.3 Noise pollution and vibration

Sources of Impacts

Significant level of noise and vibration would be generated from the gas turbine. “Noise and vibration” is an unwanted sound of an unacceptable intensity at a wrong time and wrong place. These pollutions are considered as one of the major dimensions that lead to the environmental degradation. These create psychological and physical effects on human health. It is difficult to assess and quantify the environmental degradation or discomfort caused by these nuisances. However, it includes auditory fatigue and reduces hearing capacity of the people working in the plant and living in the adjacent area. Noise levels depend on two major parameters – sound pressure and sound intensity. Since the new plant will be of modern design it will produce less sound and vibration. However, due course of time, when 150MW CCPP, 450MW CCPP & 450MW CCPP South will come into operation and the in efficient CCPP (56MW+34MW), 56MW GT & 2x64MW Steam Unit and all the rental power stations will be out of operation, the pollution level of sound and vibration will be much less than the existing figures.

The following components of the proposed plant will generate noise of various levels:

(i) Gas Turbine
(ii) Exhaust Gas System
(iii) Charge Air System

Mitigation Measures

The noise level at the power plant will be reduced by putting baffle type silencers in both inlet duct and exhaust duct to arrest noise due to flow of air and exhaust gases respectively. The noise due to running of the machine will be arrested by acoustic enclosures.

The noise level in the boundary limit of the power plant is expected to be around 65 dB (A) which is within the limit of Bangladesh Standard for Industrial Zone in Daytime (75 dBA) and also in night time (70 dBA). There are no other noises producing devices in the power plant. All these measures will keep the noise level within the prescribed permissible levels of noise for the country as shown in Table 6.6 below:

Table-6.6: Standard Values for Noise (DOE, 1997)

Area category	dBA (Day time)	dBA (Night time)
Calm Area	45	35
Residential Area	50	40
Mixed Area	60	50
Commercial	70	60
Industrial Area	75	70

Note:
1. Day time is from 0600 hrs in the morning to 1900 hrs. in the evening
2. Night time is from 2100 hrs in the night to 0600 hrs in the morning.
3. Calm area is the 100 meter radius within hospital or school or any government designated special areas.

It should be ensured that all generating equipment is noise suppressed. Tall trees are to be planted at the property line for noise attenuation particularly during operation stage. Plant foundation shall be designed to minimize vibration effect.

Residual Impacts

Residual impacts of noise pollution and vibration can be reduced to a minimum level provided the suggested mitigation measures are undertaken and properly implemented.

6.2.3.4 Lubricating oil

Source of Impacts

There will be continuous make-up of lubricating oil to the Gas Turbine. This will be supplied by engine driven pumps through lube oil coolers. A portion of the lube oil will be cleaned by means of centrifuge oil purifier and will be put back into engine oil pump. Samples of oil from engine system will be periodically taken for laboratory analysis to ensure quality of oil to acceptable specification. In case of oil quality deteriorating, the engine oil will be replaced with clean batch.

Mitigation Measures

The dirty oil from the engine will be collected in drums and proposed to be supplied to the prospective re-users in an environmental friendly manner. This oil is generally used in the brick kilns and has other secondary users. The project proponent mentioned that they would sell this waste oil to secondary users. As such there will be no waste oil discharge that can degrade the quality of soil, groundwater or river water.

Residual Impacts

There will be no residual impacts, as oil waste will not be discharged outside.

6.2.3.5 Plant waste water

Source of Impacts

The plant will be operated with full time staff people and a small quantity of sewage and domestic wastewater will be generated. Water will be used for general cleaning and garden watering purpose.

Mitigation Measures

The plant wastewater will be discharged into a small pit located at the plant site and used up for plant cleaning and garden purpose. Thus no wastewater will be discharged out of the plant premises. Septic tank with soak-pit will be installed to treat domestic sewage and wastewater.

Residual Impacts

The residual impacts will be very insignificant if the appropriate measures suggested above are implemented properly.

6.2.3.6 Solid waste

Source of Impacts

The proposed power plant will not generate any solid waste during the operational phase. However, the people working at the plant will produce some solid wastes such as paper, packaging materials and food wastes etc. All such solid waste would be non-toxic and does

not require any special disposal requirements. These materials could be transported to a designated site for final disposal in an environmentally sound manner.

Mitigation Measures

Valuable items of solid wastes would be separated at the point of generation and remaining portion would be disposed at a convenient point and transported safely to the designated disposal site. There are low lying areas surrounding the project site and the general solid wastes could be safely disposed of by transporting the wastes to the nearby designated site.

6.2.4 Other Mitigation Measures

6.2.4.1 Disaster management plan

The project authority will take necessary disaster management plan to protect the properties from water logging / flood etc. In this regard all construction works will be undertaken at a higher level taking the highest flood level into consideration.

6.2.4.2 Other safety provision

In addition to the above measures, the plant will have full provision for fire fighting and first aid medical services. The project will have provision in its recurring annual expenditure for maintaining facilities for safety measures during operational phase.

6.3 POSITIVE IMPACTS AND ENHANCEMENT

6.3.1 During Construction Phase

The project will create job opportunities during its construction phase for a good number of skilled and semi-skilled local labors. In addition to this, the area will be more commercially developed. The land value will also be increased. Local people will be encouraged to get them involved in employment and other commercial activities.

6.3.2 During Operation Phase

The most significant positive impacts of the proposed power plant is that it will improve the reliability and stability of the power supply system in order to meet the power shortage in the country, particularly, in the capital and adjoining areas including Ashuganj. It would be possible to supply the electricity during peak demand. The project will play special role in implementing the economic development in the region. The other important positive impact of the proposed plant would be the employment of personnel for the operation of the plant. The project will involve local human resources.

Apart from these positive impacts mentioned above, other beneficial impacts include benefit to the local transport business, local economy because of employment, community development etc.

CHAPTER – 7
ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

7.0 Environmental Management and Monitoring Plan

7.1 Introduction

During new construction of Ashuganj 450MW CCPP South, effective site management is required to ensure that APSCL delivers on sustainable development and that works are conducted in a manner that safeguards country's environment. A specific EMP will be prepared by the Contractor and submitted to APSCL for review and approval prior to commencement of works. A number of mitigation measures will be the responsibility of the Contractor who will be required to identify the best means for mitigating an impact as per the EMP, therefore the costs will be borne by the Contractor as part of the construction cost.

Environmental monitoring is a very important aspect during construction and operation stages of the project to safeguard the ecosystem. An environmental monitoring program for the construction and operation stages of the Project will be undertaken to monitor environmental impacts of the Project, to determine conditions requiring remedial measures and to assess compliance with national environmental safeguard policies.

The contractor will be responsible in implementing the monitoring program and preparation of monthly progress reports regarding implementation. The Project Consultant will undertake the environmental monitoring program such as water quality, air quality and noise level during the construction stage and will also monitor compliance of the contractor with the implementation of required mitigation measures and contract provisions pertaining to environmental aspects. During operation, the APSCL staff or consultant will implement the monitoring plan.

7.2 Mitigation Measures

The Chapter 6 indicates environmental impacts as a result of the proposed intervention. As part of the aims and objectives of environmental assessment it is necessary to identify mitigation measures to avoid, minimize or ameliorate these negative impacts. The costs of this mitigation are to be included in the project financial and economic analysis.

7.3 Land acquisition and loss of Immovable Assets

The proposed project will not involve any land acquisition, loss of trees will be a minimum and new species will be planted at suitable locations around the plant.

7.4 Environmental Monitoring Requirements

There will be a requirement for environmental monitoring, particularly during post construction phase of the project. These will include water quality, air quality and noise monitoring.

7.4.1 Construction Management

There will need to be an environmental management committee for addressing the direct impacts of construction. This work should cover contractors operations with the aim of minimizing disruption.

7.4.2 Security and Site Safety

Ensure site safety on the construction site by adopting following measures:

- Ensuring additional security of the area by providing adequate fencing, deploying security force and lighting
- Screening and restricting access to camps and worksites
- Setting up additional effective police patrolling of the area
- Establish emergency medical arrangements.

CHAPTER –8
PUBLIC CONSULTATION

8.1 Public Consultation

8.1.1 Information Dissemination Process

On behalf of APSCL, the consultant arranged several consultation meetings with the local stakeholders for information dissemination and community participation with the concerned NGO, and other relevant persons. The consultant and their employed enumerators investigated all the relevant matters regarding the project by arranging meetings, and group discussions for people's awareness. Information campaigns were carried out in presence of the clients of the project. The consultant addressed in a Focus Group Meeting in the community. In these meetings all classes of public including businessmen, farmers, school teachers, religious leaders, NGO and Members and Chairman of the Union Council were present. It is important to note that the project will be constructed in the existing APSCL's land. No acquisition of land is needed for the proposed project. 4 to 6 new tower is needed to be installed for transmission of the power to the national grid line. For which no permanent acquisition of land and consequent resettlement will be required. Some noise, air pollution may occur, but it will be minimized using proper methods. The consultant has carefully studied all types of impacts in the locality likely to be caused by the proposed plant. Information dissemination and consultation will continue throughout the project implementation period.

8.1.2 Key Stakeholder's View

Consultation with the key stakeholders was held at the time of field survey. It is a continuous process till the completion of the project. During the survey period, school teachers, village leaders and Members and Chairman of the local bodies and others were contacted in-groups and individually with particular importance to female headed households. The concerns and suggestions are given below.

Local people at Ashuganj thinks that

1. Sound pollution should be restricted;

2. He claims that plant authority should arrange meeting with local public representative before finalization of detailed lay out plan with the concerned person of power plant.

3. Height of the chimney should be 50 meter.

4. Water temperature is to be maintained minimum but the plant authority repeatedly confirms that it should not exceed DoE (Department of Environment) regulation and in no way hampers the environment.

8.1.3 Summary of Consultation

Consultations with the key stakeholders which is a continuous process were held at the time of field survey. Schoolteachers, village leaders and local government's Members and Chairman were contacted in group and individually. Some important highlights of public consultation are given below:

Summary of focus Group Discussion (FGD):

- Local people should be given employment opportunity during construction of the project.
- Electricity facilities to be extended to the villagers
- Local unemployed youths to be given training and employment opportunity as far as practicable.

Summary Report of Key Informant Interview (KII):

- To take care of the public safety as well as to provide security in critical locations. In order to remove any fear of explosion, the authority should exercise adequate care in construction & maintenance work, particularly of gas pipe line.
- Works should be completed as quickly as possible in order to reduce the constructional impacts.
- The electricity should be made available to the people at the earliest possible opportunity.
- To ensure quality of material & best workmanship for safe and durable power plant and to provide uninterrupted supply to the consumers.
- Prompt placement of fund by the authority for quick completion of the plant.
- The executing agency should follow all rules, regulations and standards in the construction of the project.
- Care should be taken for ensuring the least possible damage to local infrastructure viz. roads & structures during construction of the project including gas pipe line.
- Contingency plan should be taken to meet any eventual accident.

8.2 Suggestion from the Local People

(a) Local people urged to accommodate in all sorts of employment opportunity both temporary and permanent.

(b) Facilitate stable electricity connection for the local area

(c) Noise pollution should be avoided.

8.2.1 Resettlement

The project does not need any resettlement as no permanent acquisition of land is envisaged. However, there are improvised structures and abandoned building at the site of the proposed project. These will be removed when the construction of the Power Plant will start.

The proposed project is unlikely to affect any fishery in the AoI. Overall, socio economic condition of the common people is expected to improve.

CHAPTER - 9
CONCLUSIONS AND RECOMMENDATIONS

9.1 General

There is acute shortage of generation capacity in the country and addition of generation capacity is, therefore, considered essential to cope with the consumers' demand and to provide reliable power in and around Ashugnaj and Bangladesh as a whole.

As power projects are identified as having the potential for environmental impact, the Bangladesh Department of the Environment (DoE) has categorized them as being the "Red Category" of industrial processes. As such, an Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) are required. However, the Director General of DoE has exempted IEE and allowed the project proponent to go for EIA for which the project proponent prepared this report through AEL.

9.2 Conclusions

The EIA has identified a range of potential impacts and determined suitable mitigation measures together with a monitoring program. The potential negative environmental impacts associated with the construction activities are relatively minor in comparison to the significant environmental and economic benefits resulting from project operation. Implementation of the proposed mitigation measures and the monitoring program will reduce the impacts to significant levels.

During construction, the contractor will implement the mitigation measures identified in the EIA, while project consultants will conduct regular monitoring to ensure contractor's compliance with applicable provisions of the EMP. The project consultant will also assist the APSCL in preparing contractual documents so that bidding documents; bills of quantity and other contractual obligations of the contractor clearly identify environmental responsibilities and describe penalties for non-compliance. The local communities expressed support for immediate implementation of the project, during the consultations as they clearly realized the benefit of the project during the consultation.

Finally, the Project will result in positive environmental and economic beneficial impacts and will have minor negative impacts during construction period which will be carefully monitored and adequately mitigated. The completion of this EIA fully meets the GoB standards. After completion of the project, a post project evaluation would be useful for sustainability and ensuring environmental safeguards of the project.

9.3 Recommendations

Based on the environmental assessment (EIA) conducted for the project following recommendations is suggested:

Implementation of the proposed Ashuganj 450MW CCPP South project should go ahead as soon as possible considering the environmental Acts/Rules of the Government of Bangladesh

As stated in the foregoing, it can be safely said that the environmental impacts of the proposed Ashuganj 450 MW Combined Cycle Power Plant South at APSCL's premises will be minimized to an acceptable level in order to meet the Bangladesh Environmental Standards.

Further socio-economic benefits derived from the project implementation are expected to be high. It may be stated that there is no need for permanent acquisition of land for project implementation and that no resettlement will be required.

In consideration of the foregoing findings, the proposed Ashugan 450 MW Combined Cycle Power Plant South at Ashuganj may be accepted for implementation after DoE issues the environmental clearance.