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**Environmental Impact Assessment (EIA)**  
of  
**15 MW HFO Fired Power Plant**  
of  
**Desh Energy Hatiya Power Company Ltd**  
at  
**Hatiya, Noakhali, Bangladesh**

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## **ABBREVIATION**

AECL	Adroit Environment Consultants Limited
Aoi	Area of Influence
ASA	Action for Social Advancement
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
BPDB	Bangladesh Power Development Board
BRAC	Bangladesh Rural Advancement Committee
BWDB	Bangladesh Water Development Board
CARE	Cooperative for Assistance and Relief Everywhere
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
COD	Chemical Oxygen Demand
DMP	Disaster Management Plan
DO	Dissolve Oxygen
DOE	Department of Environment
ECA	Environment Conservation Act 1995
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules 1997
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
GOB	Government of Bangladesh

GRC	Grievance Redress Committee
HFO	Heavy Fuel Oil
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
LC	Least Concern
MOEFCC	Ministry of Environment, Forest and Climate Change
MOWR	Ministry of Water Resources
NEMAP	National Environmental Management Action Plan
NGO	Non-Government Organization
NOx	Oxides of Nitrogen
PAPs	Project Affected Persons
PM <sub>2.5</sub>	Particulate Matter < 2.5µm
PM <sub>10</sub>	Particulate Matter < 10µm
RIC	Resource Integration Centre
SEISs	Significant Environmental and Social Impacts
SO <sub>2</sub>	Oxides of Sulfur
SPARRO	Bangladesh Space Research and Remote Sensing Organization
SPM	Suspended Particulate Matter
TDS	Total Dissolve Solid
TOR	Terms of Reference
TSS	Total Suspended Solids
WARPO	Water Resources Planning Organization

## GLOSSARY

**Adverse impact:** An impact that is considered undesirable.

**Ambient air:** Surrounding air.

**Aquatic:** Growing or living in or near water.

**Bangla:** Bengali language.

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

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

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

**Contractor:** The legal entity that is party to and performs a works contract, the other party to the contract being the "Procuring Entity."

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Literacy:** It denotes ability to write a letter in any language. Literacy status assessment is made for population 7 years and over.

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

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

**Mahalla:** Lowest urban geographic unit having identifiable boundaries.

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

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

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

**Taka:** Unit of Bangladeshi currency.

**Terrestrial:** Living on land like forests, grasslands, deserts, shorelines, and wetlands.

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

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

**Village:** Lowest rural geographic unit either equivalent to a mauza or part of a mauza.

**Ward:** Smallest administrative urban geographic unit comprising of mahallas and having ward council institution.

**Zila:** Bengali word of district.

## **EXECUTIVE SUMMERY**

### **1. INTRODUCTION**

Electricity plays the most basic role in the economic growth through sustainable structure as well as poverty eradication and security of any country. Reliable electricity supply is a vital issue for the world today. Future economic growth crucially depends on the long-term availability of electricity, which are affordable, available and environmentally friendly. The present government's goal is to guarantee continuous and quality power supply for all by 2021 through change in generation, transmission and distribution methods.

The biggest challenge for Bangladesh's economic growth is to ensure uninterrupted electricity supply to reduce the demand- supply gap for the growing industrial, agricultural and household needs. Because of the critical nature, the Government of Bangladesh has given highest priority to the power sector to enhance the generation capacity.

Hatiya Island in Bangladesh is an off grid remote locality. Despite being only twenty kilometers away from shore, the island lacks any electricity grid connection. The government has taken a move to install a 15-megawatt (MW) HFO based power plant in Hatiya island. The Power Division under the Ministry of Power, Energy and Mineral Resources has already initiated work and selected a sponsor, Desh Energy Hatiya Power Company Ltd. to do the job.

In this regard, **Desh Energy Hatiya Power Company Ltd** would like to install a 15 MW HFO Fired Power Plant at Hatiya, Noakhali, Bangladesh from which the state-owned Bangladesh Power Development Board (BPDB) will purchase electricity for over the next 15 years. It will supply electricity in order to fulfill the demand of electricity for various purposes. This report represents the results of Environmental Impact Assessment (EIA) of **15MW HFO Fired Power Plant Desh Energy Hatiya Power Company Ltd** at Hatiya, Noakhali, Bangladesh.

### **2. LEGISLATIVE REQUIREMENTS**

The environmental classifications for industrial projects in Bangladesh are based on "inclusion lists" given in the ECR97 with "**RED**" being the highest category. As per Environment Conservation Rules (ECR) 1997, the proposed power plant has been categorized as **Red Category**. The prevailing national policies, strategies, laws, rules, action plans are briefly discussed in this chapter.

### **3. DESCRIPTIONS OF THE PROJECT**

Desh Energy Hatiya Power Company Ltd. is going to set up the 15 MW power plant at Hatiya Island from which the state-owned Bangladesh Power Development Board (BPDB) will purchase electricity for over the next 15 years.

The Facility will have a net electric power generating capacity of 15MW phase wise. Net dependable capacity and Net Energy Output from the Facility will be sold under the Power Purchase Agreement (PPA). The proposed power plant is Reciprocating Engine based power plant. The engines are capable

of running at rated output continuously. Operating plant factor is 80% and Heat rate is 8950 KJ/kWh. There is no settlement within the project site as the project will be constructed on the BPDB's owned land allotted to Desh Energy Hatiya Power Company Ltd.

**Table 1: The basic data of Desh Energy Hatiya Power Company Ltd.**

<b>1. Name of the Project</b>	15 MW HFO Fired Power Plant
<b>2. Project Proponent</b>	Desh Energy Hatiya Power Company Ltd.
<b>3. Chairman</b>	Rubana Huq
<b>4. Project Location</b>	Hatiya island, Noakhali, Bangladesh
<b>5. Land of the project</b>	BPDB's Own Land
<b>6. Fuel Type</b>	"HFO" Heavy Fuel Oil
<b>7. Plant Type</b>	Reciprocating Engine Based Power Plant Project
<b>8. Net Plant Capacity</b>	15 MW (Phase wise)
<b>9. Total Number of Engine</b>	6
<b>10. Project Cost</b>	BDT 224 crore
<b>11. Total Land Area</b>	5.56 (plant) + 0.857 (Fuel receiving station) = 6.417 Acres
<b>12. HFO source and quality</b>	Import or BPC
<b>13. Fuel quantity</b>	72.5MT/day HFO
<b>14. Water Requirement</b>	Operational water demand = 3.2 m <sup>3</sup> /h Domestic water usage = 0.8 m <sup>3</sup> /h Total Water demand = 4.0 m <sup>3</sup> /hour
<b>15. Source of Water</b>	Ground water
<b>16. Power Evacuation System</b>	The electric power to be generated by the facility will be evacuated through BPDB's 33/11 kV substation to be constructed at BPDB's own land adjacent to the Harendra Road Bazar by BPDB. Evacuation voltage shall be 33 kV.

### Location of the Project

The proposed Power Plant is located at Harendra Road Bazar, Rehania within Surjomukhi Mouza; 9 no. Burirchar Union, Hatiya Upazila, Noakhali. A land of approximately 5.56 (Power Plant Area 5.34 + Road area 0.22) acres as power plant area with access road of BPDB's land adjacent to Harendra Road Bazar, Mouza: Surjomukhi, Thana: Hatiya, Zilla: Noakhali (the site) and a land of approximately 0.857 (Property boundary 0.78 + Access Road 0.077) acres as receiving station with access road of BPDB's Land of Tamuruddin union, Mouza: Chor Tamuruddin, Thana: Hatiya, Zilla: Noakhali (the site) totaling of 6.417 (5.56 + 0.857) acres has been allotted to Desh Energy Hatiya Power Company Ltd. by BPDB.

The project site is located about 5.80 km away (South) from main CBD (Ochkhali) of Hatiya Upazila, about 61.5 km away (South) from Noakhali District and 204 km from Dhaka. Beside Nolchira Ghat & Tamuruddin Ferry ghat are respectively 14.2 km and 9.35 km away from project site. Hatiya is surrounded by Meghna River (North & West Side) and Bay of Bengal (south & East Side). Distance between Project site and Meghna River (Southern Part) & Bay of Bengal (Eastern Part) are about 14.3 km and 6.4 km respectively.

On the other hand, Receiving Station is located at Atharo Beki, 7 no. Tamuruddin Union, Hatiya Upazila, Noakhali. Receiving Station is about 8.5 km (North-West) away from main project site. This station is respectively about 1 km & 10.2 km away from Tamuruddin Ferry Ghat & Nolchira Ghat. Project location map is shown in **Figure 1** and satellite map of the Project site are shown in **Figure 2 & Figure 3**.

### **Present Site Condition**

The land development work of project site is completed. The land development work has been completed by sand filling. There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. There is no industry around the project area except one saw mill (west side approx. 250m from project site) as there is no electricity connection in the vicinity of the project area. Normally solar panel is used for electric source.

### **Power Generation Process**

Each generating unit will have 3.030MW of generation capacity. The main fuel for this project is “HFO” i.e., Heavy Fuel Oil and it’s a Reciprocating Engine Based Power Plant Project. The proponent may procure HFO from Bangladesh petroleum Corporation (BPC) or import HFO from plants by own arrangement. HFO will be transported through river route by Lighter vessel. DFO (Diesel Fuel Oil) will be used as Auxiliary fuel. Total water demand is 4.0 m<sup>3</sup>/hour during operation phase. The layout of power plant area and Fuel receiving station area are shown in **Figure 4** and **Figure 5**.

HFO received from supplier goes through a treatment process for the separation of those impurities. The fuel will be continuously heated to maintain lower density for smooth flow of fuel and treatment process. The Fuel Oil Treatment Plant removes water and solids from the Heavy fuel oil. During the treatment process of fuel, significant amount of sludge will be produced which will be sold to DoE approved Vendor. Oily water from steam heated vapor chamber, engine hall area, storage tank area, FOTP area and other processing area will be discharged through oily water drain line and will be vaporized in steam heater. During the operation of the power plant, oily water sludge, Lube oil sludge, spent Lube Oil and filters will be generated which will also be sold to the DoE approved Vendor.

Air compressor is used to compress air for turning on the engine and for better combustion of fuel. It elevates the efficiency of engine from 30% to 45%. Lube Oil is fed to the engine for smooth running and after that it is sent to LO separator for purifying and again purified lube oil is sent to Engine sump. When the engine is running then exhaust gas is generated from the engine which is used in exhaust gas boiler (EGB) to boil the water. The EGB is used to heat the fuel in Buffer tank as well as the entire pipeline of the fuel system. Exhaust gas temperature of engine is 200°C and mass flow will be 21.4 ton/hour. Gas outlet temperature of the boiler is 180°C. Coolants are used to lower the temperature of engine. Radiator/ cooling tower is used to cool the coolants of Engine. The radiator transfers the heat from the Cooling fluid (Cooling water) inside to the air outside, thereby cooling the fluid, which in turn cools the engine. Engines produce mechanical energy, while generator/alternator turn mechanical energy into electrical energy. Generating Set, Engine, fuel system, cooling water system etc. project detail is discussed in **Chapter 3**.

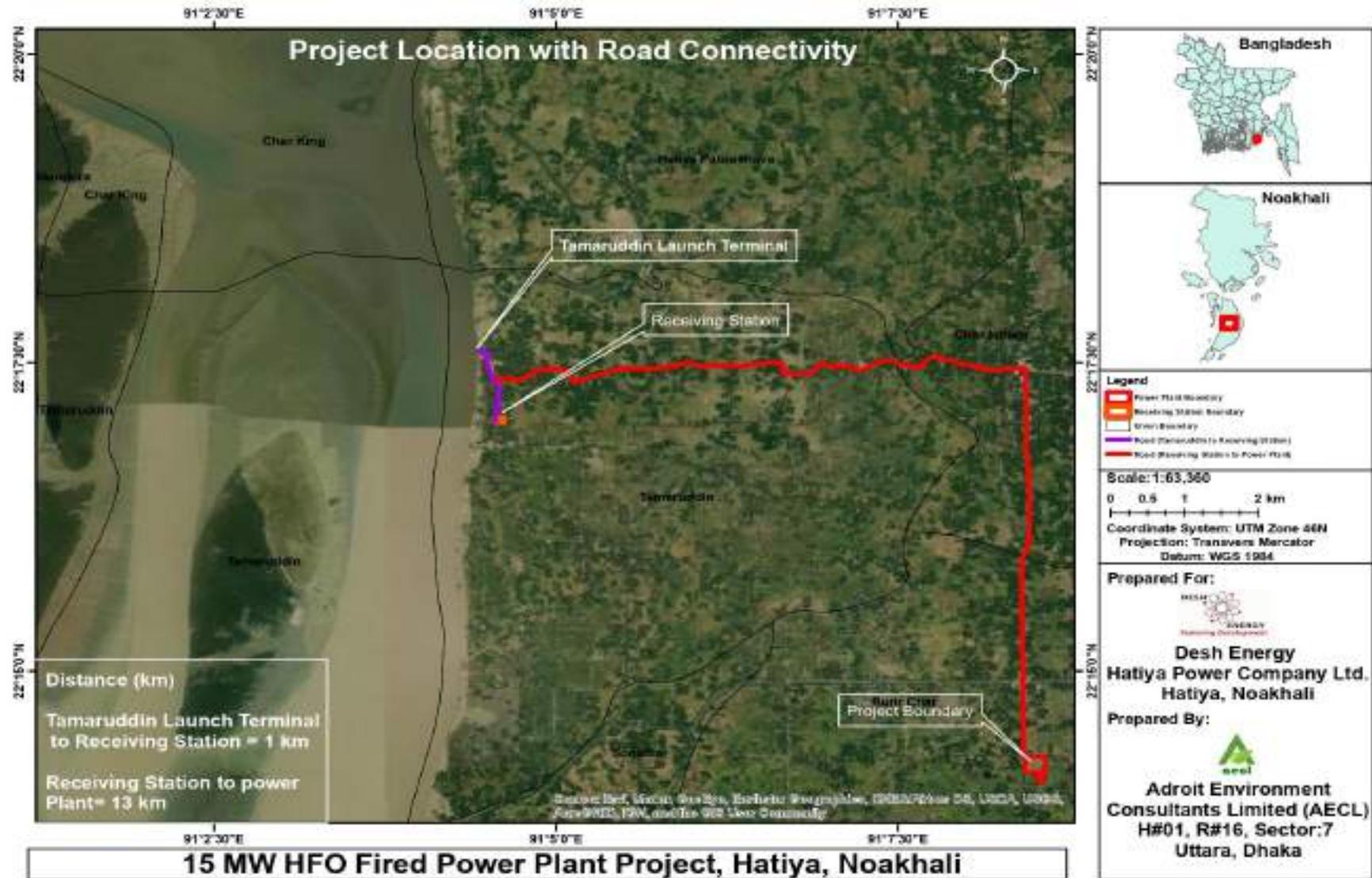


Figure 1: Project location map

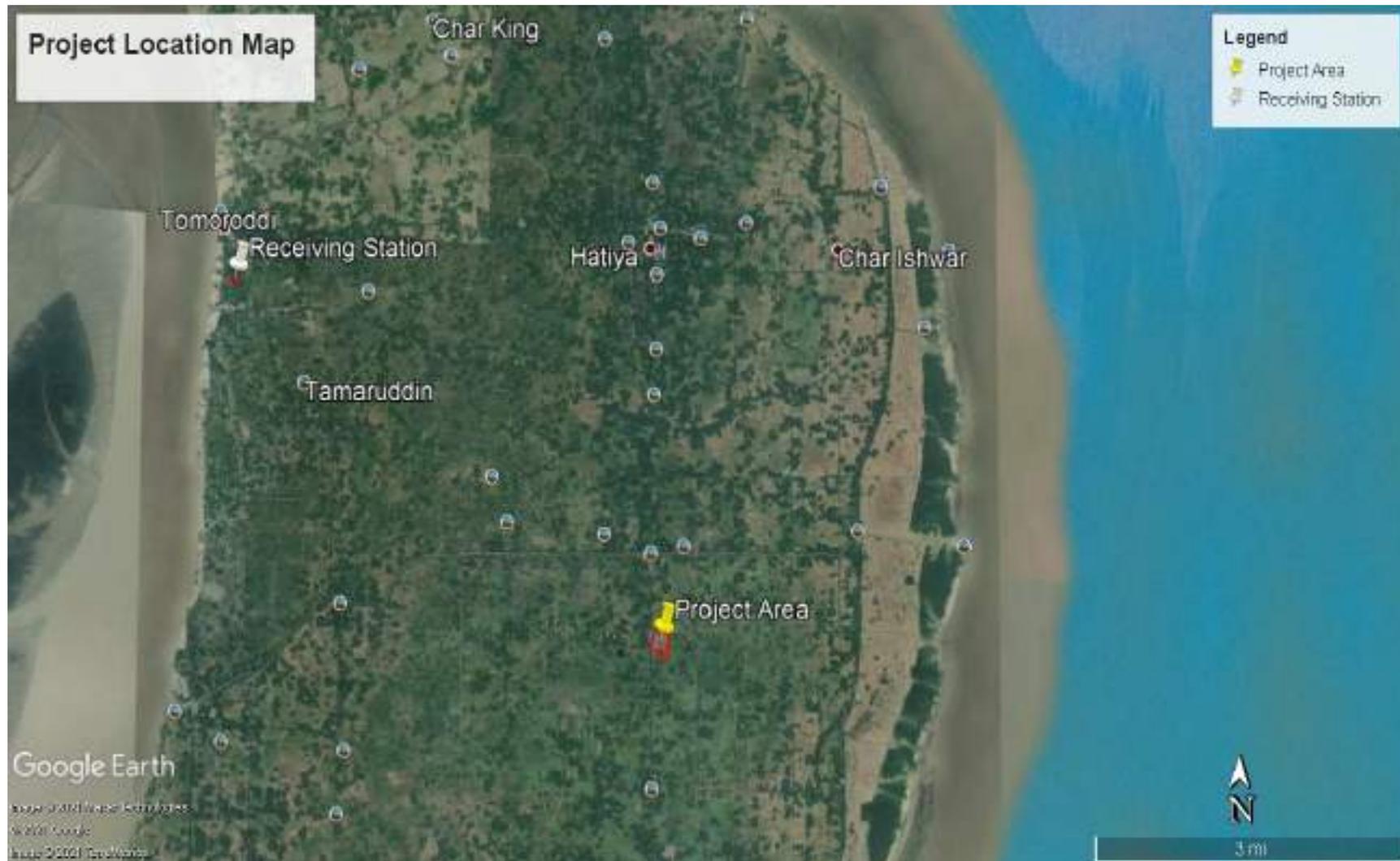


Figure 2: Satellite map of the Project site



Figure 3: Satellite map of the Project site (zoom in view)



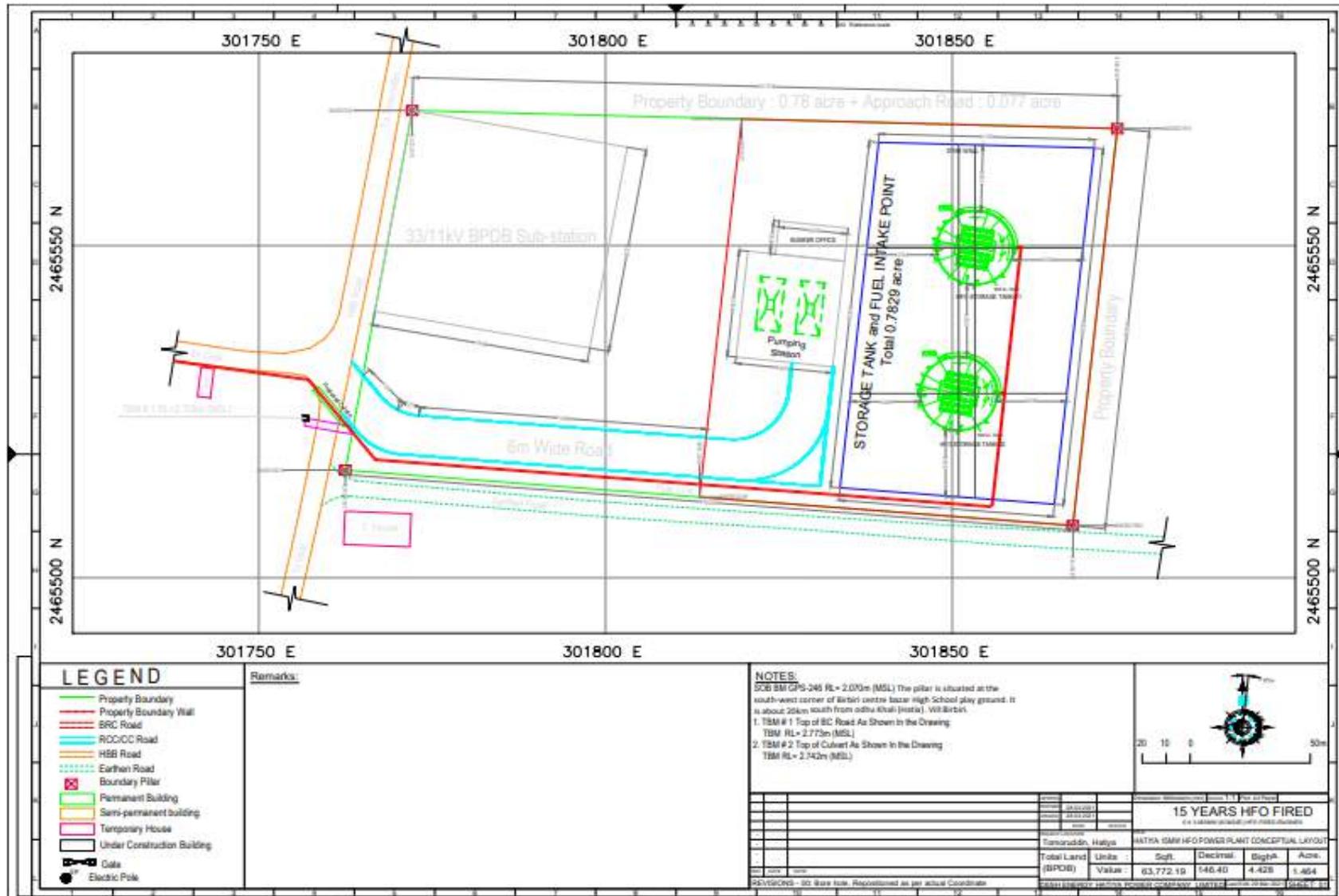


Figure 5: Layout of Fuel receiving station area

#### **4. BASELINE ENVIRONMENT**

Baseline environment is concerned with existing physical, chemical and biological conditions of the area where the project is going to be set up. The surface water, ground water, soil quality, ambient air quality and noise level have been analyzed to evaluate the primary baseline of the area. Location of the monitoring is given in **Figure 6**.

##### **❖ Climate**

Bangladesh is located in the tropical monsoon region, and its climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. January is the coolest month, and April is the warmest. Most places receive more than 1,525 mm of rain a year, and areas near the hills receive 5,080 mm per year. Most rains occur during the monsoon (June-September) and a very little occurs in winter (November-February). According to the Climate map, the project area falls in **South-eastern zone (A)**.

According to Bangladesh Meteorological Department, the monthly average Dry Bulb Temperature (maximum) at Hatiya is 29.9°C in May, 2019. Average Monthly Relative Humidity (maximum) for an average year is recorded as 94 % in July, 2017. The maximum Monthly Average Rainfall is recorded as 1170 mm in July, 2017.

##### **❖ Ambient Air Quality:**

Air monitoring has been conducted at four different locations (24 Hour Basis). The baseline levels for criteria pollutants i.e., PM<sub>2.5</sub>, PM<sub>10</sub>, SPM, SO<sub>2</sub>, NO<sub>2</sub> and SO<sub>2</sub> are compliant with DoE standard. Among the four locations, the maximum values of PM<sub>2.5</sub>, PM<sub>10</sub>, SPM, SO<sub>2</sub>, NO<sub>x</sub>, CO were found to be 29.47µg/m<sup>3</sup> (location 2), 71.62µg/m<sup>3</sup> (location 2), 102.23 µg/m<sup>3</sup> (location 2), 18.71µg/m<sup>3</sup> (location 4), 28.13 µg/m<sup>3</sup> (location 4) and 3 ppm (location 3) respectively. These maximum values are well within the permissible limits of the DOE and IFC standards.

##### **❖ Ambient Noise:**

The ambient noise level data were collected from different sides (Five locations) of the project. The highest noise level of the five locations was found in the 1<sup>st</sup> location at 35.1 (LAeq) dBA (Day), which is within the permissible limits of the DOE standards.

##### **❖ Soil**

Most of the area of Bangladesh is a vast, low-lying alluvial plain, sloping gently to the south and southeast. According to Bangladesh Agricultural research council's Agro-Ecological Zoning map [**Figure 4.27 (a)**], the project area falls in Young Meghna Estuarine Floodplain. This region occupies young alluvial land in and adjoining the Meghna estuary. The major soils are grey to olive, deep calcareous silt loam and silty clay loams, and are stratified either throughout or at shallow depth. Calcareous alluvium and non-calcareous grey floodplain soils are the dominant general soil types. Topsoils and subsoils of the area are mildly alkaline. General fertility is medium but low in N and organic matter.

❖ **Surface Water Quality:**

The primary data for surface water quality parameters was collected from two different locations and the quality of the water has been analyzed and found satisfactory.

❖ **Groundwater Quality:**

To determine quality of ground water, water sample was collected from a nearby tube well and analyzed for different parameters. The result shows that all the parameters remain within the allowable limit of drinking water value as per as Environmental Quality Standards for Bangladesh.

❖ **Traffic Study**

Traffic volume around the project site has been studied on 10<sup>th</sup> September. The traffic volume counts have been recorded continuously for 24 hours to assess the peak hour traffic and traffic composition. The details of the traffic survey are described in Section 4.9.

❖ **Seismicity:**

On the basis of distribution of earthquake epicenters and morpho-tectonic behavior of different tectonic blocks Bangladesh has been divided into three generalized seismic zones. This essentially means that Zone I is the most severe and Zone III is the least severe in seismic hazard. According to the Earthquake Zoning Map of Bangladesh (2017), the project area falls in seismic **Zone II**.

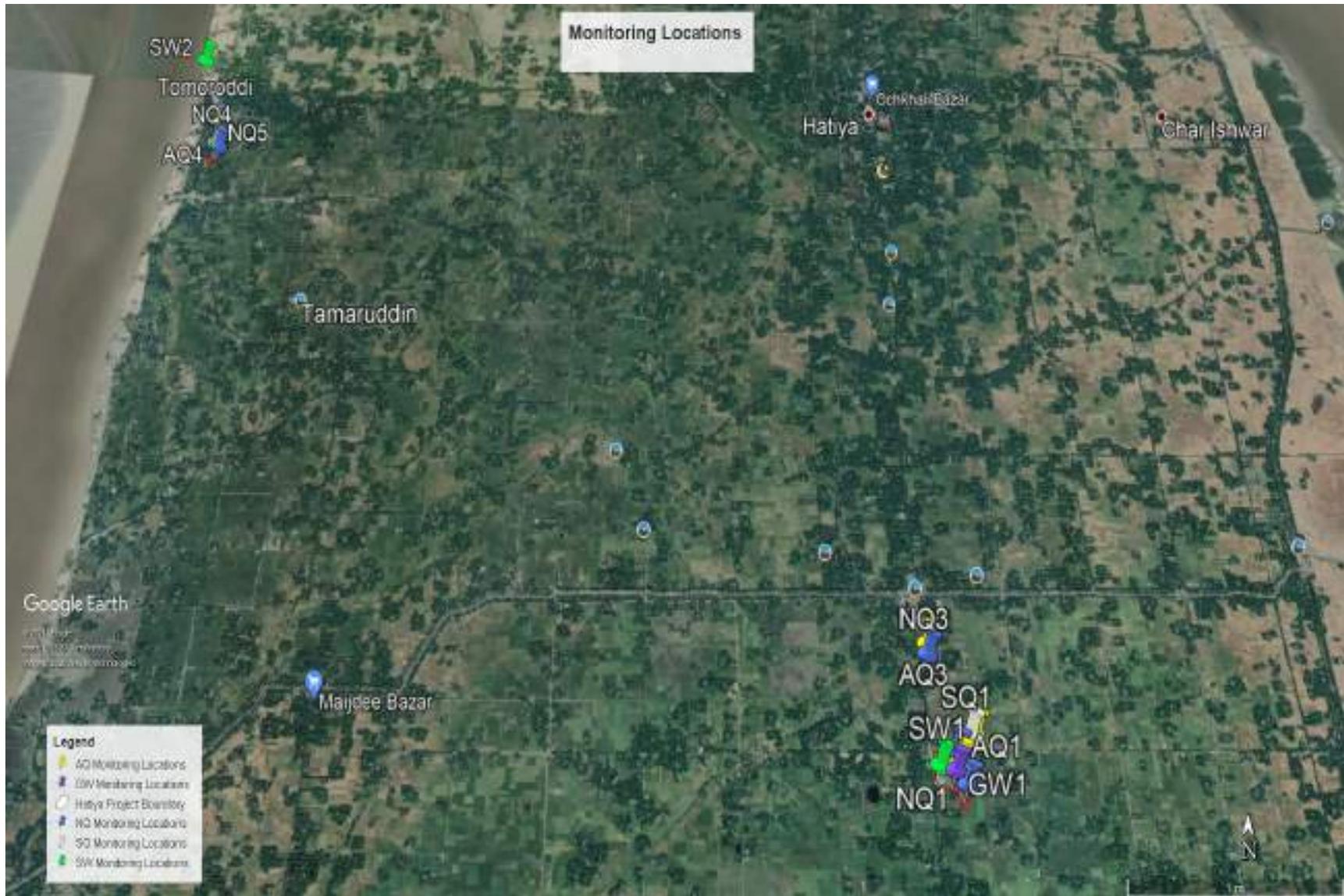


Figure 6: Monitoring Location

❖ **Socioeconomic Baseline:**

The Proposed Power Plant is located in Hatiya upazila, Noakhali district which further comes under Chittagong Division. Noakhali is a district in South-eastern Bangladesh. It is situated at the fringe of the Bay of Bengal.

Hatiya is the largest upazila of Noakhali; occupies an area of 1507.35 sq. km. It is located between 22°07' and 22°35' north latitudes and between 90°56' and 91°11' east longitudes. The upazila is bounded on the north by Noakhali Sadar, east and South by the Bay of Bengal and on the west by Monpura upazila of Bhola zila.

**Table 2: Demographic Characteristics of the Hatiya Upazila**

Upazila	Hatiya
Total Area (Sq. km)	1507.35
Total Household	91013
Total population	4,52,463
Male	2,23,853
Female	2,28,610
Average Household	4.98
Literacy rate (%)	34.2
Sex ratio (M/F)	98
Population Density (Per Sq. km)	300
Municipality	1
Union	11
Mouza	44
Village	62
Ward	9
Mahalla	23

(District Statistics 2011, Noakhali)

❖ **Terrestrial Ecology & Aquatic Ecology (flora & fauna)**

During the field visit on and from 7<sup>th</sup> – 11<sup>th</sup> September, 2021, different kinds of flora such as Khejur (*Phoenix sylvestris*), Papaya (*Carica papaya*), Kachu (*Colocasia esculenta*), Bamboo (*Bambusa bambus*), Palm Tree (*Borassus flabellifer*), Casuarina (*Casuarina equisetifolia*), Coconut (*Cocos nucifera*), Kachuripana (*Eichhornia crassipes*), Helencha (*Enhydra fluctuans*) etc. were found during the AECL field visit.

Common Toad (*Bufo melanostictus*), House Lizard (*Hemidactylus brookii*), Common Kingfisher (*Alcedo atthis*), Common Myna (*Acridotheres tristis*), House Sparrow (*Passer domesticus*), House mouse (*Mus musculus*), Domestic Cow (*Bos Indicus*), Domestic Goat (*Capra aegagrus hircus*), Shol (*Channa striatus*),

Shing (*Heteropneustes fossilis*), Ilish (*Tenualosa ilisha*), Rui (*Labeo rohita*), Freshwater Shrimp (*Macrobrachium rosenbergii*) etc. faunal species were found during AECL field survey.

There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. There is mangrove forest area approx. 4 km and more away from project site.

Any endangered, vulnerable or threatened faunal species was not found during the field visit around the project area.

## **5. IDENTIFICATIONS OF POTENTIAL IMPACT**

The purpose of impact evaluation is to assign relative significance to the predicted impacts associated with the project, and thus determine the order in which impacts are to be avoided or mitigated.

Identification of potential impacts due to the project location, construction and operation of the project has been done using a checklist. The checklist contains the environmental effects and impacts designated to stimulate the analysis and to consider broadly the possible consequence of contemplated actions. The significant impacts in different phases i.e., (i) due to Pre-construction phase, (ii) construction phase and (ii) operation phase have been identified using the process. Impact evaluation and identification has been presented in **Table 3**.

**Table 3: Impact Evaluation and Identification table**

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
<b>Pre-construction Phase</b>																
Acquisition and Involuntary Resettlement																No impact anticipated
Disruption of Earth Surface																No impact anticipated
Change in Landscape																Comparative to adjacent rural and agricultural setup
Impact on ecological habitats																As there is one canal inside the project area and another at the west side of the project area
Impact due to Solid Waste																Improper management of solid waste during boundary work
Indigenous people																No existence of indigenous people around the project site; No impact anticipated
Cultural Heritage site																No cultural heritage site within the vicinity of the project area; No impact anticipated

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments	
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben		
<b>Construction Phase</b>																	
Air Quality																	Dust emission may occur during construction activity and traffic movement will also cause additional air emission
Noise Hazard																	Equipment installations and constructional work may create noise and vibration
Impact on Soil quality																	accidental spillage of different chemicals and hazardous substances may occur
Impact on Surface Water																	Improper management of soil, sand and other fine materials
Impact on Ground Water																	Improper management of liquid waste and accidental spillage or seepage of different chemicals and over extraction of ground water

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
Impact due to Solid Waste																Generation of different kinds of solid waste, office waste from constructional work
Hazardous Materials Managements																Hazardous material transporting and handling to or from the project site can cause different types of accidents
Traffic and Transportation																Carrying of construction materials will create traffic congestion around the project area
Impact on Terrestrial Habitat																Due to constructional work, there will be some negative impact
Impact on Aquatic Habitat																Due to discharge of liquid waste and different constructional waste, chemicals etc.
Occupational Health and Safety																Irregularly accidents, injury may occur in construction period
Sanitation Hazard & Drinking Water																Concentration of labor force may create un-

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
																hygienic condition and lack of safe drinking water may cause diseases
Labor and Working Condition																Improper maintenance of standard salary, salary deductions; hours of work; overtime arrangements
Social acceptability of Construction workers to the host communities																Local community may create some problems
Community Health, Safety and Security																Possibility of occurring accidents due to lack of safety and security
Employment																Major employment opportunity during construction phase
Increase in local business																Due to project activity
Indigenous people																No existence of indigenous people around the project site; No impact anticipated
Cultural Heritage																No cultural heritage site within the vicinity of the

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
																project area; No impact anticipated
<b>Operation Phase</b>																
Air quality																Emission from the engine and generator stack may affect the ambient air quality.
Noise Hazard																Noise may be generated due to project operation
Impact on Soil Quality																Improper storage and disposal of sewage wastes, hazardous waste, accidental spillage
Impact on Surface Water																Poor management of sewage, discharge of liquid waste may deteriorate surface water quality
Impact on Ground Water																Accidental spillage of oil or Hazardous substances; Abstraction of ground water
Impact due to Solid waste																Improper management of solid waste

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
Hazardous Materials Managements																Generation of used lubricating oil from the plant and improper handling and accidental spillage of hazardous waste (i.e., fuel oil, chemical) may occur
Traffic and Transportation																Transportation of different materials, fuel and personnel may create traffic congestion
Impact on Terrestrial Habitat																Terrestrial ecosystem may get disturbed due to project operation (i.e., air, noise, soil pollution)
Impact on Aquatic habitat																Due to leakage & accidental spillage of oil and hazardous substances aquatic habitat will be impacted
Occupational Health and Safety																Improper site security and safety may lead to accidents
Sanitation Hazard & Drinking Water																Generation of human waste by workers and

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
																laborers during operation stage may cause diseases
Labor and Working Condition																Improper maintenance of standard salary, salary deductions; hours of work; overtime arrangements
Community Health and Safety																Possibility of occurring accidents and spread of several communal and infectious diseases
Social acceptability of workers to the host communities																Acceptability problem may occur due to foreign officials/workers
Employment																Major employment opportunity during operation phase
Social and Economic enhancement around project area																benefit to local economy due to electricity connection, employment, community development.
Indigenous people																No existence of indigenous people around the project site; No impact anticipated

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
Cultural Heritage																No cultural heritage site within the vicinity of the project area; No impact anticipated

**\*Notation**

ST	Short Term	
MT	Medium Term	
LT	Long Term	
L	Local	
R	Regional	
N	National	
Sm	Small	
Med	Medium	
Lar	Large	
Non	None	
Min	Minor	
Mod	Moderate	
Maj	Major	
Adv	Adverse	
Ben	Beneficial	

## **6. PREDICTION AND EVALUATION OF IMPACTS**

Environmental attributes are broadly classified into three groups, viz., physical environment, biological environment and socio-economic environment. The main potential environmental impacts, which may arise as a result of construction of the power plant, can be grouped as follows: (i) Air quality, (ii) Noise / Vibration, (iii) Impact on ground water, (iv) Impact on surface water. All these aspects have been examined and the findings are summarized below.

### **A) Impact on Air Quality**

#### **Construction Phase**

The air quality in the project area may slightly deteriorate for the time being during construction. Water should be sprayed regularly on the open surface to reduce air pollution during construction. Covered trucks must be used when transporting materials. The vehicles should be kept in good order to minimize exhaust emissions. Sufficient stack height will be maintained for the Generator.

#### **Operation Phase**

Emission from the engine and generator stack may affect the ambient air quality. Unburned gases from the engine operation may affect the air quality. The situation aggravates when the fuel (here HFO) contains high percentage of impurities like sulfur, water, metals, MCR (micro carbon residue) etc. The high temperature of flue gases also impacts the air quality in terms of thermal pollution. The combustion of heavy fuels for power Generation inevitably results in emission of particulate and gaseous pollutants to the atmosphere. As the proposed power plants would be fired with Heavy Furnace Oil, the air pollutants emitted by the power plant will be Particulate matter, carbon monoxide, nitrogen oxides and sulfur dioxide. To minimize the impact 50m stack will be used.

### **B) Impact on Noise**

#### **Construction Phase**

Noise is likely to be generated from ground preparation, assembly of building materials on site and construction of the various components of the proposed power plant. Impacts of noise and vibration will potentially affect the immediate neighbors and employees. To mitigate the effects of noise pollution, noisy construction work should be limited to day time hours, proper acoustically designed machinery must be used, workers should wear Personal Protective Equipment (PPE), noise protection wall or barrier should be constructed in case of long-term noisy construction.

#### **Operation Phase**

The sound of the exhaust system is one of the most significant environmental noise components of a power plant. Necessary abatement measures should be taken as required avoiding adverse noise & vibration impact on the neighborhood. Thick doors will be provided and holes which may create sound pollution will be sealed with sound proof materials.

### **C) Impact on Soil**

#### **Construction Phase**

For construction phase, some of the activities which may lead to impact are removal of top soil, disposal of construction waste, sewage wastes, spillage of chemical / oil and other substances on open soil.

#### **Operation Phase**

During operation phase, impact is due to accidental spillage of hazardous chemicals or due to surface runoff from spillage area. These impacts will be prevented by ensuring proper handling of sewage wastes; storage of chemicals on paved area; and spill control and management procedures on site.

### **D) Impact on Surface water**

#### **Construction Phase**

The project will affect natural drainage, surface and groundwater; if the construction work is not conducted properly. Surface drainage should be controlled to divert surface runoff away from the construction area. For domestic waste/wastewater from construction labor camp area, proper sanitation facilities, such as portable toilets will be provided to prevent contamination of the surrounding receiving water bodies.

#### **Operation Phase**

The project would affect natural drainage and surface water quality if the operation activity is not managed properly. As per the process flow of the proposed project, there will not be any liquid discharge from the plant. Only domestic and sanitary waste water will be generated from the project site during operation phase. There will be septic tank along with soak well for domestic and sanitary waste water.

### **E) Impact on Ground Water**

#### **Construction Phase**

During construction phase, ground water contamination may be caused by accidental spillage or seepage of the fuel, lubricants, waste oil and chemicals in the storage areas or in the waste handling area. Similarly, generation of sanitary/domestic waste from labor camp area may also result in ground water contamination, if not properly handled.

#### **Operation Phase**

Continuous discharge of industrial effluents, domestic sewage, waste dump and over exploitation of the resource have negative impact on ground water sustainability. The most important impact of groundwater depletion is loss of base flow; other impacts being severe crisis of safe drinking water and irrigated water. Total water demand is 4.0 m<sup>3</sup>/hr during operation phase which is a very small amount of water to have major impact on ground water quality.

## **F) Impact due to Solid Waste**

### **Construction Phase**

During construction, large amount of construction waste that includes unused construction materials, construction debris, excavated spoils, abandoned or broken machine parts, debris, kitchen wastes from labor sheds, packaging materials, used home appliances, etc. will be produced. Moreover, food waste, plastic, papers, cock sheet, cartons, metal or plastic binders, etc. may be produced as solid waste during this stage. If these wastes are not disposed and maintained properly, these would have an impact on surrounding environment. All the constructional hazardous wastes will be brought to dedicated area for recycling and/or final disposal at approved waste handling facilities near to the Project site.

### **Operation Phase**

As a result of the operation of the proposed project, it is expected that some solid waste will be generated. Due to project operation, some hazardous and non-hazardous waste will be generated from project operational work. Some food waste, plastic, papers, cartons, metal or plastic binders, etc. may be produced as solid waste during this stage. Improper disposal of papers, tissues, packaging materials, boxes, plastics can lead to littering in the project and surrounding areas. Kitchen waste will be produced as well as sanitary waste will also be produced.

## **G) Hazardous Materials Managements**

### **Construction Phase**

Hazardous material can cause different types of accidents while transporting to or from the project site. Hazardous material can also contaminate surface & ground water as well as soil. Skilled labors should be appointed for unloading the work to avoid accidents.

### **Operation Phase**

The proposed project will be operated by HFO, so, there is HFO preheating and treatment system in the project before feeding the HFO to the engine. This will end up with some oily sludge & water. Moreover, the project will use lubricating oil in the engine cooling system from where insignificant amount of used lubricating oil would be generated from the plant. Oily water from steam heated vapor chamber, engine hall area, storage tank area, FOTP area and other processing area will be discharged through oily water drain line and will be vaporized in steam heater. For Lube oil, LO separator will be used and sludge will be stored in sealed Sludge tank. This sludge then will be carried to market for sale.

The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility. Oil Sludge, spent lubricating oil will be sold only to those vendors who have approval from DoE. In case of any spillage, it should be immediately acted up on. Spillage equipment i.e., safety goggles, gloves, PPE, disposal bags, containers, absorbent material, suction pump, boom skimmer etc. should be available at the site.

## **H) Traffic and Transportation**

### **Construction Phase**

Traffic congestion in the area may increase during the construction of the power plant. To reduce the potential negative effects of increased traffic in this area, adequate internal parking needs to be provided for all vehicles and all vehicles should have updated fitness certificate. Speed limit should be imposed inside the project area.

### **Operation Phase**

Increase in vehicular traffic in the area is likely to be experienced during operation phase of the plant. During the operation phase, increase in vehicular traffic in the area is likely to be because of trucks ferrying raw and waste material. Adequate internal parking should be provided for all vehicles coming at the power plant premises.

## **I) Sanitation Hazard & drinking water**

### **Construction Phase**

During construction stage, lot of local labors will work and hence they would generate considerable amount of human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also. If arrangement of safe sanitation and drinking water is not ensured, it will create a major problem. Covid 19 virus is another alarming issue which can spread during the construction phase due to labor influx. All the labors should follow the safety protocol (i.e., Physical distancing, Face coverings, Gloves, Goggles & Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation.

### **Operation Phase**

During operation stage, workers and laborers generate human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also. Proper sanitation system will be provided and regular, proper and safe disposal of human waste will be ensured during the operation period. All the employees should follow the safety protocol (i.e., Physical distancing, Face coverings, Gloves, Goggles & Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation.

## **J) Labor and Working Condition**

### **Construction and Operation Phase**

Working conditions and terms of employment examples are wages and benefits; wage deductions; hours of work; overtime arrangements and overtime compensation, breaks, rest days and leave for illness, maternity, vacation or holiday.

## **K) Occupational Health and Safety**

### **Construction Phase**

The safety of the workers may be at risk during construction activities. The movement of trucks to and from the site, the operation of various equipment and machinery and the actual construction activities will expose the workers to work-related accidents and injuries. Pollutants such as dust and noise could also have negative implications for the health of workers and near-by communities.

### **Operation Phase**

The workers who work inside the project area will face occupational health hazards due to different operational processes. Protective clothing, gloves, helmets, shoes, mask and accessories should be provided to the workers.

## **L) Community Health and Safety**

### **Construction Phase**

Possible sources of impacts to community health and safety during the construction phase include increased pressure on communicable diseases, and dust & noise emissions. Influx of non-local workers may also lead to increased incidence of disease outbreaks and potential security issues. People living close to the site and access roads will be potentially affected due to noise and dust generated from vehicular movements, operation of machineries, construction activities.

### **Operation Phase**

The project manager will evaluate the risks and impacts to the health and safety of the affected communities during operation phase. Impact on Community Health and Safety are possibility of occurring accidents and local people may come to contact of hazardous materials related to the project.

## **M) Impacts on Terrestrial Habitat**

### **Construction Phase**

Due to air emission, noise emission there will be negative impact on terrestrial habitat. Suspended particulates can have detrimental impact on the vegetation by covering plant surfaces. There is mangrove forest approx. 4 km away from the project area. Fauna of the adjacent area could be adversely affected through construction-related activities (noise, dust, light pollution, and habitat loss).

### **Operation Phase**

Emission from the operation of the power generation facilities; illumination, noise and vibration, air emission from the site may cause disturbance to the local flora and fauna. Nitrogen oxides at higher level can damage plant cells and affect the metabolic process.

The adjacent land area is predominantly agricultural type. There is mangrove forest area approx. 4 km and more away from project site. If the proposed mitigation measures are implemented then it is expected that the impact on them will be negligible.

#### **N) Impacts on Aquatic Habitat**

##### **Construction Phase**

During construction phase, the project area may be disturbed by noise and vibration due to construction activities, surface runoff from construction site, spillage & leakage of oil and lubricants etc.

##### **Operation Phase**

Aquatic habitat would be affected due to discharge of water and disposal of solid waste into surface water. If any hazardous waste is thrown to the surface water body, then it may greatly impact the aquatic flora and fauna.

There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. If the proposed mitigation measures are implemented then it is expected that the impact on aquatic habitat will be negligible.

#### **O) Social acceptability of Constructional / Operational workers to the host communities**

The differences in the cultures of workers (in case hiring is required) and local community may create some problems in both construction & operation phase. In the rural area, the local people especially the religiously conservative section of the community will not accept the foreign workers in general.

#### **P) Employment Generation**

##### **Construction Phase**

One of the main positive impacts during the construction phase will be the availability of employment opportunities especially to casual workers and several other specialized workers. Employment opportunities are of benefit both economically and in a social sense. In the economic sense it means abundant unskilled and skilled labor will be used in construction hence economic production.

##### **Operation Phase**

During the operation phase, there will be the availability of employment opportunities of the workers. Employment opportunities are of benefit both economically and in a social sense.

#### **Q) Increase in Local Business**

There will be development of Local Infrastructure during construction phase. Moreover, connecting roads and communicating facilities will be upgraded during construction phase. As a result, Local business will

also be improved. Moreover, due to industrial development some small-scale business (small grocery shop, confectionary, tea stall, salon etc.) will also get recognizable opportunity.

#### **R) Social and Economic enhancement around project area**

After the implementation of this project, the economic condition of the area will be developed. The electricity connection of that island will be available and social livelihood of the people will be improved due to the implementation of this project. Apart from this, it includes benefit to local economy due to employment, community development etc.

#### **S) Indigenous People**

There is no existence of indigenous people within the vicinity of the project area. So, there is no impact in this regard.

#### **T) Cultural Heritage**

Not applicable because there are no cultural resources inside the project area and no structure of national cultural heritage will be affected due to project development work. So, no impact in this regard.

### **7. ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

In the context of a project, Environmental Management Plan (EMP) is concerned with the implementation of the measures necessary to minimize and offset the adverse impacts and to enhance beneficial impacts. Unless the mitigation and beneficial enhancement measures are identified in EIA and fully implemented, the prime function of the EIA cannot be achieved. Thus, the objectives of EMP for the present project are:

- Identification of monitoring requirements and monitoring indicators;
- Mitigation measures to reduce or eliminate negative impacts; and
- Enhancement measures to minimize positive impacts.

Environmental management plan has to be considered as part of the plant's overall management and it would be part of the plant operational manual. Summary of recommended mitigation and benefit enhancement measures, proposed EMP are presented in **Table 4**.

**Table 4: Recommended Management Plan**

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
<b>Pre-Construction Phase</b>					
<b>Land Acquisition and Involuntary Resettlement</b>	Within the project site	<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	Supervised by Desh Energy authority
<b>Disruption of Earth Surface</b>	Around the project site	<ul style="list-style-type: none"> <li>Regular sprinkling of water will be done on open surface and dust grounds.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Change in Landscape</b>	Within the project site	<ul style="list-style-type: none"> <li>Project should be designed considering key criteria of landscape;</li> <li>Altered green area can be turned into its original visual quality by plantation of trees.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Impact on Ecological Habitat</b>	Around the project site	<ul style="list-style-type: none"> <li>No waste should be dumped in water bodies;</li> <li>Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off;</li> <li>Re-vegetation should be done as soon as possible.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Solid Waste</b>	Around the project site	<ul style="list-style-type: none"> <li>Organize disposal of all wastes generated during pre-construction phase in the designated disposal sites approved by the Project authority;</li> <li>Waste should be properly segregated in different colored drums;</li> <li>No solid waste should be dumped in water bodies;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Difficult to dispose wastes will be minimized where practicable.</li> </ul>			
<b>Indigenous People</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Cultural Heritage</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Construction Phase</b>					
<b>Impact on Air Quality</b>	Around the project site	<ul style="list-style-type: none"> <li>Regular sprinkling of water will be done on open surface and dust grounds until paving was done;</li> <li>Transportation of materials in tarpaulin-covered trucks;</li> <li>The sand and other such dispersible material will be stored at site for minimum working period;</li> <li>Removal of soil/mud from trucks and other appliances prior to leaving the project area;</li> <li>Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses);</li> <li>Project management and contractor to enforce strict use of personal protective clothing of labors;</li> <li>Complains of dust related ailments among employees and neighbors to be given access to medical attention;</li> </ul>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>The equipment design will be chosen for least suspension of dust/sand into atmosphere;</li> <li>The construction activity will be carried out during day time only.</li> </ul>			
<b>Noise Hazard</b>	Around the project site	<ul style="list-style-type: none"> <li>Noisy construction works to be limited to day time hours;</li> <li>Proper Acoustically designed machinery should be used;</li> <li>Cutting pipes and other related works should be done in a safe zone;</li> <li>Immediate neighbors to be notified in writing on the date of commencement of construction work at one month in advance;</li> <li>All employees likely to be exposed to noise to be provide with ear protectors;</li> <li>Where applicable and possible exceptionally noisy machines to be fitted with noise reduction devices;</li> <li>Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor;</li> <li>Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A);</li> </ul>	Noise at different locations at day and night	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Workers should wear Personal Protective Equipment (PPE) for protecting them from the sound induced hazard;</li> <li>Noise protection wall or barrier should be constructed in case of long-term noisy construction.</li> </ul>			
<b>Impact on Soil Quality</b>		<ul style="list-style-type: none"> <li>Construct appropriate spill containment facilities for all fuel storage areas;</li> <li>Train personnel and implement safe work practices for minimizing the risk of spillage;</li> <li>Develop site specific waste management plan for various waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior construction work;</li> <li>Construction waste will be utilized for filling of Project site;</li> <li>Fuel, chemical and lubricant will be stored in paved storage areas;</li> <li>Properly stripping of top soil and conserve it for future use (greenbelt development);</li> <li>Municipal solid waste generated from the construction site will be transferred to the disposal site in consultation with the Union Parishad.</li> </ul>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Contractor	Supervised by Desh Energy authority
<b>Impact on Surface Water</b>	Near Project Site	<ul style="list-style-type: none"> <li>Surface drainage shall be controlled to divert surface runoff away from the construction area;</li> </ul>	Temperature, pH, TDS, TSS, DO, BOD, COD,	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Laying barrier net;</li> <li>• Undertaking construction work during dry seasons;</li> <li>• Completed areas should be restored/re-vegetated as soon as practicable;</li> <li>• Temporary silt-trap or digging of pond toward siltation prevention;</li> <li>• Stockpiling of spoil soil at a safe distance from the drainage system;</li> <li>• Strict supervision should be maintained to avoid blockage of natural creeks during the construction period;</li> <li>• Sanitary waste should be adequately disposed of to avoid surface and ground water contamination;</li> <li>• Making provision for temporary storage of wastes inside construction yard and disposal of solid wastes in an appropriate manner and at appropriate site at regular interval;</li> <li>• Adequate provision has to be retained for the treatment and disposal of cuttings, drilling fluids and other chemicals and lube oil wastes generated during drilling, testing and commissioning stage.</li> </ul>	Cd, Cr, Pb and Oil & grease		
<b>Impact on Ground Water</b>	Near Project Site	<ul style="list-style-type: none"> <li>• Proper spill control and management at site;</li> </ul>	pH, TSS, TDS, Ammonia, Nitrate,	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Storage of hazardous material and waste in proper manner and disposal of the waste at a designated location around the site;</li> <li>Minimize the extraction and proper management of ground water should be strictly followed;</li> <li>Regular inspections of machinery, equipment, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring;</li> <li>Periodic monitoring of groundwater to detect any contamination;</li> <li>Provision for treatment of waste water from labor camp, on site.</li> </ul>	Hardness, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform		
<b>Impact due to Solid Waste</b>	Around the project site	<ul style="list-style-type: none"> <li>Construction waste should be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses;</li> <li>The contractor should be committed to ensure construction materials left over at the end of construction will be used in other projects rather than being disposed off; some of the waste can be sold or donated or recycled/reused by construction companies, local community groups or institutions;</li> <li>Waste should be properly segregated in different colored drums;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Difficult to dispose wastes (plastic and hazardous waste) will be minimized and where practicable and avoided such as plastic wastes;</li> <li>• The contractor must dispose the wastes regularly at an approved refuse disposal site to ensure that waste does not build up on site and result in aesthetic impacts or odors;</li> <li>• Hazardous waste will not be mixed with other solid waste generated and should be managed by way of incineration or land-filling.</li> </ul>			
<b>Hazardous Materials Managements</b>	Around the project site	<ul style="list-style-type: none"> <li>• All hazardous materials will be provided in a secondary containment;</li> <li>• Spill kits should be available to contain any accidental release of hazardous material;</li> <li>• Skilled labors should be appointed for unloading the work;</li> <li>• In case of any spillage, it should be immediately acted up on. To combat spillage equipments i.e. safety goggles, gloves, PPE, disposal bags, containers, suction pump, boom skimmer etc. should be available at the site;</li> <li>• Regular inspections of machinery, equipment, pipe work, storage areas are</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		needed to ensure that poor maintenance is not responsible for a spillage occurring.			
<b>Traffic and Transportation</b>		<ul style="list-style-type: none"> <li>• Emphasizing on road safety aspects;</li> <li>• Licensed and trained drivers should be appointed;</li> <li>• Management to provide for adequate internal parking for all vehicles;</li> <li>• Avoid transportation of materials and machinery during the off-peak traffic periods;</li> <li>• Stick to agreed traffic routes, avoiding narrow routes;</li> <li>• Prevent unauthorized access to the construction site;</li> <li>• Implementation of a safety program (speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area;</li> <li>• All vehicles should have updated fitness certificate;</li> <li>• Regular maintenance of vehicles;</li> <li>• Speed limits, Proper signage, visibility and traffic awareness and pedestrian safety should be followed by the drivers.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Occupational Health and Safety</b>		<ul style="list-style-type: none"> <li>• The EPC contractor will provide all kinds of treatment facilities and pay compensation according to Bangladesh Labor Law 2006;</li> <li>• It is suggested that worker's health have to be checked regularly;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Emergency response policy of the EPC contractor/ Project authority should be followed;</li> <li>• All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor;</li> <li>• Necessary first aid facilities should be available at site;</li> <li>• Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order;</li> <li>• All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded;</li> <li>• All scaffolds will be erected and inspected and the appropriate records maintained by the Contractor;</li> <li>• Safety hoops or cages will be provided for ladders with a height in excess of two meters;</li> <li>• The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress;</li> <li>• Supervision of works shall be done regularly to ensure that safety conditions are met while</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work;</p> <ul style="list-style-type: none"> <li>• The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessities. So, there may not be major health hazard issue during the construction;</li> <li>• An understanding has to be built with a local hospital for the emergency incident related to the worker's health of the plant and EPC contractor/ Project Authority has to establish such health monitoring system of the workers shortly;</li> <li>• In addition, necessary steps to be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.</li> </ul>			
<b>Community and Safety</b>	<b>Health</b>	<ul style="list-style-type: none"> <li>• Water sprinkling on the access roads and at the construction sites would reduce dust emissions considerably;</li> <li>• To reduce noise related impacts, night time movement of vehicles and construction activities will be restricted;</li> <li>• Pre-employment health check-up for construction workers;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Isolate local people from project area for safety purpose;</li> <li>Construction camps equipped with proper sanitation facilities and regular pest control (i.e., to pest control for mosquitos or other insects for housing workers / labors);</li> <li>Proper fencing should be done around the project site to control the movement of local people;</li> <li>All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road.</li> </ul>			
<b>Sanitation Hazard and Drinking Water</b>		<ul style="list-style-type: none"> <li>Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured;</li> <li>Contractors and workers should obey appropriate means of waste removal and sanitation measures;</li> <li>All the labors should follow the safety protocol (i.e., Physical distancing, Face coverings, Gloves, Goggles &amp; Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Adequate number of portable toilets and bathrooms should be made for the workers;</li> <li>• Proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities;</li> <li>• Male and female toilets should be isolated as per requirement;</li> <li>• There will be enough arrangement for the supply of safe drinking water to the workers.</li> </ul>			
<b>Labor and Working Condition</b>	Project area	<ul style="list-style-type: none"> <li>• Contractor should maintain standard wage, wage deductions; hours of work; overtime arrangements and overtime compensation;</li> <li>• Leave for illness, maternity, vacation or holiday should also be maintained by the contractor;</li> <li>• Child labor and forced labor should strictly be avoided;</li> <li>• Temporary labor camp should be made for labors;</li> <li>• Discrimination between male and female labors should be prohibited.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Terrestrial Habitat</b>	Around the project site	<ul style="list-style-type: none"> <li>• Plantation of local species in surrounding areas of the Project site;</li> <li>• Bare surfaces should be grassed as soon as possible after construction to minimize time of exposure;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Only locally occurring, indigenous grasses should be used;</li> <li>• The construction area and immediate surroundings should be monitored regularly for emergent invasive vegetation;</li> <li>• Water sprinkling for dust suppression;</li> <li>• Lights of the construction area should install downwardly to avoid disturbance to the wildlife and birds;</li> <li>• Avoid working at night time.</li> </ul>			
<b>Aquatic habitat</b>		<ul style="list-style-type: none"> <li>• Wastewater from labor camp and construction site should not be disposed-off in natural water bodies;</li> <li>• Proper disposal and management of construction waste;</li> <li>• No solid, liquid or hazardous waste should be dumped in water bodies during construction;</li> <li>• septic tank along with soak wells should be provided to dispose-off the wastewater from construction camp;</li> <li>• Excavation activities should not be undertaken during monsoon season;</li> <li>• Piling of raw material at construction site should be avoided;</li> <li>• Raw material, debris and fuel should be stored on paved surfaces under covered areas;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off.</li> </ul>			
<b>Employment Generation</b>		<ul style="list-style-type: none"> <li>Service and materials for construction will be to the extent possible locally sourced;</li> <li>Prioritization of employment of skilled and non-skilled workers from the local communities;</li> <li>Priority given to local residents for both professional and nonprofessional positions;</li> <li>In order to increase the size of local employment, women should also be employed in the construction phase.</li> </ul>		-	Supervised by Desh Energy authority
<b>Social acceptability of workers</b>	Around the project site	<ul style="list-style-type: none"> <li>The project proponent and the contractor have practice of working with the workers of different cultures;</li> <li>It is recommended to aware the foreign workers (if any) about the social &amp; religious actability in the area so that they could maintain those when they are in touch with local community.</li> </ul>		-	Supervised by Desh Energy authority
<b>Increase in local business</b>		<ul style="list-style-type: none"> <li>Service and materials for construction will be to the extent possible locally sourced;</li> <li>Priority given to local residents for both professional and nonprofessional positions;</li> <li>Encourage local people with small-scale business plans.</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
<b>Indigenous People</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Cultural Heritage</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Operation Phase</b>					
<b>Impact on Air quality</b>	Around the project site	<ul style="list-style-type: none"> <li>Installation of the Best Available Control Technology (BACT) to minimize air emission;</li> <li>The SO<sub>2</sub>, NO<sub>x</sub> emission from the power plant would be kept at a minimum level with optimum designed cycle efficiency in order to maximize the MW output;</li> <li>Stack of 50m height will be used;</li> <li>Implementation of a regular watering and sprinkling for dust suppression;</li> <li>Covering of any aggregate or dusty material or storage piles should be maintained to reduce dust emissions.</li> </ul>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Project proponent	Supervised by Desh Energy authority
<b>Noise Hazard</b>	Around the project site	<ul style="list-style-type: none"> <li>All equipment and mechanical machineries shall have to be maintained in good working order;</li> <li>Noise level should be monitored at different selected location within power plant and nearest community as per the monitoring plan;</li> <li>To reduce the effect, Exhaust Gas silencers will be used in the stack which will keep the noise level within DoE limit;</li> <li>Mechanical parts with high noise potential i.e., rotating machinery, engines, fans etc.</li> </ul>	Noise at different locations at day and night	Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>should be covered with acoustic hood, if possible;</p> <ul style="list-style-type: none"> <li>• The project authority will have to optimize the plant layout in such way that the noise impact will be minimized;</li> <li>• The power house building would be constructed by double insulated casing;</li> <li>• Thick doors will be provided and holes which may create sound pollution will be sealed with sound proof materials;</li> <li>• Vibration pad will also be used at the bed of all power generation units to prevent the vibration;</li> <li>• Proper and timely preventive maintenance of approach vehicles is to be adopted to reduce noise levels;</li> <li>• Workers will use ear plugs while working where applicable;</li> <li>• The machines will be acoustically designed to cause less noise pollution;</li> <li>• Project boundary wall should be more than man height;</li> <li>• The green belt should be of at least 3.5 m width consisting two rows of plantation with the gradual increase of height of plant from inside row to outside row.</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
<b>Impact on Soil Quality</b>	Near the project site	<ul style="list-style-type: none"> <li>Spill control and management procedures at site;</li> <li>Hazardous waste should be carefully handled and disposed off;</li> <li>No liquid waste should be discharged without treatment;</li> <li>Municipal solid waste generated from the project site will be transferred to the designated disposal site in consultation with the Union Parishad;</li> <li>The operation of the power plant should be as such that it does not impact on land.</li> </ul>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Project proponent Project proponent	Supervised by Desh Energy authority
<b>Impact on Surface Water</b>	Around the project site	<ul style="list-style-type: none"> <li>Surface drainage shall be controlled to divert surface runoff away from the project area;</li> <li>Hazardous waste should be carefully handled and disposed off to avoid surface runoff or mixing with waterbody;</li> <li>Empty areas should be restored/re-vegetated as soon as practicable;</li> <li>Stockpiling of solid waste at a safe distance from the drainage system;</li> <li>Strict supervision should be maintained to avoid blockage of natural creeks during the operation period, and;</li> </ul>	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Sanitary waste should be adequately disposed of to avoid surface and ground water contamination.</li> </ul>			
<b>Impact on Ground Water</b>	Around the project site	<ul style="list-style-type: none"> <li>Minimize the extraction and proper management of ground water should be strictly followed;</li> <li>Storage of hazardous material and waste in proper manner and disposal of the waste at a designated location around the site;</li> <li>All hazardous materials will be provided in a secondary containment;</li> <li>Sanitary waste should be disposed through sewage treatment system to avoid ground water contamination;</li> <li>Regular inspections of machinery, equipment, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring</li> <li>Periodic monitoring of groundwater to detect any contamination;</li> <li>3R (Reduce, Reuse, Recycle) policy of Government should be followed and the power plant should implement the 3R plan which will be submitted to DoE.</li> </ul>	pH, TSS, TDS, Ammonia, Hardness, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform	Project proponent	Supervised by Desh Energy authority
<b>Impact due to Solid Waste</b>	Around the project site	<ul style="list-style-type: none"> <li>All solid waste will be segregated properly;</li> <li>Some solid waste has secondary demand and they should be sold to the secondary dealers.</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>Other solid wastes will be disposed to the designated landfill area;</p> <ul style="list-style-type: none"> <li>• Municipal solid waste generated from the project site will be transferred to the disposal site in consultation with the Union Parishad;</li> <li>• Difficult to dispose wastes (plastic wastes) will be minimized and where practicable avoided such as plastic wastes;</li> <li>• All type of solid waste which will be sold or disposed to the disposal site should have proper movement register from the site for waste transfer.</li> <li>• The project authority should undertake waste segregation at source to separate hazardous from non-hazardous waste;</li> <li>• All type of solid waste which will sold or disposed to the disposal site should have proper movement register from the site for waste transfer.</li> </ul>			
<b>Hazardous Material Management; Impact due to HFO and Lubricating Oil</b>	Around the project site	<ul style="list-style-type: none"> <li>• The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility;</li> <li>• An appropriate storage site should be provided for disassembled spare parts (e.g. motors and compressors) that contain oil or other types of fluids. They should be stored in containers that are secured that will not allow</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>oil and other fluids to escape with an impermeable surface and a sealed drainage system;</p> <ul style="list-style-type: none"> <li>• Components should be segregated having regard to their eventual destinations and the compatibility of the component types;</li> <li>• Oil Sludge, spent lubricating oil will be sold only to those vendors who have approval from DoE;</li> <li>• Skilled labors should be appointed for the unloading work;</li> <li>• In case of any spillage, it should be immediately acted up on. Spillage equipment i.e. safety goggles, gloves, PPE, disposal bags, containers, absorbent material, suction pump, boom skimmer etc. should be available at the site;</li> <li>• Secondary containment for all hazardous liquid storage required;</li> <li>• Regular inspections of machinery, equipment, pipe work, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring.</li> </ul>			
<b>Traffic and Transportation</b>		<ul style="list-style-type: none"> <li>• Management to provide for adequate internal parking, for all vehicles coming to the plant premises;</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road;</li> <li>• Restrict truck deliveries, where practicable, to day time working hours;</li> <li>• Restrict the transport of oversize loads;</li> <li>• All tanker truck should have updated fitness certificate and regularly checked for any kind of leakage;</li> <li>• Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions;</li> <li>• Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc.;</li> <li>• Marking of the roads, warning signs / lights, road signs to be clearly used.</li> </ul>			
<b>Terrestrial Habitat</b>		<ul style="list-style-type: none"> <li>• Proper disposal and management of solid and liquid waste should be maintained;</li> <li>• No waste should be dumped in adjacent natural water bodies or agricultural land during operation;</li> <li>• Site should be kept clean;</li> <li>• To avoid low transpiration rate of plants it is suggested to use sprinkle of waters in the roads and nearby area at 12-hour interval to</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>reduce the rate of dust particulates which will be generated by vehicle movements;</p> <ul style="list-style-type: none"> <li>• Piling of raw material at plant site should be done under strict supervision;</li> <li>• Raw material, debris, solid waste and spent oil should be properly, stored and disposed off;</li> <li>• Lights of the power plant area should install downwardly to avoid disturbance to the wildlife and birds;</li> <li>• Plantation of local species in surrounding areas of the Project site;</li> <li>• Greenbelt area should be built-up on at least 33% land as per the guideline of DoE.</li> </ul>			
<b>Aquatic Habitat</b>		<ul style="list-style-type: none"> <li>• Specific procedures and necessary preparedness to contain any accidental spill at source and also to prevent their spread in the surrounding environment;</li> <li>• Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off;</li> <li>• Wastewater should not be disposed-off in the water bodies without proper treatment.</li> </ul>		Project proponent	Supervised by Desh Energy authority
<b>Sanitation Hazard and Drinking Water</b>		<ul style="list-style-type: none"> <li>• Project personnel and workers will follow appropriate means of waste removal and sanitation measures;</li> <li>• All the employees should follow the safety protocol (i.e., Physical distancing, Face</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>coverings, Gloves, Goggles &amp; Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation;</p> <ul style="list-style-type: none"> <li>• Adequate number of toilets and bathrooms for both male and female workers will be made;</li> <li>• Proper disposal system of sewage waste will be implemented for sanitation purpose and the workers will be made aware to practice those facilities;</li> <li>• There will be enough arrangement for the supply of safe drinking water to the workers.</li> </ul>			
<b>Occupational Health &amp; Safety</b>		<ul style="list-style-type: none"> <li>• The proponent will provide all kinds of treatment facilities and pay compensation according to Bangladesh Labor Act 2006;</li> <li>• The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessities as per requirements;</li> <li>• Provide adequate lighting in all workrooms;</li> <li>• Material Safety Data Sheets (MSDS) for each chemical used should be available and readily accessible at the facility;</li> <li>• A safety manual for storage and handling of Hazardous chemicals will be prepared and implemented;</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• The staff will be trained for first-aid and firefighting procedures. The rescue team will support the first-aid and firefighting team;</li> <li>• A first-aid center with the trained personnel;</li> <li>• Train staff on how to prevent and manage incidences. This should involve proper handling of electricity, water etc. and sensitization on various modes of escape, conduct and responsibility during such incidences;</li> <li>• Use signage to warn staff and/ or visitors of dangerous places. The signage must be visible and placed strategically;</li> <li>• Pollution control measures would duly adopt if necessary, including noise and air pollution;</li> <li>• Orient all staff on safe work practices and guidelines;</li> <li>• Firefighting systems, such as sprinklers, portable extinguishers (appropriate to the flammable hazard in the area) and automated fire extinguishers will be provided at strategic locations with clear labelling of the extinguisher type;</li> <li>• Firefighting system will be tested periodically;</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Develop evacuation procedures to handle emergency situations</li> <li>• A near miss and accident reporting system will be followed and corrective measures shall be taken to avoid / minimize near miss incidents;</li> <li>• Safety measures in the form of DO and Don't Do will be displayed at strategic locations;</li> <li>• Safety audits will be conducted periodically as per the regulatory requirements;</li> <li>• A Permit to enter the project area will be established to ensure that only authorized persons can entry to the site;</li> <li>• Regular medical checkup would be done to ensure the soundness of health of employees and workers;</li> <li>• An understanding has to be built with a local hospital for the emergency incident related to the worker's health;</li> <li>• In addition, necessary steps to be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.</li> </ul>			
<b>Community Health and Safety</b>		<ul style="list-style-type: none"> <li>• Isolate local people from project area for safety purpose;</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Proper fencing should be done around the project site to control the movement of local people;</li> <li>• All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road;</li> <li>• Marking of the roads to be clearly done;</li> <li>• Speed limit and proper sign board should be provided along the said road;</li> <li>• Kitchen waste and sanitary waste should be properly handled and disposed to avoid outbreak of diseases.</li> </ul>			
<b>Labor and Working Condition</b>	Around the project site	<ul style="list-style-type: none"> <li>• The proponent will adopt and implement human resources policies and procedures as per the Labor Act, 2006;</li> <li>• The proponent will not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements;</li> <li>• Proponent should maintain standard salary, salary deductions; hours of work; overtime arrangements and overtime compensation;</li> <li>• Leave for illness, maternity, vacation or holiday should also be maintained by the contractor</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Child labor and forced labor should strictly be prohibited;</li> <li>Discrimination between male and female labor should be avoided;</li> <li>The proponent will not employ forced labor, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty.</li> </ul>			
<b>Social acceptability of workers to the host communities</b>		<ul style="list-style-type: none"> <li>The project authority has practice of working with the workers of different cultures;</li> <li>Adequate training or awareness would be done to the migratory workers about local culture and behavior. So, there may be no major problem raising in dealing with foreign or migratory workers.</li> </ul>		-	Supervised by Desh Energy authority
<b>Employment Generation</b>		<ul style="list-style-type: none"> <li>Encourage local and equitable employment;</li> <li>Salaries and other benefits based on qualification and experience;</li> <li>Priority given to local residents for both professional and nonprofessional positions.</li> </ul>		-	Supervised by Desh Energy authority
<b>Social and Economic enhancement</b>		<ul style="list-style-type: none"> <li>Improvement of economic condition of the project area.</li> </ul>			
<b>Indigenous People</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Cultural Heritage</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-

## 8. MONITORING, EVALUATION AND REPORTING

Monitoring of the performance of a plant is very important and sometimes vital. For surveillance of the environmental performance of an industry and monitoring of the quality of the local environment, environment in the work-zone and the general impact zone have to be performed on a regular basis. A management set up has to be created for the environmental monitoring program which can ensure compliance with national environmental standards. Any additional monitoring required should be defined and resources allocated for the purpose. The proceeding of the committee should be recorded and used to produce quarterly and annual environmental reports indicating compliance or otherwise of the environmental regulations. Monitoring plan during construction and operation phase are described below in **Table 5 to Table 8**.

**Table 5: Monitoring Plan during Construction Phase of the Project (Visual)**

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

**Table 6: Monitoring Plan during Construction Phase of the Project (Analytical)**

Issue	Parameters	Monitoring Frequency	Responsibility
<b>Ambient Air Quality</b>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Once in 3 months	EPC Contractor/ Consultant
<b>Noise level</b>	Noise at different locations	Once in 3 months	EPC Contractor/ Consultant
<b>Soil</b>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Once in 6 months	EPC Contractor/ Consultant
<b>Surface water</b>	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	Once in 3 months	EPC Contractor/ Consultant
<b>Ground water</b>	pH, TSS, TDS, Hardness, Ammonia, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform	Once in 6 months	EPC Contractor/ Consultant

**Table 7: Monitoring plan during Operational Phase of the Project (Visual)**

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

Issue	Key aspects	Monitoring Frequency	Responsibility
Site Drainage	Maintaining proper drainage	Quarterly	Project authority

**Table 8: Monitoring plan during operational phase of the Project (Analytical)**

Issue	Parameters	Monitoring Frequency	Responsibility
Ambient Air Quality	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Once in 3 months	Project authority
Stack emissions	CO, NO <sub>x</sub> , SPM, O <sub>2</sub> and temperature	Once in 3 months	Project authority
Noise level	Noise at different locations	Once in 3 months	Project authority
Soil	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Once in 6 months	Project authority
Surface water	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	Once in 3 months	Project authority
Ground water	pH, TSS, TDS, Hardness, Ammonia, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform	Once in 6 months	Project authority

## 9. ALTERNATIVE ANALYSIS

Hatiya Island in Bangladesh is an off grid remote locality. Despite being only twenty kilometers away from shore, the island lacks any electricity grid connection. The government has taken a move to install a 15-megawatt (MW) HFO based power plant in Hatiya island for uninterrupted electricity supply. People of this area depends on solar power system. Only in Ochkhali bazar, there is electric connection via HSD power production source within approx. 3 km radial zone which is not sufficient. Rather than this, the entire island has no electricity connection. 'No build' alternative will not bring these huge changes and other benefits to the socio-economic condition of the adjacent project area. Considering the overall scenario, it is concluded that the 'No build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimized to an allowable level.

The proposed power plant project is going to build up on BPDB's own land which does not require any Land acquisition or resettlement. Moreover, there is a good equipment, machineries and fuel transportation route to the project site via water way. Due to the rural setup, the project won't hamper the environmental condition much. So, the selected location of 15 MW HFO Fired Power Plant is quite expectable for the proposed project from environmental point of view.

Fuel alternatives and technology alternatives have been also discussed in detail in **Chapter 9** and the proposed project detail has been found more reliable and acceptable from environmental and social perspectives. The technology being offered by Desh Energy Power Company Limited is considered to be state of the art in terms of being environment friendly, energy efficiency and modern plant & process design. The plant will be built according to the applicable Best Available Technologies (BAT) defined for similar plants.

## **10. EMERGENCY RESPONSE AND DISASTER MANAGEMENT PLAN**

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

There should be trained emergency response teams, specific contingency plans and specific equipment packages in place to cope with these types of emergencies. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts.

### **I. Disaster Management Plan**

Appropriate management plan should have to be taken by the project operator to prevent any unwanted disaster in the plant as per the suggestion made in **Chapter 10**. In this regard, there should be a provision to stop the production immediately during any process failure or disaster.

## **11. RISK ASSESSMENT AND MANAGEMENT**

Risk assessment is a part of the EIA process which aims at identifying all the potential hazards, exposure to hazardous condition or hazards, and their mitigation or safety measures. The approach of risk assessment is in combination of qualitative and quantitative assessment of hazard sources, exposures, consequences and possible mitigation measures. A comprehensive risk management plan, occupational health and safety plan, and environment health & safety plan are the outcome of the risk assessment process.

Risk Management include all measures and work required for reducing the hazards to occur. The management include:

- ✓ Safety Training;
- ✓ Documentation of Implementation of Safety Measures;
- ✓ Formation of the safety management team;
- ✓ Hazardous material management measures;
- ✓ Fire hazard & Evacuation plan (refer section 10.4.1.4);

- ✓ Medical emergency measures;
- ✓ Occupational health & Safety.

Details of risk management procedure is discussed in **Chapter 11**.

## 12. STAKEHOLDER CONSULTATION

Stakeholder consultations are very important and sensitive issues for setting up a new power plant in any area of Bangladesh. The process was initiated with an open objective to ensure people’s participation right from the planning stage of the project. More specially, this was aimed at improving the study taking into account opinions from the people of the impacted area.

The consultation process was carried out in the Bangla languages. During these meeting a simple, non-technical, description of the project was given, with an overview of the project’s likely human and environmental impact. The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were considered as a good gesture and appreciated, by the men and women. The stakeholders’ consultation process will be continued in the operation phase of the plant, so that issues of public concern can be addressed.

**Table 9: Summary of Consultation and Discussion (Community People)**

Issues	Issues Discussed by Community people	Comments of Community People
<b>Employment</b>	Creating more employment opportunity	Due to lack of electricity, not much industry has been developed in this area. After the implementation of this project, various kinds of industry will be developed here which will create a lot of employment opportunity and socio-economic development for us.
<b>Agricultural Development</b>	Availability of water for crops	As we don’t have any electricity, we have to depend on rain and nearest sweet water of khal for watering our crops which is only available during rainy season. After the implementation this project, a change may happen in agricultural sector as we will get water from motorized pump.
<b>Conservation of Hilsa Fish</b>	Development of Ice Industry	Meghna is one of the habitats of Hilsa Fish. People of Hatiya mainly depend on fishing of Hilsa & other fishes. They request the authority not to discharge any kind of liquid waste directly into the river as it is harmful for fish. They expect

Issues	Issues Discussed by Community people	Comments of Community People
		that they will get electricity connection after the implementation of this project.
<b>Environment</b>	Possibilities of air, noise & water pollution	We have a humble request to the authority that they should follow all laws and regulations of environment. Besides, they should use high technology in order to protect air, water and soil from pollution.
<b>Resettlement/Relocation</b>	Community people will not face any resettlement/ relocation	The proposed project doesn't require any land acquisition and involuntary resettlement. Local people are in support of this project as they expect to get electricity connection after the implementation of this project.
<b>Repair and maintenance of local roads</b>	May damage the existing local roads	They requested to the Project authority that they should keep the existing road in good condition and should also request the local authority to do the repairing work when needed.
<b>Community development</b>	Overall development of Hatiya Upazila	We think this project will change our life as well as the existing condition of Hatiya. They expect that the socio-economic condition of local people will flourish. People are in favor of the project and they ask to prioritize local people and employ them during different phases of the project.

### 13. GRIEVANCE REDRESS MECHANISM AND DISCLOSURE

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

#### **14. CONCLUSION AND RECOMMENDATIONS**

As Hatiya Island in Bangladesh is an off grid remote locality, the proposed power plant will add 15MW electricity to the national grid that will improve the present electricity generation significantly and as well as trigger the national economic development. This proposed power plant will supply uninterrupted power at Hatiya island for various purposes. Not only that, industrial development will be induced after implementation. Additionally, it will create employment opportunity to the local people and improve transportation system in the project area, which will ultimately play an important role in poverty reduction and develop social safety condition.

The project has been designed to comply with the country's environmental laws and regulations especially on, air emissions, ambient air quality, wastewater effluent, and noise. The project management has taken steps to ensure that the plant will also meet the social compliance guideline. Given the management measures and monitoring commitments by the Desh Energy Hatiya Power Ltd. for the project, environmental and social impact of the project will be manageable.

## **1 INTRODUCTION**

### **1.1 Background**

Power is the main driving force of current progress and also the foundation of the growth rate. The vision of Bangladesh Government is to give access power to all by the year 2021 and in accordance with this present government's goal is to guarantee continuous and quality power supply for all by 2021 through change in generation, transmission and distribution methods. The Government of Bangladesh has announced the new policy, "Vision 2041" targeting Bangladesh to be a developed country by 2041. With the consistency of economic development, a secure power system would be necessary.

Now the biggest challenge for Bangladesh's economic growth is to ensure uninterrupted electricity supply to reduce the demand- supply gap for the growing industrial, agricultural and household needs. Because of the critical nature, the Government of Bangladesh has given highest priority to the power sector to enhance the generation capacity. BPDB has come up with a comprehensive plan to meet the surging demand in power. The plan envisages around 21,977 MW new generation addition by 2025. (BPDB, 2019-20). Power sector of Bangladesh is a proud and booming sector of the country with total generation capacity 20,383 MW and annual increment of generation capacity was 7.50% (BPDB, 2019-20). The majority of power produced in the country is used for commercial purposes.

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

Hatiya Island in Bangladesh is an off grid remote locality. Despite being only twenty kilometers away from shore, the island lacks any electricity grid connection. The government has taken a move to install a 15-megawatt (MW) HFO based power plant in Hatiya island. The Power Division under the Ministry of Power, Energy and Mineral Resources has already initiated work and selected a sponsor, Desh Energy Hatiya Power Company Ltd. to do the job.

Desh Energy Hatiya Power Company Ltd. is going to set up the 15 MW power plant at Hatiya Island from which the state-owned Bangladesh Power Development Board (BPDB) will purchase electricity for over the next 15 years. This proposed power plant will supply uninterrupted power at Hatiya island for various purposes.

Proper location, its process and waste abatement and control are very important for a development activity. To ensure this, an Environmental Impact Assessment (EIA) is a very effective tool, which delineates what needs to be done to make a development activity suitably located and operated in an

environment friendly way. Approved ToR for EIA of 15 MW HFO Fired Power Plant of Desh Energy Hatiya Power Company Ltd is attached as **Annexure 1** and ToR compliance matrix is attached as **Annexure 2**.

## **1.2 Objective of the Study**

This study will identify and evaluate the potential environmental and socio-economic impacts due to construction and operation of the proposed power plant providing detail Environmental Management Plan (EMP) to mitigate the project oriented negative impacts. It is expected that the study will facilitate the planning and design of the proposed power plant in the way of mitigating the potential negative impacts and enhancing the project benefits. The specific objectives are:

- ✓ To identify environmental regulatory requirements for power plant designing, construction and operation;
- ✓ To assess the existing environmental and socio-economic baseline condition;
- ✓ To identify the potential environmental and socio-economic impact of the proposed plant during its construction and operation;
- ✓ To identify possible mitigation measures and proposal of an Environmental & Social Management Plan for ensuring environmental and social safeguard;
- ✓ To prepare an Environmental Monitoring Plan including Environmental Compliance Monitoring during pre-construction, construction, and operation phase;
- ✓ To present the justification for the project, and to investigate alternatives to reduce potential environmental impacts and increase potential benefits;
- ✓ Documentation how stakeholders have been engaged during the EIA Process and feedback incorporation in the EIA;
- ✓ To obtain an Environmental Clearance Certificate issued by the DoE.

## **1.3 Scope of Study**

Department of Environment, (DoE), Bangladesh has categorized Power plant as “**RED category**” industry, which requires Environmental Impact Assessment (EIA) Study to assess the impacts of the power plant in the surrounding area of the plant and suggest the Mitigation measures, Environmental Management plan etc. So, the scopes of this study include but not limited to the following:

- ✓ Study of the relevant documents on Policy, Legal and Administrative framework and their review, particularly on environmental aspects and effluent discharge limits, health and safety requirements, identification of sensitive areas and endangered species, land use etc. ;
- ✓ Carrying out an Environmental baseline survey covering the project site i.e. , study areas;
- ✓ Identification of major project activities, both during construction and operational phases of the project;
- ✓ Identification of environmental impacts of project activities on the surrounding environment, including cumulative impacts of the proposed power plant;

- ✓ Identification of the most significant Environmental and Social impacts and suggestions for mitigation measures in order to eliminate negative impacts and to enhance positive impacts;
- ✓ Arrangement of consultation meetings to consult with potentially affected people ;
- ✓ Development of Environmental Management Plan (EMP) for both construction as well as operational phases of the project;
- ✓ Development of Corporate Environmental Policy for the project authority regarding environmental protection and sustainability;
- ✓ Identification of environmental and health risks associated with major accidents, natural disasters and external threats and recommendations for measures to be taken for reduction of these risks.

#### **1.4 EIA Approach & Methodology**

EIA is a process, and basically one that involves planning with all key stakeholders involved in some manner and at the right time. The idea is to give due consideration to social, environmental, and economic factors during the planning stage of a project. The EIA has been conducted considering the following activities:

- **Project Data Compilation:** A generic description of the proposed activities relevant to environmental assessment has been compiled with the help of the proponent.
- **Legislative Review:** Information on relevant & prevailing national legislation, regulations, guidelines, and standards was reviewed and compiled.
- **Baseline Data Collection:** Extensive field visits have been conducted to collect primary and secondary data to ensure establishment of proper baseline information. Secondary data on weather, soil, water resources, wildlife and vegetation were reviewed and compiled. Terrestrial ecological and fisheries baseline has also been prepared. This section covers the following aspects comprehensively in addition:
  - Relevant physical, biological, and socioeconomic conditions within the study area;
  - Detail description of local geology, topography, Local climatic condition, hydrological (Surface and ground) condition, geography, extreme environment, wind pattern and soil condition;
  - Description of land use/land cover has been provided including ecologically critical area, national parks, forest, orchard, cultural heritage site etc. (if any), in the selected project site. Landsat 8 image (Spatial Resolution: 30m\*30m and color composite band: 1-7) has been used for Land use and land cover analysis.
  - While describing the meteorological condition, mean, minimum & maximum temperature, monthly & yearly total rainfall, humidity, wind speed & wind direction of last 5 years including several relevant distribution maps of Bangladesh have been collected from Bangladesh Meteorological department (BMD) and provided in the relevant section;

- Cyclones and alignment of cyclones has been provided with maps, figures, data and information;
  - Similarly, seismicity risk and flood risk have been described with relevant maps, figures, data and information;
  - Latest Primary and Secondary Socio-economic information have been collected from latest BBS;
  - In describing ecology, aquatic flora, aquatic fauna, terrestrial flora, terrestrial fauna and forest as are available in the site and site area have been described with photographs;
  - Description of map unique sites or special features such as parks and protected areas, Heritage Rivers, historic sites, environmentally and culturally significant sites;
  - Baseline representative data has been collected (air, noise, surface & ground water and soil) as per the DoE Guideline and approved ToR for EIA.
- **Identification of potential impacts:** The information collected in the previous steps were reviewed and potential environmental issues were identified.
  - **Impact Assessment:** The environmental, socioeconomic, and project information was collected to assess the potential impacts of the proposed activities. The impact assessment was considered for the project during pre-construction, Construction and Operation stage of the project.
  - **Suggestion of Mitigation Measures for Adverse Impacts:** After identifying all negative impacts at all stages i.e., pre-construction, Construction and Operation stage of the project, suggestions for mitigation measures have been outlined as per the prevailing national guideline.
  - **Suggestion of Environmental Management and Monitoring Plan:** A structured Environment management and monitoring plan has been suggested to mitigate all adverse impacts with appropriate monitoring suggestions to ensure the compliance of the local and international lender legislations.
  - **Stakeholder Consultation:** Extensive consultation has been conducted with key stakeholders' including the local population, government departments/agencies, and NGOs.

## **1.5 Scientific Approach for Baseline Study**

### **1.5.1 Particulate/Air Quality Monitoring**

Particulate monitoring is accomplished with Respirable Dust sampler, which is a vacuum type device that draws air with particulate matter through a filter paper. Particles within the range of 100 to 0.1 microns diameter are ordinarily collected on glass fiber filter. The instrument sucks the ambient air with a blower at a flow rate that allows suspended particles to pass to the filter surface. This sampling filter paper is dried up in the laboratory and the weight difference is the amount of PM<sub>2.5</sub> and PM<sub>10</sub>, content measured in micro grams per cubic meter of air collected over a period of 24 hours.

- **Principle of West Gaeke Method:** This method is based on the absorption and stabilization of SO<sub>2</sub> from air by a solution of Sodium tetrachloromercurate II to form the dichlorosulfitomercurate II complex. Quantitative determination is accomplished by adding acid bleached parasonaline HCl and formaldehyde to the sulfite complex and measuring the color intensity by a UV Spectrophotometer.

- **Principle of Jacobs-Hochheiser Method:** Ambient NO<sub>2</sub> is collected by bubbling Air through a solution of Sodium Hydroxide and Sodium Arsenite. The concentration of Nitrite ion produce during sampling is determined colorimetrically by reacting the Nitrite ion with Hydrogen Peroxide, Sulphanilamide, NEDA (N-(1-Naphthyl) Ethylenediamine di-hydrochloride) and measuring the absorbance of highly colored azo dye at 540 nm.

#### ❖ **Equipment Used**

The **APM 460** sampler uses an improved cyclone with sharper cutoff (D50 at 10 microns) to separate the coarser particulates from the air stream before filtering it on the glass microfibre filter. By using the APM 460, measurement of Respirable Particulate Matter can be done accurately and TSPM can also be assessed by collection of dust retained in the cyclone cup.

**APM 460 BL** comes with an in-built voltage stabilizer to compensate for voltage fluctuations. This model has been made more user-friendly by providing a lighting arrangement for night operation, tool box within the instrument, softer handles, lockable top-cover and wheels for easy transportation. The cabinet design has also been improved to prevent entry of rain water and dust into the machine. Owing to its modular design, APM 460 BL can be easily paired with a gaseous sampling attachment (for monitoring SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub>, Ozone etc.) as gaseous sampling requires only a few LPM of air flow.

The **AAS 127** system is a manual method for sampling fine particles (PM<sub>2.5</sub> fraction) and is based on impactor designs standardized by USEPA for ambient air quality monitoring. Ambient air enters the sampler system through an omni-directional inlet designed to provide a clean aerodynamic cut-point for particles greater than 10 microns. Particles in the air stream finer than 10 microns proceed to a second impactor that has an aerodynamic cut-point at 2.5 microns. The air sample and fine particulates exiting from the PM<sub>2.5</sub> impactor are passed through a 47 mm diameter Teflon filter membrane that retains the fine particulate matter. The sampling rate of the system is held constant at 1 m<sup>3</sup>/hr by a suitable critical orifice. The standard system is supplied with a Dry Gas Meter to provide a direct measure of the total air volume sampled. Owing to its modular design, APM 550 can be easily paired with a gaseous sampling attachment (for monitoring SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub>, Ozone etc.) as gaseous sampling requires only a few LPM of air flow.

**CO Meter** (KXL-801 Portable Carbon Monoxide (CO) Detector) is used to measure carbon monoxide. CO meter gives the data of carbon monoxide directly. The CO meter is shown in **Figure 1.2** below:



**Fig: APM 460 BL**



**Fig: AAS 217 BL**



**Fig: AAS 127 Mini**

**Figure 1.1: Particulate/Air Quality Monitoring Instrument**



**Figure 1.2: KXL-801 Portable Carbon Monoxide (CO) Detector**

### 1.5.2 Monitoring of Noise Level

Noise is an important environmental pollutant. A survey by the U S. Federal Council of Science and Technology has revealed that noise is a technology generated problem and that the overall loudness of environmental noise doubles every ten years in pace with our social and industrial progress. This geometric progression wise growth of noise could be mind-boggling in view of the ever-increasing pace of technological growth. According to Robert Koch a Nobel Prize winner German bacteriologist “**A day will come when man will have to fight merciless noise as the worst enemy of health**”. According to him “Noise like smog, is a slow agent of death.”

**Measurement of noise—Noise is a combination of intensity and frequency** and can be measured in decibels. Decibel is a unit of sound, named after Alexander Graham Bell.

The level of sound is usually expressed in terms of the Sound Pressure Level (SPL) in decibels, which is defined as:

$$\text{SPL} = 20 \log_{10} P / P_0 \text{ dB}$$

Where P is the pressure variation measured in N/ m<sup>2</sup> and P<sub>0</sub> is the standard reference pressure taken as 2x 10<sup>-5</sup> N/m<sup>2</sup>



**Figure 1.3: Noise Meter (CEM Sound Level Meter)**

➤ **Monitoring procedure of noise level**

Noise level monitoring was performed for 24 hours (day and night). At the time of measurement, whenever there was an interfering effect like mike noise, human voice from house and bazaar, vehicular sound, sound of machine and tool from workshop etc., was also recorded.

### **1.5.3 Water Sampling Method**

The procedures described are to be used by field personnel when collecting and handling water samples in the field. On the occasion that field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a water sample, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Prepare a Sampling and Analysis Plan (SAP) which describes the sampling locations, numbers and types of samples to be collected, and the quality control requirements of the assigned project.

#### **Equipment**

- 1) Plastic Bottle
- 2) Gloves
- 3) Niskin sampler
- 4) Icebox

➤ **Surface Water sampling procedure**

1. Surface water samples shall be collected either by directly filling the container from the surface water body being sampled or by decanting the water from Niskin sampler;
2. Use a funnel to fill up the bottle. The collecting device i.e., Niskin sampler shall not touch the container;
3. Cap the bottle well and label the container prior to storing inside the icebox.

➤ **Ground / Drinking Water sampling procedure**

1. Select a cold-water faucet for sampling which is free of contaminating devices such as screens, aeration devices, hoses, purification devices or swiveled faucets. Check the faucet to be sure it is clean. If the faucet is in a state of disrepair, select another sampling location;
2. Open the faucet and thoroughly flush. Generally, 2 to 3 minutes will suffice;
3. Do not rinse or overfill container. Close the plastic bottle cap and store in the icebox.

**1.6 The EIA Team**

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

**Table 1.1: EIA Team**

Professional	Name	Expected Expertise
EIA & Emission Modeling Expert	<b>Dr. Nasir Uddin Khan</b> B.Sc. Eng. (Civil), M.Sc. Eng. (Environment), PhD (USA)	Environmental & Social Impact Assessment (IEE, EMP/ESIA), Industrial Wastewater Treatment, Environment monitoring, Solid waste management, Climate Change, Environmental Management System, Occupational Health & safety, Cleaner Production and Energy efficiency, Air & Noise modeling, environmental education & awareness.
Disaster Impact and Risk Assessment Specialist	<b>Dr. Md. Rezaul Karim</b> B.Sc. Eng. (Civil), M.Sc. Eng. (Environment), PhD (Japan)	Identify the threats of disaster, preparation of plans to minimize the risks from those threats, Prepare Disaster Management Plan (related to climate change, natural hazards, flood management, vulnerability and disaster related risk).
Ecologist	<b>Dr. Lutfor Rahman</b> BSc (Hons) and MSc in Forest Ecology, University of Chittagong, Bangladesh,	Ecological survey on the fauna (macro and micro invertebrates, fishes, birds) of the project area, Primary Aquatic and Ecological survey details

Professional	Name	Expected Expertise
	PhD in Ecology, University of Northampton, UK	analysis, Establishing baseline condition fisheries and aquatic resources.
Environmental Specialist	<b>Md Saiful Islam</b> B.Sc. Engineering (Civil, RUET), M.Sc. Engg. (Civil & Environment)	Industrial wastewater Treatment, Engineering survey, site plan, Preparation of IEE, EMP & EIA. Environmental Monitoring
Environmental Specialist	<b>Shanjana Haider</b> B.Sc. Engineering (Civil, BUET), M.Sc. Engg. (Civil & Environment)	Analyze the impact of a project on the environment, identifying environmental issues, and recommending solutions. Engineering survey, site plan, Preparation of IEE, EMP & EIA. Environmental Monitoring and report preparation.
Environmental Monitoring Specialist	<b>Al-Amin</b> B.Sc. Engineering (Civil, RUET)	Industrial wastewater Treatment, Engineering survey, site plan, Performing monitoring and preparation of Environmental Monitoring report.
Environmental Engineer	<b>Suchita Kha</b> B.Sc. Engineering (Civil, KUET)	Engineering survey, site plan, Preparation of IEE, EMP & EIA. Environmental Monitoring.
GIS Analyst	<b>Md. Golam Rasul</b> B.Sc. Engineering (BURP, RUET)	Analyzing spatial data through mapping software and preparing digital maps with geographic data and various other data sets.
Senior Chemist	<b>Md. Faisal Bin Mahmud</b>	Environmental Monitoring, Laboratory analysis for different environmental parameters.
Field Investigator/ co-coordinator	<b>Md. Kamal Uddin</b>	Base line data collection, secondary data collection, sample collection and site survey.
	<b>Md. Al Mamun</b>	Base line data collection, sample collection from site, sample preservation and laboratory analysis.
	<b>Md. Khalid Hossain</b>	Base line data collection, sample collection from site, sample preservation and laboratory analysis.

## 1.7 Limitations of the Study

An EIA is generally carried out as an integral part of the Feasibility Study (FS) or together with it and before going into the final design phase and into the construction phase of a particular development project. If so than the findings of the EIA could be incorporated in the project design, overall planning and budget and that the project could be implemented accordingly.

Services performed by the consultant are conducted in a manner consistent with level of care and skill generally exercised by members of the engineering and consulting profession. The report may not

exhaustively cover an investigation of all possible aspects and circumstances that may exist. However, an effort is made to discover all meaningful areas under the stipulated time available.

In evaluating subject site, consultant relies in good faith on information provided by client's management or Employees. The Consultant assume that the information provided is factual, accurate and accepts no responsibility for any deficiency, misstatement or inaccuracies contained in this report as a result of omission or misrepresentation of any person interviewed or contacted. However, the consultant notifies the contradictions and errors in the data, where it seems appropriate.

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

## **1.8 Acknowledgement**

The EIA Report has been prepared basically with the support from Desh Energy Hatiya Power Company Ltd. and also from various government agencies and NGOs including Department of Environment (DOE), Bangladesh Meteorological Department (BMD), Bangladesh Bureau of Statistics (BBS), Bangladesh Water Development Board (BWDB), Forest department, Fisheries department etc. We would like to express our gratitude to each organization and its employees for their contribution and kind co-operation in conducting the study.

## **2 LAW AND LEGISLATION**

### **2.1 Introduction**

The emerging environmental scenario calls for attention on conservation and judicious use of natural resources. There is a need to fulfill the environmental outcomes of the development activities and for planning suitable measures in order to ensure sustainable development. The environmental considerations in any developmental process have become necessary for attaining sustainable development. For protecting the environment from pollution and environmental degradation, Government of Bangladesh has promulgated some policies, strategies, laws, rules and regulations.

As an institutional arrangement, Government of Bangladesh has designated the "Department of Environment" (DOE) with the responsibility for the regulatory functions to enforce of the provisions of environmental laws, rules and regulations to prevent environmental degradation in the country. Under these legal provisions, the industrial entrepreneurs/ project owner must take mitigation measures to protect the environment from pollution and adverse impacts and must get "Environmental Clearance" from DOE before setting up and running their industries/project.

Desh Energy power Company Ltd. is committed to environmental protection in accordance with the existing environmental laws, rules and regulations of Bangladesh. The environmental classifications for industrial projects in Bangladesh are based on "inclusion lists" given in the ECR97 with 'RED' being the highest. Power Plant is listed in the 'Red Category' in ECR97 (i.e., serial no.6 in the ECR97 Red list in Schedule-1.). The prevailing national policies, strategies, laws, rules, action plans etc. on environment are discussed briefly in the following section.

### **2.2 Environment Related Policies**

#### **2.2.1 Industrial Policy 1991**

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

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

### **2.2.2 National Environmental Policy 1992**

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

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

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

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

### **2.2.3 National Conservation Strategy**

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

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

#### **2.2.4 National Environmental Management Action Plan (NEMAP), 1995**

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

NEMAP has the broad objectives of:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development;
- Improvement in the quality of life of the people;
- One of the key elements of NEMAP is that sectoral environmental concerns are identified. In outline, the environmental issues of the industrial sector include the following:
  - ✓ Pollution arising from various industrial processes and plants throughout the country causing varying degrees of degradation of the receiving environment (Air, Water, and Land);
  - ✓ There is a general absence of pollution abatement in terms of waste minimization and treatment;
  - ✓ Low level of environmental awareness amongst industrialists and entrepreneurs;
  - ✓ Lack of technology, appropriate to efficient use of resources and waste minimization leading to unnecessary pollution loading in the environment;
  - ✓ Economic constraints on pollution abatement and waste minimization such as the cost of new technology, the competitiveness of labor, and intensive production methods as compared to more modern methods;
  - ✓ Concentration of industry and hence pollution in specific areas which exacerbate localized environmental degradation and exceed the carrying capacity of the receiving bodies;
  - ✓ Unplanned industrial development has resulted in several industries located within or close to residential areas, which adversely affects human health and quality of human environment;
  - ✓ Establishment of industries at the cost of good agricultural lands and in the residential areas;
  - ✓ Lack of incentives to industrialists to incorporate emission/discharge treatment plant in their industries.

## **2.3 National Legislation Related to Environment**

### **2.3.1 Environment Conservation Act 1995 (ECA 1995), Amended in 2010**

The national environmental legislation known as **Environmental Conservation Act, 1995 (ECA'95)** is currently the main legislative document relating to environmental protection in Bangladesh, which repealed the earlier environment pollution control ordinance of 1997 and has been promulgated in 1995. It was amended in 2002 and then again in 2010. The main objectives of ECA'95 are:

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

The main strategies of the act can be summarized as:

- Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas;
- Restriction on cutting hill, on pollution due to ship breaking and on water reservoir;
- Restriction on production, import, storage, loading, transportation etc. of hazardous waste;
- Regulation in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities - discharge permit;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of standard limit for discharging and emitting waste;
- Formulation and declaration of environmental guidelines.

### **2.3.2 Environment Conservation Rules, 1997 (subsequent amendments in 2002, 2003 and 2017)**

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

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

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

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

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

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

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

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

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

The ambient standard of water quality, air quality and noise are presented in **Table 2.1 to Table 2.5** in the following page. Standards refer to discharges to freshwater bodies with values in parentheses referring to direct discharges to agricultural land.

**Table 2.1: Inland Surface Water Quality Standards**

Best practice-based Classification	p <sup>H</sup>	BOD mg/l	DO mg/l	Total Coliform No./100
Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less

Best practice-based Classification	p <sup>H</sup>	BOD mg/l	DO mg/l	Total Coliform No./100
Water usable for recreational activity	6.5-8.5	3 or less	5 or above	200 or less
Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or above	5,000 or less
Water usable by fisheries	6.5-8.5	6 or less	5 or above	-
Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or above	5,000 or less
Water usable for irrigation	6.5-8.5	10 or less	5 or above	1,000 or less

(ECR- Schedule 3)

**Table 2.2: Standards for Waste from Industrial Units**

Parameters	Unit	Inland Surface Water	Irrigated Land
Biological Oxygen Demand (BOD <sub>5</sub> ) at 20° C	mg/l	50	100
Chemical Oxygen Demand (COD)	mg/l	200	400
Dissolve Oxygen (DO)	mg/l	4.5-8	4.5-8
Total Dissolved Solids (TDS)	µmho/cm	2,100	2,100
p <sup>H</sup>		6-9	6-9
Suspended Solid (SS)	mg/l	150	200
Chloride	mg/l	600	600
Iron	µmho/cm	2	2

(ECR- Schedule 10)

**Table 2.3: Ambient Air Quality Standards**

Air Pollutant	Standards	Average time
Carbon Monoxide (CO)	10 mg/m <sup>3</sup> (9 ppm) <sup>ka</sup>	8 hours
	40 mg/m <sup>3</sup> (35 ppm) <sup>ka</sup>	1 hour
Lead (Lb)	0.5 µg/m <sup>3</sup>	Annual
Oxides of Nitrogen (NO <sub>x</sub> )	100 µg/m <sup>3</sup> (0.053ppm)	Annual
Suspended Particulate Matter (SPM)	200 µg/m <sup>3</sup>	8 hours
PM <sub>10</sub>	50 µg/m <sup>3</sup> <sup>kha</sup>	Annual
	150 µg/m <sup>3</sup> <sup>Ga</sup>	24-hours
PM <sub>2.5</sub>	15 µg/m <sup>3</sup>	Annual
	65 µg/m <sup>3</sup>	24-hours

Air Pollutant	Standards	Average time
Ozone(O <sub>3</sub> )	235 µg/m <sup>3</sup> <sup>kha</sup> (0.12ppm) <sup>Gha</sup>	1-hour
	157 µg/m <sup>3</sup> (0.08ppm)	8-hours
Sulphur di Oxide (SO <sub>2</sub> )	80 µg/m <sup>3</sup> (0.03ppm)	Annual
	365 µg/m <sup>3</sup> (0.14ppm) <sup>ka</sup>	24-hours

ECR- Schedule 2 (Amended in 2005)

Abbreviation: ppm: Parts Per Million

Notes:

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

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

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

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

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

**Table 2.4: Standards for Gaseous Emission from Industries**

Parameters for power plant (<200 MW)	Standard present
Particulate	350 mg/Nm <sup>3</sup>
Oxides of Nitrogen	30 ppm

(ECR- Schedule 11)

**Table 2.5: Ambient Noise Standards**

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

ECR- Schedule 1 (Amendment in 2006)

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

### **2.3.3 EIA (Environmental Impact Assessment) Guidelines for Industries, 1997**

The Department of Environment (DoE) has prepared 'EIA Guideline for Industries' 1997 under the project entitled "To Develop and Apply Sector wise Industrial Guidelines and Standards and to Monitor Compliance" as well as on the requirements of the Environmental Conservation Rules, 1997. According to this guideline, even industrial project should take care about specific environmental issues depending on type of waste emission, possible environmental and social effects and available mitigation technologies. This guideline states the process of environmental impact assessment, key issues related to specific industries, format of checklist and EIA report including environmental management plan.

### **2.3.4 Environmental Court Act, 2010**

The 2010 Environmental Court Act supports the Environmental Conservation Act (1995) and the Environmental Conservation Rules (1997) by providing for the establishment of environmental courts for the trial of offences relating to environmental pollution. It includes protocols for the establishment of the court, and defines the court's jurisdiction, appropriate penalties, powers of search and entry, and procedures for investigation, trial and appeal. With the enactment of 2010 law, the earlier Act of 2000 was repealed which proved ineffective due to various limitations. Of course, the efficacy of the present Act is still to be proven.

## **2.4 Other Legislation**

### **2.4.1 National Land-use Policy, 2001**

The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may be not possible through artificial land reclamation process, which is cost effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained.

### **2.4.2 Bangladesh Labor Act (2006)**

Labor relation in Bangladesh is governed Bangladesh Labor Act of 2006 (Amended in 2013) and Labor Rules of 2015. The amendments to the 2006 Labor Act make it more in line with the International Labor Standards. The new labor law has 87 sections of amendments to strengthen workers' rights, including better protections related to freedom of association (i.e., to form trade unions), and improving occupational health and safety conditions.

The Bangladesh Labor Act and the Labor Rules of 2015 (made under the Act) are generally consistent with ILO's core conventions ratified by Bangladesh, as listed in Section 4.4. The only core convention not ratified by Bangladesh is ILO 138 (Minimum Age Convention). However, consistently with ILO 138, the Bangladesh Labor Act provides that the minimum age to work is 14 (although a special clause states that children

between the ages of 12 and 14 may be Employed to do “light work” that does not endanger their health, development and education).

### **2.4.3 The Bangladesh Water Act 2013**

The recently published Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. In general, if one takes a Bangladesh Water Development Board 2-11 critical look at the Act, the new law has provided the right framework for better management of water resources in the country.

As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. The private landowners will be able to use the surface water inside their property for all purposes in accordance with the Act. A worthwhile initiative is the requirement for permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks. However, the maximum amount of surface water or groundwater that can be withdrawn by individuals or organizations is not mentioned in the Act. Setting up a priority order for water usage in an area where the water resources is in critical condition is also a significant step.

The Act also makes a provision for approving National Water Resources Plan prepared in accordance with the Water Resources Planning Act, 1992 containing among others, the following matters namely:

- Analysis of economic, natural, social, political, environmental, and ecological and institutional elements, characteristics and impact of water resources;
- Integrated use of surface and ground water emphasizing the highest possible use of rain water;
- Determination of water quality standard;
- Fixation of priority of water use.

### **2.4.4 National Water Management Plan, 2001**

The National Water Management Plan addresses options for water quality, considerations behind measures to clean up industrial pollution, where effluent discharge monitoring and zoning regulations for new industries are emphasized.

### **2.4.5 National Fisheries Policy, 1996**

The National Fisheries Policy (NFP), 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture

and management programs. The policy particularly focuses on aquaculture and marine fisheries development. The policy suggests following actions:

- Biodiversity will be maintained in all-natural water bodies and in marine environment
- Chemicals harmful to the environment will not be used in fish shrimp farms
- Environment friendly fish shrimp culture technology will be used
- Expand fisheries areas and integrate rice, fish and shrimp cultivation
- Control measures will be taken against activities that have a negative impact on fisheries resources and vice-versa
- Laws will be formulated to ban the disposal of any untreated industrial effluents into the water bodies.

#### **2.4.6 National Water Policy, 2000**

The National Water Policy recognizes that continued development and management of the nation's water resources is essential. Specific provisions made under the Policy include: protection, restoration and enhancement of water resources; protection of water quality, including strengthening regulations concerning agro-chemicals and industrial effluent; sanitation and potable water; fish and fisheries; and, participation of local communities in all water sector development.

The Policy also includes provisions for protection, restoration and preservation of the environment and biodiversity including wetlands, mangrove and other natural forests, endangered species and water quality. It also states objectives for all agencies and departments entrusted with water management in regards to their responsibilities for regulation, planning, construction, operation and maintenance. Pollution of surface and ground water around various industrial centers from untreated effluent discharge into water courses is a critical water management issue. The Policy of the Government in this regard is that:

- a) Zoning regulations will be established for location of new industries in consideration of safe water availability and suitable effluent discharge possibilities;
- b) Effluent disposal will be monitored by relevant government agencies to prevent water pollution;
- c) Standards of effluent disposal into common water courses will be set by Water Resources Planning Organization (WARPO) of the Ministry of Water Resources in consultation with DoE; and
- d) Industrial polluters will be required by law to pay for remedial clean-up of water bodies polluted by them.

#### **2.4.7 Bangladesh National Building Code (BNBC) 2020**

Bangladesh National Building Code widely known as BNBC Code, is the ultimate code that is followed in Bangladesh to build safe houses and buildings. Earthquakes and wind effect of different building systems are incorporated in this code. However, there are some differences in that, it incorporates modifications by keeping in view the biological, environmental and geological factors in Bangladesh. Moreover, socio-

economic factors have also been taken into consideration while preparing this code. This code is very helpful to the related professionals like architects and town planners as it takes into account the conditions specific to Bangladesh. The purpose of this Code is to establish minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of all buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property and public welfare.

#### **2.4.8 Antiquities Act, 1968**

This legislation governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and excavation of archaeological sites.

#### **2.4.9 Inland Water Transport Authority Ordinance, 1958**

An Ordinance to set up an Authority for development, maintenance and control of inland water transport and of certain inland navigable waterways. The main development and maintenance functions of this ordinance are-

- ✓ Carry out river conservancy works including river training works for navigational purposes and for provision of aids to navigation including marks, buoys, lights and semaphore signals;
- ✓ Disseminate navigational and meteorological information including publication of river charts;
- ✓ Draw up programmers of dredging requirements and priorities for efficient maintenance of existing navigable waterways and for resuscitation of dead or dying rivers, channels, or canals, including development of new channels and canals for navigation;
- ✓ Develop, maintain and operate inland river ports, landing/ferry ghats and terminal facilities in such ports or ghats;
- ✓ Carry out removal of wrecks and obstruction in inland navigable waterways;
- ✓ Conduct traffic surveys to establish passenger and cargo requirements on the main rivers, feeders and creek routes;
- ✓ Develop rural water transport by progressing of schemes for modernizing and mechanizing country craft;
- ✓ Arrange programs of technical training for Inland Water Transport personnel;
- ✓ Maintain liaison with the Government and facilitate import of repair materials for the Inland Water Transport Industry.

#### **2.4.10 Inland Shipping Ordinance, 1976**

This act deals with the administration, registration, competency and pollution control, etc., of inland water transport. Primarily addresses pollution in the coastal and national waters and seaports of Bangladesh. The Act provides control for oil or pollutants discharged, spilled or dumped into Bangladesh water from ships, ship transfer to land, land, ports, and exploration of the sea bed, pipeline and offshore installations.

#### **2.4.11 Convention on Biological Diversity. Rio de Janeiro, (1992)**

The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 05 June, 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March, 1994. This is the overarching framework for bio-diversity and the signatories are required to develop a National Bio-diversity Strategy and Action Plan that incorporates the articles of the convention into national law and statutes. Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity.

#### **2.5 Implications of Policies and Regulations on the Proposed Project**

**Table 2.6** below presents an outline of other National legal instruments that will have relevance to the proposed Project with respect to the social and environmental considerations.

**Table 2.6 National Legal Instruments relevant to the Project**

Act/ Rule/ Law/ Ordinance	Enforcement Agency - Ministry/ Authority	Key Features	Applicability to the Project
<b>National Environmental Policy, 1992</b>	Department of Environment Ministry of Environment, Forest and Climate Change (MOEFCC)	<ul style="list-style-type: none"> <li>• To maintain the ecological balance and overall progress and development of the country through protection and improvement of the environment;</li> <li>• To protect the country against natural disasters;</li> <li>• To identify the regulation of all types of activities which pollute and degrade the environment;</li> <li>• To ensure sustainable utilization of all-natural resources.</li> </ul>	Applicable as the proposed project activity associated with environmental issues.
<b>Industrial Policy, 1991</b>	Ministry of Industry (Mol)	<ul style="list-style-type: none"> <li>• To conserve ecological balance and prevent pollution during industrialization;</li> <li>• To take effective steps for pollution control and conservation of environment during industrialization;</li> <li>• To ensure embodying of necessary pollution control and preventive measures by industrial investment project endangering environment.</li> </ul>	Applicable as the project type is an industrial development which may have impacts on ecology and may pollute the environment.
<b>National Conservation Strategy, 1992</b>	Ministry of Environment, Forest and Climate Change (MOEFCC)	<ul style="list-style-type: none"> <li>• All industries shall be subject to an EIA and the adoption of pollution prevention/ control technologies shall be enforced;</li> <li>• Hazardous or toxic materials/wastes shall not be imported as raw materials for industry;</li> <li>• Import of appropriate and environmentally-sound technology shall be ensured;</li> </ul>	Applicable as the project authority needs to meet all the requirements effectively.

Act/ Rule/ Law/ Ordinance	Enforcement Agency - Ministry/ Authority	Key Features	Applicability to the Project
		<ul style="list-style-type: none"> <li>• Dependence on imported technology and machinery should gradually be reduced in favor of sustainable local skills and resources.</li> </ul>	
<b>National Environmental Management Action Plan (NEMAP), 1995</b>	Department of Environment  Ministry of Environment, Forest and Climate Change (MOEFCC)	<ul style="list-style-type: none"> <li>• To identify the key environmental issues affecting Bangladesh;</li> <li>• To identify the actions necessary to halt or reduce the rate of environmental degradation;</li> <li>• To improve the natural and built environment;</li> <li>• To conserve the habitats and biodiversity;</li> <li>• To promote the sustainable development;</li> <li>• To improve the quality of life of the people.</li> </ul>	Applicable as the project is related with environmental issues.
<b>National Land-use Policy, 2001</b>	Ministry of Land	<ul style="list-style-type: none"> <li>• To deal with several lands uses including agriculture (crop production, fishery, and livestock), housing, forestry, industrialization, railways and roads, tea and rubber;</li> <li>• To identify land use constraints in all these sectors.</li> </ul>	Applicable as land usage involved in this project and there are agricultural lands around the project area.
<b>National Fisheries Policy, 1996</b>	Ministry of Fisheries and Livestock	<ul style="list-style-type: none"> <li>• Preservation, management, and exploitation of fisheries resources in inland open water;</li> <li>• Fish cultivation and management in inland closed water;</li> <li>• Prawn and fish cultivation in coastal areas;</li> <li>• Preservation, management, and exploitation of sea fishery resources.</li> </ul>	Applicable as there may be some negative impact on fish fauna resulting from project activities.

Act/ Rule/ Law/ Ordinance	Enforcement Agency - Ministry/ Authority	Key Features	Applicability to the Project
<b>National Water Policy, 2000</b>	Ministry of Water Resources (MOWR)	<ul style="list-style-type: none"> <li>• Protection, restoration, and enhancement of water resources;</li> <li>• Protection of water quality, including strengthening regulations concerning agrochemicals and industrial effluent;</li> <li>• Participation of local communities in all water sector development.</li> </ul>	Applicable for the protection of water resources and water quality of the water sources around the project area.
<b>The Environment Conservation Act, 1995 and subsequent amendments in 2000, 2002 and 2010</b>	Department of Environment Ministry of Environment, Forest and Climate Change (MOEFCC)	<ul style="list-style-type: none"> <li>• Define Applicability of environmental clearance;</li> <li>• Regulation of development activities from environmental perspective;</li> <li>• Framing applicable limits for emissions and effluents;</li> <li>• Framing of standards for air, water, and noise quality;</li> <li>• Formulation of guidelines relating to control and mitigation of environmental pollution, conservation, and improvement of environment;</li> <li>• Declaration of Ecologically critical areas.</li> </ul>	Applicable as the proposed project activity associated with environmental issues.
<b>Environmental conservation Rules, 1997 and subsequent amendments in 2002, 2003 and 2017</b>	Department of Environment Ministry of Environment, Forest and Climate Change (MOEFCC)	<ul style="list-style-type: none"> <li>• Declaration of Ecologically critical areas;</li> <li>• Requirement of environmental clearance certificate for various categories of projects;</li> <li>• Requirement of IEE/EIA as per category;</li> <li>• Renewal of the environmental clearance certificate within 30 days after the expiry;</li> <li>• Provides standards for quality of air, water and sound and acceptable limits for</li> </ul>	Applicable as the Project falls under Red Category and require EIA approval prior to start construction and environmental Clearance Certificate prior to start of operation

Act/ Rule/ Law/ Ordinance	Enforcement Agency - Ministry/ Authority	Key Features	Applicability to the Project
		emissions/discharges from vehicles and other sources.	
<b>Environment Court Act, 2000 and subsequent amendments in 2002</b>	Ministry of Environment and Forests and judiciary	<ul style="list-style-type: none"> <li>• GoB has given highest priority to environment pollution;</li> <li>• Passed 'Environment Court Act, 2000 for completing environment-related legal proceedings effectively;</li> <li>• Provides the Jurisdictions of environment court, the penalty for violating court's order, trial procedure in special magistrate's court, the power of entry and search, the procedure for investigation, procedure and power of environment court, the authority of environment court to inspect, appeal procedure and formation of environment appeal court.</li> </ul>	Applicable as the project authority needs to meet all the requirements effectively.
<b>Bangladesh National Building Code (BNBC) 2020</b>	Ministry of Housing and Public Works	<ul style="list-style-type: none"> <li>• This code is followed in Bangladesh to build safe houses and buildings;</li> <li>• Earthquakes and wind effect of different building systems are incorporated in this code.</li> </ul>	Applicable as the structural work will be carried out in the project area.
<b>Bangladesh Water Act, 2013</b>	Ministry of Water Resources (MOWR)	<ul style="list-style-type: none"> <li>• All forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people;</li> <li>• The private landowners will be able to use the surface water inside their property for all purposes;</li> </ul>	Applicable as the proposed project will use surface water as well as groundwater and will require permit for ground water extraction.

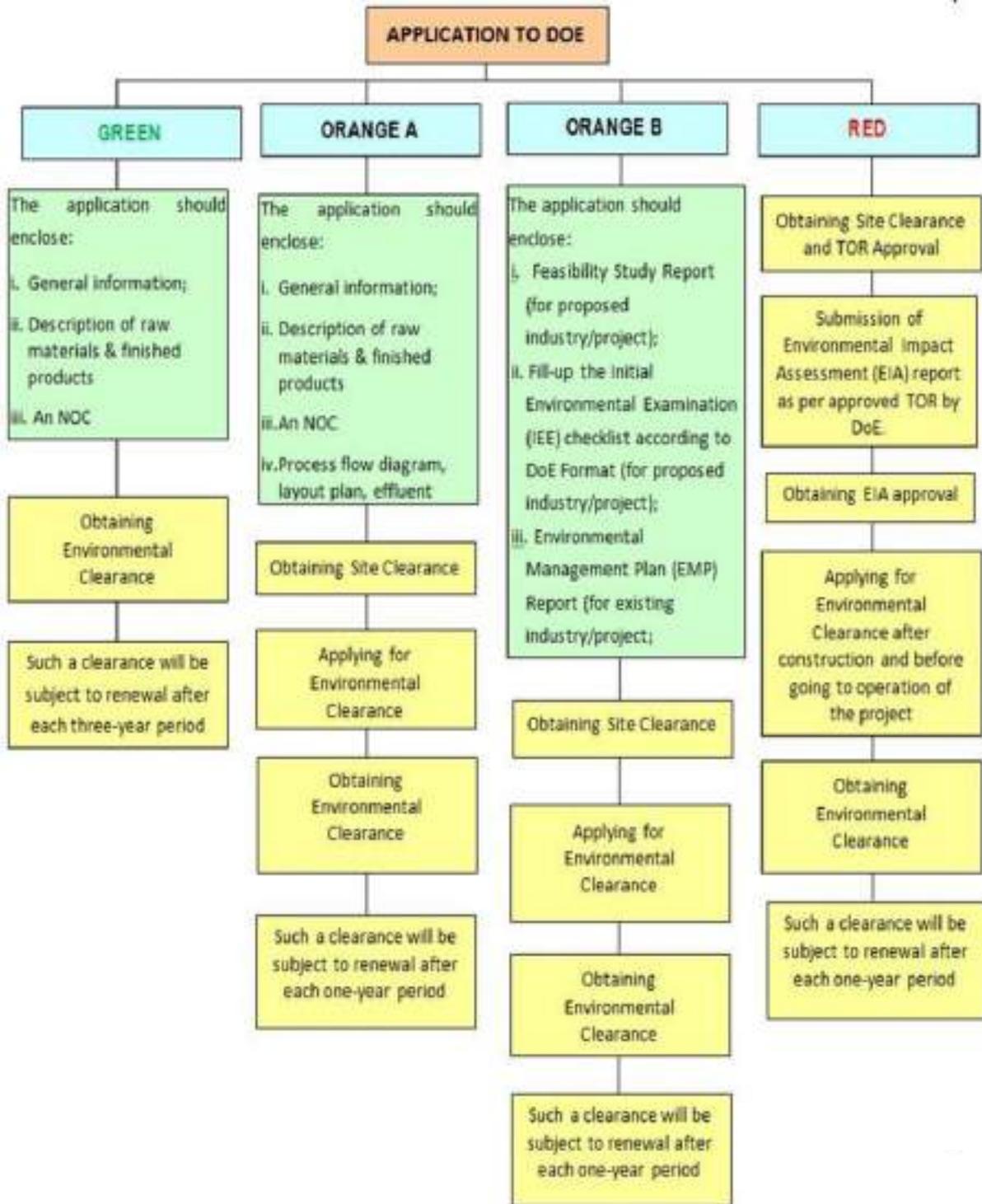
Act/ Rule/ Law/ Ordinance	Enforcement Agency - Ministry/ Authority	Key Features	Applicability to the Project
		<ul style="list-style-type: none"> <li>As per this act WARPO issues permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources.</li> </ul>	
<b>Bangladesh Labor Act, 2006</b>	Ministry of Labor and Employment	<ul style="list-style-type: none"> <li>Provides health, safety, and well-being of workforce during project life cycle. In addition, it also stipulated that, children under 18 years are not allowed to be employed during project life cycle and therefore, this law requires to be complied with.</li> </ul>	Applicable as skilled, semi-skilled and day labor will work at different phases of the project.
<b>National Water Management Plan, 2001</b>	Ministry of Water Resources (MOWR)	<ul style="list-style-type: none"> <li>The National Water Management Plan addresses options for water quality, considerations behind measures to clean up industrial pollution, where effluent discharge monitoring and zoning regulations for new industries are emphasized.</li> </ul>	Applicable for the preservation of water quality of the project area.
<b>Antiquities Act, 1968</b>	Ministry of Law, Justice and Parliamentary Affairs	<ul style="list-style-type: none"> <li>To preserve the national cultural heritage;</li> <li>To protect and control ancient monuments;</li> <li>To regulate antiquities as well as the maintenance, conservation and restoration of protected sites and monuments;</li> <li>To control planning, exploration and excavation of archaeological sites.</li> </ul>	Applicable for the preservation of cultural heritages around the project site.

Act/ Rule/ Law/ Ordinance	Enforcement Agency - Ministry/ Authority	Key Features	Applicability to the Project
<b>The Inland Water Transport Authority Ordinance, 1958</b>	Ministry of Shipping (MoS)	<ul style="list-style-type: none"> <li>• Carry out river conservancy works including river training works for navigational purposes and for provision of aids to navigation including marks, buoys, lights and semaphore signals;</li> <li>• Develop, maintain and operate inland river ports, landing/ferry ghats and terminal facilities in such ports or ghats;</li> <li>• Removal of wrecks and obstruction in inland navigable waterways;</li> <li>• Conduct traffic surveys to establish passenger and cargo requirements on the main rivers, feeders and creek routes.</li> </ul>	Applicable as loading and unloading of raw material and equipment is involved at existing ferry ghat.
<b>Inland Shipping Ordinance 1976</b>	Ministry of Shipping (MoS)	<ul style="list-style-type: none"> <li>• Deals with the administration, registration, competency and pollution control, etc. of inland water transport;</li> <li>• Provides control for oil or pollutants discharged, spilled or dumped into Bangladesh water from ships, ship transfer to land, land, ports, and exploration of the sea bed, pipelines and offshore installations.</li> </ul>	Applicable as there may be some discharge of oil, chemicals or other pollutants from ships/vessels into water due to project activities
<b>Convention on Biological Diversity. Rio de Janeiro, (1992)</b>	-	<ul style="list-style-type: none"> <li>• This is the overarching framework for bio-diversity and the signatories are required to develop a National Bio-diversity Strategy and Action Plan that incorporates the articles of the convention into national law and statutes.</li> </ul>	Applicable for protecting biological diversity that may have significant adverse impacts due to project activities

## **2.6 Environmental Clearance**

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

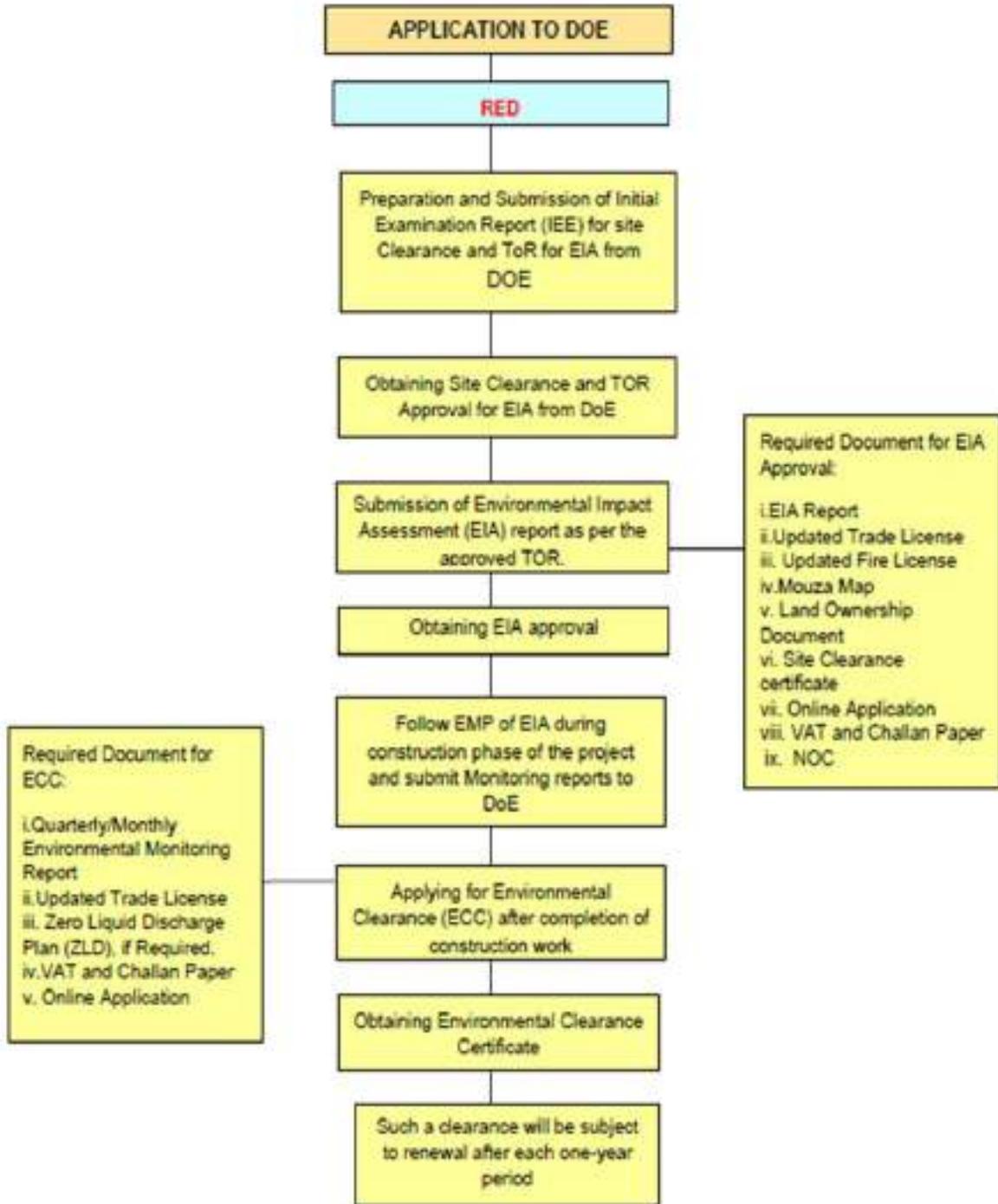
Firstly, to obtain environmental clearance for the project, the proponent needs to complete & submit an application form which may be obtained from the appropriate DoE regional offices as per the category. The application accompanied by other supporting documents (i.e., project profile, lay-out plan, NOC from local authority, updated IEE and EIA certificates, monitoring reports as prescribed in EIA report, Govt. fees, License or approval from other relevant authority etc.) is reviewed by the divisional and district offices of DOE who has the authority to request supporting documents as per necessity. All the Power plant falls under **RED category** according to ECR 1997. The EIA approval and obtaining Environmental Clearance Certificate (ECC) process of the RED Category of Projects/industries is shown in Figure below-



(ECR, 1997)

**Figure 2.1: Process flow diagram for obtaining Environmental clearance from DoE**

The EIA approval and obtaining Environmental Clearance Certificate (ECC) process of the RED Category of Projects/industries is shown in **Figure 2.2**.



(ECR, 1997)

Figure 2.2: Process flow diagram for obtaining Environmental clearance from DoE

## 3 DESCRIPTIONS OF THE PROJECT

### 3.1 The Project

Hatiya Island in Bangladesh is an off grid remote locality. Despite being only twenty kilometers away from shore, the island lacks any electricity grid connection. The government has taken a move to install a 15-megawatt (MW) HFO based power plant in Hatiya island for uninterrupted electricity supply. The Power Division under the Ministry of Power, Energy and Mineral Resources has already initiated work and selected a sponsor, Desh Energy Hatiya Power Company Ltd. to do the job.

Desh Energy Hatiya Power Company Ltd. is going to set up the 15 MW power plant at Hatiya Island from which the state-owned Bangladesh Power Development Board (BPDB) will purchase electricity for over the next 15 years.

The Facility will have a net electric power generating capacity of 15MW phase wise. Net dependable capacity and Net Energy Output from the Facility will be sold under the Power Purchase Agreement (PPA). The proposed power plant is Reciprocating Engine based power plant. The engines are capable of running at rated output continuously. Operating plant factor is 80% and Heat rate is 8950 KJ/kWh. There is no settlement within the project site as the project will be constructed on the BPDB's owned land allotted to Desh Energy Hatiya Power Company Ltd. Plant unit size has been determined 15 MW by BPDB in order to fulfil the demand of the locality of Hatiya.

**Table 3.1: The basic data of Desh Energy Hatiya Power Company Ltd.**

<b>1. Name of the Project</b>	15 MW HFO Fired Power Plant
<b>2. Project Proponent</b>	Desh Energy Hatiya Power Company Ltd.
<b>3. Chairman</b>	Rubana Huq
<b>4. Project Location</b>	Hatiya island, Noakhali, Bangladesh
<b>5. Land of the project</b>	BPDB's Own Land
<b>6. Fuel Type</b>	"HFO" Heavy Fuel Oil
<b>7. Plant Type</b>	Reciprocating Engine Based Power Plant Project
<b>8. Net Plant Capacity</b>	15 MW (Phase wise)
<b>9. Total Number of Engine</b>	6
<b>10. Project Cost</b>	BDT 224 crore
<b>11. Total Land Area</b>	5.56 (plant) + 0.857 (Fuel receiving station) = 6.417 Acres
<b>12. HFO source and quality</b>	Import or BPC
<b>13. Fuel quantity</b>	72.5MT/day HFO
<b>14. Water Requirement</b>	Operational water demand = 3.2 m <sup>3</sup> /h Domestic water usage = 0.8 m <sup>3</sup> /h

	Total Water demand = 4.0 m <sup>3</sup> /hour
<b>15. Source of Water</b>	Ground water
<b>16. Power Evacuation System</b>	The electric power to be generated by the facility will be evacuated through BPDB's 33/11 kV substation to be constructed at BPDB's own land adjacent to the Harendra Road Bazar by BPDB. Evacuation voltage shall be 33 kV.

### 3.2 Location of the project

The proposed Power Plant is located at Harendra Road Bazar, Rehania within Surjomukhi Mouza; 9 no. Burirchar Union, Hatiya Upazila, Noakhali. A land of approximately 5.56 (Power Plant Area 5.34 + Road area 0.22) acres as power plant area with access road of BPDB's land adjacent to Harendra Road Bazar, Mouza: Surjomukhi, Thana: Hatiya, Zilla: Noakhali (the site) and a land of approximately 0.857 (Property boundary 0.78 + Access Road 0.077) acres as receiving station with access road of BPDB's Land of Tamuruddin union, Mouza: Chor Tamuruddin, Thana: Hatiya, Zilla: Noakhali (the site) totaling of 6.417 (5.56 + 0.857) acres has been allotted to Desh Energy Hatiya Power Company Ltd. by BPDB.

Surjomukhi village is at the east side, Botta bazar is at south side, Chowmuhani Bazar is at north side and Char king is at the west side of the project site. Beker bazar is at the east side, Kata Ali Khal par is at the south side, Tamuruddin bazar is at the north side and Meghna River is at the west side of the receiving station.

The project site is located about 5.80 km away (South) from main CBD (Ochkhali) of Hatiya Upazila, about 61.5 km away (South) from Noakhali District and 204 km from Dhaka. Beside Nolchira Ghat & Tamuruddin Ferry ghat are respectively 14.2 km and 9.35 km away from project site. Hatiya is surrounded by Meghna River (North & West Side) and Bay of Bengal (south & East Side). Distance between Project site and Meghna River (Southern Part) & Bay of Bengal (Eastern Part) are about 14.3 km and 6.4 km respectively.

On the other hand, Receiving Station is located at Atharo Beki, 7 no. Tamuruddin Union, Hatiya Upazila, Noakhali. Receiving Station is about 8.5 km (North-West) away from main project site. Proposed Receiving station is about 1 km & 10.2 km away from Tamuruddin Ferry Ghat & Nolchira Ghat respectively.

The project location in District map & Upazila map, Project location map, Satellite map and Satellite map (zoom in view) are presented in **Figure 3.1 (a), 3.1 (b), 3.1 (c), 3.1 (d)** and **3.1 (e)** respectively. Project location map is attached as **Annexure 3** and Layout of the proposed project is attached as **Annexure 4**.



Figure 3.1 (a): Noakhali District Map

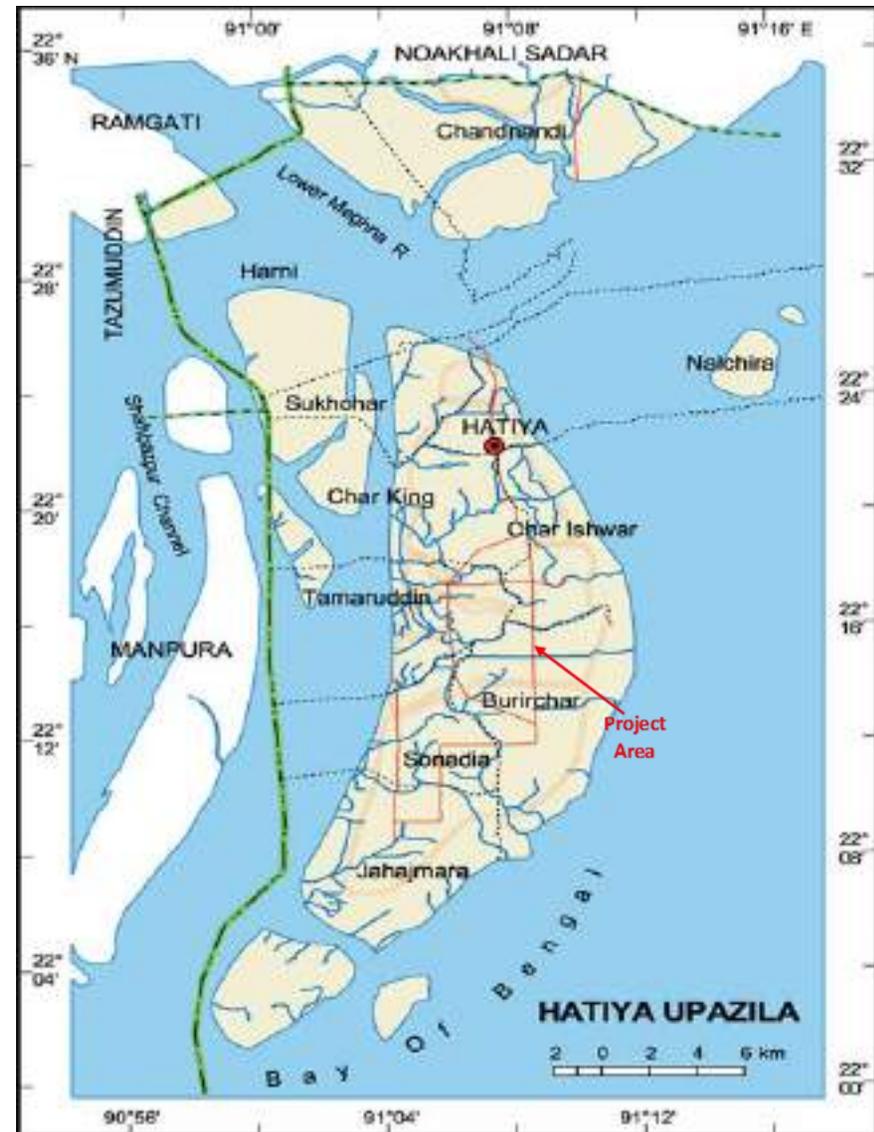


Figure 3.1 (b): Hatiya Upazila Map

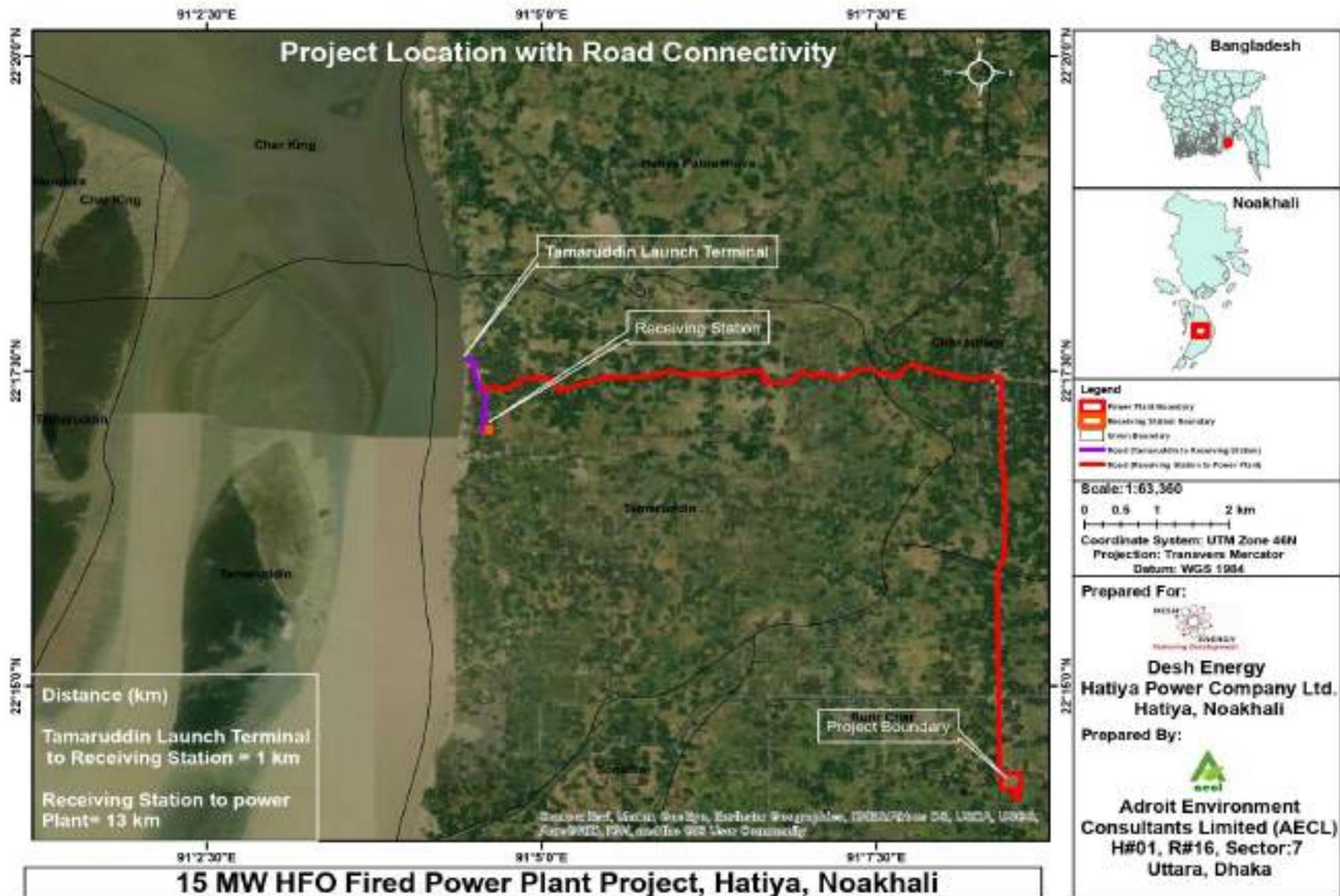


Figure 3.1 (c): Project Location Map

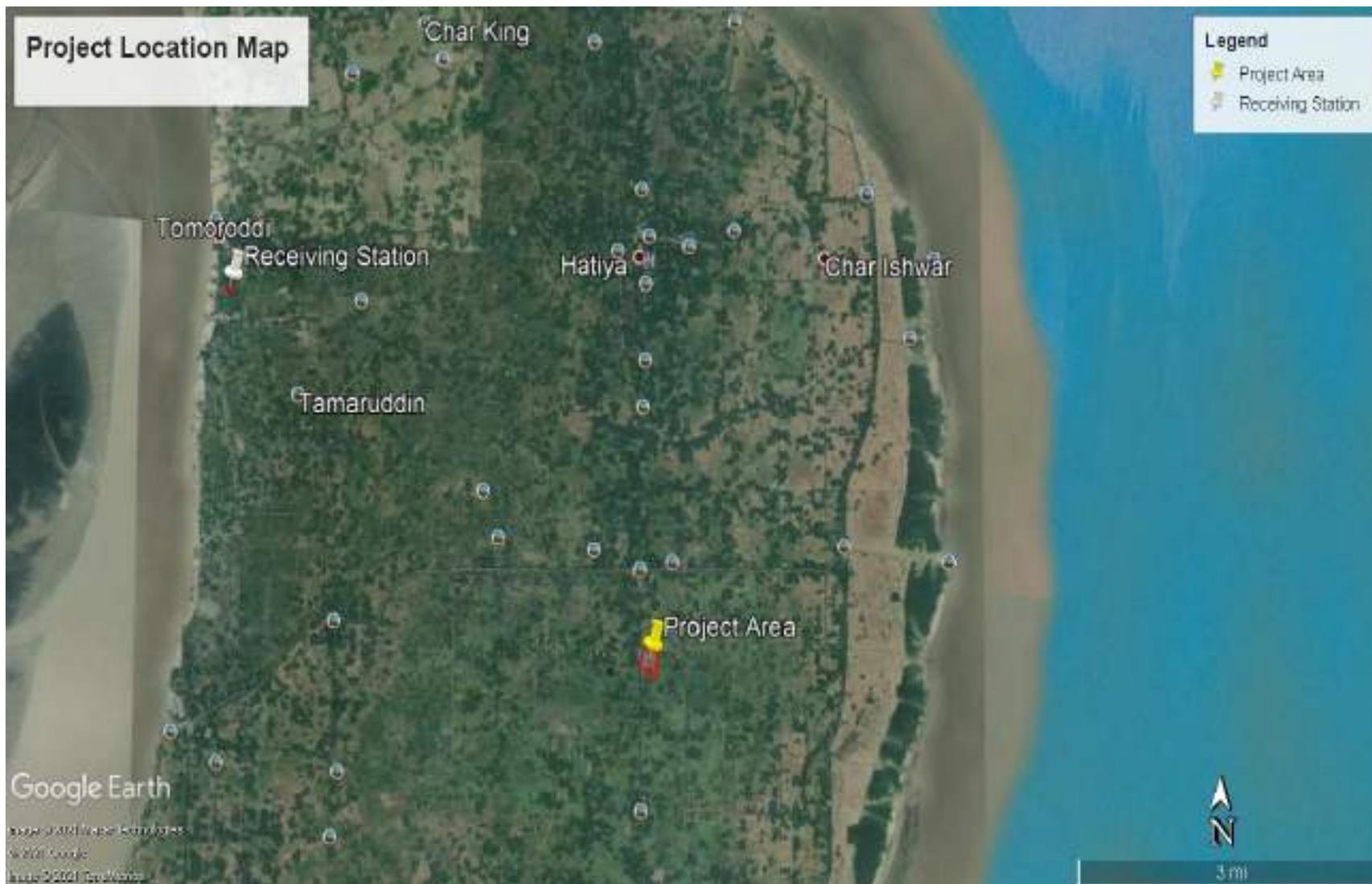


Figure 3.1 (d): Satellite map of the Project site

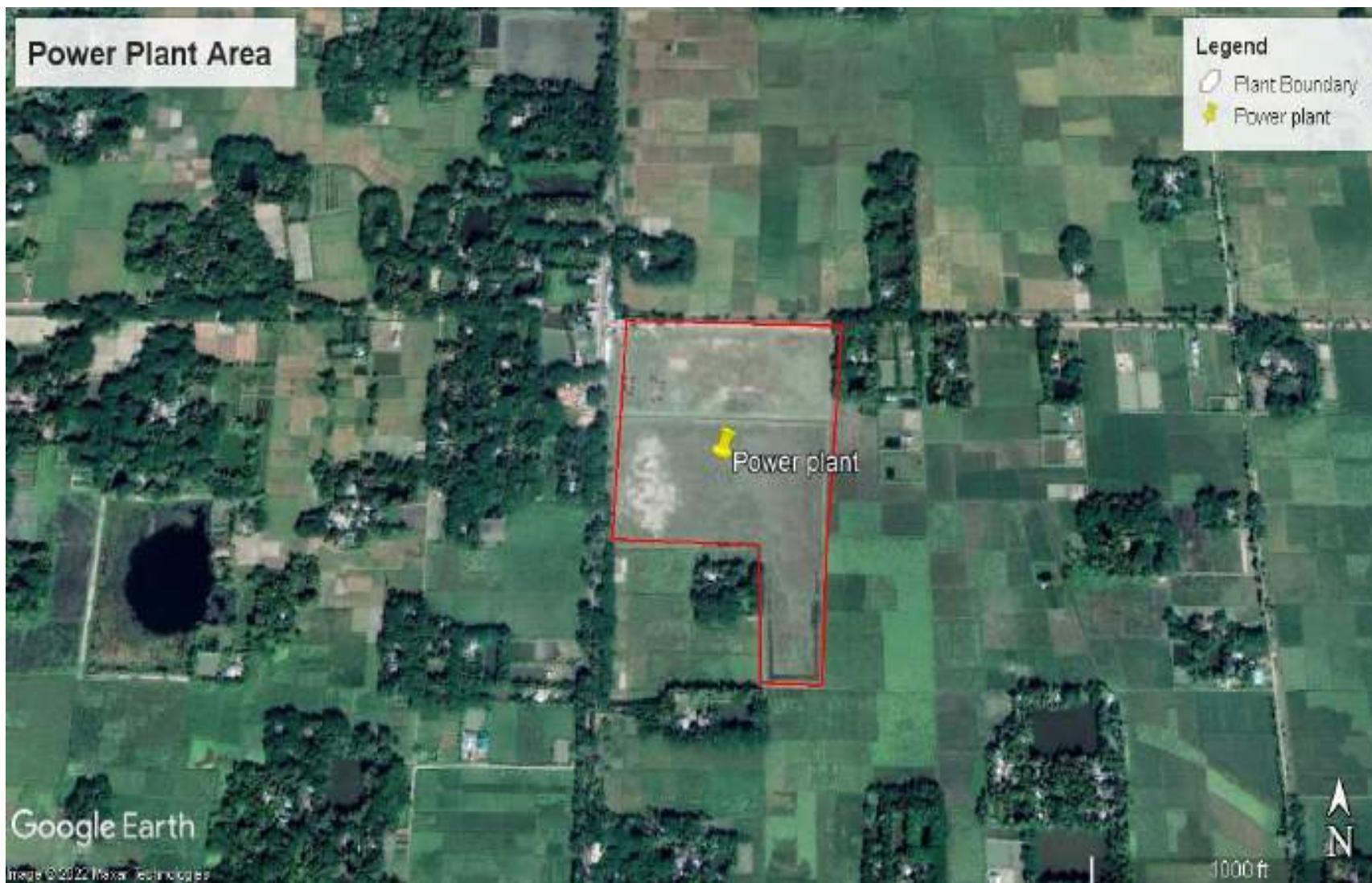


Figure 3.1 (e): Satellite map of the Project site (zoom in view)

### **3.3 Accessibility to Project Site**

The proposed Power Plant is located at Harendra Road Bazar, Rehanian; Burirchar Union, Hatiya Upazila, Noakhali. There are two ways to access the project site. One is through direct water way and another consists of both road and water way. From Dhaka Sadar Ghat to Tamuruddin Ferry Ghat via Monpura by launch is the main way to reach Hatiya by water way from Dhaka. Project site is about 14.2 km away from Tamuruddin Ferry Ghat. Auto Rickshaw and CNG are available to access the project site from Tamuruddin Ferry Ghat.

On the other hand, Dhaka to Chairman Ghat, Hatiya via Comilla, Noakhali by Bus is the main road way to reach Hatiya. Speed Boat, Trawlers and Sea King (Launch) are available to reach Nolchira Ghat from Chairman Ghat. Project Site is about 32 km from Chairman Ghat and 14.2 km (South) away from Nolchira Ghat. CNG, Motor Cycle, Bus & Auto Rickshaw are available to access the Project site (Harendra Road Bazar).

### **3.4 Present Site Condition**

The project site is located in Hatiya Island which is in the northern Bay of Bengal, Bangladesh, at the mouth of the Meghna river. The land development work of project site is completed. The land development work has been completed by sand filling. There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. There is no industry around the project area except one saw mill (west side approx. 250m from project site) as there is no electricity connection in the vicinity of the project area. Normally solar panel is used for electric source.



**East Side**



**South Side**



**East Southern Side**



**North Side**



**West Side**



**North - Western Side**

**Project Site**



**West Side**



**North Side**



**East Side**



**South Side**

**Around the Project Site**



**Nolchira To Jahajmara Road**



**Entrance Road**



**Access Road**



**Approach Road**

**Accessibility to Project Site**



**North Side**



**East side**



**North - Eastern Side**



**South Side**



**West Side**



**South - Eastern Side**

**Receiving Station**



**West Side**



**North Side**



**East Side**



**South Side**

**Around the Receiving Station**



Ochkhali - Tamuruddin Road



Entry Road



Access Road



Approach Road

Accessibility to Receiving Station

Figure 3.2: Surrounding Picture of the Project Site

### 3.5 Project Component

A detail list of power plant component/equipment is given in table below:

**Table 3.2: List of equipment for the Proposed Project**

Sl. No	Name of Equipment	Unit	Quantity
<b>A. Engines and Auxiliary Modules</b>			
<b>A1</b>	<b>Generating Set</b>		
<b>A1.1</b>	Engine	Unit	6
<b>A1.2</b>	Generator	Unit	6
<b>A2</b>	<b>Mechanical Auxiliary System</b>		
<b>A2.1</b>	<b>Engine Genset Accessories</b>	Set	6
<b>A2.2</b>	<b>Fuel System</b>		
	A2.2.1 HFO Unloading Pump Module	Unit	1
	A2.2.2 DFO Unloading Pump Module	Unit	1
	A2.2.3 HFO Separator Module	Unit	2
	A2.2.4 HFO Pre-pressure Module	Unit	1
	A2.2.5 HFO- DFO Circulation Module	Unit	6
	A2.2.6 Engine Piping to Circulation Module	Piece	6
<b>A2.3</b>	<b>Lubricating Oil System</b>		
	A2.3.1 Fresh Lube Oil Transfer Pump Module	Unit	1
	A2.3.2 Lube Oil Force Pump	Piece	6
	A2.3.3 Lube Oil Separator Module	Piece	6
<b>A2.4</b>	<b>Cooling System</b>		
	A2.4.1 Engine Piping to Combined Module Cooling	Set	6
	A2.4.2 Radiator	Set	6
	A2.4.3 Combined Module	Unit	6
<b>A2.5</b>	<b>Intake Air System</b>		
	A2.5.1 Combustion Air Filter Module	Unit	6
	A2.5.2 Deep Weather Hood	Piece	6
	A2.5.3 Insect Screen	Piece	6
<b>A2.6</b>	<b>Exhaust System</b>		
	A2.6.1 Exhaust Gas Silencer	Piece	6
	A2.6.2 Exhaust Gas Expansion Joints to Engine	Set	6
	A2.6.3 Exhaust Gas Expansion Joints before Silencer	Set	6
<b>A2.7</b>	<b>Compressed Air System</b>	Set	1
<b>A3</b>	<b>Electrical Systems</b>		
<b>A3.1</b>	Control System		
	A3.1.1 Local Data Panel	Piece	6
	A3.1.2 Generator Control Panel	Piece	6
	A3.1.3 Common Control Panel	Piece	1

Sl. No		Name of Equipment	Unit	Quantity
	A3.1.4	SCADA System	Unit	1
	<b>A3.2</b>	Low Voltage System	Set	6
<b>A4</b>		<b>Tools</b>	Set	1
<b>A5</b>		<b>Commissioning Parts</b>	Set	1
<b>A6</b>		<b>Protective Emergency Parts</b>	Set	1
<b>A7</b>		<b>Engineering &amp; Documentation</b>		
	<b>A7.1</b>	Engineering Services	Lot	1
	<b>A7.2</b>	Documentation	Set	6
<b>A8</b>		<b>Site Advisory Services</b>	Lot	1
<b>B. Mechanical Balance of Plant (MBOP)</b>				
<b>B1</b>		<b>Equipment and Instruments</b>		
	<b>B1.1</b>	<b>Engine Genset Accessories</b>		
	B1.1.1	Lube Oil Circulating Tank	Piece	6
	B1.1.2	Piping between Engine and Lube Oil Circulating Tank	Piece	6
	B1.1.3	Maintenance Platform	Piece	6
	<b>B1.2</b>	<b>Compressed Air System</b>		
	B.1.2.1	Service Air Compressor	Piece	2
	B.1.2.2	Compressed Air Bottle	Piece	6
	<b>B1.3</b>	<b>Cooling System</b>		
	B1.3.1	Water Expansion Tank	Unit	12
	B1.3.2	Radiator Support Structure	Set	6
	<b>B1.4</b>	<b>Intake Air and Ventilation System</b>		
	B1.4.1	Combustion Air Ducting	Lot	1
	B1.4.2	Power House Ventilation Inlet module-Generator Side	Set	6
	B1.4.3	Power House Ventilation Inlet module- Annex Side	Set	6
	B1.4.4	Power House Ventilation Outlet	Unit	8
	<b>B1.5</b>	<b>Exhaust gas System</b>		
	B1.5.1	Other Exhaust Gas Expansion Joints	Lot	1
	B1.5.2	Exhaust transition Piece	Lot	1
	B1.5.3	Exhaust Gas Stack	Unit	6
	B1.5.4	Exhaust Gas pipe/ Duct (Horizontal)	Set	6
	B1.5.5	Exhaust Gas Tail Pipe/ Chimney (Vertical)	Unit	6
	B1.5.6	Vibration Damper Inside Power House	Set	6
	B1.5.7	Vibration Damper outside Power House	Set	6
	B1.5.8	Exhaust Stack Structure	Set	2
	B1.5.9	Exhaust Pipe Support Structure	Set	2
	<b>B1.6</b>	<b>Plant Water System</b>		

Sl. No		Name of Equipment	Unit	Quantity
	B1.6.1	Hydrofor (treated only) Module	Set	1
	B1.6.2	Water Treatment Module	Unit	1
	<b>B1.7</b>	<b>Plant Water System</b>		
	<b>B1.8</b>	<b>Heat Recovery System</b>		
	B1.8.1	Exhaust Gas Boiler with steam drum and Accessories	Unit	6
	B1.8.2	Packaged steam Auxiliary Boiler	Unit	1
	<b>B1.9</b>	<b>Waste Water System</b>	Unit	1
	<b>B1.10</b>	<b>Fire Protection System as per NFPA and Local Laws and Regulations</b>		
	B1.10.1	Fire Pump Module	Unit	3
	B1.10.2	Fire Alarm and detection System	Set	1
	B1.10.3	Fire Sprinkler Systems	Set	1
	B1.10.4	Fire Hose-Loop Components	Set	1
	B1.10.5	Fire Water Monitors	Set	1
	B1.10.6	Fire extinguishers and wheel units	Lot	1
	B1.10.7	Fire water Tank	Unit	1
	<b>B1.11</b>	Cranes for PHB and Workshop		3
<b>B2</b>		<b>Structures and Support</b>		
	<b>B2.1</b>	<b>Hot Air Duct (Alternator)</b>	Set	6
	<b>B2.2</b>	<b>Structures</b>		
	B.2.2.1	Engine maintenance platform and support	Lot	1
	B.2.2.2	Pipe Bridge and Supports	Lot	1
	B.2.2.3	Charge Air Duct support	Lot	1
	B.2.2.4	Charge Air filter platform	Lot	1
	B.2.2.5	All Railings	Lot	1
	B.2.2.6	Gratings	Lot	1
	B.2.2.7	Anchor bolts, nut-bolts	Lot	1
	<b>B.2.3</b>	<b>Piping and Fittings</b>		
	B.2.3.1	LFO Pipings	Lot	1
	B.2.3.2	HFO Pipings	Lot	1
	B.2.3.3	LO PIPINGS	Lot	1
	B.2.3.4	Oily Water System Pipings	Lot	1
	B.2.3.5	Compressed Air Pipings	Lot	1
	B.2.3.6	Cooling Water System Pipings	Lot	1
	B.2.3.7	WTP System Pipings	Lot	1
	B.2.3.8	Heat Recovery System Pipings	Lot	1
	<b>B2.4</b>	<b>Tanks (Superstructures)</b>		
	B.2.4.1	HFO Storage Tank (1000 m <sup>3</sup> )	Unit	2
	B.2.4.2	HFO Storage Tank (500 m <sup>3</sup> )	Unit	2

Sl. No		Name of Equipment	Unit	Quantity
	B.2.4.3	HFO Day Tank (250 m <sup>3</sup> )	Unit	2
	B.2.4.4	HFO FOTP Tank	Unit	1
	B.2.4.5	LFO Storage Tank (50 m <sup>3</sup> )	Unit	1
	B.2.4.6	Fresh Lube Oil Tank (30 m <sup>3</sup> )	Unit	1
	B.2.4.7	Used Lube Oil/Sludge Tank (30 m <sup>3</sup> )	Unit	1
	B.2.4.8	Lube Oil Service Tank (15 m <sup>3</sup> )	Unit	1
	B.2.4.9	Maintenance Water Tank (4 m <sup>3</sup> )	Unit	2
	B.2.4.10	SS Treated Water Tank (10 m <sup>3</sup> )	Unit	1
<b>B3</b>		<b>Workshop Equipment (Electromechanical)</b>	Lot	1
<b>B4</b>		<b>Laboratory (Chemical &amp; Electrical)</b>	Lot	1
<b>B5</b>		<b>Pontoon &amp; Jetty</b>	Set	1
<b>B6</b>		<b>Tools &amp; Spares</b>	Lot	1
<b>B7</b>		<b>Documentations</b>	Set	3
<b>B8</b>		<b>Engineering, Fabrication, Installation &amp; Erection</b>	Lot	1
<b>C. Electrical Balance of Plant (EBOP)</b>				
<b>C1</b>		<b>Electrical Systems BOP</b>		
	<b>C1.1</b>	<b>Medium Voltage system</b>		
	C1.1.1	Main busbar	Unit	3
	C1.1.2	Power (Step-up) transformer	Unit	3
	C1.1.3	Station auxiliary transformer	Unit	2
	C1.1.4	Measuring cubicle	Unit	3
	C1.1.5	Neutral point cubicle	Unit	5
	C1.1.6	MV Switchgears	Set	5
	<b>C1.2</b>	<b>Low voltage system</b>		
	C1.2.1	MCC Fuel Treatment	Unit	1
	C1.2.2	Black Start Generator unit	Unit	2
	C1.2.3	LV Main Distribution Panel	Unit	1
	C1.2.4	LV Station Auxiliary Panel	Unit	1
	C1.2.5	Distribution Panel Unloading Station	Unit	1
	C1.2.6	Cables and accessories for MV and LV	Lot	1
	<b>C.1.3</b>	<b>Neutral Grounding Resister Panel</b>	Unit	1
	<b>C.1.4</b>	<b>DC System Control with Cables</b>	Unit	1
	<b>C.1.5</b>	<b>High Voltage system</b>		
	C1.5.1	Single Busbar-Transformer Bay(s)	Set	3
	C1.5.2	Busbar-Line Bay with CB	Set	1
	C1.5.3	Bus voltage measurement bay	Unit	1
	C1.5.4	Switchyard Structure	Lot	1
	C1.5.5	33 kV Overhead transmission line towers	Lot	1

Sl. No		Name of Equipment	Unit	Quantity
	C1.5.6	High voltage underground cables and conductors	Lot	1
	<b>C.1.6</b>	<b>Plant Electrification and Earthing</b>	Lot	1
<b>C.2</b>		<b>Engineering, installation and Commissioning</b>	Lot	1
<b>C.3</b>		<b>Documentations</b>	Lot	1
<b>D. Super Structure Works</b>				
<b>D.1</b>		<b>Superstructures</b>		
	<b>D.1.1</b>	<b>Process related Structures (Steel Prefab Structures)</b>		
	D1.1.1	Power House Building	Unit	1
	D1.1.2	Heat Recovery Building	Unit	1
	D1.1.3	Substation Control Building	Unit	1
	D1.1.4	Fuel Separator	Unit	1
	D1.1.5	Water Treatment Plant	Unit	1
	<b>D.1.2</b>	<b>Support Structures (Steel Prefab Structures)</b>		
	D1.2.1	Warehouse/Store Building	Unit	1
	D1.2.2	Workshop (Electromechanical)	Unit	1
	D1.2.3	Laboratory (chemical & electrical)	Unit	1
	<b>D.1.3</b>	<b>Non-Process Structures (Steel/ Concrete Structures)</b>		
	D1.3.1	Administration/Office Building	Unit	1
	D1.3.1	Bunker Office	Unit	1
	D1.3.1	Gate House with Security Post	Unit	1
	D1.3.1	Staff Quarter	Unit	1
	D1.3.1	Officers Quarter	Unit	1

The layout of power plant area and Fuel receiving station area are shown in **Figure 3.3** and **Figure 3.4**



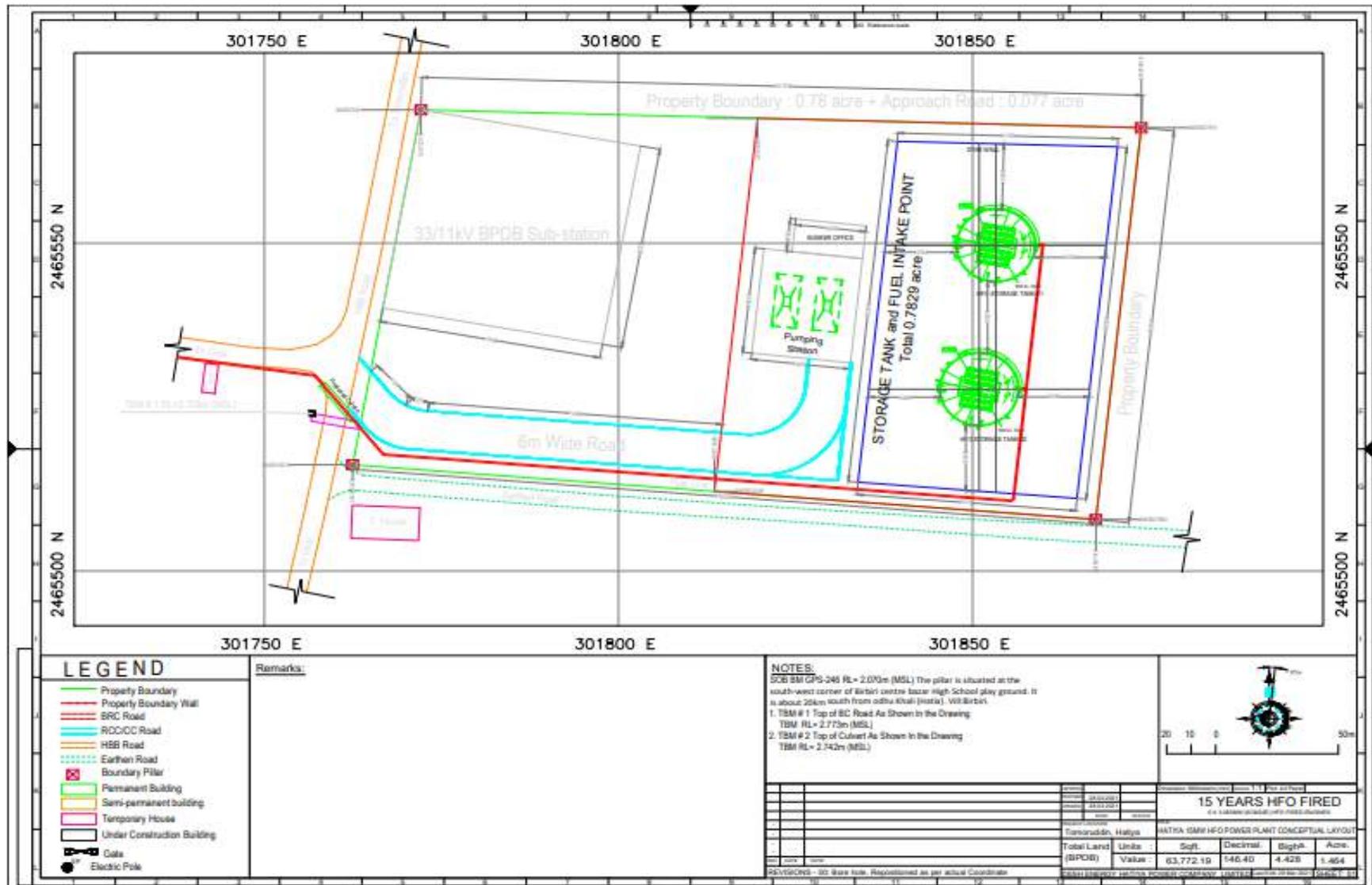


Figure 3.4: Layout of Fuel receiving station area

### 3.6 Project Detail

The proposed power plant will be installed to serve uninterrupted electricity within Hatiya Island. The project will be implemented phase wise. Bangladesh Power Development Board (BPDB) will purchase electricity for over the next 15 years. Each generating unit will have 3.030MW of generation capacity.

#### 3.6.1 Fuel Transportation

The main fuel for this project is “HFO” i.e., Heavy Fuel Oil and it’s a Reciprocating Engine Based Power Plant Project. The proponent may procure HFO from Bangladesh petroleum Corporation (BPC) or import HFO from plants by own arrangement. HFO will be transported through river route by Lighter vessel and will be collected from the existing jetty at Tamuruddin ghat (65’ x 30’). Tamuruddin ghat has all the facility for anchoring the vessels. The vessels will be well equipped to pump the fuel from vessel to the storage tank. For inland transportation (Receiving station to power plant site) of fuel, Tanker truck will be used. DFO (Diesel Fuel Oil) will be used as Auxiliary fuel which will be collected locally.

##### 3.6.1.1 Fuel Specification

**Table 3.3: Specification of HFO**

Item	Unit	Guaranteed Specs	Method
Density @ 15 DEG C	KG/M <sup>3</sup>	991 MAX	ASTM D1298 & D4052
Viscosity @ 15 DEG C	Cst	180Max	ISO3104
Ash Content	% WT	0.10 MAX	ASTM D482
Flash Point (PMCC)	DEG C	60 MIN	ASTM D93
Pour Point	DEG C	24 MAX	ASTM D5985
Sulphur Content	% WT	3.0 MAX	ASTM D4294
Hydrogen Sulphide	mg/kg	2.00 MAX	IP570
Water by Distillation	% VOL	0.5 MAX	ASTM D1796
Sediment by Extraction	% WT	0.1 MAX	ASTM D473
Conradson carbon Residue (CCR)	% WT	14 MAX	ASTM D189/D4530
Vanadium	PPM	250 MAX	IP501
Sodium	PPM	30 MAX	IP501
Aluminium + Silicon	PPM	50 MAX	IP501
Aluminium	PPM	30 MAX	IP501
Total Existent Sediment	% WT	0.1 MAX	IP375
Calcium	PPM	30 MAX	IP501
Zinc	PPM	15 MAX	IP501
Phosphorus	PPM	15 MAX	IP501
Net Specific Energy (LHV)	MG /KG	39.00 MIN	ASTMD240& D4868

Item	Unit	Guaranteed Specs	Method
<b>Acid Number</b>	MG KOH/G	2.5 MAX	ASTM 664
<b>CCAI</b>	-	870 MAX	-
<b>Total Sediment Potential</b>	% WT	0.1 MAX	IP375
<b>Asphaltenes</b>	% WT	12 MAX	ASTM 3279

### 3.6.2 Fuel Treatment Process

Fuel received from supplier may contain water and other solid impurities, which may have detrimental effect on combustion quality and fuel injection system components. So, it is imperative that the fuel is properly treated to separate oily water and sludge before the fuel is fed to the engine. HFO received from supplier goes through a treatment process for the separation of those impurities.

In this project, Fuel will be first transferred to the receiving station via pumping facility of the vessel/ barge through pipe. The fuel will be received in a storage tank at the receiving station. Sludge of this fuel will be preliminarily accumulated at the bottom of this storage tank over time due to gravity and after it fills 50% of the storage tank then it will be pumped out and directly sold to the vendors which has a huge demand in market. As the fuel will not be kept in the storage tank for long time and will be transferred to the Buffer tank at the power plant area through tanker truck of capacity 1000 KL so the amount of sludge accumulated at the bottom of the storage tank will be small.

Buffer tank at power plant site will be used as storage tank as the power plant size is very small. The fuel here will be continuously heated to maintain lower density for smooth flow of fuel and will be sent to Fuel Oil Treatment Plant (FOTP) for treatment process. Heating requirements will vary depending on the viscosity of the fuel. However, heavy fuel oils may require heating to 135-160°C to reduce viscosity to an acceptable level. The FOTP remove water and solids from the Heavy fuel oil. The separator receives fuel from the buffer tank and sends clean fuel to the day tank for engine consumption. The separators and auxiliary equipment are built on a steel frame, which forms a compact skid unit. Fuel in the buffer tank is heated and allowed to settle to facilitate separation by gravity where some solid impurities/ sludge accumulate at the tank bottom. This sludge is then sent to sludge tank. The sludge separated in the FOTP is also sent to sludge tank and is directly sold to vendors. The oily water separated at FOTP is collected through oily water drain line and is evaporated through steam heated/vapor chamber. The dry sludge produced here will be also sold to vendors. The treated fuel is then sent to Day tank engine feeding.

### 3.6.3 Power Generation Process

Electrical power will be generated by 6 units of Engines with each having capacity of 3.03.MW. The Engines will be fed with treated HFO and the transportation & treatment process of Fuel is described in detail in the previous article. After treatment of HFO, it will be sent to Engine through feed pump from Day tank. An air compressor is used which forces more and more air into air compressor tank, increasing the pressure. An air compressor is such a device which is used to compress the air and to raise its pressure. It

sucks the air from atmosphere and delivers it at same temperature but at high pressure. This compressed air is used for turning on the engine and for better combustion of fuel. It elevates the efficiency of engine from 30% to 45%. Lube Oil is fed to the engine for smooth running and after that it is sent to LO separator for purifying and again purified lube oil is sent to Engine sump. When the engine is running then exhaust gas is generated from the engine which is used in exhaust gas boiler (EGB) to boil the water. The EGB is used to heat the fuel in Buffer tank as well as the entire pipeline of the fuel system. When the plant is not running even then the fuel and the pipelines needs be heated continuously. In that case, Auxiliary Boiler is used. Auxiliary boiler run on HFO for the continuation of heating process. When the plant is in running state, exhaust gas is produced which is used by Turbocharger. The job of a turbocharger is to compress and feed more air into the engine's combustion chamber. When air is compressed the oxygen molecules are packed closer together. This increase in air means that more energy can be obtained from burning same amount of fuel thus more energy can be gained from the engine without increasing fuel consumption. This then generates increased mechanical power and overall efficiency improvement of the combustion process. The exhaust gas is used to heat the water and generate superheated steam in EGB which helps to reduce the temperature of exhaust gas by further utilizing the waste heat, and then it is emitted through Chimney/ exhaust stack. Exhaust gas temperature of engine is 200°C and mass flow will be 21.4 ton/hour. Gas outlet temperature of the boiler is 180°C. Coolants are used to lower the temperature of engine. Radiator/ cooling tower is used to cool the coolants of Engine. The radiator transfers the heat from the Cooling fluid (Cooling water) inside to the air outside, thereby cooling the fluid, which in turn cools the engine. Engines produce mechanical energy, while generator/alternator turn mechanical energy into electrical energy. Schematic diagram of Process Flow is shown in **Figure 3.5** and attached as **Annexure 5**. Details of all the components are provided in the following sections.

A small portion of the produced electricity will be consumed by all electrically operated machinery and for lighting of the plant. All the systems of the plant will be installed as per the design, drawing and guide lines by the Original Equipment Manufacturer (OEM) and complying with the Standards as set by the OEM. The engines are started by High Pressure Air. The carefully designed forced ventilated Power House will contain the generating units and other auxiliary machinery. All MV and LV electrical controls will be from the Plant's Control Room through the MV and LV Switch Room.

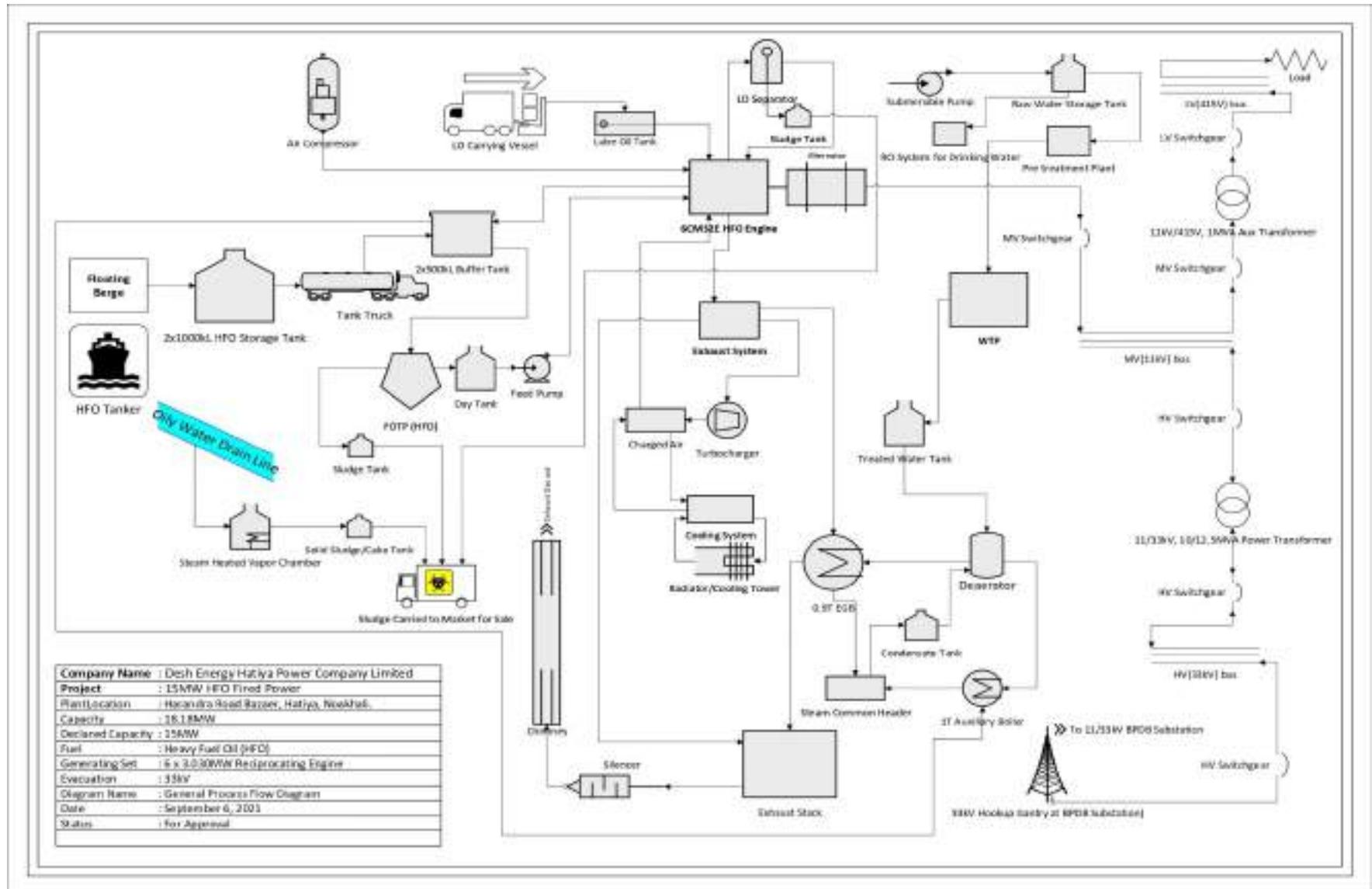


Figure 3.5: General Process Flow Diagram

### 3.6.3.1 Generating Set & Engine Detail

Detail of Generating set & Engine detail is presented in **Table 3.4** & **Table 3.5** respectively. **Table 3.6** shows Performance Data @ Site per Engine and site per genset.

**Table 3.4: Technical data of Genset**

Technical particulars of Gensets	Contracted Guaranteed Specifications
Engine Manufacturer	Caterpillar
Brand	CAT™
Model No.	6CM32E
Guaranteed output	3.030 MW
Total Nos of Engines	6 nos.
RPM	750 (medium speed)
Power Generation	11 kV
Operating Frequency	48.5-51.5 Hz
Operating Power Factor	0.80
Country of Origin	Germany

**Table 3.5: Technical data of Engine**

Engine Data	Unit	
Engine		6CM32 E / 50 Hz / EM3130
Emission Info		World Bank II
Configuration		Inline
Number of Cylinders		6
Brake Mean Effective Pressure	bar	24.9
Engine Speed	rpm	750
Bore	mm	320
Stroke	Mm	460

**Table 3.6: Performance Data @ Site per Engine and site per genset**

Performance Data @ Site per Engine	Unit	Tolerance	100%	85%	75%	50%
<b>Site Rating</b>						
<b>Engine Brake Power</b>	kW		3,150	2,678	2,363	1,575
<b>Average High Temperature (32°C)</b>						
<b>Engine Brake Power</b>	kW		3,150	2,678	2,363	1,575
<b>Heat Rate</b>	kJ/kWh	+5%	7,702	7,673	7,727	8,173
<b>Maximum Temperature (42°C)</b>						
<b>Engine Brake Power</b>	kW		3,150	2,678	2,363	1,575
<b>Heat Rate</b>	kJ/kWh	+5%	7,755	7,727	7,780	8,231
<b>Specified Temperature (32°C)</b>						
<b>Engine Brake Power</b>	kW		3,150	2,678	2,363	1,575
<b>Heat Rate</b>	kJ/kWh	+5%	7,702	7,673	7,727	8,173
<b>Performance Data @ Site per Genset</b>	<b>Unit</b>	<b>Tolerance</b>	<b>100%</b>	<b>85%</b>	<b>75%</b>	<b>50%</b>
<b>Generator efficiency @ 0.8 PF</b>	%		96.20	96.20	96.10	95.90
<b>Site Rating</b>						
<b>Site Power at Gen. Terminals per genset</b>	kW		3,030	2,576	2,270	1,510
<b>Average High Temperature (32°C)</b>						
<b>Site Power at Gen. Terminals per genset</b>	kW		3,030	2,576	2,270	1,510
<b>Heat Rate</b>	kJ/kWh	+5%	8,006	7,976	8,040	8,523
<b>Maximum Temperature (42°C)</b>						
<b>Site Power at Gen. Terminals per genset</b>	kW		3,030	2,576	2,270	1,510
<b>Heat Rate</b>	kJ/kWh	+5%	8,062	8,032	8,096	8,583
<b>Specified Temperature (32°C)</b>						
<b>Site Power at Gen. Terminals per genset</b>	kW		3,030	2,576	2,270	1,510
<b>Heat Rate</b>	kJ/kWh	+5%	8,006	7,976	8,040	8,523

### **3.6.3.2 Mechanical Auxiliary System**

The proper function of the stationary power plant depends on the mechanical auxiliary systems. The proposed systems have been optimized for this particular application. The function of this system is to provide the engine with fuel, lubricating oil, air, cooling system, and charge air of the required quantity and quality, as well as to dispose of exhaust gases in a proper manner.

### **3.6.3.3 Fuel System**

The main function of the fuel system is to provide the engine with fuel of correct flow, pressure and degree of purity. HFO Unloading Pump Module, DFO Unloading Pump Module, HFO Separator Module, HFO Pre-Pressure Module, HFO-DFO Circulation Module and Engine Piping to Circulation Module will be used for Fuel system. Process Flow Diagram of Fuel System is shown in **Figure 3.6**.

### **3.6.3.4 Lubricating Oil System**

The lubricating oil system provides required lubrication for all moving parts on the engine. It consists of the engine related lubricating oil system which handles the cooling and filtration of the lubrication oil and the plant related lubricating oil system, with storage of new and old lubrication oil. Fresh Lube Oil Transfer Pump Module, Lube Oil Force Pump and Lube Oil Separator Module will be used for Lubricating Oil system. Process Flow Diagram of Lubricating System is shown in **Figure 3.7**.

### **3.6.3.5 Cooling System**

The main task of the cooling system is to provide adequate cooling of critical engine components such as cylinder jackets, cylinder heads and turbochargers as well as to cool the lubrication oil and charge air entering the cylinders after it has been compressed by the turbocharger. This system is closed circuit system, so no recycling is required considering zero discharge. Engine Piping to Combined Module Cooling, Radiator and Combined Module will be used for Cooling system. Cooling system is shown in Process Flow Diagram for Process water System in **Figure 3.8**.

### **3.6.3.6 Boiler System**

In this project two boilers will be used i.e., Exhaust Gas Boiler and Auxiliary Boiler for heating of HFO. For Boiler, water is pumped from ground and then treated before feeding to the boiler. Ground water will be pumped and stored in storage tank. A portion of this water will be used for drinking purpose after treating through RO system. The rest of the water will be treated in pre-treatment plant and then in Water Treatment Plant (WTP). Then it will be sent to Deaerator. Deaerators are mechanical devices that remove dissolved gases from boiler feedwater. Deaeration protects the steam system from the effects of corrosive gases. It accomplishes this by reducing the concentration of dissolved oxygen and carbon dioxide to a level where corrosion is minimized. After that the water will be sent to the boilers. Steam exits the boiler through piping referred to as the steam header. The header also serves as a reservoir that feeds steam

to the individual heating circuits. The steam header must be large enough to virtually eliminate pressure drop between the boiler and the beginning of the circuit. Steam header Sizing reduces pressure drop and radiation loss. Steam pipes that are undersized cause high pressure drop and result in steam starvation at the point of usage. This accumulated steam is then sent to condensate tank and then to deaerator for recirculation.

### 3.6.3.7 Intake Air System

Combustion Air Filter Module, Deep Weather Hood and Insect Screen will be used for Intake Air System.

### 3.6.3.8 Exhaust System

Exhaust Gas Silencer, Exhaust Gas Expansion Joints to Engine and Exhaust Gas Expansion Joints before silencer will be used for Exhaust System.

### 3.6.4 Water requirement

Water requirement for the proposed power plant project is comparatively low. Estimation of water demand for main system is presented in **Table 3.7** below.

**Table 3.7: Estimation of Water Demand for main system**

Consumers		Average Use	Consumption per Consumer	Total consumption/day	Water demand per hour
2x	HFO- Separator, Wash water demand	2x per hour	4 Liter / ejection	384 l/day	0.016 m <sup>3</sup> /h
3x	Lube Oil Separator, Wash water demand	2x per hour	4 Liter / ejection	576 l/day	0.024 m <sup>3</sup> /h
3x	Compressor washing	1x per day	10 Liter/ ejection	30 l/day	0.001 m <sup>3</sup> /h
3x	Turbine washing	1x per day	60 Liter / 5min	900 l/day	0.038 m <sup>3</sup> /h
3x	Water losses cooling water system	1x per day	20 Liter / CW-system	60 l/day	0.003 m <sup>3</sup> /h
<b>Water demand for CAT Scope of Supply:</b>					<b>0.082 m<sup>3</sup>/h</b>

Water demand for main system = 0.082 m<sup>3</sup>/h

Water demand for Boiler is 3.0 m<sup>3</sup>/h

Domestic water usage is 0.8 m<sup>3</sup>/h

Total water requirement is = (0.082 + 3.0 + 0.8) m<sup>3</sup>/h = 3.882 m<sup>3</sup>/h ~ 4.0 m<sup>3</sup>/h

### **3.6.5 Pollution Abatement Measures**

#### **3.6.5.1 Waste Water Treatment and Discharge**

Process water system is closed circuit system (recycled in closed circuit system), so no recycling is required considering zero discharge. There will not be any Effluent Treatment Plant (ETP) as well as no disposal of sludge. Oily water from process flow will be vaporized in steam heater. Storm Water will be discharged to local canal. There will be Septic tank and Soak well for sewer water and domestic waste water.

#### **3.6.5.2 Operational Waste (Sludge) Management**

Used lubricating oil from the engine will be stored in a dedicated used oil tank of 30 m<sup>3</sup> capacity. Each engine uses lubricating oil, 50% of which is replaced at a time when the properties of the oil crosses certain threshold after continuous operation. The used lube oil from these engines has been found to be in high demand among the people working in the transportation, vehicle repair sectors. In order to ensure that the used lubricating oil do not end up in the informal sector so used lube oil will be sold to DOE certified vendors who are expected to handle the used oil in environment friendly manner.

Approximate rate of sludge generation due to 15MW power generation is 150kg/day or 4.5MT/month. All the sludge from fuel preparation and treatment will be collected in the sludge tank and will be directly sold to DoE approved vendors. Oily water from buffer tank, FOTP, Engine Hall area and other process area will be collected through oily water drain line and will be evaporated through steam heated/vapor chamber. The dry sludge produced here will be also sold to DoE approved vendors. Sludge from Lube oil separator will also be sold to DoE approved vendors.

#### **3.6.5.3 Air Pollution**

- ✓ Two 50m stack will be used to exhaust combustion gases into the air;
- ✓ The fuel specification will be such that it meets the guideline of WB;
- ✓ The buffer area around the plant, development of greenbelt, boundary wall etc. around the project will reduce the emission effect.

#### **3.6.5.4 Noise Pollution**

- ✓ In a power plant, major noise generating sources are rotating machines like, generators, pumps, compressors, fans, and other rotating equipment from where noise is continuously generated. The individual reciprocating engine stack will emit a noise level of 72dBA after providing the silencer (36 dBA abatement). The power house building will be capable to absorb around 130dBA noise from the engine room where as the maximum engine room noise is around 108 dBA near the generators;

- ✓ Moreover, all noise producing machineries will be under noise proof hoods and the workers will be provided with personal protective equipment (PPE) like earplug, ear muffler etc. to use at work site;
- ✓ The buffer area around the plant, development of greenbelt, boundary wall etc. around the project shall dampen the noise level so that nearby community will not be disturbed by the generated noise;
- ✓ Noise impact that will be caused by construction activities will be mitigated by managing the construction schedule in order to level out the construction amount and scale as well as introducing up-to-date low-noise equipment's.

### **3.6.6 Power Evacuation**

The electric power to be generated by the facility will be evacuated through BPDB's 33/11 kV substation to be constructed at BPDB's own land adjacent to the Harendra Road Bazar by BPDB. The proponent has to build transmission line from power plant to BPDB's substation at its own cost. Evacuation voltage shall be 33 kV. The proponent will own, operate and maintain the electrical Interconnection Facilities (EIF) up to BPDB's upcoming 33/11 kV substation. Single line diagram for 33 kV and 11 kV is shown in **Figure 3.9** and **Figure 3.10**. Single line diagram is also attached as **Annexure 6**.

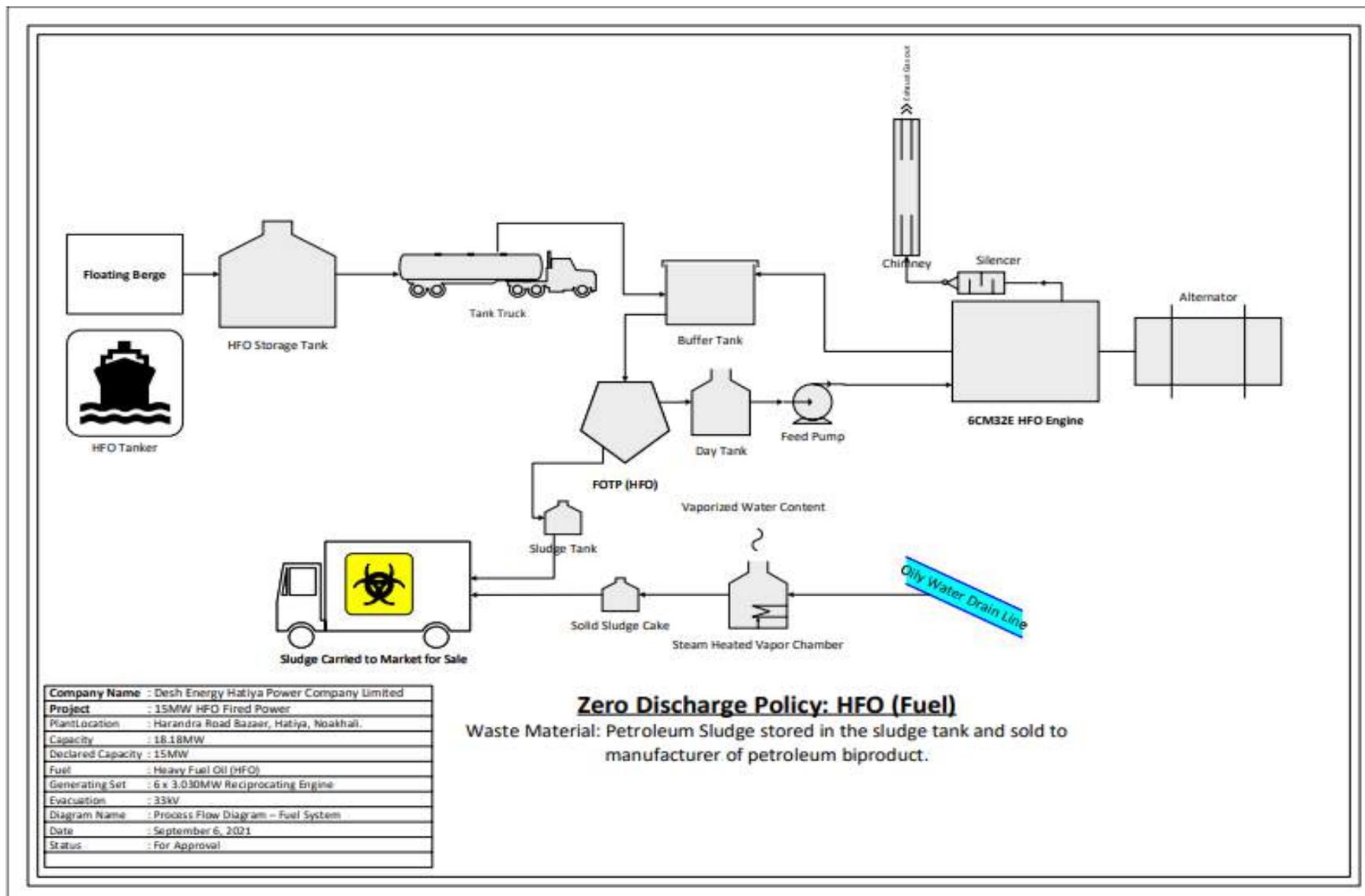


Figure 3.6: Process Flow Diagram (Fuel System)

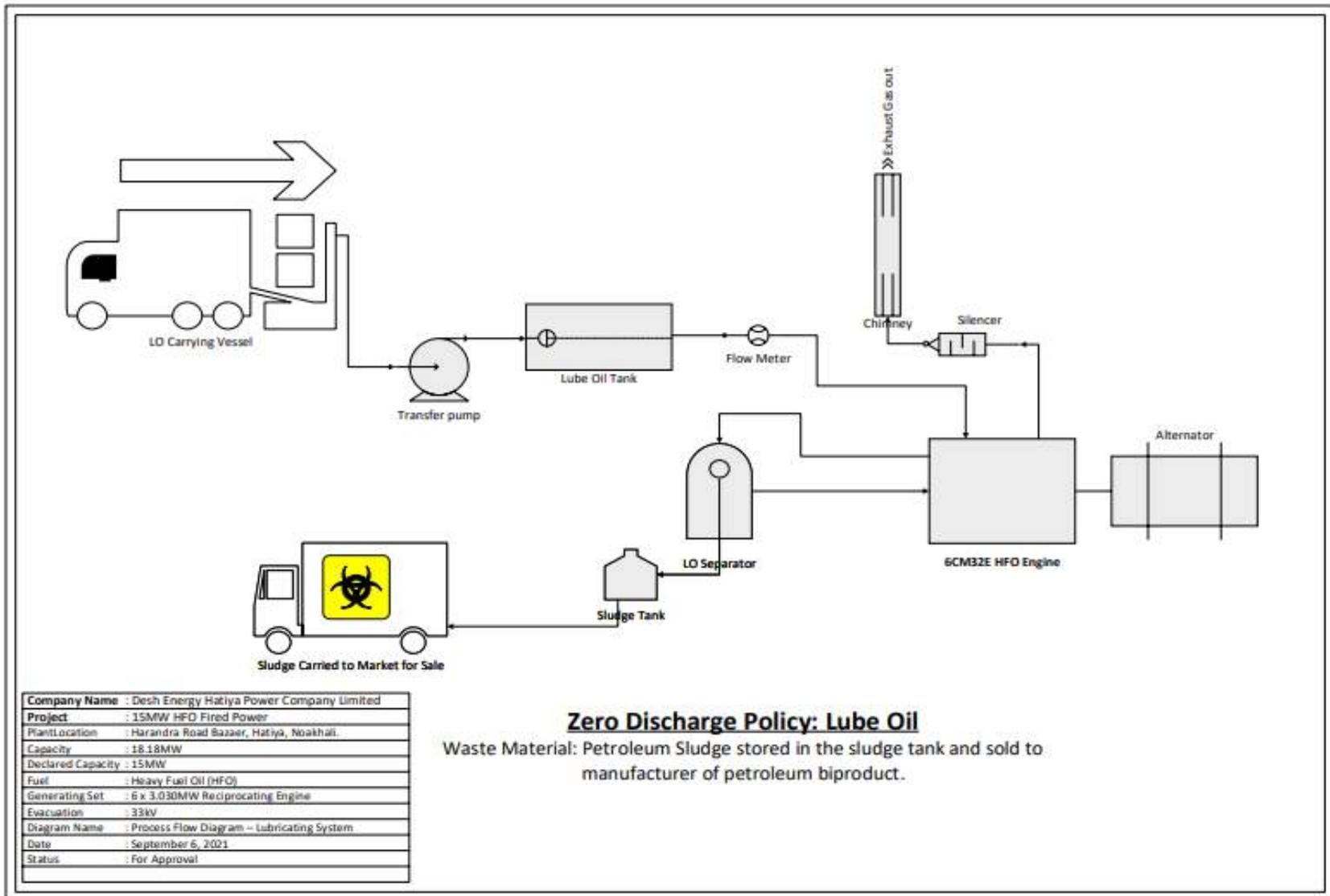


Figure 3.7: Process Flow Diagram (Lubricating System)

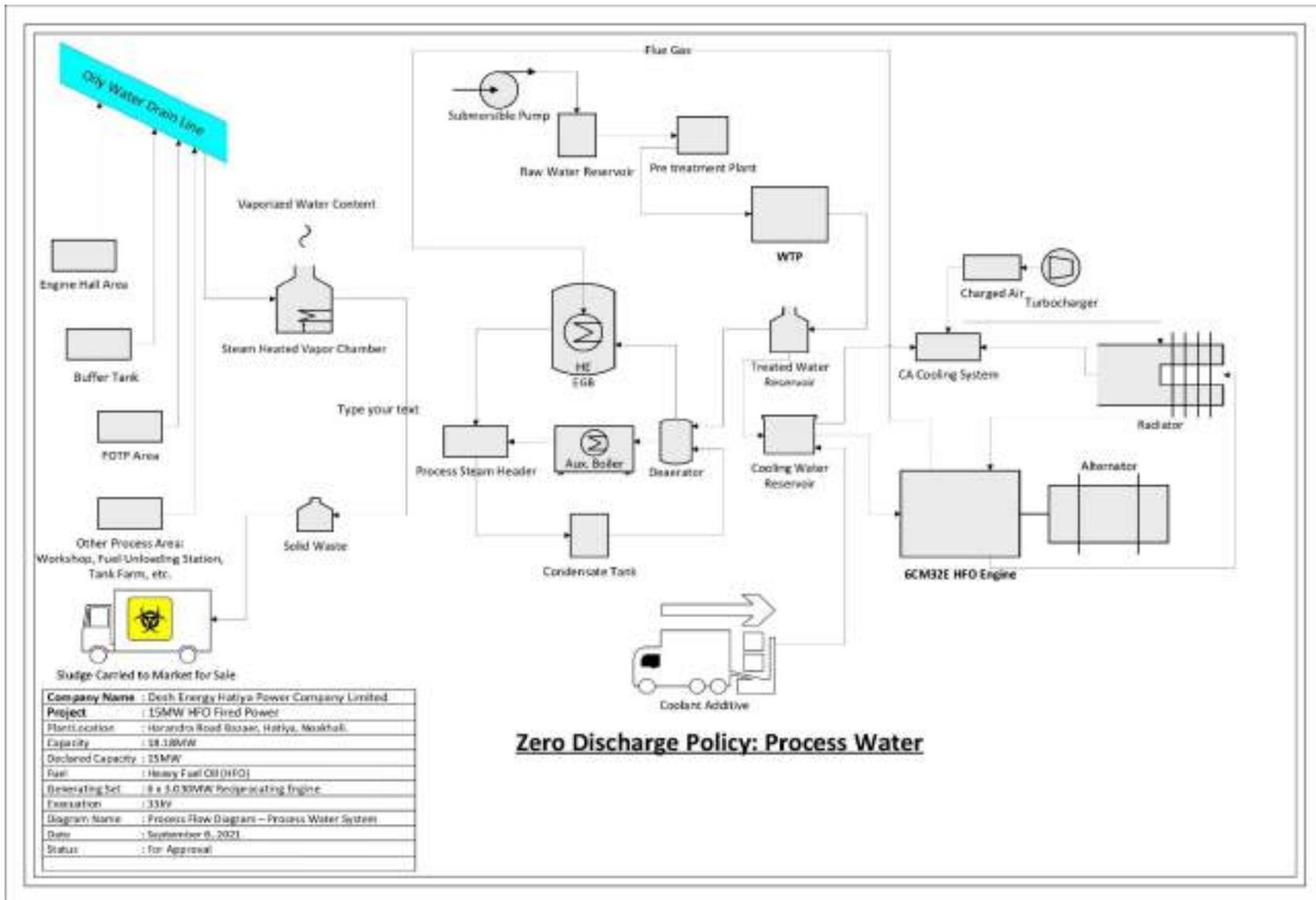


Figure 3.8: Process Flow Diagram (Process water System)

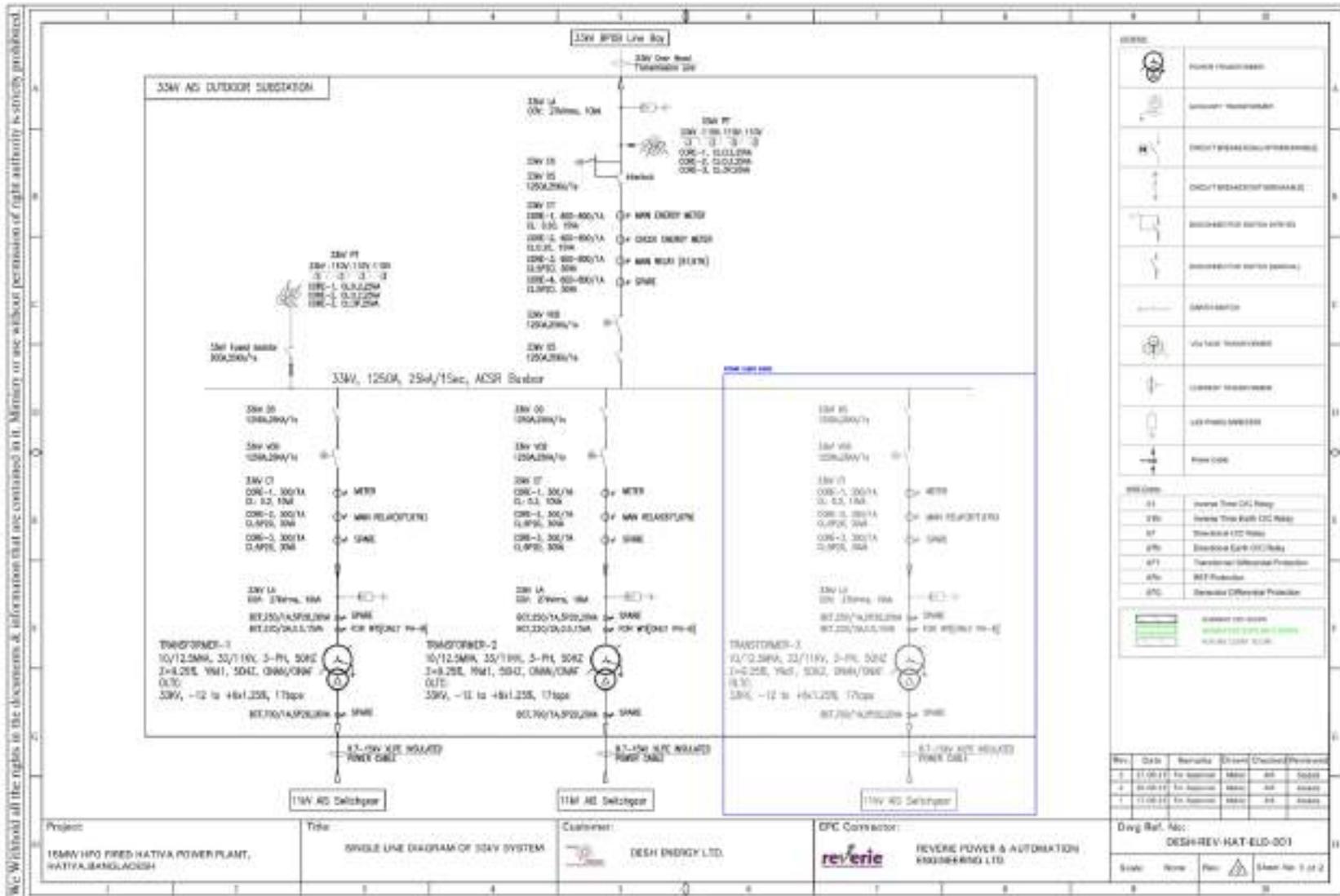


Figure 3.9: Single Line Diagram of 33 kV System

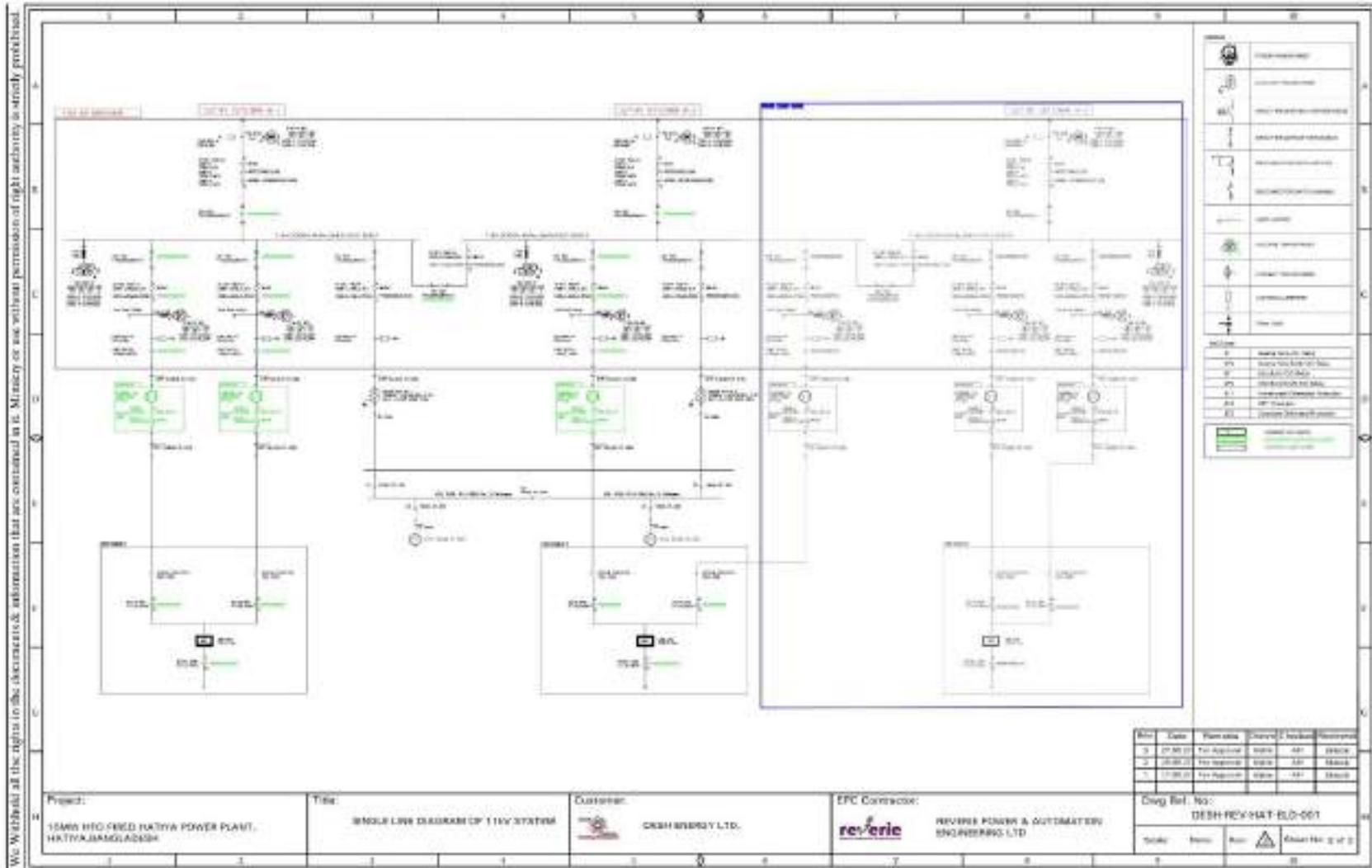


Figure 3.10: Single Line Diagram of 11 kV System

### 3.7 Resources and Utilities Demand

#### 3.7.1 Electricity

As Hatiya Island is an off grid remote locality. So, during construction phase Generator will be used.

#### 3.7.2 Water

Ground water will be used during both construction and operation phase of the project. Total water demand is 4.0 m<sup>3</sup>/hour during operation phase.

#### 3.7.3 Fuel

The main fuel for this project is “HFO” Heavy Fuel Oil. The proponent may procure HFO from Bangladesh petroleum Corporation (BPC) or HFO from plants by own arrangement. To transport the fuel through river route Lighter vessel will be used and for inland transportation (Receiving station to power plant site) of fuel, Tanker truck will be used. DFO (Diesel Fuel Oil) will be used as Auxiliary fuel.

#### 3.7.4 Infrastructure (road, drains)

Roads beside of the project area has been properly planned. Natural drainage system is available (khal). Access road from Harendra Road Bazar to Project Site and Tamuruddin ghat to receiving station is semi-pucca and damaged. The width of this roads is almost 10-15 ft. Some buses, trucks, motorcycles, easy bikes, CNG and auto rickshaw were seen in the project area during our site visit. There is no traffic jam in the project area. The approach road to project side is approx. 25 ft wide. The road around the project site is shown in **Figure 3.2**.

### 3.8 Project Schedule

Table 3.8: Project Schedule

S L	Particulars	Year 2021												Year 2022											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1.	LOI Awarded (Project Start)																								
2.	L/C Opening																								
3.	Main Equipment Shipment																								



## **4 BASELINE ENVIRONMENT**

### **4.1 General Consideration**

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

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

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

### **4.2 Objective and Methodology**

The primary objective of the environmental and social baseline condition study is to provide an environmental and social baseline against which potential impacts from the construction and operational phases of the Project can be compared.

The methodology adopted for collecting the baseline data was as follows:

- Study area of 5 km radial zone from the center of the proposed Project location was selected for the baseline studies;
- Primary data collection was conducted through environmental monitoring and field survey for water, air, soil, noise and ecology;
- Social baseline of the study area was captured through primary and secondary data review;
- Secondary data was collected from government reports, academic institutes, websites, published literature etc.

### **4.3 Physical Environment Surrounding Project Site & Study Area**

The land of the proposed project is located in Hatiya, Noakhali. It is bounded on the north by Noakhali Sadar, east and South by the Bay of Bengal and on the west by Monpura upazila of Bhola zila. Primary and Secondary data has been generated and collected for conducting the Baseline Study.

The immediate surrounding extended area of about 5 km radius has been considered as “Area of Influence (AoI)” for this study. AoI of the proposed project site is shown in **Figure 4.1**. Baseline sampling locations has been shown in **Figure 4.2** and **Figure 4.3** and details of the Baseline study is presented in **Table 4.1**.

**Table 4.1: Details of Monitoring**

SL. No.	Attribute	Parameters	Frequency of Monitoring
1	Ambient air quality	SPM, SO <sub>2</sub> , NO <sub>x</sub> , CO and Particulate matter (PM <sub>2.5</sub> & PM <sub>10</sub> )	The monitoring was carried out at 4 locations for 24 hours
2	Noise levels	Noise levels in dB(A)	Once during study period continuously for 24 hours at 5 locations
3	Water quality	Physical, Chemical and Bacteriological Parameters	Once during the study period at 2 locations for surface water and 1 location for ground water
4	Soil characteristics	Physical, Chemical Parameters	Once during the study period at 1 location
5	Meteorology	Wind Speed, Direction, Temperature, Relative Humidity, Rainfall & duration and other non-instrumental observations	Data collected from secondary sources like Meteorological Station.
6	Ecology	Existing terrestrial and aquatic flora and fauna	Based on data collected during the site visit
7	Geology	Geological history	Based on data collected from secondary sources
8	Hydrology	History of water level of the river Meghna (maximum, danger level, peak water level) and the existing groundwater level	Based on Data collected from secondary sources
9	Socio-economic aspects	Socio-economic characteristics	Based on data published in latest census

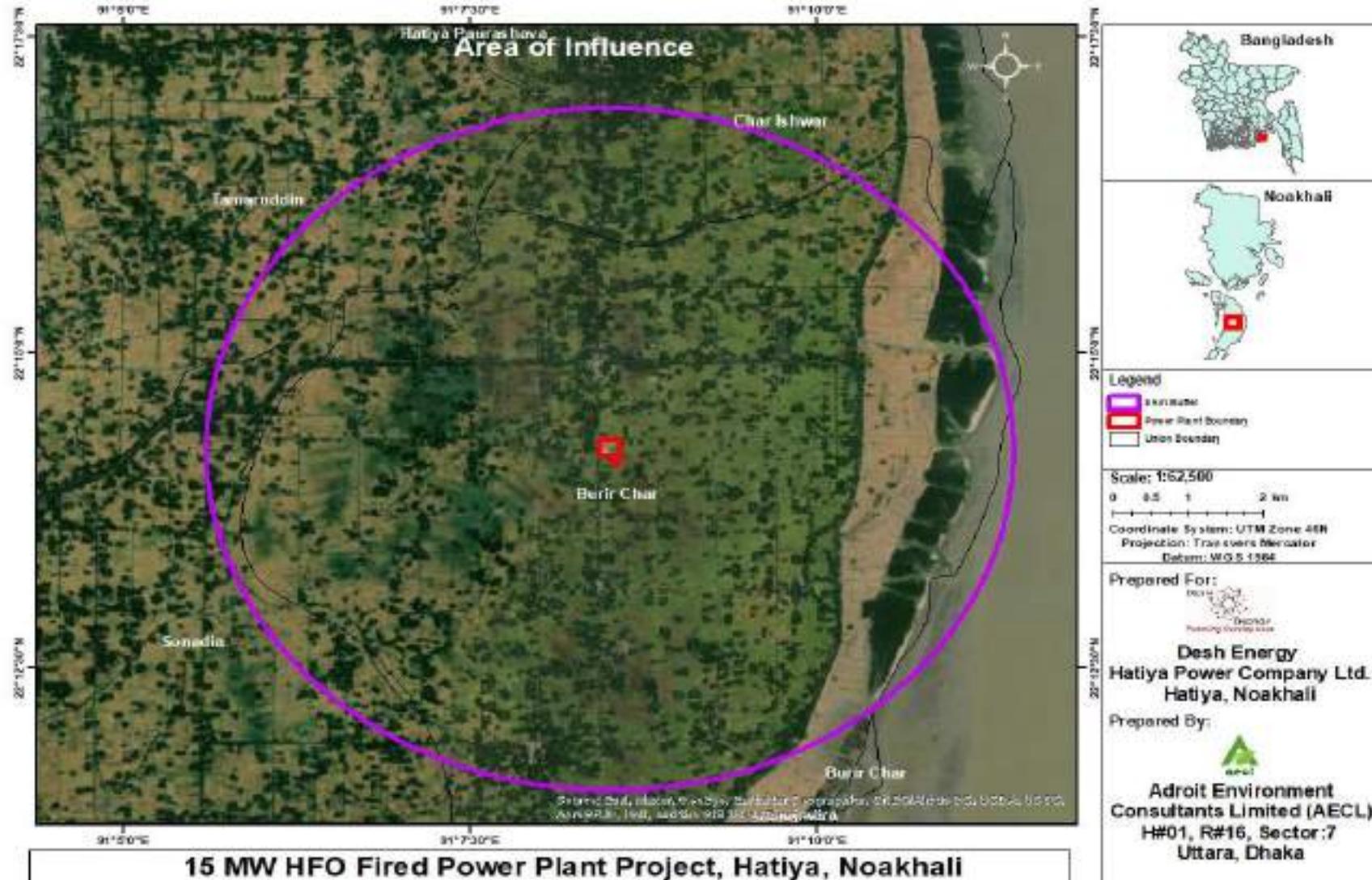


Figure 4.1: AoI of the Proposed Project Site



Figure 4.2: Monitoring Location of the Project Site

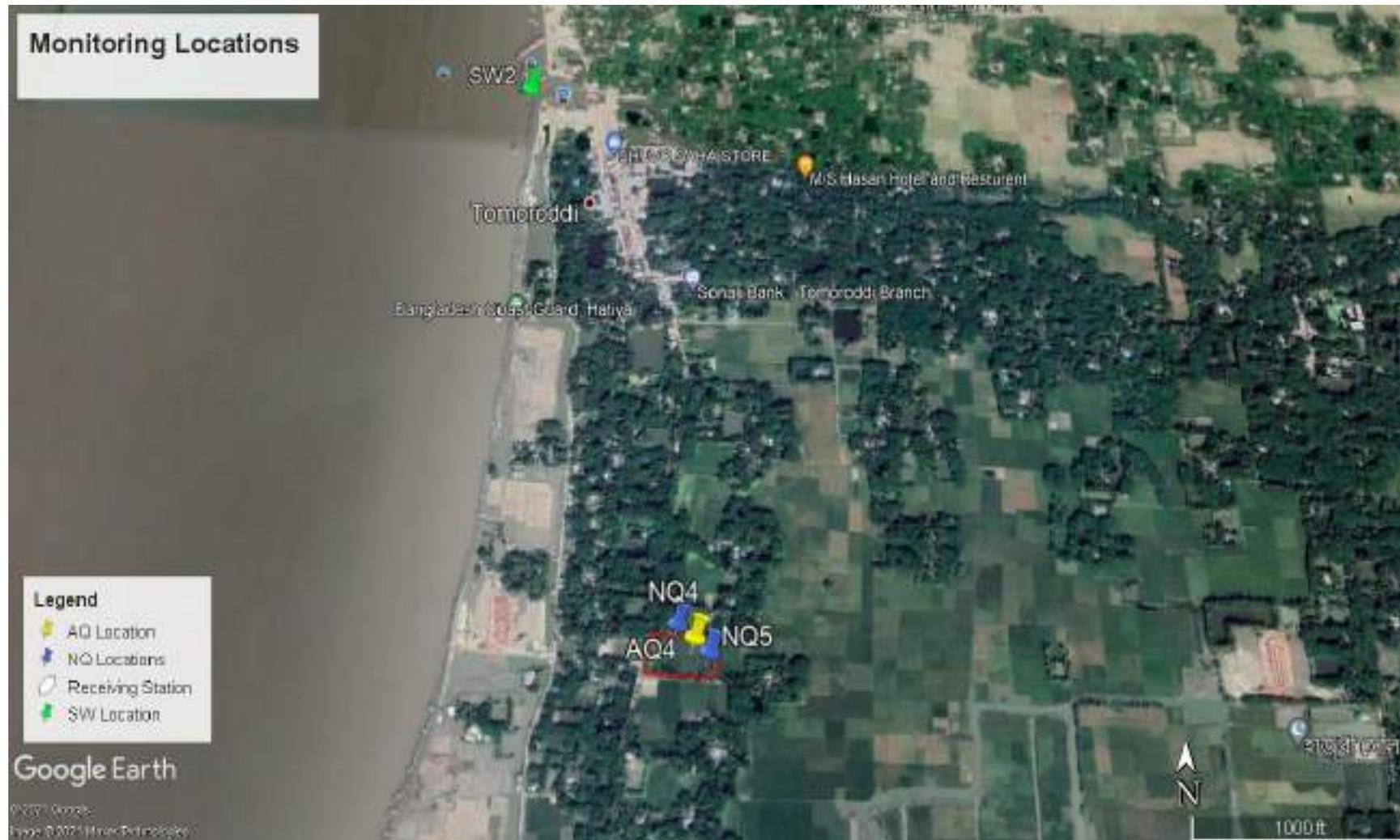


Figure 4.3: Monitoring Location of Receiving Station

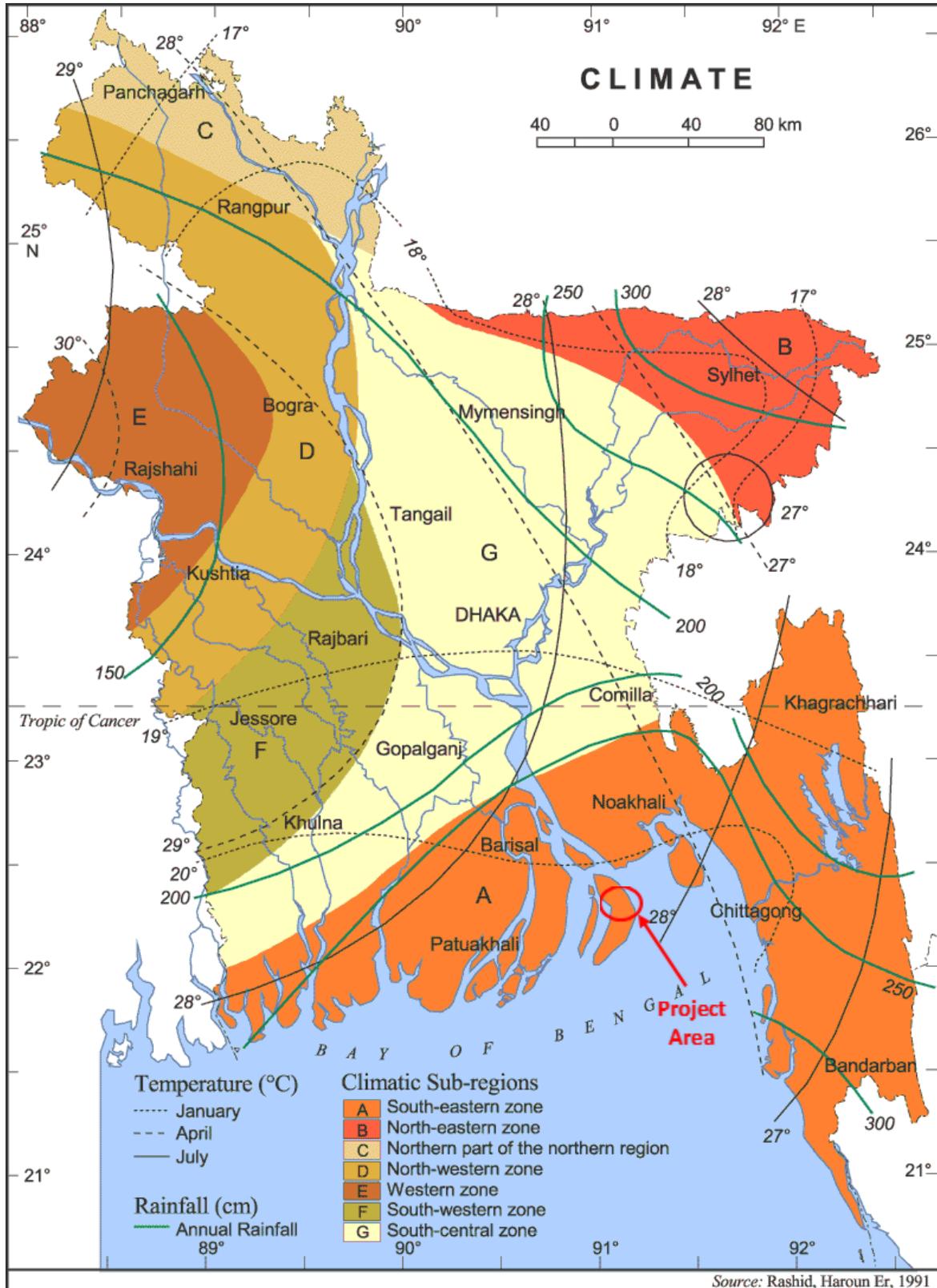
#### **4.4 Climate**

Bangladesh is located in the tropical monsoon region, and its climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. From the climatic point of view, three distinct seasons can be recognized in Bangladesh and these are:

- Summer/pre-monsoon - March to May
- Rainy season/monsoon - June to October
- Winter - November to February

January is the coolest month, and April is the warmest. Most places receive more than 1,525 mm of rain a year, and areas near the hills receive 5,080 mm per year. Most rains occur during the monsoon (June-September) and a very little occurs in winter (November-February). Climate map of Bangladesh is presented in **Figure 4.4**. According to the Climate map, the project area falls in South-eastern zone (A).

South-eastern zone (A) comprises the Chittagong sub-region and a strip of land extending from southwest Sundarbans to the south of Comilla. The hills over 300m in height have north-eastern zone climate. The rest of the area has a small range of temperature, rarely goes over a mean of 32°C and below a mean of 13°C. Rainfall is heavy, usually over 2,540 mm. In winter dew fall is heavy.



(Rashid, 1991)

Figure 4.4: Climate Map of Bangladesh

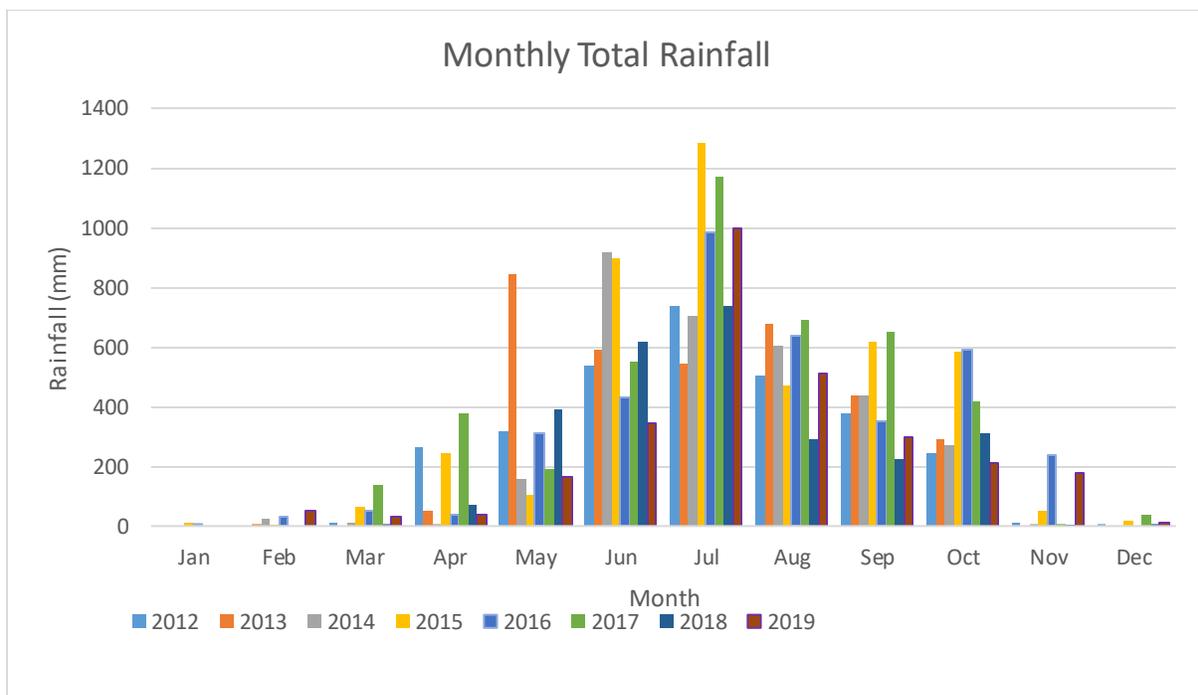
#### 4.4.1 Rainfall

The rainfall follows the general climate pattern with the highest rainfall in the summer month of June to September and minimum rainfall in the cooler and drier months of November to March. Total monthly rainfall values of Hatiya are given in **Table 4.2**. Rainfall variability map of Bangladesh is presented in **Figure 4.6**. According to the map the rainfall variability of the project area is 16.1~18%.

**Table 4.2 Monthly Total Rainfall in Hatiya (2012- 2019)**

Year	Total Rainfall in mm											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	0	0	8	267	317	538	738	501	377	244	13	2
2013	0	4	0	50	842	592	544	677	435	292	0	0
2014	0	27	14	2	158	916	702	603	435	269	2	0
2015	14	7	65	243	107	900	1281	471	619	585	52	16
2016	4	34	50	40	314	430	984	637	348	589	238	0
2017	0	0	136	379	192	553	1170	691	650	420	3	41
2018	0	0	1	73	394	616	736	291	226	309	7	5
2019	0	48	31	39	162	344	1000	509	297	209	175	8

(Bangladesh Meteorological Department)



**Figure 4.5: Monthly Total Rainfall data of Hatiya (2012- 2019)**

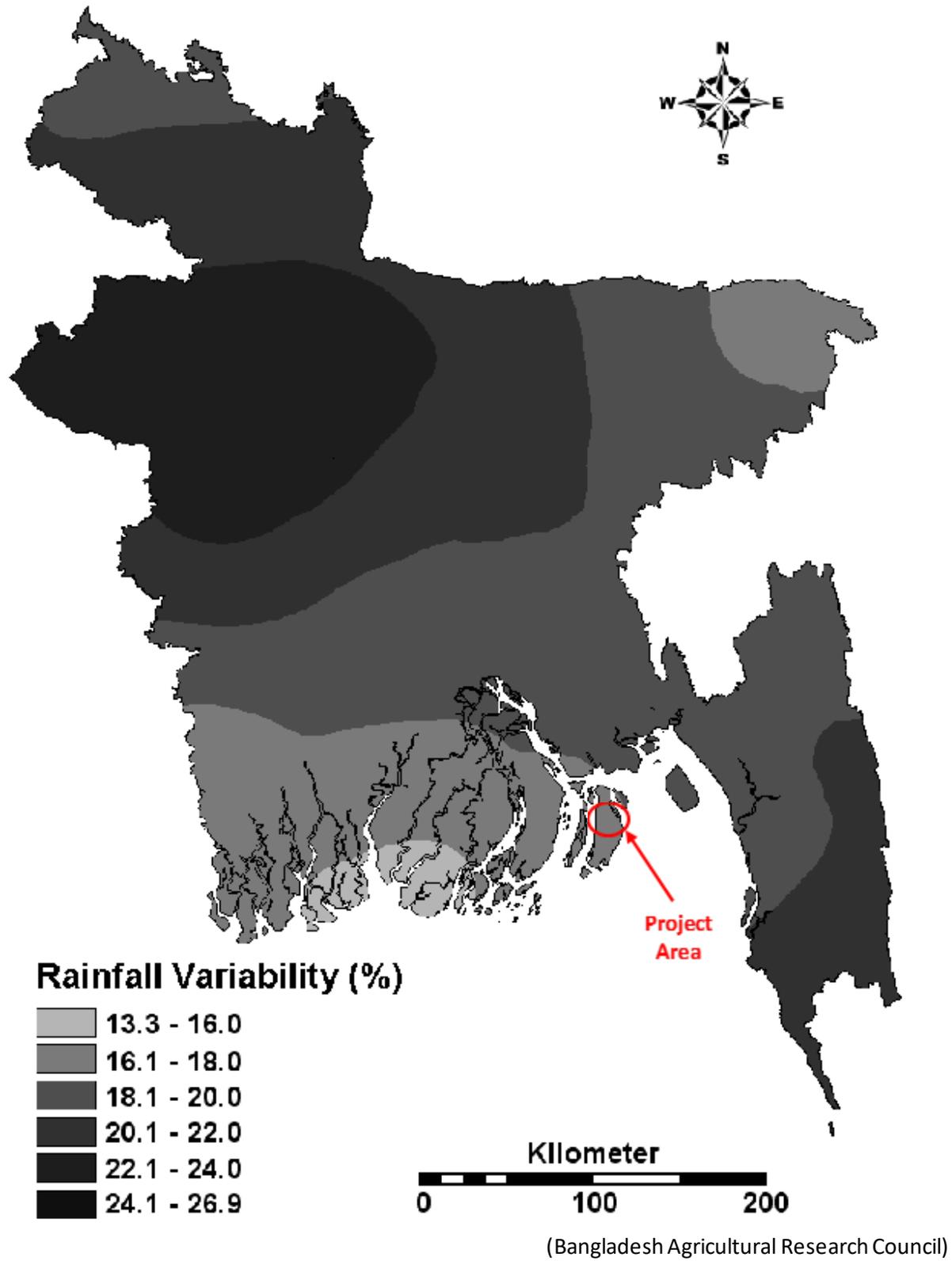


Figure 4.6: Rainfall variability map of Bangladesh

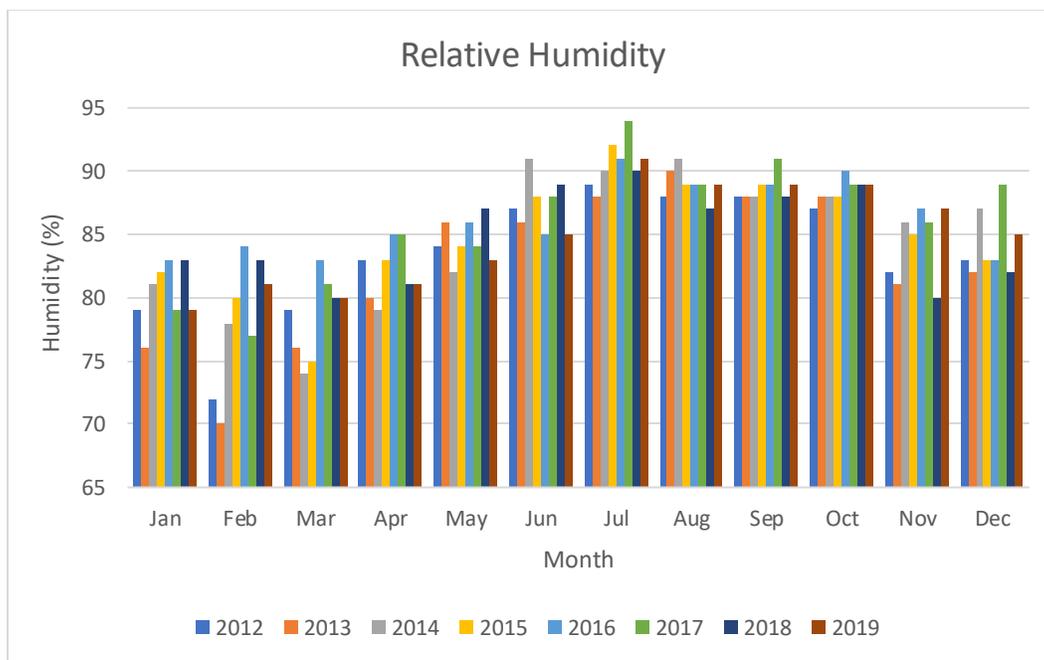
#### 4.4.2 Relative Humidity

Humidity during the wet season is naturally the highest compared to those occurring at other times of the year. The monthly average relative humidity from year 2012 to year 2019 of project area (Hatiya) are given in **Table 4.3**

**Table 4.3 Average Monthly Relative Humidity of Hatiya (2012- 2019)**

Year	Monthly Average Humidity in %											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>2012</b>	79	72	79	83	84	87	89	88	88	87	82	83
<b>2013</b>	76	70	76	80	86	86	88	90	88	88	81	82
<b>2014</b>	81	78	74	79	82	91	90	91	88	88	86	87
<b>2015</b>	82	80	75	83	84	88	92	89	89	88	85	83
<b>2016</b>	83	84	83	85	86	85	91	89	89	90	87	83
<b>2017</b>	79	77	81	85	84	88	94	89	91	89	86	89
<b>2018</b>	83	83	80	81	87	89	90	87	88	89	80	82
<b>2019</b>	79	81	80	81	83	85	91	89	89	89	87	85

(Bangladesh Meteorological Department)



**Figure 4.7: Average Monthly Relative Humidity of Hatiya (2012-2019)**

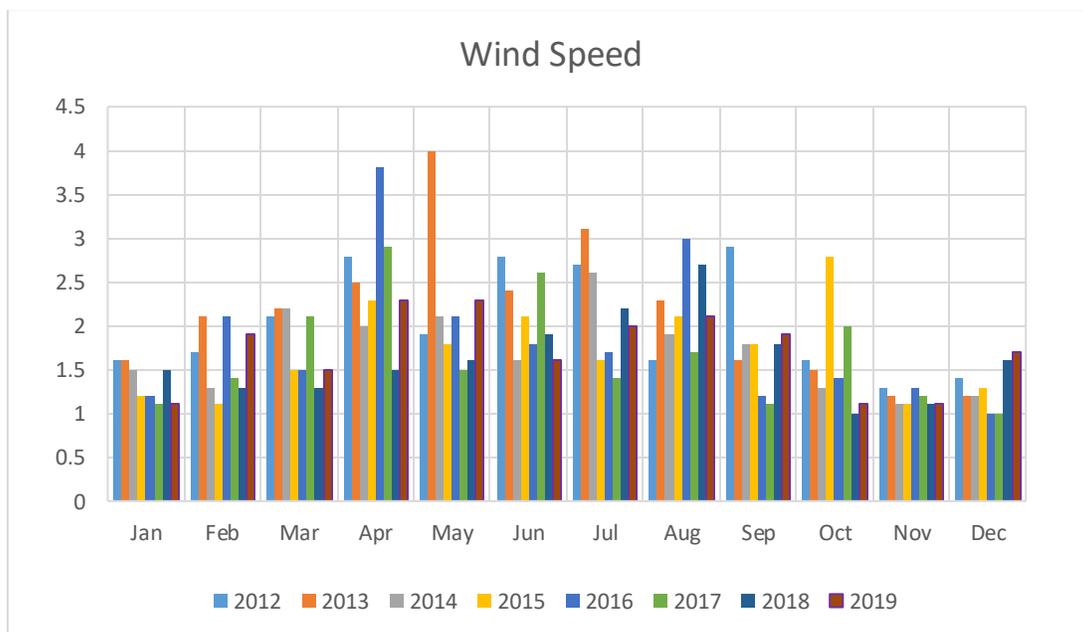
#### 4.4.3 Wind Speed

According to Bangladesh Meteorological Department the average wind speed at Hatiya Upazila since 2012 to 2019 are given in **Table 4.4**

**Table 4.4 Monthly Prevailing Wind Speed and Direction in Hatiya (2012- 2019)**

Year	Wind Speed in Knots with Direction											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>2012</b>	1.6N	1.7N	2.1S	2.8S	1.9S	2.8S	2.7S	1.6S	2.9SE	1.6S	1.3NE	1.4N
<b>2013</b>	1.6N	2.1N	2.2S	2.5S	4.0SE	2.4S	3.1S	2.3S	1.6S	1.5SE	1.2N	1.2N
<b>2014</b>	1.5N	1.3N	2.2N	2.0S	2.1S	1.6S	2.6S	1.9S	1.8S	1.3N	1.1N	1.2N
<b>2015</b>	1.2NW	1.1NW	1.5N	2.3S	1.8S	2.1S	1.6S	2.1S	1.8S	2.8E	1.1N	1.3N
<b>2016</b>	1.2N	2.1S	1.5S	3.8S	2.1S	1.8S	1.7S	3.0S	1.2S	1.4S	1.3N	1.0N
<b>2017</b>	1.1N	1.4S	2.1S	2.9S	1.5S	2.6S	1.4S	1.7S	1.1S	2.0S	1.2N	1.0N
<b>2018</b>	1.5N	1.3N	1.3S	1.5S	1.6S	1.9S	2.2S	2.7S	1.8S	1.0N	1.1N	1.6 N
<b>2019</b>	1.1N	1.9N	1.5S	2.3S	2.3S	1.6S	2.0S	2.1S	1.9S	1.1S	1.1N	1.7NW

(Bangladesh Meteorological Department)



**Figure 4.8 (a): Monthly Prevailing Wind Speed of Hatiya (2012- 2019)**

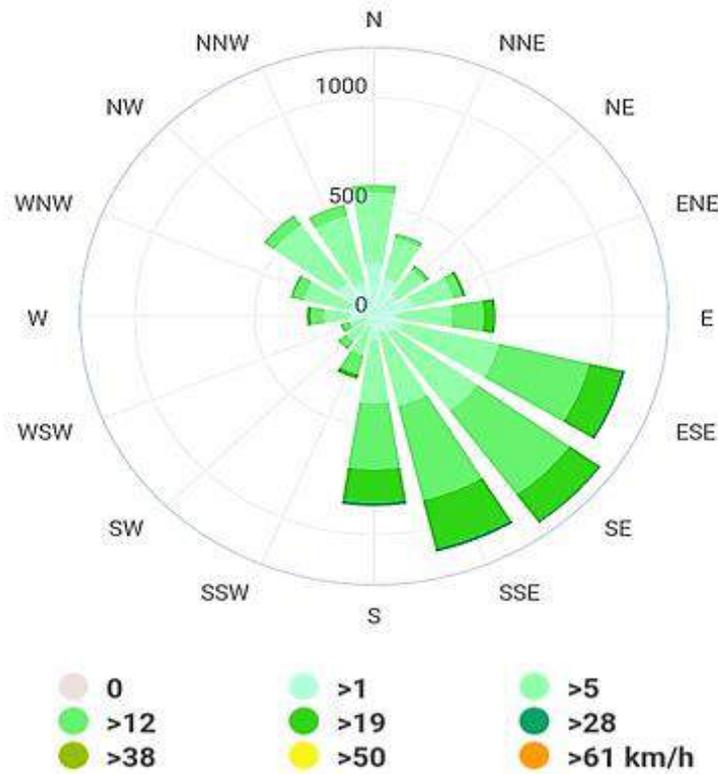


Figure 4.8 (b): Windrose diagram

#### 4.4.4 Ambient Air Temperature

In general, cool seasons coincide with the period of lowest rainfall. **Table 4.5 - table 4.7** shows the Monthly average, Maximum and minimum Temperature in degree Celsius for the period 2012 to 2019.

Table 4.5: Monthly average Dry Bulb Temperature in degree Celsius of Hatiya (2012-2019)

Year	Monthly Average Temperature in degree Celsius											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	18.8	21.8	26.4	27.8	29.2	29.1	28.2	28.3	28.5	27.1	23.5	18.5
2013	17.7	22.1	26.0	28.3	27.8	29.1	28.2	27.9	28.3	27.2	23.8	19.9
2014	18.4	21.0	25.5	29.4	29.9	28.8	28.7	28.3	28.5	27.5	23.8	19.8
2015	19.3	21.6	25.6	27.7	29.5	28.6	27.8	28.6	28.8	27.2	24.3	20.6
2016	18.9	23.6	27.0	29.3	28.8	29.0	28.1	28.5	28.6	27.8	23.7	21.2
2017	19.3	22.5	24.7	27.8	29.6	28.9	28.1	28.6	28.3	27.5	24.4	21.0
2018	17.7	22.4	26.2	27.7	28.1	28.7	28.4	28.7	28.7	26.7	23.5	19.6
2019	18.9	21.4	25.3	28.2	29.8	29.6	28.4	28.8	28.5	27.4	24.3	19.4

(Bangladesh Meteorological Department)

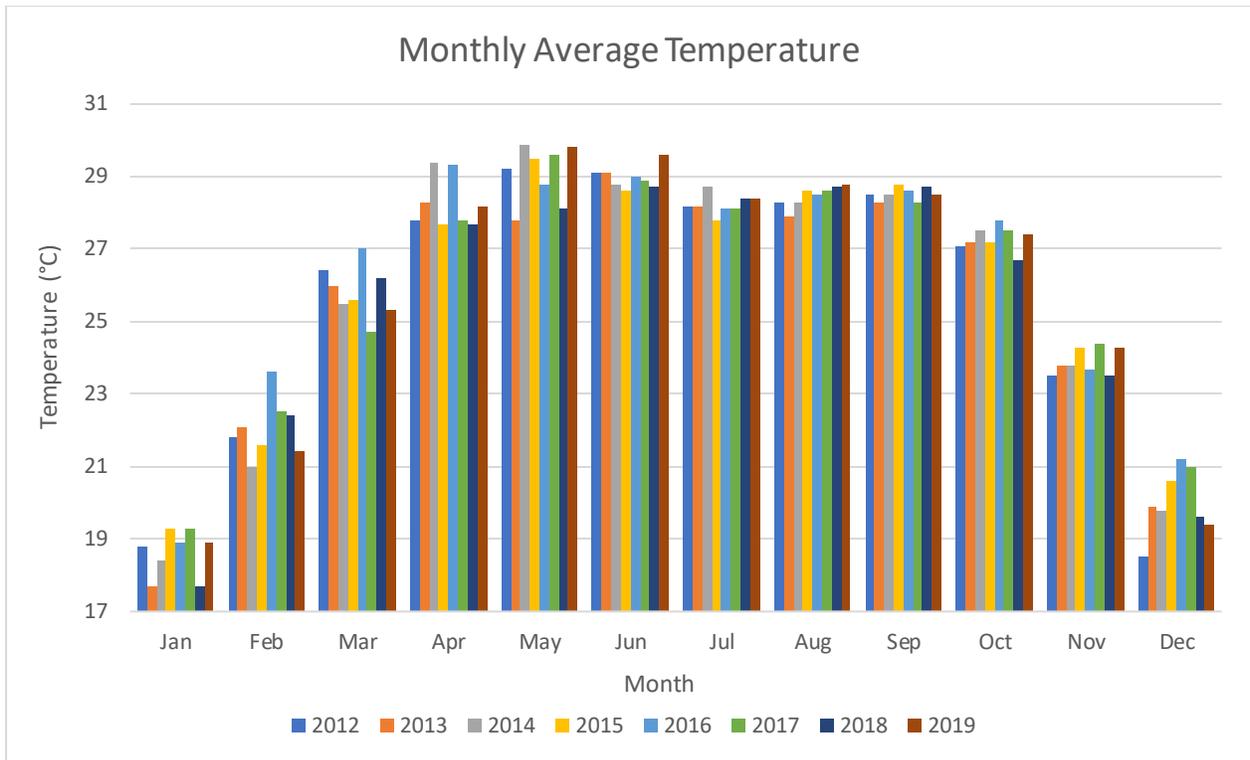


Figure 4.9: Monthly Ambient Average Temperature of Hatiya (2012- 2019)

Table 4.6: Monthly Maximum Temperature in degree Celsius of Hatiya (2012-2019)

Year	Monthly Maximum Temperature in degree Celsius											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>2012</b>	28.6	33.5	34.4	35.7	35	34.5	32.5	33.2	34.5	33.5	33	29
<b>2013</b>	30.3	33.2	34.6	35	33.4	35.7	32.4	34.4	36	34.5	32.2	30
<b>2014</b>	29.3	30.5	35.4	39.4	36	35.2	33.5	32.5	33.7	34.2	33.3	30
<b>2015</b>	30	31.5	35	35.2	35.7	35.5	33.5	33.2	35.3	34.2	31.8	29.8
<b>2016</b>	27.5	32.3	35	35	36	34.2	33.8	34	33.4	34	34.4	30.8
<b>2017</b>	29.5	31.5	33.3	34.8	37.2	36.2	33.4	34	35.4	35	33	30.7
<b>2018</b>	27.5	32.7	34.7	34.6	35.6	34	36.2	33.5	35.5	35	32.2	29.5
<b>2019</b>	30.2	32	35	37.1	35.6	37.7	34.5	36	35.2	35	31.7	30.2

(Bangladesh Meteorological Department)

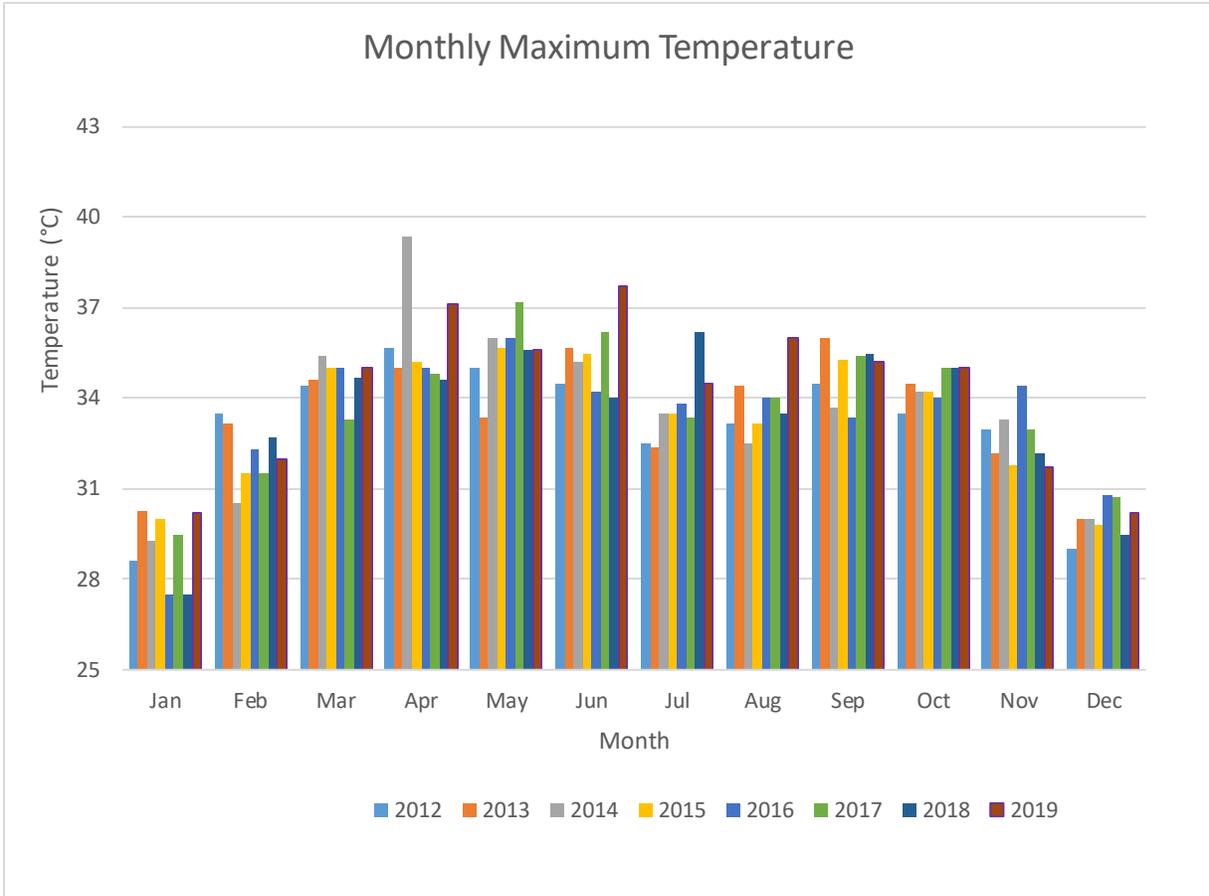


Figure 4.10: Monthly Maximum Temperature of Hatiya (2012- 2019)

Table 4.7: Monthly Minimum Temperature in degree Celsius of Hatiya (2012-2019)

Year	Monthly Minimum Temperature in degree Celsius											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	10	12	16.5	19.5	19.6	23.6	24	24.4	24.4	20.2	13.4	9.9
2013	7.8	12.9	15	20	20.7	23.4	23.4	23.4	23.4	20.5	16	11.1
2014	9.9	12.3	15	19.8	21.4	23.8	24	23.8	24.3	20.5	15	11.8
2015	11.3	10.9	12.5	20	21.6	23.3	22	24	23.5	21.8	17.5	11.8
2016	10	12.7	19.8	18.1	21.4	22.8	24	24.5	24.7	22.8	16.8	14.2
2017	10.6	13	16.3	18	21.8	23.8	24	24.5	23	20	15.8	13.6
2018	9.7	14	17.4	20.8	20.8	23.5	24.8	24.3	24.1	20	16	10.2
2019	11.5	11.3	14	19.4	22	24.2	23.6	24.5	24.3	22.5	17.9	11.7

(Bangladesh Meteorological Department)

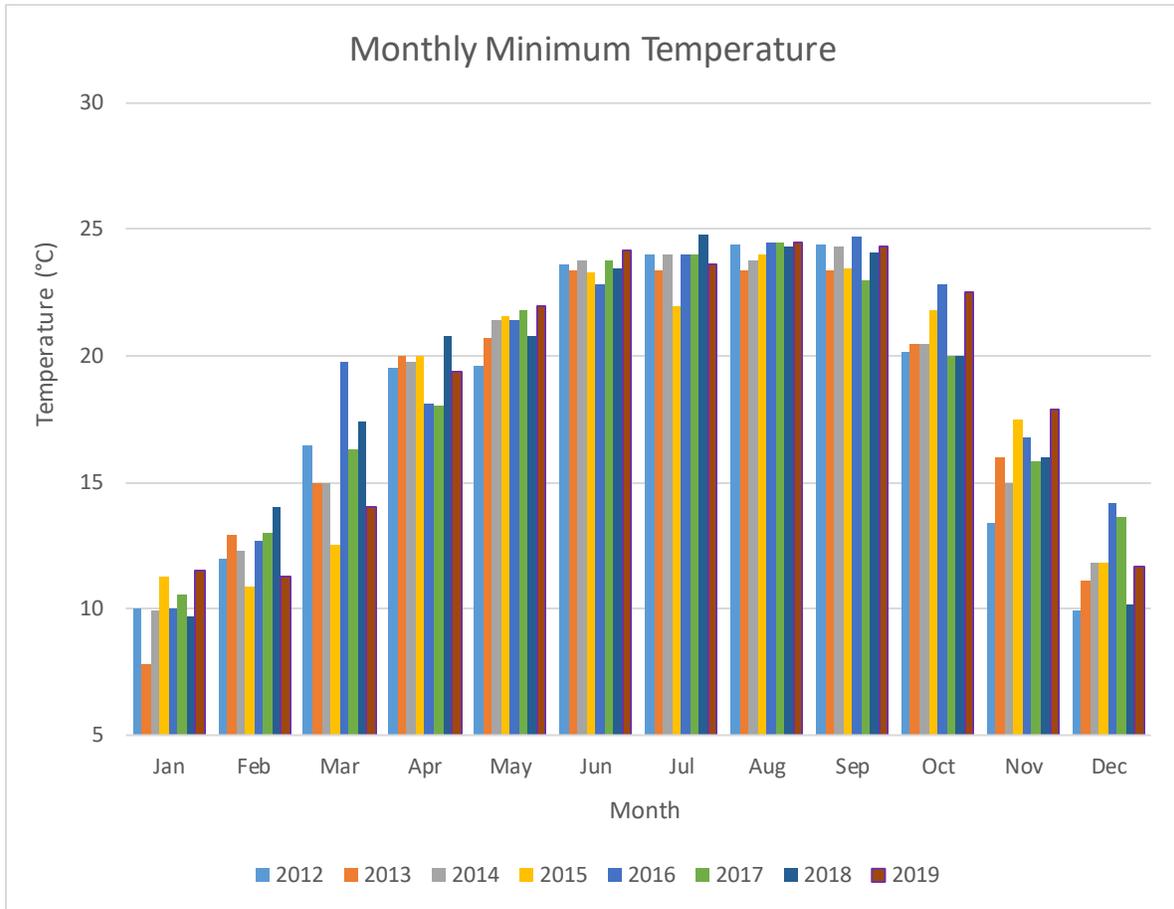


Figure 4.11: Monthly Minimum Temperature of Hatiya (2012- 2019)

#### 4.5 Land Use/land Cover

Land use/ land cover inventories are an essential component in land resource evaluation and environmental studies due to the changing nature of land use patterns. By proper analysis of Land use, existing land use pattern can be known easily. The land use study for the proposed Project Site and its 5 km buffer is undertaken with the following objectives:

- To study the land use/cover in the 5 km area of the Proposed Project Site and provide inputs for environmental planning of the proposed plant by analyzing the existing land use/land cover scenario;
- To establish the existing base line scenario using a GIS database for incorporation of thematic information on the different physical features including Agricultural Land, Settlements, Water Body, Sandy Area, Mangrove Forest.

#### **4.5.1 Process of Analysis**

Land use analysis is carried out using Google Earth and ArcGIS 10.8 software. A multi-step task has been followed in analyzing the images. A series of tasks were followed for analyzing after receiving the images from image provider.

On screen digitization techniques are used to extract required land use and land cover data from the satellite images. Using this technique, major classes such as Agricultural Land, Settlements, Water Body, Sandy Area and Mangrove Forest are derived from the images.

##### **4.5.1.1 Agricultural Land**

Agricultural land is flat/plain land comprising of many continuous plots, which have various kinds of agricultural products such as crops, vegetables etc. They are identified by light green color with orange dots in land use map.

##### **4.5.1.2 Settlements**

Settlement area contains homestead plants, house structures and small yards and sometimes attached small farmlands surrounded by different types of homestead vegetation in both urban and rural area. This class is identified by Orange-Black parallel Texture.

##### **4.5.1.3 Water Bodies**

Water Bodies includes Sea, River, Canal, Khal, Pond etc. The study area is surrounded by small ponds and khal. In Land use map, water bodies are indicated by light blue color.

##### **4.5.1.4 Sandy Area**

At the west side of the project area near Bay of Bengal, sandy area is found during image classification. This class is identified by light grey color in Land Use Map.

##### **4.5.1.5 Mangrove Forest**

Mangrove Forest is found beside the Bay of Bengal at the west side of the project area. This class is identified by green-whitish color in Land Use Map.

#### **4.5.2 Land Use Interpretation of the Study Area**

The evaluation of the existing environmental status of the study area is conducted within 5 km buffer zone area. This revealed that the land use/land cover consists mainly of Agricultural Land, Settlements, Water Body, Sandy Area and Mangrove Forest

A land sat 8 images (Resolution 30m\*30m) has been used to make the detail analysis of Existing land use Pattern. The Existing Land Use Map has been given below:

#### 4.5.2.1 Land Use Analysis

**Table 4.8: Area Calculation of Existing Land use for 5 km Buffer Area**

Land Type	Area (Acres)	Percentage
<b>Agricultural Land</b>	12259.02	63.16803215
<b>Settlements</b>	4049.65	20.86695522
<b>Water Body</b>	987.36	5.087648787
<b>Sandy Area</b>	1324.71	6.825939094
<b>Mangrove Forest</b>	780.7	4.022775287
<b>Project Area</b>	5.56	0.028649456
<b>Total</b>	19407	100

As per the Table 4.8, among 19407 acres (5 km around Project site) about 63.16% (12259.02) area is Agricultural Land. Actually, a lot of crops especially Paddy are produced in Hatiya. From land use map, it is found that settlements are situated at scattered way. About 20.87% (4049.65 Acres) land is Settlements within 19407 acres of land. About 5.08% lands are water body. Many Khal and ponds are located within 5 km area of the project site. At the west side of project site, Bay of Bengal is located where Mangrove Forest (4.02%) and Sandy Area (6.82%) have been found during land use.

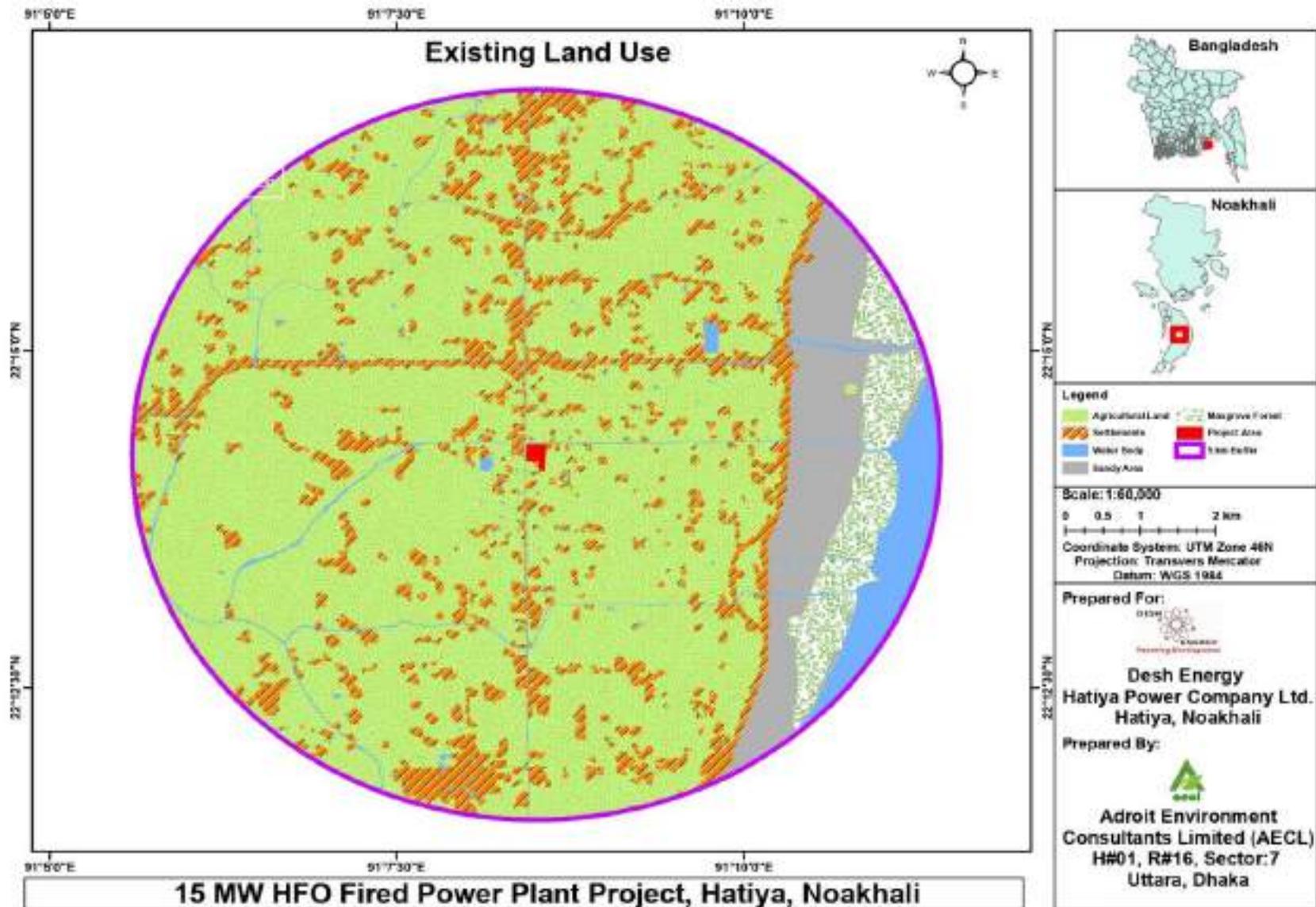


Figure 4.12: Existing Land Use Map for 5 km Buffer Area

#### 4.5.3 Land area based on utilization

The proposed project site is located at Hatiya, Noakhali District, Bangladesh. According to Bangladesh Bureau of Statistics (BBS) 2011, total area of Hatiya is 1507.35 Sq. km, Land Area 872.96 Sq. km, Riverine Area 336 Sq km. Land area based on utilization 2008 is given in **Table 4.9**.

**Table 4.9: Land area (Acre) based on utilization**

Land Area (In Acre)	Ashuganj
Permanent Cropped Area	4,543
Temporary Cropped Area	79,863
Permanent fallow Area	155

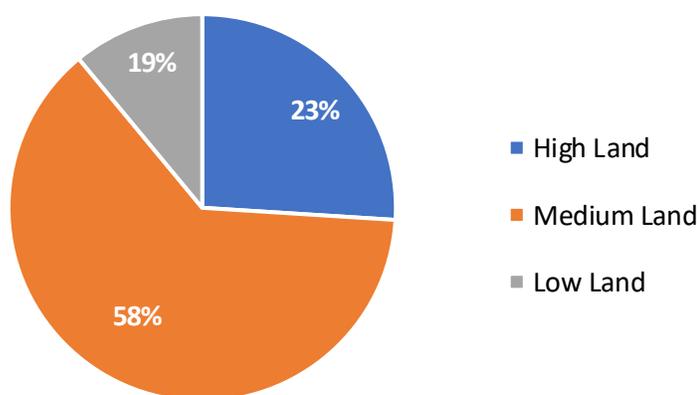
(BBS, 2011)

The area of high, medium and low land of Hatiya is attached below in **Table 4.10** and its total percentage is shown in **Figure 4.13**.

**Table 4.10: Area of high, medium and low land**

Land Area (In Acre)	Ashuganj
High Land	2,470
Medium Land	6,338
Low land	1,992

(BBS, 2011)



**Figure 4.13: Area of high, medium and low land**

#### 4.5.4 Ecologically Critical Area

Bangladesh Government declared 8 areas as Ecologically Critical area (ECAs) in Bangladesh (1999), i.e., Cox's Bazar, Teknaf Peninsula, St. Martin's Island, Sonadia Island, Hakaluki Haor, Tanguar Haor and Marjat

Baor, Gulshan-Baridhara Lake and Sundarbans. **Table 4.12** shows the ECA and their distance from the project site. According to the list, there is no ecologically critical area within 5 km of the project site.

**Figure 4.14 and Figure 4.15** shows the location of the project site in relation to the country's ecologically critical area and Protected Areas, Eco Parks & Safari Park of Bangladesh respectively. The maps illustrates that no ecologically critical area or Protected Areas, Eco Parks & Safari Park falls within 5 km area of the project site.

#### **4.5.5 Physical and Cultural Heritage**

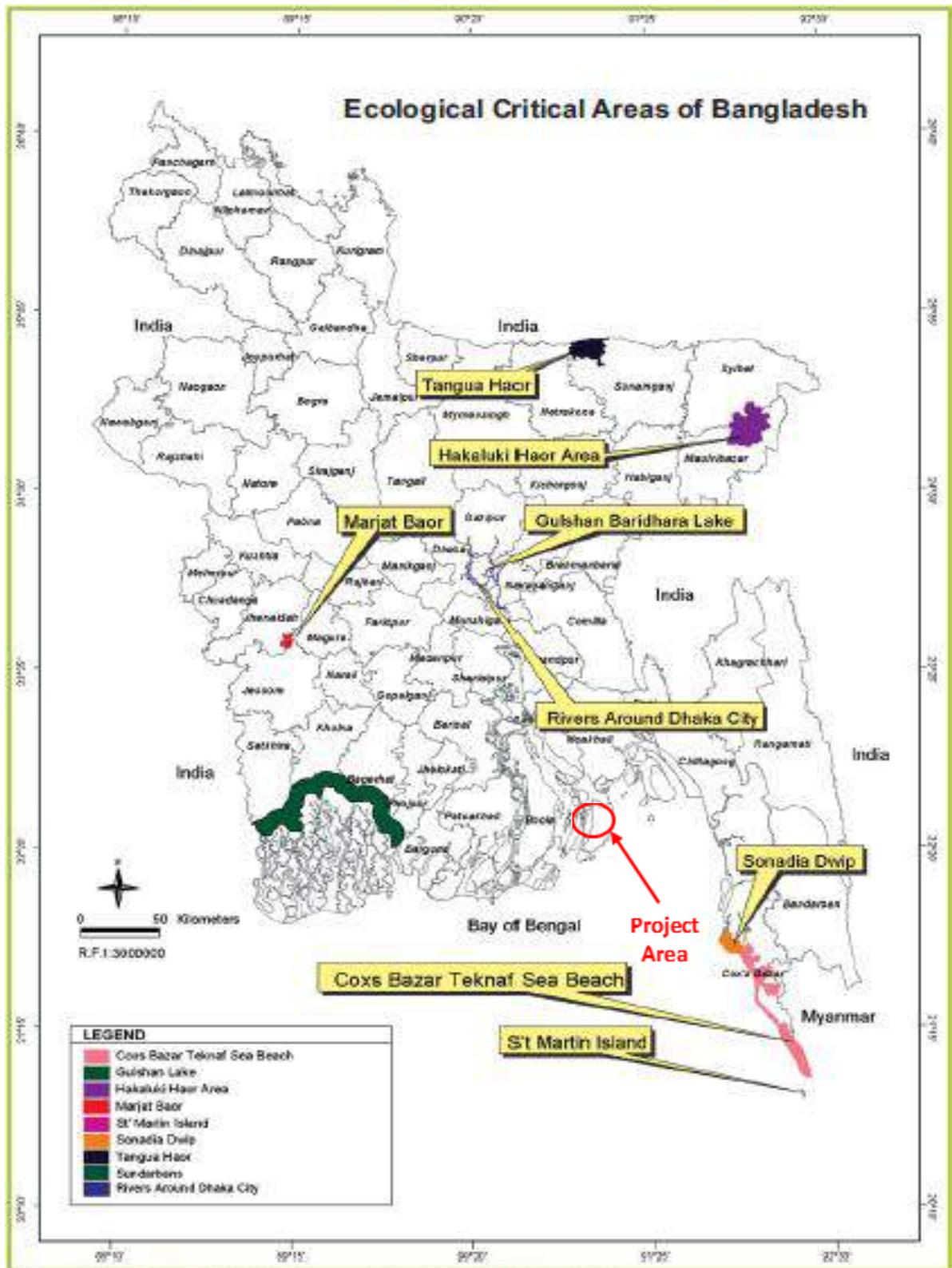
The project area as such, does not encompass any key cultural heritage or resource of national or regional value. Moreover, there is no key cultural heritage or resource of national or regional value within the 5 km radial zone. **Table 4.11** denotes the distance of other Physical and Cultural Heritage from the project site.

**Table 4.11: Physical and Cultural Heritage from the project site**

SL No.	Physical and Cultural Heritage	Distance from Project site (approx.)
1.	Noakhali Public Library	70 km
2.	Bajra Shahi Mosque	85 km
3.	Eidagazi Mosque at Char Hazari	71.5 km
4.	Budi Mosque at Basurhat	67 km
5.	Jagannath Bari Mandir	77.5 km

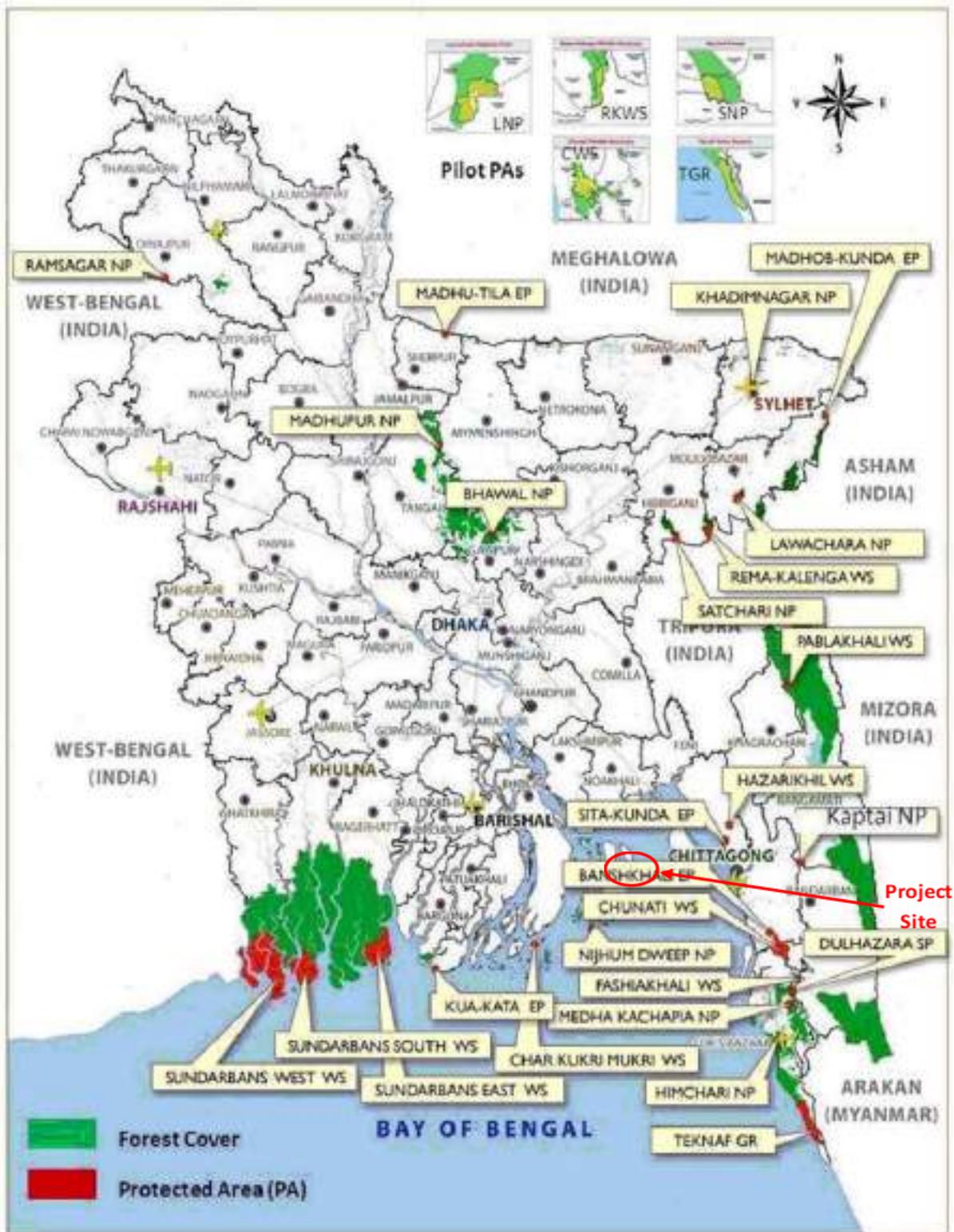
**Table 4.12: Ecologically Critical areas (ECA) of Bangladesh and their distance from project site**

No.	Name of the ECA	Type of Ecosystem	Location	Areas (ha)	Year of Declaration	Distance from Project site
1.	Cox's Bazar-Teknaf Peninsula	Coastal-Marine	Cox's Bazar	20,373	1999	131 km
2.	Sundarbans (10 km landward periphery)	Coastal-Marine	Bagerhat, Khulna, Barguna, Pirojpur and Satkhira	292,926	1999	238 km
3.	St. Martin's Island	Marine Island with coral reefs	Teknaf Upazila, Cox's Bazar	1,214	1999	218 km
4.	Hakaluki Haor	Inland Freshwater Wetland	Sylhet and Moulvibazar	40,466	1999	281 km
5.	Sonadia Island	Marine Island	Moheshkhali, Cox's Bazar	10,298	1999	112.6 km
6.	Tanguar Haor	Inland Freshwater Wetland	Tahirpur, Sunamganj	9,727	1999	327 km
7.	Marjat Baor	Oxbow Lake	Kaliganj Upazila of Jhenaidah and Chaugacha Upazila of Jessore	325	1999	244 km
8.	Gulshan-Baridhara Lake	Urban Wetland	Dhaka city	101	2001	185 km
9.	Buriganga	River	Around Dhaka	1336	2009	180 km
10.	Turag	River	Around Dhaka	1184	2009	200.5 km
11.	Sitalakhya	River	Around Dhaka	3771	2009	190 km
12.	Balu including Tongi canal	River	Around Dhaka	1315	2009	194 km
13.	Jaflong-Dawki	River	Jaflong, Sylhet	1493	2015	338.5 km



(Green & Islam, 2012)

Figure 4.14: Ecologically Critical Areas of Bangladesh

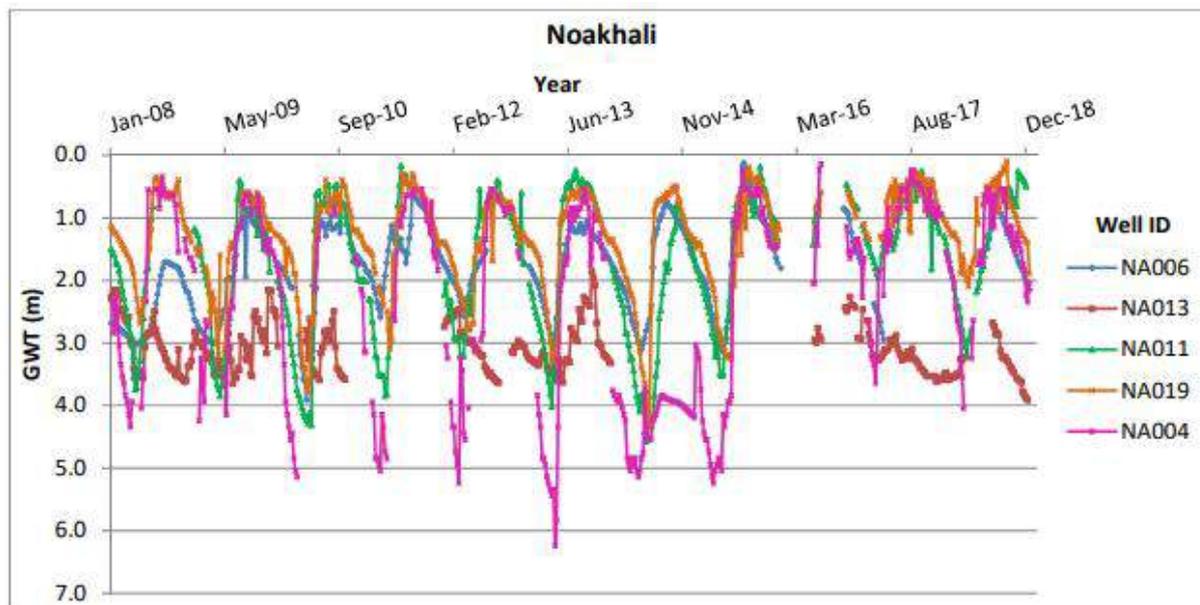


(Bangladesh Forest Department)

Figure 4.15: Protected Areas, Eco Parks and Safari Park of Bangladesh

## 4.6 Hydrology

Groundwater is an important segment of the hydrologic cycle and constitutes about one third of world's fresh water reserves. It has distinct advantages over surface water resources. It is the most dependable resource and is available almost everywhere on land phases. It is the only source of water supply for drinking and main source of irrigation. As other parts of the country this area also receives sufficient amount of rainfall and there is a good availability of ground water, which is being used by hand pumps for drinking and domestic purposes. The source of groundwater is either precipitation or seepage from large water bodies like reservoirs, lakes, River.



(BWDB 2020)

**Figure 4.16: Hydrographs of GWT of Noakhali District**

Among 5 wells the overall trends of hydrographs are almost similar in 4 wells NA006, NA011, NA019 and NA004 which situated in Begumganj, Hatiya, Noakhali Sadar and Senbagh upazilas in that order. The hydrographs show decreasing trend in dry period (December-February) and these shows lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In these wells GWT fluctuated between 0.09m to 6.24m and reaches the static level from surface level of those areas during monsoon. In well NA013 the water table fluctuated in an abnormal way in relation to seasonal fluctuation.

### 4.6.1 Surface Water Quality

The primary data for surface water quality parameters near the project site was collected and the sample was analyzed in the laboratory. **Table 4.14** represents surface water quality report near the project site. Surface Water quality test report is attached as **Annexure 7 (c)**.

**Sampling date:** 7<sup>th</sup> September, 2021

**Reporting date:** 18<sup>th</sup> September, 2021

**Table 4.13: Sampling locations ID and Name with Longitude-Latitude**

Category	Identification of Location	GPS Co-ordinate		Specific Location
		X	Y	
Surface Water Quality	Location-01, SW1	22°14'11.05"N	91° 8'25.65"E	Western-South Side (Nearest Khal) of Power Plant Area
	Location-02, SW2	22°17'33.69"N	91° 4'24.82"E	Tamuruddin Ferry Ghat

**Table 4.14: Surface Water Quality**

Name of the Parameter	Concentration present		Unit	Method of analysis
	SW1	SW2		
Temperature	23.7	23.1	°C	Mercury filled thermometer
pH	7.26	7.11	-	pH meter
TDS	305	548	mg/l	TDS meter
TSS	32	43	mg/l	Dried at 105°C
Dissolved Oxygen (DO)	5.4	4.5	mg/l	DO meter
BOD5	4.2	7.5	mg/l	5-day BOD test
COD	12.4	20.8	mg/l	Open Reflux
Chromium	<0.02	<0.02	mg/l	Atomic Absorption Spectrophotometer
Cadmium	<0.005	<0.005	mg/l	Atomic Absorption Spectrophotometer
Pb	<0.05	<0.05	mg/l	Atomic Absorption Spectrophotometer
Oil & Grease	<5.0	<5.0	mg/l	APHA 5520.B

\*\*\*No standard was found for River Water



**Figure 4.17: Photograph of Surface Water Sampling**

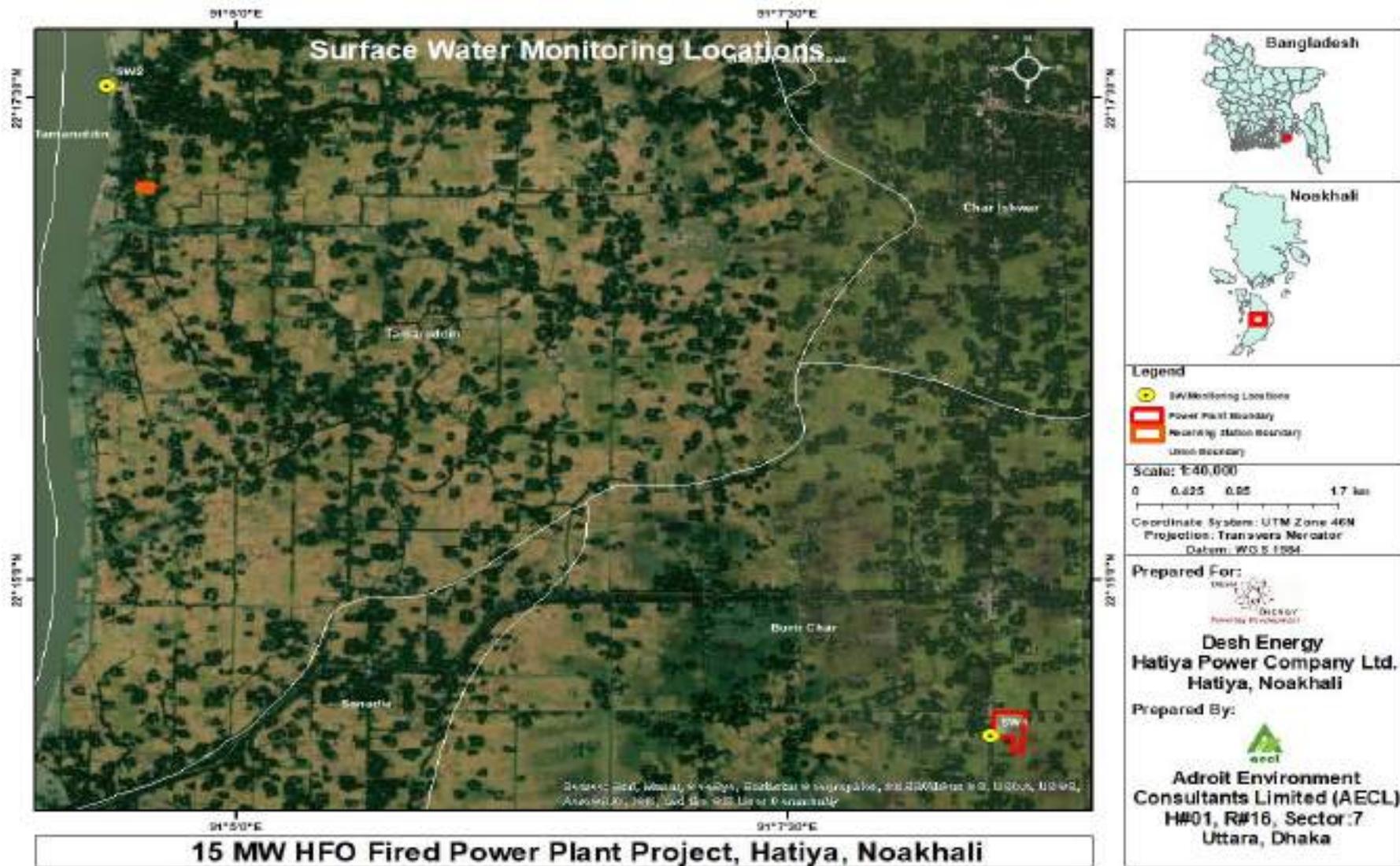


Figure 4.18: Surface Water Quality Monitoring locations

#### 4.6.2 Ground Water Quality

To determine quality of ground water, water sample was collected from a nearby tube well and analyzed for different parameters. The results shows that all the parameters remain within the allowable limit of drinking water value as per as Environmental Quality Standards for Bangladesh. The parameters which have been analyzed in AECL laboratory during this study are presented below in **Table 4.15**. Ground Water quality test report is attached as **Annexure 7 (d)**.

**Figure 4.21** shows the Ground Water Zoning map of Bangladesh. According to the map the ground water level of the project site is 0-5.3m.

**Sampling date:** 07<sup>th</sup> September, 2021

**Reporting date:** 18<sup>th</sup> September, 2021

**Table 4.15: Ground Water Quality**

Name of the Parameter	Concentration Present GW -01 22°14'9.80"N, 91° 8'29.63" E	DoE (Bangladesh) Standard	Unit	Method of analysis
pH	6.84	6.5 – 8.5	-	pH Meter
TDS	310	1000	mg/l	TDS Meter
TSS	18	-	mg/l	Dried at 105°C
Hardness	33.8	200-500	mg/l	Titrimetric
Ammonia	<0.01	0.5	mg/l	Photometric
Nitrate	2.3	10	mg/l	Potentiometric
Phosphate	0.1	6	mg/l	Photometric
As	<0.003	0.05	mg/l	Atomic Absorption Spectroscopy
Fe	0.45	0.3 – 1.0	mg/l	UV-Vis Spectrophotometric
Mn	0.1	0.1	mg/l	Atomic Absorption Spectrophotometer
Free Residual Chlorine	<0.2	0.2	mg/l	APHA 4500 Cl-B
Total Coliform	0	0	n/100 ml	Membrane Filter Technique
Fecal Coliform	0	0	n/100 ml	Membrane Filter Technique

*N.B. No standard found for ground water. Water result has been compared with drinking water standard.*

*Comment: From the aforementioned results it is discernible that, all the parameters are within standard values.*



**Figure 4.19: Photograph of Ground Water Sampling**

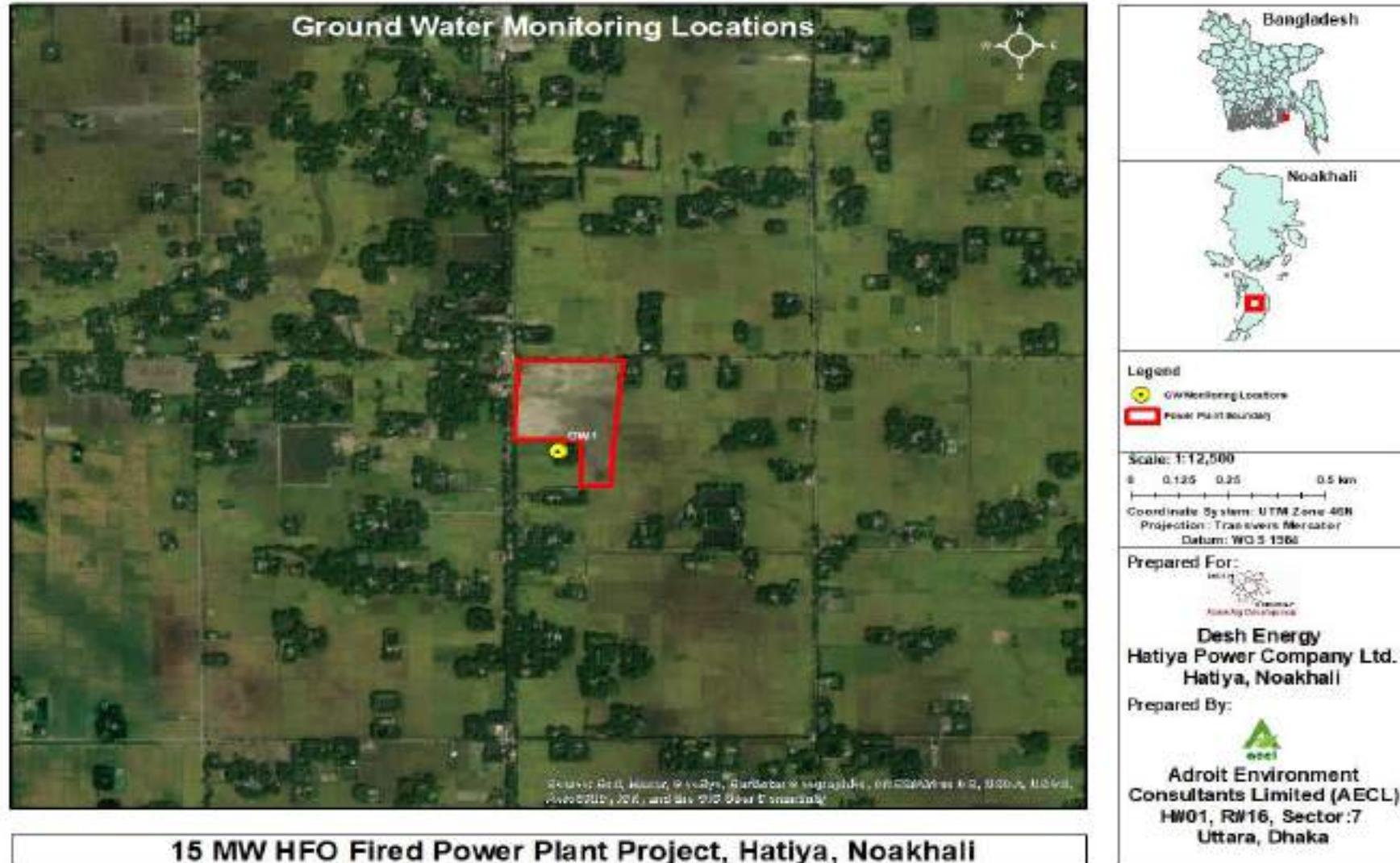
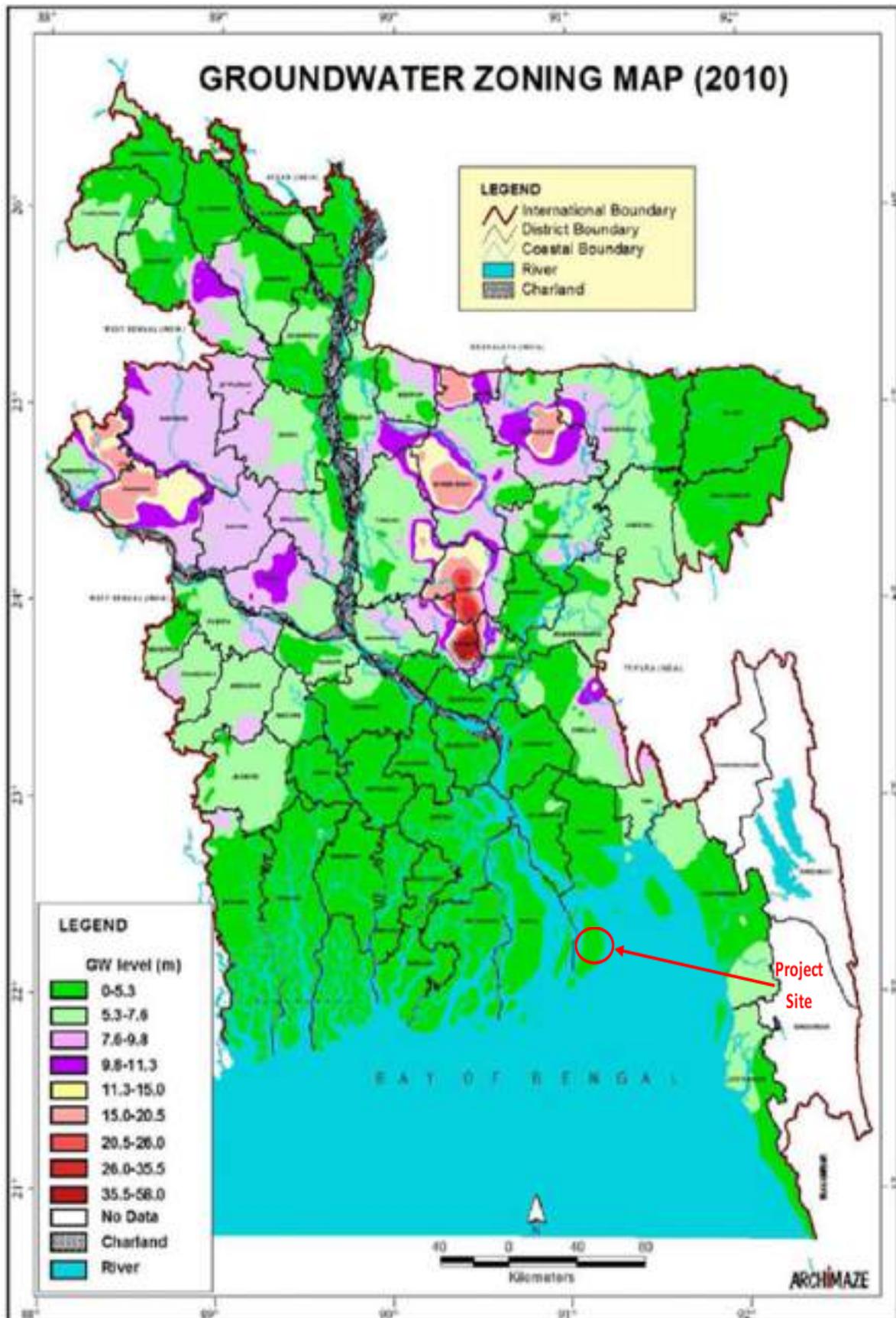


Figure 4.20: Ground Water Quality Monitoring Location



(Bangladesh Agricultural Development Corporation)

Figure 4.21: Ground Water Zoning Map of Bangladesh

#### 4.7 Air Quality

Major atmospheric pollution is caused by construction works and transportation activity. Air monitoring has been conducted at four different locations (24 Hour Basis). The air quality data of the proposed site is given in **Table 4.17**. The result for ambient air quality monitoring shows the PM<sub>2.5</sub>, PM<sub>10</sub>, SPM, SO<sub>2</sub>, NO<sub>x</sub> & CO concentrations of the ambient air. Air quality test report is attached as **Annexure 7 (a)**.

**Sampling date:** 8<sup>th</sup> – 9<sup>th</sup> September, 2021

**Reporting date:** 14<sup>th</sup> September, 2021

**Table 4.16: Sampling locations ID and Name with Longitude-Latitude**

Category	Identification of Location	GPS Co-ordinate		Specific Location
		X	Y	
Ambient Air Quality	Location-01, AQ1	22°14'11.35"N	91° 8'30.83"E	South Side of Power Plant Area
	Location-02, AQ2	22°14'18.01"N	91° 8'35.48"E	Northern-East Side of Power Plant Area (In front of Nearest settlement)
	Location-03, AQ3	22°14'38.05"N	91° 8'25.14"E	Northern-West side of Power Plant Area (Beside Main Road of Hatiya)
	Location-04, AQ4	22°17'2.22"N	91° 4'35.60"E	Middle point of Receiving Station

**Table 4.17: Ambient Air Quality Analysis**

S N	Parameters	Method	Test Duration (hours)	Unit	AQ1	AQ2	AQ3	AQ4	(DoE) Standard	IFC Standard
1	PM <sub>2.5</sub>	Gravimetric	24	µg/m <sup>3</sup>	26.61	29.47	24.10	22.93	65	75
2	PM <sub>10</sub>	Gravimetric	24	µg/m <sup>3</sup>	59.34	71.62	65.34	54.29	150	150
3	SPM	Gravimetric	8	µg/m <sup>3</sup>	98.10	102.23	93.29	80.17	200	NF
4	SO <sub>2</sub>	West-Geake	24	µg/m <sup>3</sup>	12.29	12.08	13.36	18.71	365	125
5	NO <sub>x</sub>	Jacob and Hochheiser	1	µg/m <sup>3</sup>	20.10	18.42	20.80	28.13	NF	200
6	CO	CO/O <sub>3</sub> Meter	1	ppm	2	0	3	0	35	NF

(NF – not found, DoE – Department of Environment.), \*1-hour standard Not Found

Note: This monitoring report was usually accomplished by - Respirable Dust Sampler (Model- Envirotech India APM-460BL) and Fine Particulate Sampler (Model- Envirotech India AAS-127BL).

1. Fine Particulate Matter (PM<sub>2.5</sub>).
2. Respirable Dust Content (PM<sub>10</sub>).
3. Suspended Particulate Matter (SPM).
4. Oxides of Nitrogen (NO<sub>x</sub>).
5. Oxides of Sulfur (SO<sub>2</sub>).
6. Carbone Mono-Oxide (CO).

**Comment:** From the aforementioned results it is discernible that, all the parameters are inside the allowable limits.



**AQ-1**



**AQ-2**



**AQ-3**



**AQ-4**

**Figure 4.22: Ambient Air quality monitoring locations**

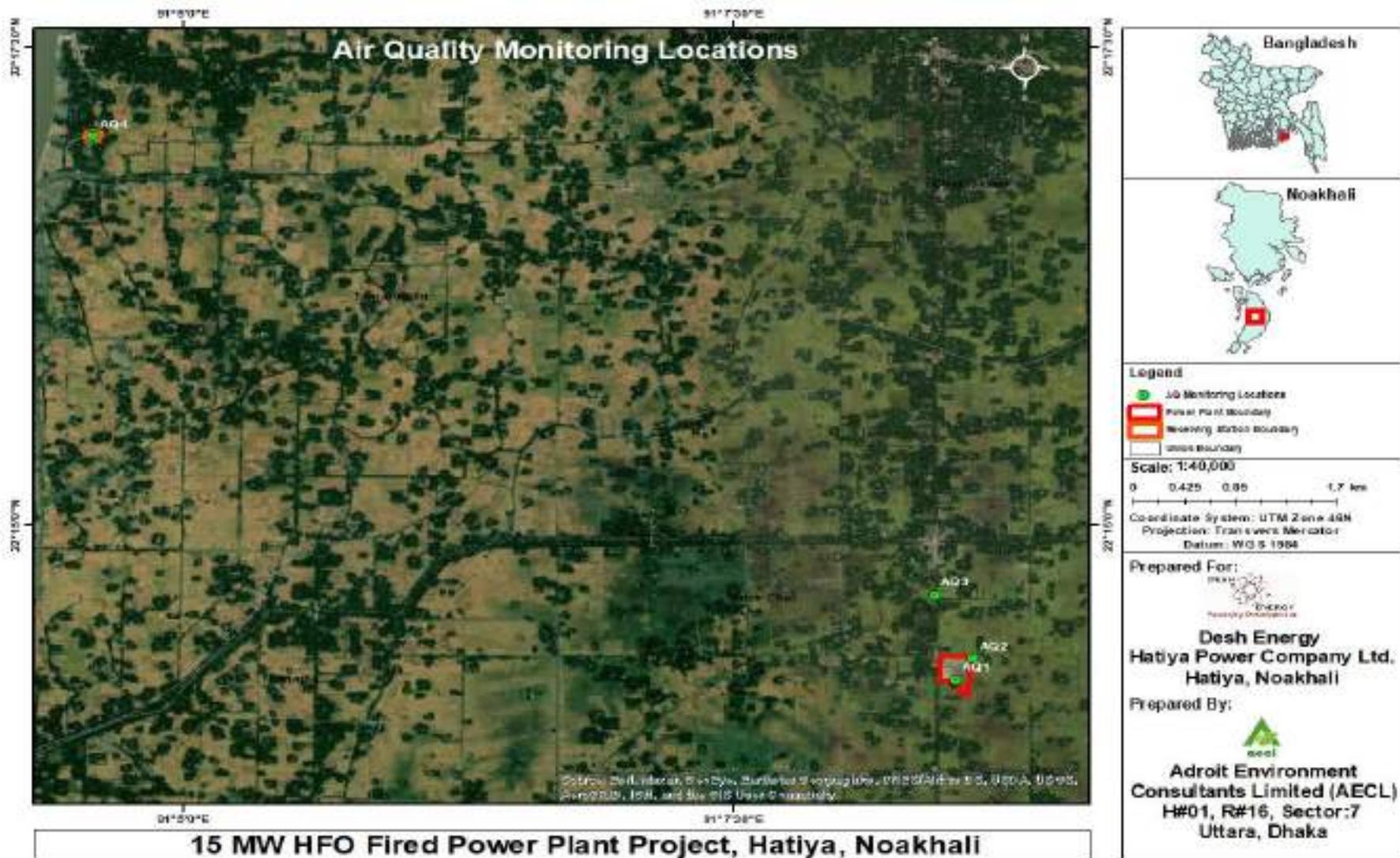


Figure 4.23: Air Quality Monitoring Location

#### 4.8 Noise Level

It was found calm and quiet in and around the project site during the site visit. The ambient noise level data were collected from different sides (Five location) of the project within 5 km radius area by noise level meter and has been given below in **Table 4.19**. Noise quality test report is attached as **Annexure 7 (b)**.

**Sampling date:** 8<sup>th</sup> – 9<sup>th</sup> September, 2021

**Reporting date:** 14<sup>th</sup> September, 2021

**Table 4.18: Sampling locations ID and Name with Longitude-Latitude**

Category	Identification of Location	GPS Co-ordinate		Specific Location
		X	Y	
Ambient Noise Level	Location-01, NQ1	22°14'6.83"N	91° 8'32.35"E	Northern-East Side of Power Plant Area
	Location-02, NQ2	22°14'13.77"N	91° 8'30.05"E	North Side of the Power Plant Area (Near canal)
	Location-03, NQ3	22°14'35.67"N	91° 8'24.92"E	Northern-West side of Power Plant Area (Beside Main Road of Hatiya)
	Location-04, NQ4	22°17'2.82"N	91° 4'34.64"E	Western-North Side at Receiving Station
	Location-05, NQ5	22°17'1.53"N	91° 4'36.33"E	Eastern-South Corner at Receiving Station

**Table 4.19: Ambient Noise Quality Analysis**

SN.	Site Location with GPS Coordinates	Site Condition	Concentration present (LA <sub>eq</sub> ) dBA.			
			Day Time		Night Time	
			Minimum	Maximum	Minimum	Maximum
01	NQ-1	Pre-construction Stage	26.2	35.1	24.6	30.2
02	NQ-2	Pre-construction Stage	25.7	32.2	22.5	25.2
03	NQ-3	Pre-construction Stage	24.7	29.3	23.9	26.2
04	NQ-4	Pre-construction Stage	24.2	27.1	28.1	29.1
05	NQ-5	Pre-construction Stage	28.1	33.2	24.8	26.3
DoE (Bangladesh) Standard for Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes)			60		50	
IFC/International Standard for Residential; institutional; educational			55		45	

**Note:** This noise data was usually accomplished by – CEM Sound Level Meter (Model – DT 8850).

**Comment:** According to the Department of Environment (ECR'1997), the standard for ambient noise level in the industrial zone is 75 and 70 decibels at day & night time respectively. The results were found within the limit as per DoE Standards.



**NQ-1 (Day)**



**NQ-1 (Night)**



**NQ-2 (Day)**



**NQ-2 (Night)**



**NQ-3 (Day)**



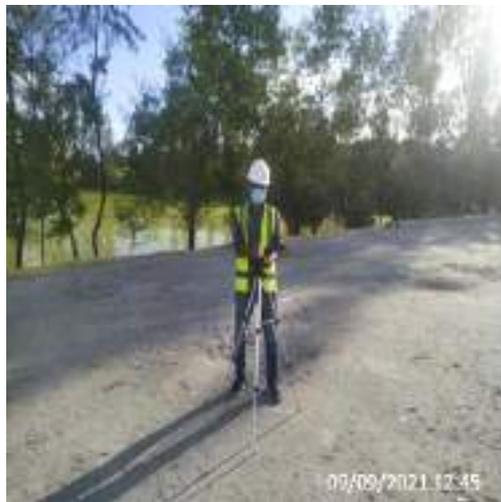
**NQ-3 (Night)**



**NQ-4 (Day)**



**NQ-4 (Night)**



**NQ-5 (Day)**



**NQ-5 (Night)**

**Figure 4.24: Ambient Noise quality monitoring locations**

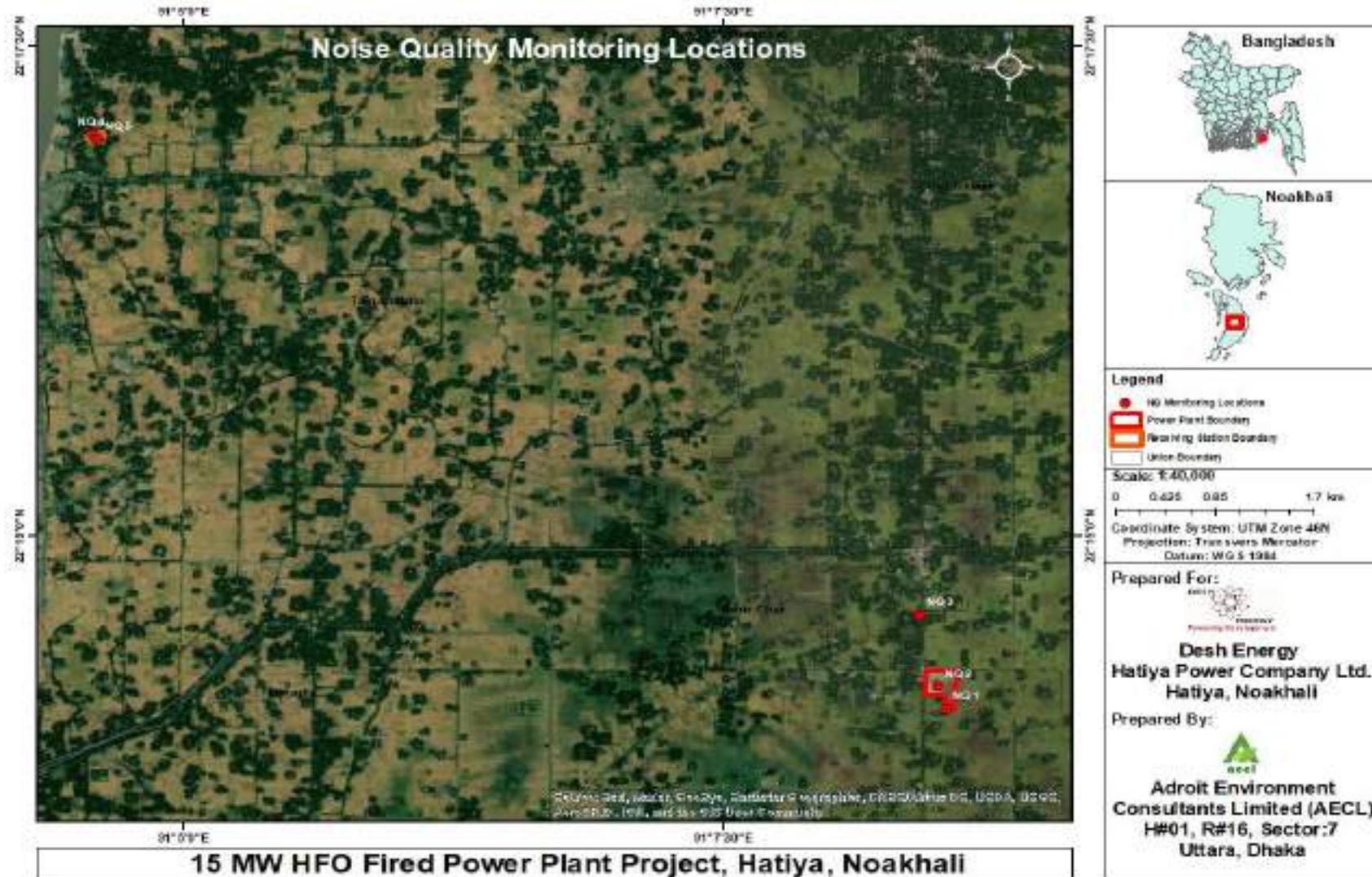


Figure 4.25: Noise Quality Monitoring Location

#### 4.9 Traffic Volume Study

Traffic volume around the project site has been studied on 10<sup>th</sup> September. The traffic volume counts have been recorded continuously for 24 hours to assess the peak hour traffic and traffic composition. The full data of the traffic survey is listed in the Table below:

**Table 4.20: Traffic Volume Data (Road Traffic)**

Hour	Direction	Truck	Bus	CNG	Rickshaw	E. Bike	M. cycle	Bicycle	Van	Tractor
<b>Day</b>										
07:00-09:00AM	N - S	1		5	4	3	7	2	1	
	S - N			6	6	2	5	3	2	
09:00-11:00AM	N - S		1	9	6	2	8	1	2	1
	S - N			7	4	3	9	2	1	
11:00AM-01:00PM	N - S			8	9	1	10			
	S - N		1	6	6	2	7	1		1
01:00-03:00PM	N - S			7	7	2	7	1	1	
	S - N			8	7	1	9			
03:00-05:00PM	N - S		1	9	8	2	11	3	1	
	S - N			6	5	2	8	1	1	1
05:00-07:00PM	N - S			6	6	1	9	1		
	S - N	1		8	7	3	6	1		1
<b>Night</b>										
07:00-09:00PM	N - S			5	5	2	8	1		
	S - N		1	6	3	2	8	2		
09:00-11:00PM	N - S			3	6		6			
	S - N			4	4	1	7	1		
11:00PM-01:00AM	N - S			2	2		4			
	S - N			2	1		2			
01:00-03:00AM	N - S						2			
	S - N			1			2			
03:00-05:00AM	N - S			1	1		2			
	S - N						1			
05:00-07:00AM	N - S			4	3	2	4			
	S - N			4	4	1	3			
<b>Total</b>		<b>2</b>	<b>4</b>	<b>116</b>	<b>104</b>	<b>32</b>	<b>145</b>	<b>20</b>	<b>9</b>	<b>4</b>

**Table 4.21: Traffic Volume Data (River Traffic)**

Hour	Direction	Launch	Speed Boat	Trawler	Fishing Boat	Boat	Cargo
<b>Day</b>							
07:00-09:00AM	N - S		1	2	2	1	
	S - N		1	2	4	2	1
09:00-11:00AM	N - S			1	1	1	
	S - N						1

Hour	Direction	Launch	Speed Boat	Trawler	Fishing Boat	Boat	Cargo
11:00AM-01:00PM	N - S		1	1	2	1	1
	S - N	1		2	1		
01:00-03:00PM	N - S			3	1		1
	S - N	1		1	4	2	
03:00-05:00PM	N - S			1			
	S - N		1	1	1		1
05:00-07:00PM	N - S		1	2	2	1	
	S - N		1	1	1	3	1
<b>Night</b>							
07:00-09:00PM	N - S			1	1	1	1
	S - N				3	1	1
09:00-11:00PM	N - S						
	S - N				2		1
11:00PM-01:00AM	N - S						
	S - N				2		
01:00-03:00AM	N - S					1	
	S - N				1	1	
03:00-05:00AM	N - S	1			2		
	S - N				4		1
05:00-07:00AM	N - S	1			2	1	1
	S - N				3	2	1
<b>Total</b>		<b>4</b>	<b>5</b>	<b>18</b>	<b>39</b>	<b>18</b>	<b>12</b>



Day



Night

**Harendra Road Bazar (Road Traffic)**



Day



Night

**Tamuruddin Ghat (River Traffic)**

**Figure 4.26: Traffic Study**

## **4.10 Geology**

The geological evolution of Bangladesh is related to the uplift of the Himalayan mountains and outbuilding of deltaic landmass by major river systems having their origin in the uplifted Himalayas. This geology is mostly characterized by the rapid subsidence and filling of a basin in which a huge thickness of deltaic sediments was deposited as a mega delta built out and progressed towards the south. The delta building is still continuing into the present Bay of Bengal and a broad fluvial front of the Ganges-Brahmaputra-Meghna River system gradually follows it from behind.

### **4.10.1 Soil**

Most of the area of Bangladesh is a vast, low-lying alluvial plain, sloping gently to the south and southeast. According to Bangladesh Agricultural research council's Agro-Ecological Zoning map [**Figure 4.27 (a)**] the project area falls in Young Meghna Estuarine Floodplain.

The proposed project area falls in the Young Meghna Estuarine Floodplain. This region occupies young alluvial land in and adjoining the Meghna estuary. The major soils are grey to olive, deep calcareous silt loam and silty clay loams, and are stratified either throughout or at shallow depth. Calcareous alluvium and non-calcareous grey floodplain soils are the dominant general soil types. Topsoil and subsoil of the area are mildly alkaline. General fertility is medium but low in N and organic matter. (Banglapedia)

The project area falls under Calcareous Alluvium soils according to **Figure 4.27 (b)**. Calcareous Alluvium Soils are stratified or raw alluvium throughout or below the cultivated layer. They are calcareous throughout or part of it and lack in having diagnostic subsoil horizon. This alluvium on the active Ganges floodplain mainly comprises brownish grey to pale brown sandy and silty deposits, which are moderately calcareous. Soils on the Lower Meghna estuarine floodplain are slightly calcareous grey to olive, finely stratified silts. They are mainly Calcaric Fluvisols. (Banglapedia)

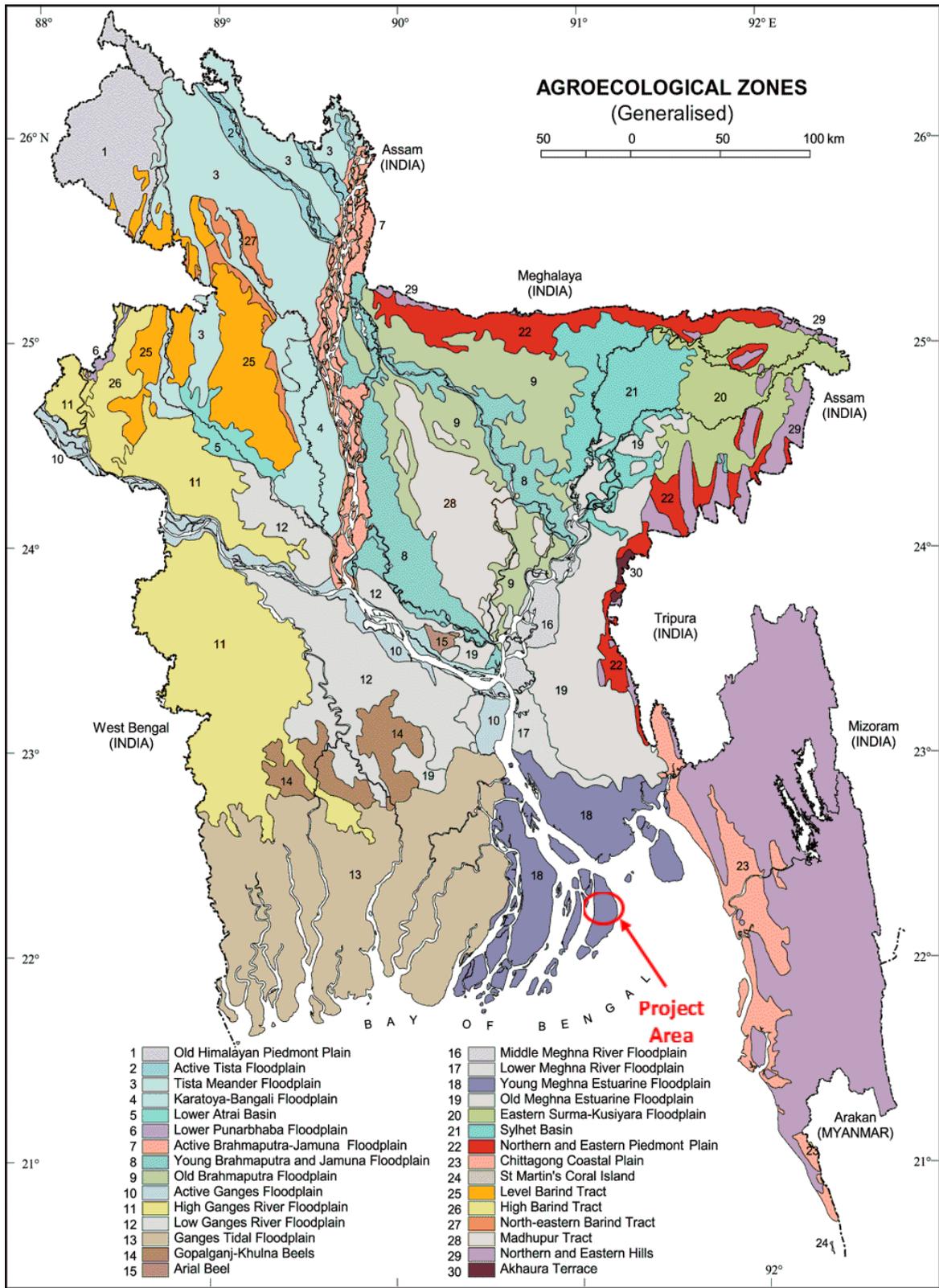
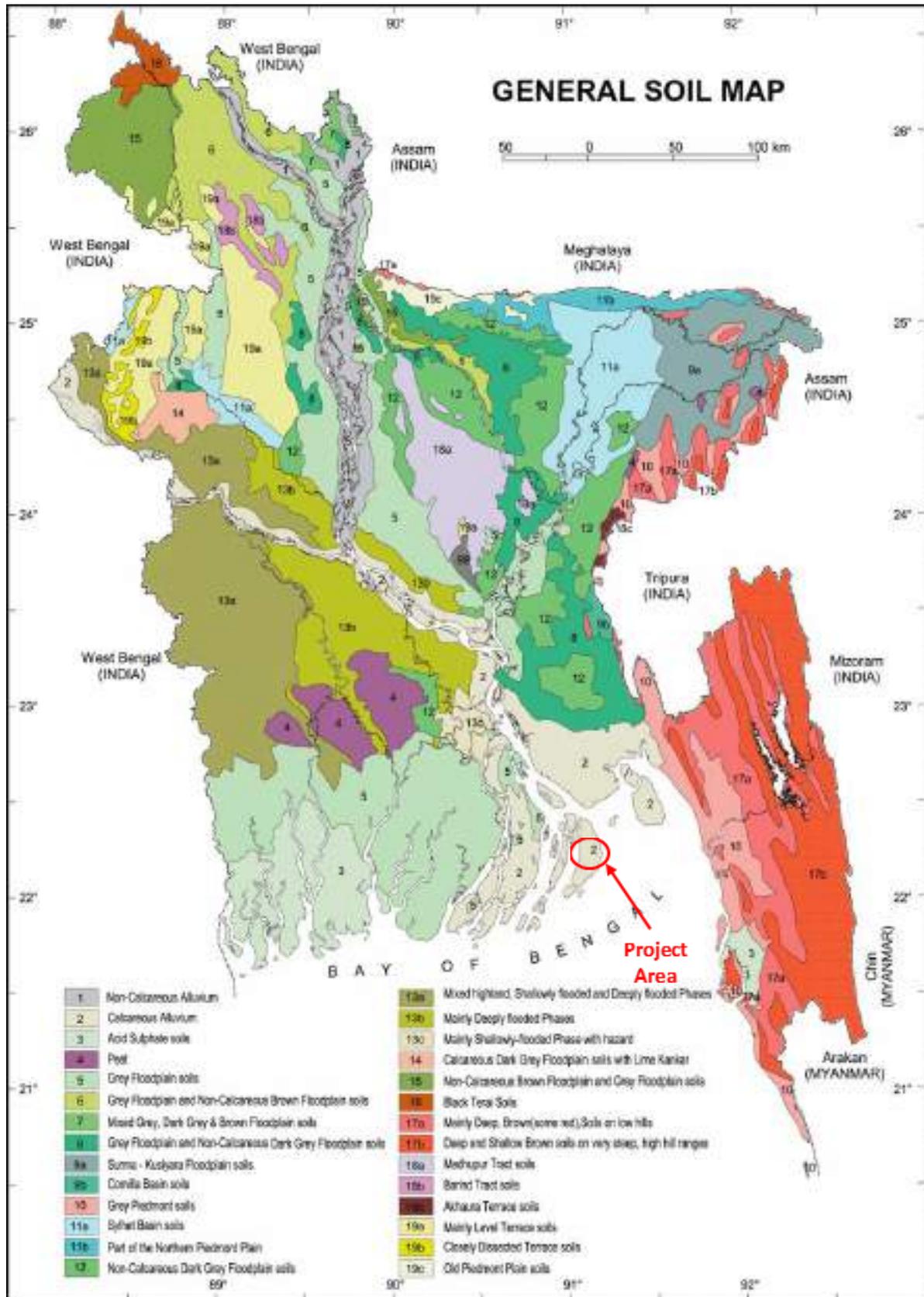


Figure 4.27 (a): Agro-ecological zones Map of Bangladesh



(Banglapedia)

Figure 4.27 (b): Soil Map of Bangladesh

#### 4.10.2 Soil Quality

Soil sample has been collected during field survey. Test result on soil sample has been presented in **Table 4.22**. Soil quality test report is attached as **Annexure 7 (e)**. Figure 4.28 shows the soil sampling location.

**Sampling date:** 7<sup>th</sup> September, 2021

**Reporting date:** 18<sup>th</sup> September, 2021

**Table 4.22: Soil quality test result**

Name of the Parameter	Concentration present		Unit	Method of analysis
	SQ-01	22°14'17.86" N, 91°8'34.37" E		
<b>pH</b>	7.2		-	pH Meter
<b>Porosity</b>	65		%	Saturation
<b>Texture</b>	Silt Clay		-	-
<b>Electrical Conductivity (EC)</b>	15.74		mS/cm	EC Meter
<b>Chromium (Cr)</b>	12.9		mg/kg	ICP-MS/Colorimetric UV-VIS/Colorimetric IC Analysis
<b>Cadmium (Cd)</b>	<2.0		mg/kg	ICP-MS/Colorimetric UV-VIS/Colorimetric IC Analysis
<b>Lead</b>	4.6		mg/kg	ICP-MS/Colorimetric UV-VIS/Colorimetric IC Analysis

\*\*\*No standard found for soil



**Figure 4.28: Soil Quality monitoring locations**

#### 4.11 Climate Change and Natural Disaster

Bangladesh is one of the most vulnerable countries, who is facing problems on climate change due to global warming. Low-lying coastal regions like Bangladesh are vulnerable to sea level rise and increased occurrence of intense, extreme weather conditions such as the cyclones from 2007 and 2009. It is necessary to identify all present vulnerabilities and future opportunities, adjusting priorities, at times even changing commodity and trade policies in the agricultural sector while promoting training and education throughout the masses in all possible spheres.

##### 4.11.1 Seismicity

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

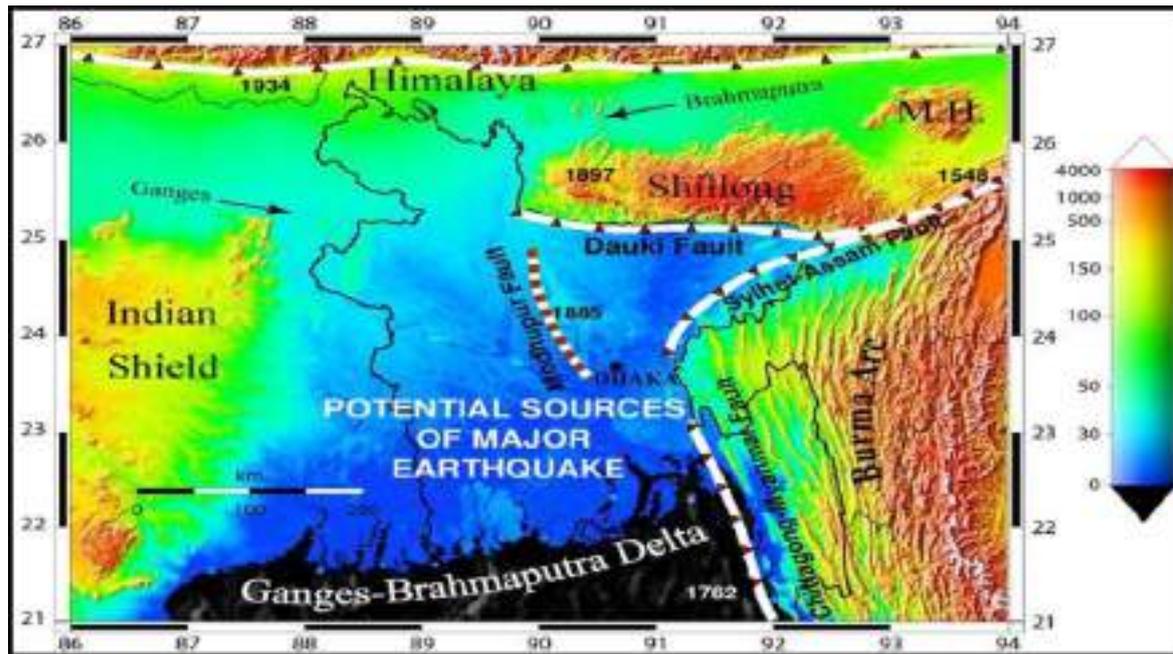
Tectonically, Bangladesh lies in the north-eastern Indian plate near the edge of the Indian craton and at the junction of three tectonic plates – the Indian plate, the Eurasian plate and the Burmese micro plate. These form two boundaries where plates converge– the India-Eurasia plate boundary to the north forming the Himalaya Arc and the India-Burma plate boundary to the east forming the Burma Arc (**Figure 4.29**).

Active faults of regional scale capable of generating moderate to great earthquakes are present in and around Bangladesh. These include the Dauki fault, about 300 km long trending east-west and north-south situated between Madhupur Tract and Jamuna flood plain, Assam-Sylhet fault located along the southern edge of Shillong Plateau (Meghalaya- Bangladesh border), the 150 km long Madhupur fault trending north-south, about 300 km long trending north east south west located in the southern Surma basin and the Chittagong-Myanmar plate boundary fault, about 800 km long runs parallel to Chittagong-Myanmar coast (**Figure 4.30**).



(Akhter, 2010)

**Figure 4.29: Regional tectonic setup of Bangladesh with respect to plate configuration**



(Islam et al, 2016)

**Figure 4.30: Digital Elevation Model (DEM) of Bangladesh and surroundings showing geological faults – potential sources of major earthquakes in Bangladesh**

The Chittagong- Myanmar plate boundary continues south to Sumatra where it ruptured in the disastrous 26 December 2004 Mw 9.3 earthquake (Apu & Das, 2020). These faults are the surface expression of fault systems that underlie the northern and eastern parts of Bangladesh. Another tectonic element, the ‘Himalayan Arc’ is characterized by three well defined fault systems (HFT, MBT and MCT) that are 2500 km long stretching from northwest syntaxial bend in Pakistan in the west to northeast syntaxial bend in Assam in the east. It poses a great threat to Bangladesh as significant damaging historical earthquakes have occurred in this seismic belt (Sarraz et al, 2015). The tectonic set-up and the plate motions together place Bangladesh potentially vulnerable to earthquake.

On the basis of distribution of earthquake epicenters and morphotectonic behavior of different tectonic blocks Bangladesh has been divided into three generalized seismic zones.

The proposed project area falls in seismic zone II according to the **(Figure 4.31)** Revised Seismic Zonation of Bangladesh (2017) and BNBC 2020. According to Revised Seismic Zonation of Bangladesh (2017) and BNBC 2020, the country is divided into four seismic zones with different expected levels of intensity of ground motion. Each zone has a seismic zone coefficient (Z) which represents the maximum considered peak ground acceleration (PGA) on very stiff soil/rock (site class SA) in units of g (acceleration due to gravity). The zone III consists of Dhaka, Comilla, Noakhali and western part of Chittagong Folded belt in where seismic zone coefficient (Z) is 0.20 **(Table 4.23)**. Project area falls in seismic zone II.

**Table 4.23: Revised Seismic Zonation of Bangladesh (2017, new)**

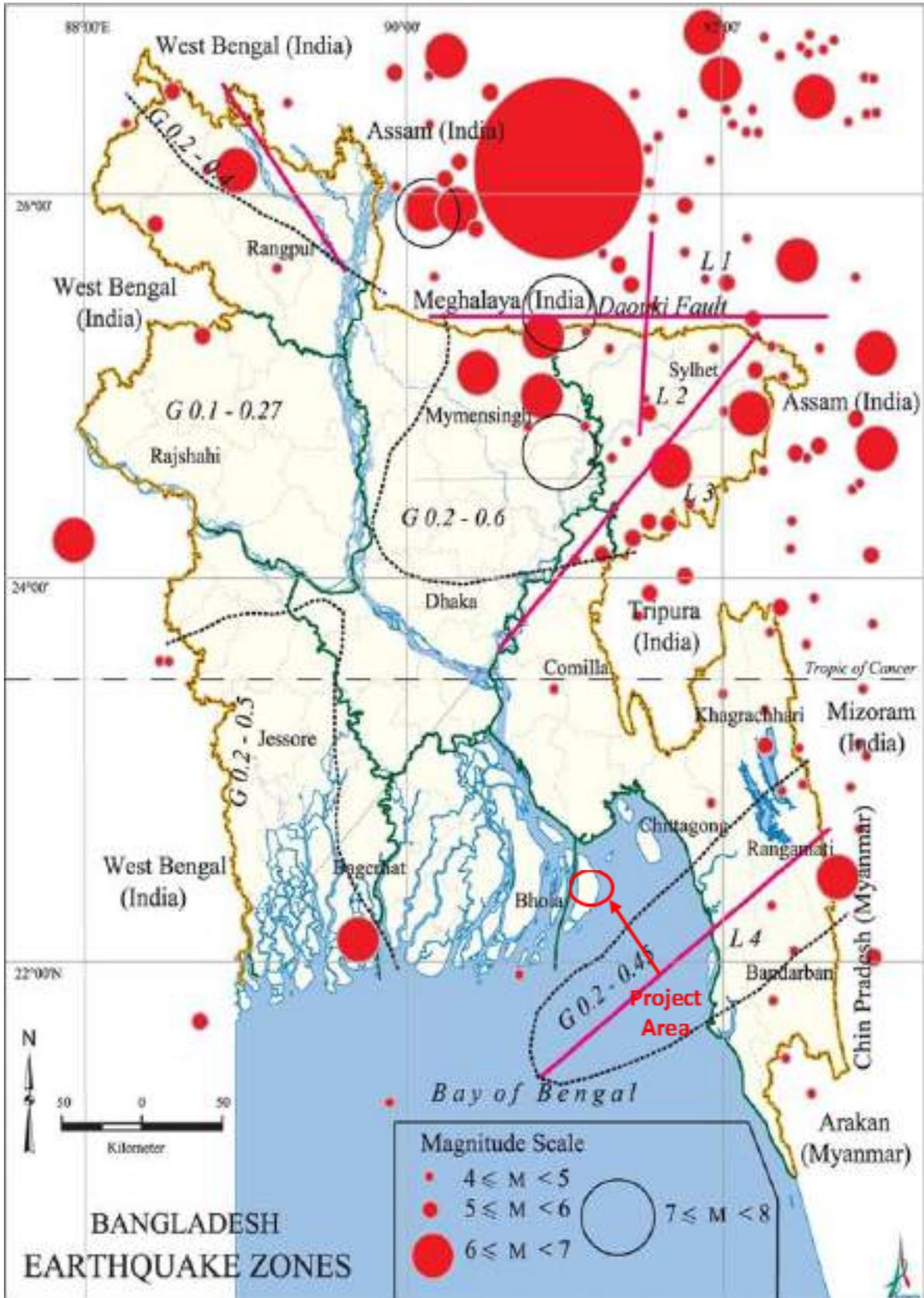
Zoning	Area Mercalli Scale	Zone Coefficient
I	Bhola, Barguna, Patuakhali, Bagerhat, Khulna, Pirojpur, Barishal, Satkhira, Gopalganj, Jessore, Narail, Magura, Jhenaidah, Kustia, Chuadanga, Meherpur, Rajshahi, Nawabganj.	Z=0.12
II	Feni, Noakhali, Lakshmipur, Comilla, Shariatpur, Chandpur, Madaripur, Munshiganj, Narayanganj, Faridpur, Dhaka, Manikganj, Rajbari, Pabna, Kustia, Sirajganj, Netore, Naogaon, Joypurhat, Dinajpur, Nilphamari, Thakurgaon, Panchgarh, Bagerhat.	Z=0.20
III	Khagrachari, Rangamati, Chittagong, Bandharban, Cox's Bazar, Lalmonirhaat, Rangpur, Kurigram, Gaibandha, Joypurhat, Bogra, Jamalpur, Sirajganj, Tangail, Gazipur, Narsingdi, Brahmanbaria.	Z=0.28
IV	Sherpur, Mymensingh, Netrakona, Kishorganj, Sunamganj, Habiganj, Sylhet, Maulvibazar, Jamalpur (some part)	Z=0.36

## Revised Bangladesh Seismic Zone



(BNBC, 2020)

Figure 4.31: Earthquake Zoning Map of Bangladesh



(Hossain, 1989)

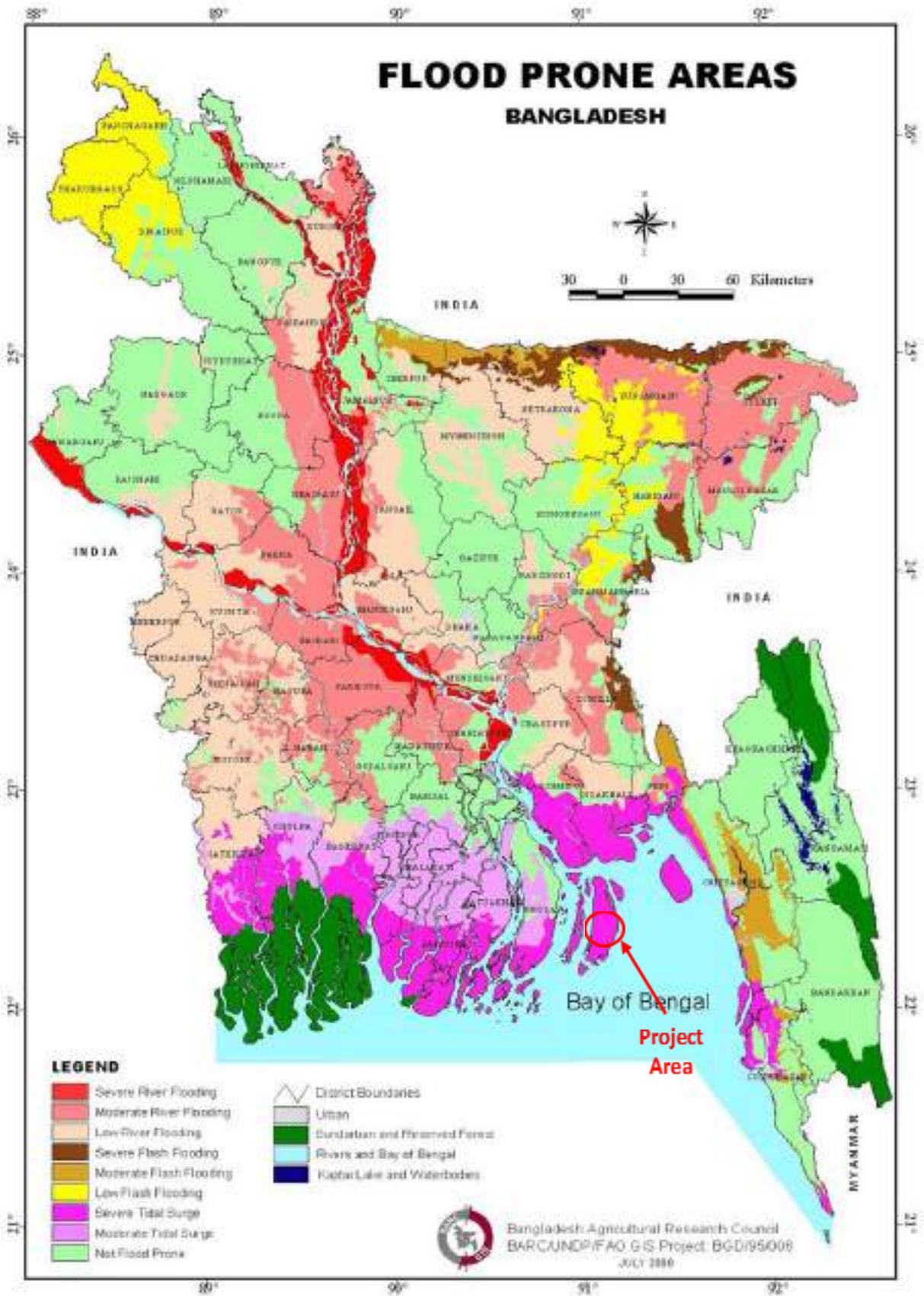
Figure 4.32: Seismic Activity of Bangladesh

#### 4.11.2 Floods

Bangladesh is a land of rivers. It is prone to flooding due to being situated on the Brahmaputra River Delta (also known as the Ganges Delta) and the many distributaries flowing into the Bay of Bengal. Each year in Bangladesh about 26,000 square kilometres (10,000 Sq meter) (around 18% of the country) is flooded, killing over 5,000 people and destroying more than seven million homes. The project area falls in Severe tidal surge prone area shown in **Figure 4.33**. Major floods occurred in Bangladesh since 1988 are listed here below:

**Table 4.24: Major floods occurred in Bangladesh since 1988**

Year	Description
<b>1987</b>	The catastrophic floods occurred throughout July and August and affected 57,300 km <sup>2</sup> of land (about 40% of the total area of the country) and was estimated as a once in 30-70-year event. The seriously affected regions were on the western side of the Brahmaputra, the area below the confluence of the Ganges and the Brahmaputra and considerable areas north of Khulna.
<b>1988</b>	The flood of 1988, which was also of catastrophic consequence, occurred throughout August and September. The waters inundated about 82,000 km <sup>2</sup> of land, (about 60% of the area) and its return period was estimated at 50–100 years. Rainfall together with synchronization of very high flows of all the three major rivers of the country in only three days aggravated the flood. Dhaka, the capital of Bangladesh, was severely affected. The flood lasted 15 to 20 days.
<b>1998</b>	Over 75% of the total area of the country was flooded, including half of the capital city Dhaka. A combination of heavy rainfall within and outside the country and synchronization of peak flows of the major rivers contributed to the river. 30 million people were made homeless and the death toll reached over a thousand 700,000 hectares of crops were destroyed and 400 factories were forced to close. Communication within the country also became difficult.
<b>1999</b>	The floods occurred between July and September, causing many deaths, and many people were left homeless. The extensive damage had to be paid for with foreign assistance. The entire flood lasted approximately 65 days
<b>2004</b>	The flood was very similar to the 1988 and 1998 floods with two thirds of the country under water.
<b>2005</b>	Dozens of villages were inundated when rain caused the rivers of northwestern Bangladesh to burst their banks.
<b>2017</b>	Inundated municipal areas and road communication were blocked. A total 8 municipality and 78 unions were affected. Most affected 23 people including children have been killed due to this flood in Dinajpur. The number of total affected family in Rangpur was 22,565



Bangladesh Agricultural Research Council (BARC)

Figure 4.33: Flood Prone Areas of Bangladesh

Danger water level of Lower Meghna River is set at 4.0 mPWD by BWDB. Previously recorded highest water level was observed 5.35 mPWD in year 2017. The average elevation of Hatiya is 2m with respect to mean sea level that is 3.5 mPWD. Water level data of Lower Meghna is presented in **Table 4.25** below. The proponent will raise the ground level of the power plant considering the previously recorded maximum water level.

**Table 4.25: Water Level Data (in mPWD)**

SL No.	River	Previously Recorded Maximum (m)	Danger Level (m)	Year	Peak Water Level (m)
1	Lower Meghna	5.35	4.00	2019	4.14
2	Lower Meghna	5.35	4.00	2018	4.07
3	Lower Meghna	5.35	4.00	2017	4.59
4	Lower Meghna	5.35	4.00	2016	4.63
5	Lower Meghna	5.35	4.00	2015	4.54

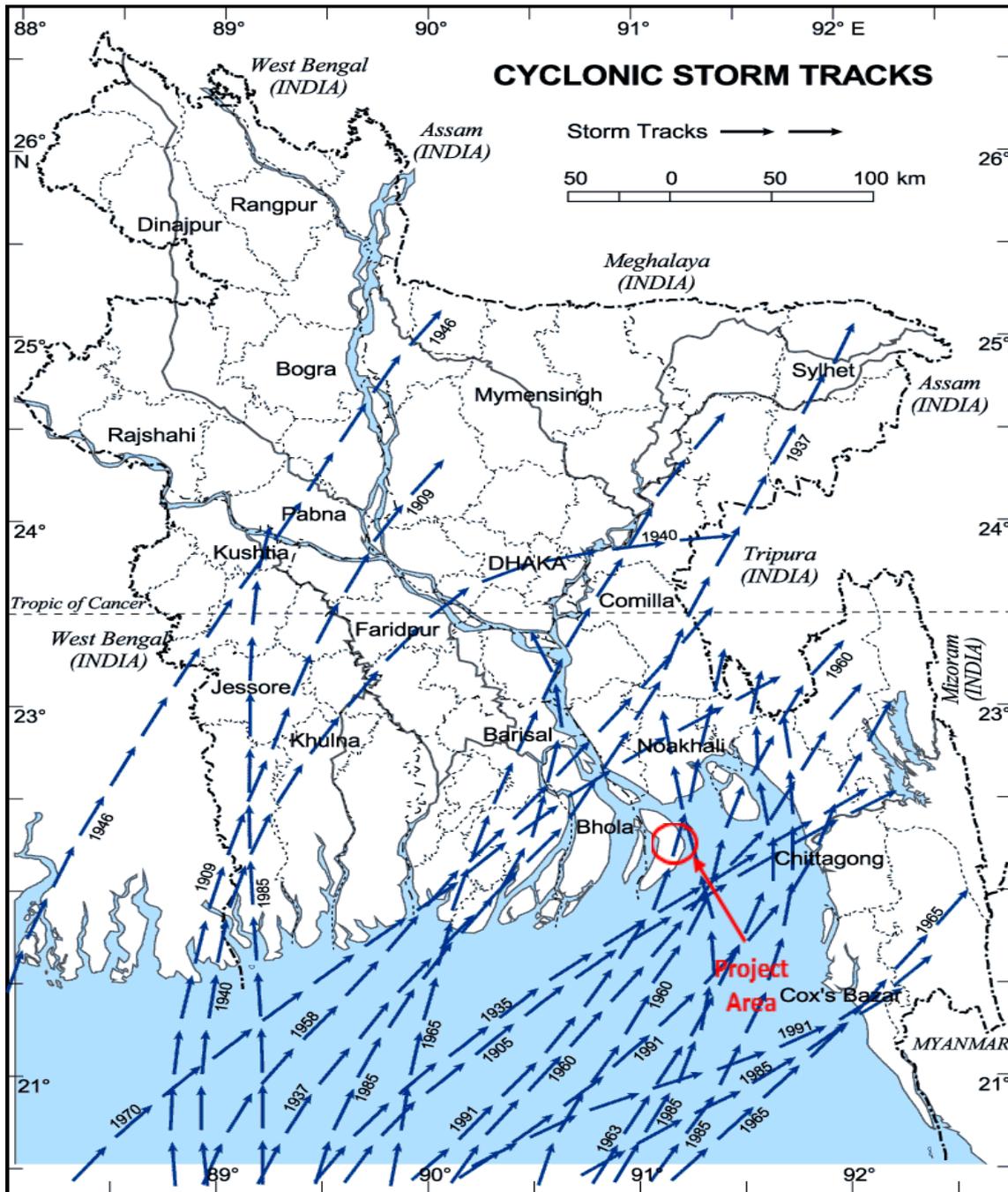
(Annual Flood Report, BWDB)

#### 4.11.3 Cyclones

Bangladesh is one of the most cyclone prone areas on the earth. Devastating cyclones hit the coastal zones almost every year and are usually accompanied by high-speed winds, sometimes reaching 250 km/hr. or more and with 3 m to 10m high waves, causing extensive damage to life, property and livestock. These cyclones usually occur in two seasons, April-May and October November – i.e., before and after the monsoon season. As per Cyclone Affected Area Map of Bangladesh shown in **Figure 4.35**, the project site falls in high-risk cyclone prone area where surge height is above 1m.

Severe cyclonic storm “Amphan” had crossed Hatiya islands of Bangladesh between afternoon and evening of 20 May, 2020. It was about 1285 km South-Southwest of Chittagong port, 1220 km South-Southwest of Cox’s Bazar port, 1210 km South-Southwest of Mongla port and 1190 km South-Southwest of Payra port, according to Bangladesh Meteorological Department (BMD).

Severe cyclonic storm "Yaas" hit Bangladesh in 26 may, 2021 and was in North-West Bay and adjoining area, about 390 kms south-southwest off Mongla and Payra maritime ports. Under the influence of the very severe cyclonic storm, the Noakhali district and other offshore islands and chars experienced wind speed up to 80-100 km/h in gusts or squalls with heavy to very heavy rain falls during the passage of the storm.



(SPARRSO)

Figure 4.34: Cyclonic Storm Tracks in Bangladesh



(SPARRSO)

Figure 4.35: Cyclone Affected Area Map of Bangladesh

#### 4.12 Socio-Economic Conditions

As part of the Environmental Impact Assessment (EIA) of the proposed project, a social baseline study was carried out in areas surrounding the project site. This has been done on the basis of several surveys around the locality as well as Hatiya Upazila Profile. Bangladesh Bureau of Statistics (BBS), Bangladesh National Portal, concerned books and periodicals were also consulted.

##### 4.12.1 Administrative Information

Proposed Power Plant- is located in Hatiya upazila, Noakhali district which further comes under Chittagong Division. Noakhali is a district in South-eastern Bangladesh. It is situated at the fringe of the Bay of Bengal.

Hatiya upazila is in Noakhali district. Noakhali District (Chittagong Division) area 3,685.87 sq km. Noakhali is bounded on the north by Comilla district, on the east by Feni and Chittagong districts, on the south by the Bay of Bengal and on the west by Bhola and Lakshimpur districts. The district lies between 22°07' and 23°08' north latitudes and between 90°53' and 91°27' east longitudes.

**Table 4.26: Demographic Characteristics of Noakhali District**

District	Noakhali
Upazila	9
Union	91
Mouza	882
Village	967
Paurashavas	8
Ward	72
Mahalla	153

(District Statistics 2011, Noakhali)

The project area is in Hatiya Upazila. Hatiya is the largest upazila of Noakhali; occupies an area of 1507.35 sq. km. It is located between 22°07' and 22°35' north latitudes and between 90°56' and 91°11' east longitudes. The upazila is bounded on the north by Noakhali Sadar, east and South by the Bay of Bengal and on the west by Monpura upazila of Bhola zila.

##### 4.12.2 Population and Social Structure

The project location is at Hatiya Upazila, Noakhali. The Demographic characteristic of the Hatiya Upazila is presented in **Table 4.27**.

**Table 4.27: Demographic Characteristics of the Hatiya Upazila**

Upazila	Hatiya
Total Area (Sq. km)	1507.35
Total Household	91013
Total population	4,52,463

Upazila	Hatiya
Male	2,23,853
Female	2,28,610
Average Household	4.98
Literacy rate (%)	34.2
Sex ratio (M/F)	98
Population Density (Per Sq. km)	300
Municipality	1
Union	11
Mouza	44
Village	62
Ward	9
Mahalla	23

(District Statistics 2011, Noakhali)

#### 4.12.3 Religion

**Table 4.28: Religion of the households Hatiya Upazila**

Upazila	Total population	Muslim	Hindu	Buddhists	Christian	Others
Hatiya	452463	424655	27729	23	21	35
%	100	93.86	6.13	0.005	0.004	0.007

(District Statistics 2011, Noakhali)

From the above table it could be understood that Hatiya is predominantly a Muslim populated area with 93.86 percent of Muslim population, while Hindus are the second most populated religion, with a presence of 6.13 percent. Buddhists are Christians are the two other religions having a slight presence of 0.005 and 0.004 percent while others are 35 in number representing a trivial population of 0.007 percent. There are 345 Mosques, 5 Eid-Gahs and 21 Temples (Mandir) in Hatiya Upazila.

#### 4.12.4 Commercial factories, Local employment and Economy

As per the site visit, majority of local people is dependent on agricultural activity and fishing. Secondary information on Local Employment is given below.

**Table 4.29: Local Employment of Hatiya Upazila**

Industry	Unit	Person engaged		
		Family	Hired	Total
Cottage Industry	41	125	0	125
Bamboo and cane Industry	41	125	0	125
Plastic industry	4	4	10	14
Saw Mill	100	300	600	900
Rice Mill	3	36	12	48
Bakery	26	52	182	334

Industry	Unit	Person engaged		
		Family	Hired	Total
Pottery	39	110	0	110
Tailoring Shop	89	93	187	280

(District Statistics 2011, Noakhali)

**Table 4.30: Economy of Hatiya Upazila**

Economy	Percentage
Agriculture	65.38%
Non-agricultural laborer	5.27%
Commerce	11.96%
Service	4.19%
Transport and communication	1.33%
Construction	1.0%
Rent and remittance	0.72%
Industry	0.48%
Religious service	0.39%
Others	9.28%

(Banglapedia)

#### 4.12.5 Transportation and Communication

According to census (2011) of Hatiya, total length of road is 876.74 km in which 129.85 km road is Metalled, 59.60 km road is Semi metalled and 687.19 km road is Unmetalled (Kacha road).

#### 4.12.6 Health and Medical facilities

There is an Upazila Health Complex and 10 family planning centres in Hatiya. The number of Union Health Centres in this upazila are 8, number of community clinics are 31 and number of diagnostic centres are 4.

#### 4.12.7 Source of Drinking Water

In Hatiya upazila, 89.6% general households get the facilities of drinking water from tube -well, 0.2% from tap and the remaining 10.2% households get water from other sources. (Population and Housing Census 2011; Community Report: Noakhali).

#### 4.12.8 Sanitation

In the upazila, 53.2% general households use sanitary latrine, 38.6% non-sanitary latrine and the remaining 8.2% have no toilet facilities. (Population and Housing Census 2011; Community Report: Noakhali).

#### **4.12.9 Literacy**

According to BBS 2011 census in Hatiya Upazila the literacy rate for both sexes is 34.2%, for male is 35.6% and for female is 32.9%. Number of Government Primary schools in Hatiya Upazila are 105, number of Registered primary schools are 99, number of kindergarten schools are 5.

#### **4.12.10 Access to Electricity**

All the 11 unions under Hatiya upazila have been brought under the Rural Electrification Program. However, a total of 8.9% of the general households reported to have electricity connection in the entire upazila in 2011 as against 3.8% in 2001. (Population and Housing Census 2011; Community Report: Noakhali). Most people in Hatiya island uses solar panel for electricity. In Ochkhali bazar, there is electric connection via HSD power production source within approx. 3 km radial zone which is not sufficient. Rather than this, the entire island has no electricity connection.

#### **4.12.11 Agriculture**

The economy of Noakhali is predominately agriculture. The main crops of this district are boro and aman paddy, peanut, varieties of pulses, chilli, sugarcane, potato etc. Fruits like Mango, jackfruit, papaya, coconut, banana, litchi, betel nut and palm are also produced. Most of the people depend on agriculture in this Island.

#### **4.12.12 Archeological, Cultural Heritage and Religious Site**

The famous archaeological heritage and relics are Noakhali Public Library, Bajra Shahi Mosque, Statue of Kali, Budi Mosque at Basurhat etc.

#### **4.12.13 Indigenous people and others**

There is no presence of indigenous people in and around the project area.

#### **4.12.14 NGO Activities**

ASA, BRAC, Proshika, Rural Services foundation, BURO Bangladesh, Bangladesh Probin Hitoishi Sangha, Resource Integration Centre (RIC), Dwip Unnayan Sangstha, Grameen bank, Heed Bangladesh, CARE, and Caritas. etc. NGO are working in Hatiya Upazila.

### **4.13 Biological Resources**

#### **4.13.1 General Consideration**

Forests, pasture lands, rivers, surface water and other water bodies, etc. are the most important natural ecosystems. They are the foundation on which conservation of biological diversity depends. Biological diversity, which refers to genetic variation as well as to the diversity of human populations and ecosystems, is a resource that belongs not only to regions and to nations but also to all of humankind. Although it is a renewable resource, it can be irreversibly destroyed. Future uses of this resource (medicine, plant breeding. etc.) cannot be foreseen at present, although they will certainly be extensive in scope, and they even are crucial to the survival of humankind.

It is extremely rare to encounter completely natural areas nowadays. On the other hand, both extensive and local use of natural flora and fauna can be regarded as normal occurrences in natural ecosystems. Although the transition from hunting and gathering to settle agriculture in established agro-ecological zones is complete almost everywhere, traditional forms of resource use continue to play an important role in the lives of rural populations. Current pressure due to increase production and extend the area of land under cultivation is leading to more intensive use of remaining predominantly natural areas. This results in environmental stress and rapid loss of biological diversity, as well as permanent conversion of land to agricultural use.

Opening up natural areas in order to exploit their resources with modern technology frequently leads to additional forms of resource use. For example, forests opened up to commercial forestry are more exposed to uncontrolled over exploitation, as well as being subjected to ecological stress by migrants who practice agriculture.

Both extensive resource use over large areas and selective, intensive use of every favorable site can severely damage an ecosystem. Small-scale operations preservation of remaining natural areas and resource use in harmony with nature are important if the resources of a region are to be managed in an ecologically appropriate manner, proper monitoring is needed in order to obtain reliable information about significant changes in an ecosystem.

#### **4.13.2 Habitats**

The project surrounding area has distinctive terrestrial and aquatic habitats. The homesteads and roads are the major places of the terrestrial habitat with flora and fauna near the project site. There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. There are some natural and manmade mangrove forest approx. 4km away from the project site. Flora and fauna details survey is given below.

#### **4.13.3 Flora**

A comprehensive survey was conducted at the vicinity of the proposed project area. The baseline ecological survey was conducted 7<sup>th</sup> – 11<sup>th</sup> September, 2021 to get an idea about the status of the diversity of Flora and Fauna in that area. The basic methodological approaches which were followed for the present baseline work are:

- Field survey,
- Visual observations,
- Review of literature,
- Secondary available data,
- By interviewing local people,
- Data analysis and interpretation.

##### **4.13.3.1 Terrestrial Flora**

Detail lists of Terrestrial Flora found during our field visit is presented in **Table 4.31**.

**Table 4.31: Terrestrial Flora around the Study Area**

SL No.	English Name	Scientific name	Common Name	Family
1.	Olive	<i>Elaeocarpus tectorius</i>	Jalpai	Elaeocarpaceae
2.	Star Fruit	<i>Averrhoa carambola</i>	Kamranga	Averrhoaceae
3.	Asian rice	<i>Oryza sativa</i>	Dhan	Poaceae
4.	Indian gooseberry	<i>Phyllanthus emblica</i>	Amloki	Phyllanthaceae
5.	Karoi tree	<i>Albizia chinensis</i>	Koroi	Mimosaceae
6.	Gurjun, gurgina	<i>Dipterocarpus turbinatus</i>	Garjan	Dipterocarpaceae
7.	Honduras Mahogany	<i>Swietenia macrophylla</i>	Mahagoni	Meliaceae
8.	Shisham	<i>Dalbergia sissoo</i>	Sissu	Fabaceae
9.	Indian Coral tree	<i>Erythrina variegata</i>	Mandar	Fabaceae
10.	Kadamba	<i>Anthocephalus cadamba</i>	Kadom	Rubiaceae
11.	Betel nut	<i>Areca catechu</i>	Supari	Arecaceae
12.	Banyan Tree	<i>Ficus benghalensis</i>	Bot	Moraceae
13.	Cotton Tree	<i>Bombax ceiba</i>	Shimul	Bombacaceae
14.	Wood apple	<i>Aegle marmelos</i>	Bel	Rutaceae
15.	Neem Tree	<i>Azadirachta indica</i>	Neem	Meliaceae
16.	Papal Tree	<i>Ficus religiosa</i>	Peepul	Moraceae
17.	Palm Tree	<i>Borassus flabellifer</i>	Tal	Arecaceae
18.	Sola pith plant	<i>Aeschynomene aspera</i>	Sola	Fabaceae
19.	Cool mat	<i>Phrynium dichotomum</i>	Sitalpati	Marantaceae
20.	Date Palm	<i>Phoenix sylvestris</i>	Khejur	Arecaceae
21.	Guava	<i>Psidium guajava</i>	Piara	Myrtaceae
22.	Papaya	<i>Carica papaya</i>	Pepe	Caricaceae
23.	Kala	<i>Musa Sepientum</i>	Banana	Musaceae
24.	Lichu	<i>Lichi chinensis</i>	Lichi	Sapindaceae
25.	Black berry	<i>Syzygium cumini</i>	Jam	Myrtaceae
26.	Tamarind	<i>Tarmariandus indica</i>	Tentul	Fabaceae
27.	Indian jujube	<i>Zizyphus mauritiana</i>	Boroi	Rhamnaceae
28.	Elephant apple	<i>Dillenia indica</i>	Chalta	Dilleniaceae
29.	Coconut	<i>Cocos nucifera</i>	Narikel	Arecaceae
30.	Casuarina	<i>Casuarina equisetifolia</i>	Jhau	Casuarinaceae
31.	Mango	<i>Mangifera indica</i>	Aam	Anacardiaceae
32.	Eddo, Cocoyam	<i>Colocasia esculenta</i>	Kachu	Araceae
33.	Cluster fig, red river fig	<i>Ficus racemosa</i>	Dumur	Moraceae
34.	Bamboo	<i>Bambusa bambus</i>	Bash	Poaceae
33.	Keora Tree	<i>Sonneratia apetala</i>	Keora	Lythraceae
34.	Milky mangrove	<i>Excoecaria agallocha</i>	Gewa	Euphorbiaceae

Source: Field survey of AECL team



***Carica papaya***



***Cocos nucifera***



***Musa Sepientum***



***Mangifera indica***



***Phoenix sylvestris***



***Colocasia esculenta***



***Swietenia macrophylla***



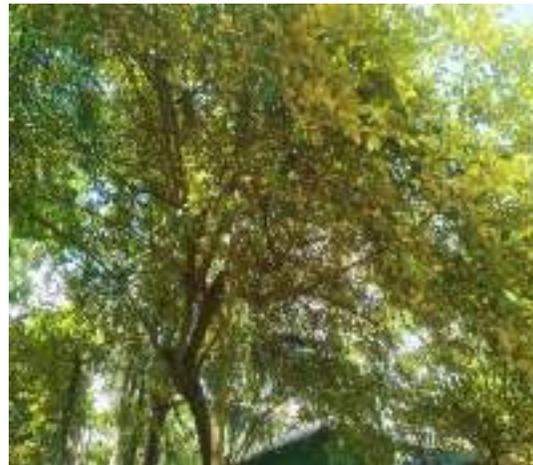
***Psidium guajava***



***Areca catechu***



***Ficus racemosa***



***Zizyphus mauritiana***



***Borassus flabellifer***



***Bambusa bambus***



***Casuarina equisetifolia***



***Oryza sativa***



***Albizia chinensis***



***Sonneratia apetala***



***Excoecaria agallocha***

**Figure 4.36: Terrestrial Flora around the project area**

#### 4.13.3.2 Aquatic Flora

Aquatic flora is divided into three major types - tree, shrub and herb. Aquatic floral species grow in rivers, canals, ditches, seasonal wetland and low-lying agricultural lands in submerged, free floating, or rooted floating states. Common aquatic floral species in the study areas include Kalmi Shak (*Ipomoea aquatica*), Shapla (*Nymphaea nouchali*), Helencha (*Enhydra fluctuans*), Kuchuripana (*Eichhornia crassipes*) are also seen.



*Ipomoea aquatica*



*Eichhornia crassipes*



*Nymphaea nouchali*



*Enhydra fluctuans*

Figure 4.37: Aquatic Flora around the project area

#### 4.13.4 Fauna

##### 4.13.4.1 Terrestrial Fauna

The study was based on field survey methods where an appropriate questionnaire was prepared and used for collecting data from different sampling locations. During collection of data, both primary and secondary sources were considered to interpret the results. Primary data were collected from fishermen through questionnaire interviews and also from the local fish markets. The secondary information was collected from books, journals and thesis and also discussion with the local people.

After collecting the data through questionnaire interviews, it was cross-checked through interviews of school teachers, local leaders and ecosystem people in the study area. Finally, data were analyzed. List of Fauna Identified in and around the Project Area are mentioned below **Table 4.32**.

**Table 4.32: List of Terrestrial Fauna Identified in and around the Project Area**

Sl. No	English name	Scientific name	Local Name	Conservational status	
				IUCN Bangladesh status	IUCN Global status
<b>Amphibians</b>					
1.	Skipper Frog	<i>Rana cyanophlyctis</i>	Kotkoti Bang	LC	LC
2.	Bull Frog	<i>Rana tigrina</i>	Sona Bang, Kola Bang	LC	LC
3.	Common Toad	<i>Bufo melanostictus</i>	Kuno Bang	LC	LC
<b>Reptiles</b>					
1.	House Lizard	<i>Hemidactylus brookii</i>	Goda Tiktiki	LC	NE
2.	Common House Gecko	<i>Hemidactylus frenatus</i>	Mosrin Tiktiki	LC	LC
<b>Birds</b>					
1.	Marsh harrier	<i>Circus aeruginosus</i>	Poshchima Pankapashi	LC	LC
2.	Black Kite	<i>Milvus migrans</i>	Bhubon Chil	LC	LC
3.	Cattle Egret	<i>Bubulcus ibis</i>	Go-Boga	LC	LC
4.	Black Hooded Oriole	<i>Oriolus xanthornus</i>	Halde pakhi	LC	LC
5.	Common Myna	<i>Acridotheres tristis</i>	Shalik	LC	LC
6.	Red-vented bulbul	<i>Pycnonotus cafer</i>	Bangla Bulbul	LC	LC
7.	Tailor Bird	<i>Orthotomus sutorious</i>	Tuntuni	LC	LC
8.	White-rumped Shama	<i>Copsychus malabaricus</i>	Shama	LC	LC
9.	House Sparrow	<i>Passer domesticus</i>	Pati Chorui	LC	LC
10.	Baya Weaver	<i>Ploceus phillippinus</i>	Babui	LC	LC
11.	Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Metethot Fuljhuri	LC	LC
12.	Shikra	<i>Accipiter badius</i>	Pati Shikre	LC	LC
13.	Cuckoos	<i>Cuculus micropterus</i>	Kokil	LC	LC
14.	King Crows	<i>Dicrurus adsimilis</i>	Kak	LC	LC
15.	House Crows	<i>Corvus splendens</i>	Pati Kak	LC	LC
16.	Magpie Robin	<i>Copsychus saularis</i>	Doel	LC	LC
<b>Mammalian</b>					
1.	Jackals	<i>Canis aureus</i>	Shial, Pati Shial	LC	LC

Sl. No	English name	Scientific name	Local Name	Conservational status	
				IUCN Bangladesh status	IUCN Global status
2.	Pallas's Squirrel	<i>Callosciurus erythraeus</i>	Lalche-buk Kathbirali	LC	LC
3.	Bengal mongoose	<i>Herpestes edwardsii</i>	Boro Beji	LC	LC
4.	House Mouse	<i>Mus musculus</i>	Indur	LC	LC
5.	Indian Flying Fox	<i>Pteropus giganteus</i>	Baro Badur	LC	LC
6.	Domestic Goat	<i>Capra aegagrus hircus</i>	Chhagol	LC	-
7.	Domestic Cow	<i>Bos Indicus</i>	Goru	LC	-
*Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Not Added (N/A)					

Source: Field survey of AECL team

#### 4.13.4.2 Aquatic Fauna

There are different types of fishes in the project area. Some of the commonly available fishes and other fauna in the project influence area are mentioned below in **Table 4.32**.

**Table 4.33: List of Aquatic fauna in the project area**

Sl. No.	Common English Name	Scientific Name	Local Name	Red List Category	
				IUCN Bangladesh status	IUCN Global status
<b>Fish Fauna</b>					
1.	Rohu	<i>Labeo Rohita</i>	Rui	LC	LC
2.	Catla	<i>Catla catla</i>	Katla	LC	NE
3.	Orangefin labeo, Black rohu	<i>Labeo calbasu</i>	Kalibaus, Baus	LC	LC
4.	Stinging Catfish	<i>Saccobranthus fossilis</i>	Shing	LC	LC
5.	Bleeker's Mystus	<i>Mystus bleekeri</i>	Tengra	LC	LC
6.	Walking Catfish	<i>Clarias batrachus</i>	Magur	LC	LC
7.	Bleeker's Mystus, Day's Mystus	<i>Mystus bleekeri</i>	Tengra	LC	LC
8.	Snakehead Murrel	<i>Channa striatus</i>	Shol	LC	LC
9.	River Shad, Hilsha Shad	<i>Tenualosa ilisha</i>	Ilish, Ilsha	LC	LC
10.	Black Rohu	<i>Labeo calbasu</i>	Kalbaosh, Baus	LC	LC

Sl. No.	Common English Name	Scientific Name	Local Name	Red List Category	
				IUCN Bangladesh status	IUCN Global status
11.	Pama Croaker, Pama	<i>Otolithoides pama</i>	Poa	LC	NE
12.	Freshwater Shrimp	<i>Macrobrachium rosenbergii</i>	Chingri	LC	LC
13.	Bata Labeo	<i>Labeo bata</i>	Bata	LC	LC
14.	Indian Potasi	<i>Pseudeutropius atherinoides</i>	Batasi	LC	LC
15.	Gangetic Hairfin Anchovy	<i>Setipinna phasa</i>	Phasa	LC	LC
16.	Ganges River-sprat	<i>Corica soborna</i>	Kachki	LC	LC
17.	Fresh Water Goby	<i>Glossogobius giuris</i>	Baila	LC	LC
18.	Spotted Snakehead	<i>Channa punctatus</i>	Taki	LC	LC
19.	Paradise Threadfin	<i>Polynemous paradiseus</i>	Topshe	LC	NE
20.	Bearded Worm Goby	<i>Taenioides cirratus</i>	Chewa	LC	NE
21.	Mozambique tilapia	<i>Oreochromis mossambicus</i>	Tilapia	N/A	-
22.	Silver Carp	<i>Hypophthalmichthys molitrix</i>	Silver Carp	N/A	-
23.	Grass Carp	<i>Ctenopharyngodon idella</i>	Grass Carp	N/A	-
<b>Other Fauna (Birds)</b>					
1.	Bar headed goose	<i>Anser indicus</i>	Raj Hans	LC	LC
2.	Greenleggoose	<i>Anser anser</i>	Metey Rajhash	LC	LC
3.	Indian Pond Heron	<i>Ardeola grayii</i>	Kani Bok	LC	LC
4.	Little cormorant	<i>Phalacrocorax niger</i>	Pankawri	LC	LC
5.	Waterhen	<i>Amauornis phoenicurus</i>	Dahuk	LC	LC
6.	Pintail	<i>Anas acuta</i>	Lenja Hans	LC	LC
7.	Watercock	<i>Gallicrex cinerea</i>	Kora	LC	LC

Source: Field survey of AECL team

**Amphibian**



*Rana cyanophlyctis*



*Bufo melanostictus*

**Reptile**



*Hemidactylus brooki*

**Aves**



*Corvus splendens*



*Passer domesticus*



*Acridotheres tristis*



*Ploceus philippinus*



*Accipiter badius*



*Dicaeum erythrorhynchos*



*Copsychus saularis*



*Orthotomus sutorius*



*Milvus migrans*

**Mammals**



*Mus musculus*



*Capra aegagrus hircus*



*Bos Indicus*

**Figure 4.38: Terrestrial Fauna around the project area**

**Fish Fauna**



***Catla catla***



***Tenulosa ilisha***



***Channa striatus***



***Macrobrachium rosenbergii***



***Clarias batrachus***



***Mystus bleekeri***



***Labeo calbasu***



***Labeo Rohita***



***Corica soborna***

**Other Fauna**



*Anser indicus*



*Anser anser*



*Ardeola grayii*



*Anas acuta*



*Phalacrocorax niger*



*Amaurornis phoenicurus*

**Figure 4.39: Aquatic Fauna around the project area**

## 5 IDENTIFICATIONS OF POTENTIAL IMPACT

### 5.1 General Consideration

In case for most projects, potential negative impacts sometime could be far more numerous than beneficial impacts. The regional and national economic benefits associated with the implementation of any development project are considered to fall outside the scope of an EIA, and therefore not considered here. However, it is generally expected that these long-term benefits will ultimately trickle down to the local population and will make a contribution to an improvement in the quality of life. Likewise, the indirect benefits of strengthening of technical capabilities of local persons through association with foreign experts and other training elements that may form part of a project have been considered to fall outside the scope of EIA.

### 5.2 Scoping of Impacts

Identification of potential impacts due to the Project location, construction and operation of the Power Plant has been done using Checklist.

#### 5.2.1 Checklist

**Table 5.2** represents the checklists developed for construction and operation of the Power Plant. In this checklist, actions, which may affect at the various stages of the project activities, are listed and the degrees of Significant Environmental and Social Impacts (SESIs) are shown. Though the project is an existing facility, impacts that generally believed to occur at the construction stages of such kind of project have also been identified. In the checklists, pre-construction, construction and operational phases are considered separately in order to distinguish the short term and long-term impacts. It can be observed from the checklists, the major activities, which have the potential of creating moderate/major SESIs either negative or positive are, water, air and noise pollution and employment.

The magnitude combines the impact characteristics of Extent, Duration and Impact Scale is a multiplicative factor of these three criteria set. Based on this understanding magnitude of impact is assessed as per the **Table 5.1**.

**Table 5.1: Assessing Magnitude of Impact**

Extent	Duration	Impact Scale	Magnitude
Local	Short term	No impact	None
Regional	Short term	No impact	None
National	Short term	No impact	None
Local	Medium term	No impact	None
Regional	Medium term	No impact	None
National	Medium term	No impact	None
Local	Long term	No impact	None
Regional	Long term	No impact	None
National	Long term	No impact	None
Local	Short term	Low	Minor
Regional	Short term	Low	Minor
Local	Medium term	Low	Minor
Local	Short term	Medium	Minor
National	Short term	Low	Minor
Local	Long term	Low	Minor
Local	Short term	High	Minor
Regional	Medium term	Low	Minor
Regional	Short term	Medium	Minor
Local	Medium term	Medium	Minor
National	Medium term	Low	Moderate
National	Short term	Medium	Moderate
Regional	Long term	Low	Moderate
Regional	Short term	High	Moderate
Local	Long term	Medium	Moderate
Local	Medium term	High	Moderate
Regional	Medium term	Medium	Moderate
National	Long term	Low	Moderate
National	Short term	High	Moderate
Local	Long term	High	Moderate
National	Medium term	Medium	Major
Regional	Long term	Medium	Major
Regional	Medium term	High	Major
National	Long term	Medium	Major
National	Medium term	High	Major
Regional	Long term	High	Major
National	Long term	High	Major

**Table 5.2: Impact Evaluation and Identification table**

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments	
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben		
<b>Pre-construction Phase</b>																	
Acquisition and Involuntary Resettlement																	No impact anticipated
Disruption of Earth Surface																	No impact anticipated
Change in Landscape																	Comparative to adjacent rural and agricultural setup
Impact on ecological habitats																	As there is one canal inside the project area and another at the west side of the project area
Impact due to Solid Waste																	Improper management of solid waste during boundary work
Indigenous people																	No existence of indigenous people around the project site; No impact anticipated
Cultural Heritage site																	No cultural heritage site within the vicinity of the project area; No impact anticipated

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments	
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben		
<b>Construction Phase</b>																	
Air Quality																	Dust emission may occur during construction activity and traffic movement will also cause additional air emission
Noise Hazard																	Equipment installations and constructional work may create noise and vibration
Impact on Soil quality																	accidental spillage of different chemicals and hazardous substances may occur
Impact on Surface Water																	Improper management of soil, sand and other fine materials
Impact on Ground Water																	Improper management of liquid waste and accidental spillage or seepage of different chemicals and over extraction of ground water

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
Impact due to Solid Waste																Generation of different kinds of solid waste, office waste from constructional work
Hazardous Materials Managements																Hazardous material transporting and handling to or from the project site can cause different types of accidents
Traffic and Transportation																Carrying of construction materials will create traffic congestion around the project area
Impact on Terrestrial Habitat																Due to constructional work, there will be some negative impact
Impact on Aquatic Habitat																Due to discharge of liquid waste and different constructional waste, chemicals etc.
Occupational Health and Safety																Irregularly accidents, injury may occur in construction period
Sanitation Hazard & Drinking Water																Concentration of labor force may create un-

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
																hygienic condition and lack of safe drinking water may cause diseases
Labor and Working Condition																Improper maintenance of standard salary, salary deductions; hours of work; overtime arrangements
Social acceptability of Construction workers to the host communities																Local community may create some problems
Community Health, Safety and Security																Possibility of occurring accidents due to lack of safety and security
Employment																Major employment opportunity during construction phase
Increase in local business																Due to project activity
Indigenous people																No existence of indigenous people around the project site; No impact anticipated
Cultural Heritage																No cultural heritage site within the vicinity of the

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
																project area; No impact anticipated
<b>Operation Phase</b>																
Air quality																Emission from the engine and generator stack may affect the ambient air quality.
Noise Hazard																Noise may be generated due to project operation
Impact on Soil Quality																Improper storage and disposal of sewage wastes, hazardous waste, accidental spillage
Impact on Surface Water																Poor management of sewage, discharge of liquid waste may deteriorate surface water quality
Impact on Ground Water																Accidental spillage of oil or Hazardous substances; Abstraction of ground water
Impact due to Solid waste																Improper management of solid waste

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
Hazardous Materials Managements																Generation of used lubricating oil from the plant and improper handling and accidental spillage of hazardous waste (i.e., fuel oil, chemical) may occur
Traffic and Transportation																Transportation of different materials, fuel and personnel may create traffic congestion
Impact on Terrestrial Habitat																Terrestrial ecosystem may get disturbed due to project operation (i.e., air, noise, soil pollution)
Impact on Aquatic habitat																Due to leakage & accidental spillage of oil and hazardous substances aquatic habitat will be impacted
Occupational Health and Safety																Improper site security and safety may lead to accidents
Sanitation Hazard & Drinking Water																Generation of human waste by workers and

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
																laborers during operation stage may cause diseases
Labor and Working Condition																Improper maintenance of standard salary, salary deductions; hours of work; overtime arrangements
Community Health and Safety																Possibility of occurring accidents and spread of several communal and infectious diseases
Social acceptability of workers to the host communities																Acceptability problem may occur due to foreign officials/workers
Employment																Major employment opportunity during operation phase
Social and Economic enhancement around project area																benefit to local economy due to electricity connection, employment, community development.
Indigenous people																No existence of indigenous people around the project site; No impact anticipated

Action Affecting Environmental Resources & Values	Impact Duration			Impact Extent			Impact Scale			SEIs Magnitude without Mitigation Measures				Type		Comments
	ST	MT	LT	L	R	N	Sm	Med	Lar	Non	Min	Mod	Maj	Adv	Ben	
Cultural Heritage																No cultural heritage site within the vicinity of the project area; No impact anticipated

**\*Notation**

ST	Short Term	
MT	Medium Term	
LT	Long Term	
L	Local	
R	Regional	
N	National	
Sm	Small	
Med	Medium	
Lar	Large	
Non	None	
Min	Minor	
Mod	Moderate	
Maj	Major	
Adv	Adverse	
Ben	Beneficial	

## *Chapter 6*

# **6 PREDICTION AND EVALUATION OF IMPACTS**

## **6.1 General Considerations**

This chapter defines the details of investigated environmental impacts due to project location, design, construction, and operations of the proposed power plant and measures for minimizing and / or off-setting adverse impacts identified. The Impacts, which are likely to be occurred in the different phases of the project, are identified and discussed along with mitigation measures in the following sections.

## **6.2 Impact due to Project Location/ during Pre-construction Phase**

### **6.2.1 Land Acquisition and Involuntary Resettlement**

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

- Loss of Homestead land
- Loss of Agricultural Land

### **Mitigation Measures**

The proposed project doesn't require any land acquisition and involuntary resettlement since the project is situated in BPDB's own land. The proposed project land is a vacant land. No agricultural or homestead land falls inside the proposed project site. So, the above-mentioned impacts are absent. So, no mitigation measure required.

### **6.2.2 Disruption of Earth Surface**

The land raising from its original level certainly disrupt the natural surface of earth which will obstruct the natural drainage system of the area and as a result water logging will occur in certain area. At present, the boundary work has not started yet. The land development work is not required as the land is already developed land (approximately 7~8ft higher than the adjacent land area).

### **Mitigation Measures**

- ✓ Regular sprinkling of water will be done on open surface and dust grounds.

### **6.2.3 Change in Landscape**

A landscape is a subjective concept that cannot be precisely quantified. However, in general, any project when not designed considering the local landscape, then it creates visual intrusion to the people. The present project may change the local landscape to some extent as the adjacent land area is rural and agricultural type.

## **Mitigation Measures**

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

### **6.2.4 Impact on Ecological Habitat**

Terrestrial ecosystem may change and aquatic habitat may get disturbed due to pre-constructional work. As the land is already a developed land, there is no terrestrial habitat inside the project area. There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. As there is not much pre-constructional work so, small impact anticipated on Ecological habitat.

#### **Proposed Mitigation Measures**

- ✓ No waste should be dumped in water bodies;
- ✓ Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off;
- ✓ Re-vegetation should be done as soon as possible.

### **6.2.5 Solid Waste**

- ✓ Aesthetic tiring due to negligence in management of waste generated during boundary work activities;
- ✓ Negative impact on other aquatic habitat due to improper solid waste disposal;
- ✓ May induce several diseases due to lack of proper handling of sanitary waste of labors.

#### **Proposed Mitigation Measures**

- ✓ Organize disposal of all wastes generated during pre-construction phase in the designated disposal sites approved by the Project authority;
- ✓ Waste should be properly segregated in different colored drums;
- ✓ No solid waste should be dumped in water bodies;
- ✓ Difficult to dispose wastes will be minimized where practicable.

### **6.2.6 Indigenous People**

There is no existence of indigenous people within the vicinity of the project area. So, there is no impact in this regard.

## **6.2.7 Cultural Heritage**

There is no cultural heritage site within the vicinity of the project area and no structure of national cultural heritage will be affected due to project development.

## **6.3 Impact during Construction Phase**

### **6.3.1 Air Quality**

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

- ✓ Delivery of construction materials to site;
- ✓ Handling and mixing of cement;
- ✓ Cutting/filling and sand storage may cause air pollution;
- ✓ Poorly Paved Service.

A brief elaboration of each of the potential source/cause of air pollution is as follows:

#### **a. Delivery of construction Materials to Site**

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

- Handling of sand, stone/brick chips may contain loose dust particles;
- Air emissions including SO<sub>2</sub> and NO<sub>x</sub> may be released;
- Handling of cement which is dusty by nature of the way it is;
- Site clearing of area of holding ballast, building blocks and sand will expose the site to wind action;

#### **b. Handling and Mixing of Cement**

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

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

#### **c. Cutting/filling and sand storage may cause air pollution**

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

- Stripping off of overburden material will loosen soil aggregates thus making them easily susceptible to wind action;
- Removal of tree stumps and roots will weaken soil bounding and thus can easily be blown by wind

#### **d. Poorly Paved Service**

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

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

#### **❖ Potential Environmental Impacts of Dust**

Dust produced will potentially negatively affect the following:

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

#### **1. Effects of Dust to Employees**

Cement dust can affect Employees in the following way

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

#### **2. Dust Impacts to Vegetation**

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

## **Mitigation Measures**

The impact of construction activities would be temporary and restricted to the construction phase. The impact will be confined within the close vicinity and is expected to be negligible due to its small magnitude. Following mitigation measures will be taken to minimize the air pollution during the construction stage:

- ✓ Regular sprinkling of water will be done on open surface and dust grounds until paving was done;
- ✓ Transportation of materials in tarpaulin-covered trucks;
- ✓ The sand and other such dispersible material will be stored at site for minimum working period;
- ✓ Removal of soil/mud from trucks and other appliances prior to leaving the project area;
- ✓ Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses);
- ✓ Project management and contractor to enforce strict use of personal protective clothing of labors;
- ✓ Complains of dust related ailments among employees and neighbors to be given access to medical attention;
- ✓ The equipment design will be chosen for least suspension of dust/sand into atmosphere;
- ✓ The construction activity will be carried out during daytime only.

### **6.3.2 Impacts on Acoustic Environment**

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

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

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

#### **a) Ground Preparation**

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

- ✓ Use of machinery such as generator, engine will be a source of noise nuisance; and
- ✓ Transportation of different material from site by using trucks will result in noise nuisance. The noise will be mainly from the trucks.

#### **b) Assembly of Building Materials**

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

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

### **c) Construction of the Various Components of the Proposed Power Plant**

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

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

#### **6.3.2.1 Potential Environmental Impacts of Noise**

Impacts of noise and vibration will potentially affect the following:

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

#### **a. Impacts of Noise to Immediate Neighbors**

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

#### **b. Noise Impacts to Employees**

- ✓ High noise level will force employees to shout loud when communicating to one another;
- ✓ Exposure of employees to high noise level (above 85dB) continuous for 8 hours per day may result in noise induced hearing loss;
- ✓ Exposure of ear to peak sound level instantaneously may result to deafness.

#### **Mitigation Measures**

- ✓ Noisy construction works to be limited to day time hours;
- ✓ Proper Acoustically designed machinery should be used;
- ✓ Cutting pipes and other related works should be done in a safe zone;
- ✓ Immediate neighbors to be notified in writing on the date of commencement of construction work at one month in advance;

- ✓ All employees likely to be exposed to noise to be provide with ear protectors;
- ✓ Where applicable and possible exceptionally noisy machines to be fitted with noise reduction devices;
- ✓ Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor;
- ✓ Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A);
- ✓ Workers should wear Personal Protective Equipment (PPE) for protecting them from the sound induced hazard;
- ✓ Noise protection wall or barrier should be constructed in case of long-term noisy construction.

### **6.3.3 Impact on Soil Quality**

The impacts on soil quality can result from:

- ✓ Removal of top soil;
- ✓ Disposal of construction waste, sewage wastes;
- ✓ Spillage of chemical / oil and other substances on open soil.

### **Proposed Mitigation Measures**

- ✓ Construct appropriate spill containment facilities for all fuel storage areas;
- ✓ Train personnel and implement safe work practices for minimizing the risk of spillage;
- ✓ Develop site specific waste management plan for various waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior construction work;
- ✓ Construction waste will be utilized for filling of Project site;
- ✓ Fuel, chemical and lubricant will be stored in paved storage areas;
- ✓ Properly stripping of top soil and conserve it for future use (greenbelt development);
- ✓ Municipal solid waste generated from the construction site will be transferred to the disposal site in consultation with the Union Parishad.

### **6.3.4 Impact on Surface Water**

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

### **Proposed Mitigation Measures**

- ✓ Surface drainage shall be controlled to divert surface runoff away from the construction area;
- ✓ Laying barrier net;
- ✓ Undertaking construction work during dry seasons;

- ✓ Completed areas should be restored/re-vegetated as soon as practicable;
- ✓ Temporary silt-trap or digging of pond toward siltation prevention;
- ✓ Stockpiling of spoil soil at a safe distance from the drainage system;
- ✓ Strict supervision should be maintained to avoid blockage of natural creeks during the construction period;
- ✓ Sanitary waste should be adequately disposed of to avoid surface and ground water contamination;
- ✓ Making provision for temporary storage of wastes inside construction yard and disposal of solid wastes in an appropriate manner and at appropriate site at regular interval;
- ✓ Adequate provision has to be retained for the treatment and disposal of cuttings, drilling fluids and other chemicals and lube oil wastes generated during drilling, testing and commissioning stage.

### **6.3.5 Impact on Ground Water**

Spillage and seepage of chemical, over extraction of ground water, oil and lubricants from storage area, waste handling area and generation of sewage / domestic wastes from construction labor camp area may adversely affect ground water quality in the area. The project would affect ground water quality if the construction works are not managed properly.

### **Proposed Mitigation Measures**

- ✓ Proper spill control and management at site;
- ✓ Storage of hazardous material and waste in proper manner and disposal of the waste at a designated location around the site;
- ✓ Minimize the extraction and proper management of ground water should be strictly followed;
- ✓ Regular inspections of machinery, equipment, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring;
- ✓ Periodic monitoring of groundwater to detect any contamination;
- ✓ Provision for treatment of waste water from labor camp, on site.

### **6.3.6 Impact due to Solid Waste**

#### **• Solid waste due to project work**

During construction, large amount of construction waste that includes unused construction materials, construction debris, excavated spoils, abandoned or broken machine parts, debris, kitchen wastes from labor sheds, packaging materials, used home appliances, etc. will be produced. Moreover, food waste, plastic, papers, cock sheet, cartons, metal or plastic binders, etc. may be produced as solid waste during this stage. If these wastes are not disposed and maintained properly, these would have impact on surrounding environment.

• **Kitchen and Sanitary waste**

During construction phase labor will be engaged in different constructional work. Some of them will be living at the labor shed and kitchen waste and sewage will be generated within the project site. If these are not handled properly then it may impact the surrounding environment negatively.

**Mitigation Measures**

- ✓ Construction waste should be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses;
- ✓ The contractor should be committed to ensure construction materials left over at the end of construction will be used in other projects rather than being disposed off; some of the waste can be sold or donated or recycled/reused by construction companies, local community groups or institutions;
- ✓ Waste should be properly segregated in different colored drums;
- ✓ Difficult to dispose wastes (plastic and hazardous waste) will be minimized and where practicable and avoided such as plastic wastes;
- ✓ The contractor must dispose the wastes regularly at an approved refuse disposal site to ensure that waste does not build up on site and result in aesthetic impacts or odors;
- ✓ Hazardous waste will not be mixed with other solid waste generated and should be managed by way of incineration or land-filling.

**6.3.7 Hazardous Materials Managements**

Hazardous material can cause different types of accidents while transporting to or from the project site. They may cause damage during inadequate storage, transportation, treatment, or disposal operations. Improper hazardous-waste storage or disposal frequently contaminates surface water and groundwater supplies as harmful water pollution and can also be a source of dangerous land pollution.

**Mitigation Measures**

- ✓ All hazardous materials will be provided in a secondary containment;
- ✓ Spill kits should be available to contain any accidental release of hazardous material;
- ✓ Skilled labors should be appointed for unloading the work;
- ✓ In case of any spillage, it should be immediately acted up on. To combat spillage equipments i.e., safety goggles, gloves, PPE, disposal bags, containers, suction pump, boom skimmer etc. should be available at the site;
- ✓ Regular inspections of machinery, equipment, pipe work, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring.

### **6.3.8 Traffic and Transportation**

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

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

#### **Potential Negative Environmental Impacts Likely to Result from Increased Vehicular Traffic in the Area**

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

#### **Mitigation Measures**

The following measures will be adopted to mitigate possible negative impacts likely to result from increase in vehicular traffic in the area:

- ✓ Emphasizing on road safety aspects;
- ✓ Licensed and trained drivers should be appointed;
- ✓ Management to provide for adequate internal parking for all vehicles;
- ✓ Avoid transportation of materials and machinery during the off-peak traffic periods;
- ✓ Stick to agreed traffic routes, avoiding narrow routes;
- ✓ Prevent unauthorized access to the construction site;
- ✓ Implementation of a safety program (speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area;
- ✓ All vehicles should have updated fitness certificate;
- ✓ Regular maintenance of vehicles;
- ✓ Speed limits, Proper signage, visibility and traffic awareness and pedestrian safety should be followed by the drivers.

### **6.3.9 Impact on Terrestrial Habitat**

Potential impact sources include-

- ✓ Fugitive emission and deposition on vegetation;
- ✓ Suspended particulates can have detrimental impact on the vegetation by covering plant surfaces;
- ✓ Fauna could be adversely affected through construction-related activities (noise, dust, light pollution, and habitat loss).

### **Mitigation Measure**

- ✓ Plantation of local species in surrounding areas of the Project site;
- ✓ Bare surfaces should be grassed as soon as possible after construction to minimize time of exposure;
- ✓ Only locally occurring, indigenous grasses should be used;
- ✓ The construction area and immediate surroundings should be monitored regularly for emergent invasive vegetation;
- ✓ Water sprinkling for dust suppression;
- ✓ Lights of the construction area should install downwardly to avoid disturbance to the wildlife and birds;
- ✓ Avoid working at night time.

There is mangrove forest area approx. 4 km and more away from project site. If the above-mentioned mitigation measures are implemented then it is expected that the impact on them will be negligible.

### **6.3.10 Impact on Aquatic Habitat**

Source of impacts include:

- ✓ Surface runoff from construction site, spillage & leakage of oil and lubricants etc.;
- ✓ Runoff erosion from the project site may have negative impact on Aquatic fauna.

### **Mitigation Measures**

- ✓ Wastewater from labor camp and construction site should not be disposed-off in natural water bodies;
- ✓ Proper disposal and management of construction waste;
- ✓ No solid, liquid or hazardous waste should be dumped in water bodies during construction;
- ✓ Septic tank along with soak wells should be provided to dispose-off the wastewater from construction camp;
- ✓ Excavation activities should not be undertaken during monsoon season;
- ✓ Piling of raw material at construction site should be avoided;
- ✓ Raw material, debris and fuel should be stored on paved surfaces under covered areas;
- ✓ Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off.

There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. If the above-mentioned mitigation measures are implemented then it is expected that the impact on aquatic habitat will be negligible.

### **6.3.11 Occupational Health and Safety**

The safety of the workers may be at risk during construction activities. The movement of trucks to and from the site, the operation of various equipment and machinery and the actual construction activities will expose the workers to work-related accidents and injuries. Pollutants such as dust and noise could also have negative implications for the health of workers and near-by communities.

In addition, falling debris could injure workers if personal protective equipments (PPE) are not provided or properly used. Back injury could occur if workers lift heavy objects using inappropriate body posture. Other potential hazards might be; driving equipment with improper brake system, lack of concentration while working. The protection of head, eye, ear, and hand, foot of the workers, labors and project personnel could be affected if proper and adequate arrangement is not ensured.

### **Mitigation Measures**

- ✓ The EPC contractor will provide all kinds of treatment facilities and pay compensation according to Bangladesh Labor Law 2006;
- ✓ It is suggested that worker's health have to be checked regularly;
- ✓ Emergency response policy of the EPC contractor/ Project authority should be followed;
- ✓ All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor;
- ✓ Necessary first aid facilities should be available at site;
- ✓ Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order;
- ✓ All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded;
- ✓ All scaffolds will be erected and inspected and the appropriate records maintained by the Contractor;
- ✓ Safety hoops or cages will be provided for ladders with a height in excess of two meters;
- ✓ The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress;
- ✓ Supervision of works shall be done regularly to ensure that safety conditions are met while any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work;
- ✓ The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessities. So, there may not be major health hazard issue during the construction;

- ✓ An understanding has to be built with a local hospital for the emergency incident related to the worker's health of the plant and EPC contractor/ Project Authority has to establish such health monitoring system of the workers shortly;
- ✓ In addition, necessary steps to be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.

### **6.3.12 Sanitation Hazard & Drinking water**

The health of the project personnel, construction workers and laborers living at the labor camp could be impacted. The most common diseases that can be transmitted through water are diarrheal diseases such as bacillary dysentery, typhoid, paratyphoid, cholera, amoebiasis etc. During construction stage, lot of local labors will work and hence they would generate considerable amount of human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also. If arrangement of sanitation and drinking water is not ensured adequately and properly, it will create a major problem. Presently, Covid 19 virus is another alarming issue which can spread during the construction phase due to labor influx.

#### **Mitigation Measures**

- ✓ Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured;
- ✓ Contractors and workers should obey appropriate means of waste removal and sanitation measures;
- ✓ All the labors should follow the safety protocol (i.e., Physical distancing, Face coverings, Gloves, Goggles & Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation;
- ✓ Adequate number of portable toilets and bathrooms should be made for the workers;
- ✓ Proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities;
- ✓ Male and female toilets should be isolated as per requirement;
- ✓ There will be enough arrangement for the supply of safe drinking water to the workers.

### **6.3.13 Labor and Working Condition**

Working conditions and terms of employment examples are wages and benefits; wage deductions; hours of work; overtime arrangements and overtime compensation; breaks; rest days; and leave for illness, maternity, vacation or holiday.

#### **Mitigation Measures**

- ✓ Contractor should maintain standard wage, wage deductions; hours of work; overtime arrangements and overtime compensation;

- ✓ Leave for illness, maternity, vacation or holiday should also be maintained by the contractor;
- ✓ Child labor and forced labor should strictly be avoided;
- ✓ Temporary labor camp should be made for labors;
- ✓ Discrimination between male and female labors should be prohibited.

### **6.3.14 Social acceptability of Construction workers to the host communities**

The differences in the cultures of workers (in case hiring is required) and local community may create some problems. In the rural area, the local people especially the religiously conservative section of the community will not accept the foreign workers in general.

#### **Mitigation measures**

- ✓ The project proponent and the contractor have practice of working with the workers of different cultures;
- ✓ It is recommended to aware the foreign workers (if any) about the social & religious actability in the area so that they could maintain those when they are in touch with local community.

### **6.3.15 Community Health and Safety**

Possible sources of impacts to community health and safety during the construction phase are dust, noise emissions, possibility of occurring accidents and local people may come to contact of hazardous material related to the project. Influx of non-local workers may also lead to increased incidence of disease outbreaks and potential security issues. The contractor will evaluate the risks and impacts to the health and safety of the Affected Communities during construction phase.

#### **Mitigation Measures**

- ✓ Water sprinkling on the access roads and at the construction sites would reduce dust emissions considerably;
- ✓ To reduce noise related impacts, night time movement of vehicles and construction activities will be restricted;
- ✓ Pre-employment health check-up for construction workers;
- ✓ Isolate local people from project area for safety purpose;
- ✓ Construction camps equipped with proper sanitation facilities and regular pest control (i.e., to pest control for mosquitos or other insects for housing workers / labors);
- ✓ Proper fencing should be done around the project site to control the movement of local people;
- ✓ All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road.

### **6.3.16 Employment Generation**

One of the main positive impacts during the construction phase will be the availability of employment opportunities especially to casual workers and several other specialized workers. Employment opportunities are of benefit both economically and in a social sense. In the economic sense it means abundant unskilled and skilled labor will be used in construction hence economic production.

#### **Proposed Mitigation Measures**

- ✓ Service and materials for construction will be to the extent possible locally sourced;
- ✓ Prioritization of employment of skilled and non-skilled workers from the local communities;
- ✓ Priority given to local residents for both professional and nonprofessional positions;
- ✓ In order to increase the size of local employment, women should also be employed in the construction phase.

### **6.3.17 Increase in local business**

There will be development of Local Infrastructure during construction phase. Moreover, connecting roads and communicating facilities will be upgraded during construction phase. As a result, Local business will also be improved. Moreover, due to industrial development some small-scale business (small grocery shop, confectionary, tea stall, salon etc.) will also get recognizable opportunity.

#### **Proposed Mitigation Measures**

- ✓ Service and materials for construction will be to the extent possible locally sourced;
- ✓ Priority given to local residents for both professional and nonprofessional positions;
- ✓ Encourage local people with small-scale business plans.

### **6.3.18 Indigenous People**

There is no existence of indigenous people within the vicinity of the project area. So, there is no impact in this regard.

### **6.3.19 Cultural Heritage**

There is no cultural heritage site within the vicinity of the project area and no structure of national cultural heritage will be affected due to project development.

## **6.4 Impact during Operation Phase**

### **6.4.1 Air quality**

The primary emissions to air from the combustion of HFO are sulfur dioxide (SO<sub>2</sub>), Nitrogen oxides (NO<sub>x</sub>), particulate matter (PM), carbon monoxide (CO). The amount and nature of air emissions depends on

factors such as the type and design of the combustion unit (e.g., reciprocating engines, combustion turbines, or boilers), operating practices, emission control measures (e.g., primary combustion control, secondary flue gas treatment), and the overall system efficiency.

Emission from the engine and generator stack may affect the ambient air quality. Unburned gases from the engine operation may affect the air quality. The situation aggravates when the fuel (here HFO) contains high percentage of impurities like sulfur, water, metals, MCR (micro carbon residue) etc. The high temperature of flue gases also impacts the air quality in terms of thermal pollution. The combustion of heavy fuels for power Generation inevitably results in emission of particulate and gaseous pollutants to the atmosphere. As the proposed power plants would be fired with Heavy Furnace Oil, the air pollutants emitted by the power plant will be Particulate matter, carbon monoxide, nitrogen oxides and sulfur dioxide.

#### ➤ **Sulfur dioxide (SO<sub>2</sub>) Emissions from the power plant**

SO<sub>2</sub> is a colorless gas. It smells like burnt matches. It can be oxidized to Sulfur trioxide, which in the presence of water vapor is readily transformed to Sulfuric acid mist. SO<sub>2</sub> can be oxidized to form acid aerosols. SO<sub>2</sub> is a precursor to Sulfates, which are one of the main components of respirable particles in the atmosphere.

#### **Health Effects**

Health effects caused by exposure to high levels of SO<sub>2</sub> include breathing problems, respiratory illness, changes in the lung's defenses, and worsening respiratory and cardiovascular disease. People with asthma or chronic lung or heart disease are the most sensitive to SO<sub>2</sub>. It also damages trees and crops. SO<sub>2</sub>, along with nitrogen oxides, are the main precursors of acid rain. This contributes to the acidification of lakes and streams, accelerated corrosion of buildings and reduced visibility. SO<sub>2</sub> also causes formation of microscopic acid aerosols, which have serious health implications as well as contributing to climate change.

#### ➤ **Nitrogen Oxides (NO<sub>x</sub>) Emissions from the Proposed Plant**

Nitrogen gas, normally relatively inert (nonreactive), comprises about 78% of the air. At high temperatures and under certain other conditions it can combine with oxygen in the air, forming several different gaseous compounds collectively called oxides of nitrogen (NO<sub>x</sub>). Nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub> - the criteria pollutant) are the two most important. Major source of nitrogen oxides in the proposed power plant includes the fuel combustion in power plants.

#### **Health Effects**

Certain members of this group of pollutants, especially nitrogen dioxide (NO<sub>2</sub>), are known to be highly toxic to various animals as well as to humans. High levels may be fatal, while lower levels affect the delicate structure of lung tissue. In experimental animals this leads to a lung disease that resembles

emphysema in humans. As with ozone, long-term exposure to nitrogen oxides makes animals more susceptible to respiratory infections. Nitrogen dioxide exposure lowers the resistance of animals to such diseases as pneumonia and influenza. Humans exposed to high concentrations suffer lung irritation and potentially lung damage. Increased respiratory disease has been associated with lower-level exposures.

The human health effects of exposure to nitrogen oxides, such as nitrogen dioxide, are similar to those of ozone. These effects may include:

- ✓ Short-term exposure at concentrations greater than 3 parts per million (ppm) can measurably decrease lung function;
- ✓ Concentrations less than 3 ppm can irritate lungs;
- ✓ Concentrations as low as 0.1 ppm cause lung irritation and measurable decreases in lung function in asthmatics;
- ✓ Long-term lower-level exposures can destroy lung tissue, leading to emphysema;
- ✓ Children may also be especially sensitive to the effects of nitrogen oxides.

#### ❖ **Other Effects**

Oxides of nitrogen also can:

- ✓ Seriously injure vegetation at certain concentrations. Effects include:
  - Bleaching or killing plant tissue
  - Causing leaves to fall
  - Reducing growth rate
- ✓ Deteriorate fabrics and fade dyes;
- ✓ Corrode metals (due to nitrate salts formed from nitrogen oxides);
- ✓ Reduce visibility.

Oxides of nitrogen, in the presence of sunlight, can also react with hydrocarbons, forming photochemical oxidants. Also, NO<sub>x</sub> is a precursor to acidic precipitation, which may affect both terrestrial and aquatic ecosystems.

#### ❖ **Particulate Matter**

Amount of PM emission can be substantial from HFO plants, which is generally estimated as 1.50 g/kWH. With this level of emission, the emission from the plant will be 7.5gm/sec. As a non-attainment area for PM (Table 4.17), the addition of the present plant (i.e., 15 MW) would not make substantial difference to the PM levels as there are no other power plants in the air shed. So, PM issue has not been examined in detail as it is small compared to the cumulative PM emission in the air shed. Moreover, the project will use the exhaust temperature in the exhaust gas boiler to reuse the heat in the preheating of the HFO which will also bring down the PM concentration significantly.

## ❖ **Carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>) Emissions from the Proposed Plant**

Carbon monoxide is generated when incomplete combustion takes place. The emission of carbon dioxide depends on the fuel burn and the carbon content in the fuel. The proposed power station is a Heavy Furnace Oil fired modern design with optimum designed cycle efficiency in order to maximize the MW output and less consumption of fuel and water, CO & CO<sub>2</sub> emission per unit of fuel burnt will be smaller amount compare to other power stations. The ambient CO level is low (Table 4.17) and compression ignition engines use excess air for combustion. So, CO emission is low and it no mitigation is required.

### **Mitigation Measures**

#### **A. Engine Emission**

##### **i. SO<sub>2</sub> Emission**

The emissions of SO<sub>2</sub> are dependent on the sulfur content of the fuel. The project authority will use HFO with approximated sulfur content of less than 3% which is below the allowable limit of IFC/WB Environmental Health & Safety Guideline 2008, is 3% or less Sulfur content for the SO<sub>2</sub> emission of liquid fuel oil power plant in non-degraded air shed. There is no standard set in the Bangladesh ECR 1997 for the SO<sub>2</sub> emission for the liquid fuel fired power station. So, we should consider the standard of IFC/WB guideline in this situation. The project will use the exhaust temperature in the exhaust gas boiler to reuse the heat in the preheating of the HFO which will bring down the exhaust temperature from 450 °C to 200 °C which also brings down the SO<sub>2</sub> concentration significantly.

##### **ii. NO<sub>x</sub> Emission**

The engine emission data from the HFO generator shows that NO<sub>x</sub> emission from each engine will be below 1450 mg/Nm<sup>3</sup> (15% O<sub>2</sub>), which is within the allowable limit of the IFC/WB guideline. NO<sub>x</sub> emission guideline for liquid fuel-fired reciprocating engine power plants located in non-degraded air shed is 1850 mg/Nm<sup>3</sup> (15%O<sub>2</sub>) as the compression ignition, bore size diameter is 480 mm (≥ 400 mm). There is no standard set in the Bangladesh ECR 1997 for the NO<sub>x</sub> emission for the liquid fuel fired power station. So, we should consider the standard of IFC/WB in this situation. The ambient NO<sub>2</sub> level is low (Table 4.17) and considering small contribution to cumulative emission in the air shed, the NO<sub>x</sub> level is not expected to exceed the NAAQS. The project will use the exhaust temperature in the exhaust gas boiler to reuse the heat in the preheating of the HFO which will bring down the exhaust temperature from 450 °C to 200 °C which also bring down the NO<sub>x</sub> concentration significantly.

#### **B. Ambient Air Quality**

An effect on ambient air quality has been assessed based on air emission dispersion modeling. In this study, the SO<sub>2</sub> and NO<sub>x</sub> emissions for the reciprocating HFO engine system discharged through stack were

modeled to obtain maximum possible downward ground concentration. USEPA AERMOD view version 10.0.1 model was used to estimate emission concentration from the plant. The exhaust specifications and stack parameters for the proposed reciprocating HFO engine are used as input to AERMOD model. The individual engine stack data was used as point source of SO<sub>2</sub> & NO<sub>x</sub> emissions and the results are the summation of 2 emission sources. The parameters and corresponding values are summarized in the **Table 6.1** below:

**Table 6.1: Summary of the exhaust specifications and model input data**

Parameters	Values
Stack height	50 m
Stack inside diameter	710 mm (Exhaust pipe diameter)
Number of stacks	2
Stack exit velocity	7.146 m/s
Exhaust temperature	473.15 K
Exhaust flow rate	21.4 TPH after turbocharger
NO <sub>x</sub> emission rate as NO <sub>2</sub>	1450 mg/Nm <sup>3</sup> (100% Capacity)
SO <sub>2</sub> emission rate	1130 mg/Nm <sup>3</sup> (100% Capacity)

The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO<sub>x</sub> and SO<sub>2</sub> concentration contour have been analyzed with 1000 m interval with a radius of 10000m from the point source.

**i. NO<sub>2</sub> concentration:**

The NO<sub>2</sub> concentration contour of 24 hour and annual average of stacks have been analyzed. The maximum of 24 hours concentration of NO<sub>x</sub> has been predicted 3-5 µg/m<sup>3</sup> at a radius of 2-3 km north and 3-4 km west, whereas the concentrations is within 3-0.5 µg/m<sup>3</sup> at other sides from 3km to 10 km around the project site. The maximum annual concentration of NO<sub>x</sub> has been detected as 2-0.90 µg/m<sup>3</sup> at around 2-3 km west to the project site. The concentrations have been detected within 0.20-.020 µg/m<sup>3</sup> on either side beyond this radius up to 10 km.

There is no IFC/WHO and Bangladesh standard set for 24 hours concentration for NO<sub>x</sub>. The maximum yearly concentration of NO<sub>x</sub> has been detected (below 3 µg/m<sup>3</sup>) well below the IFC/WHO (40 µg/m<sup>3</sup>) and Bangladesh standard (100 µg/m<sup>3</sup>) at all sides at any radius around the project.

**ii. SO<sub>2</sub> concentration:**

The SO<sub>2</sub> concentration contour of 24 hour and annual average of stacks have been analyzed. The maximum of 24 hours concentration of SO<sub>2</sub> (3-7 µg/m<sup>3</sup>) has been predicted at a radius of 3 km west and 1 km north, whereas the concentrations are within 1-0.50 µg/m<sup>3</sup> at the other sides of the project up to 10 km radius

to the project site. The maximum annual concentration of SO<sub>2</sub> has been detected as 0.50-0.30 µg/m<sup>3</sup> at around 3 km west and 1 km north to the project site. The concentration has been found below 0.10– 0.02 µg/m<sup>3</sup> on either side of the project beyond this radius up to 10 km radius.

There is no IFC/WHO annual standard set for SO<sub>2</sub> for ambient air quality. The 24-hour concentration of SO<sub>2</sub> have been found (3-7 µg/m<sup>3</sup>) below the 24-hour standard of IFC/WHO standard (20 µg/m<sup>3</sup>), 24-hour (365 µg/m<sup>3</sup>) Bangladesh standard. The maximum annual concentration of SO<sub>2</sub> has been detected as 0.50-0.30 µg/m<sup>3</sup> which is also below the annual (80 µg/m<sup>3</sup>) Bangladesh standard at all sides of the project.

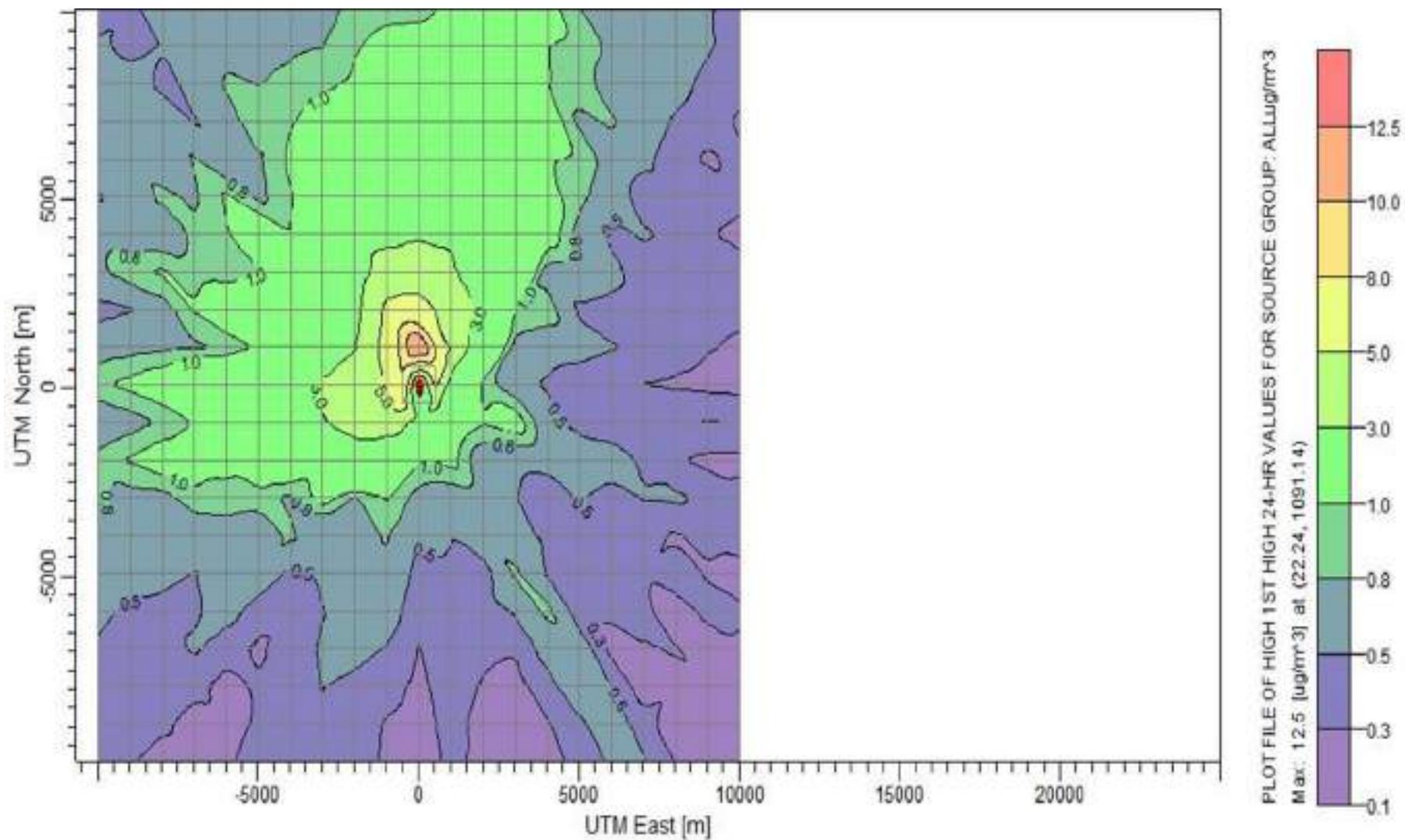


Figure 6.1: Emission contour map showing the NO<sub>2</sub> concentration (24-hour average) at 10km radius of the project location

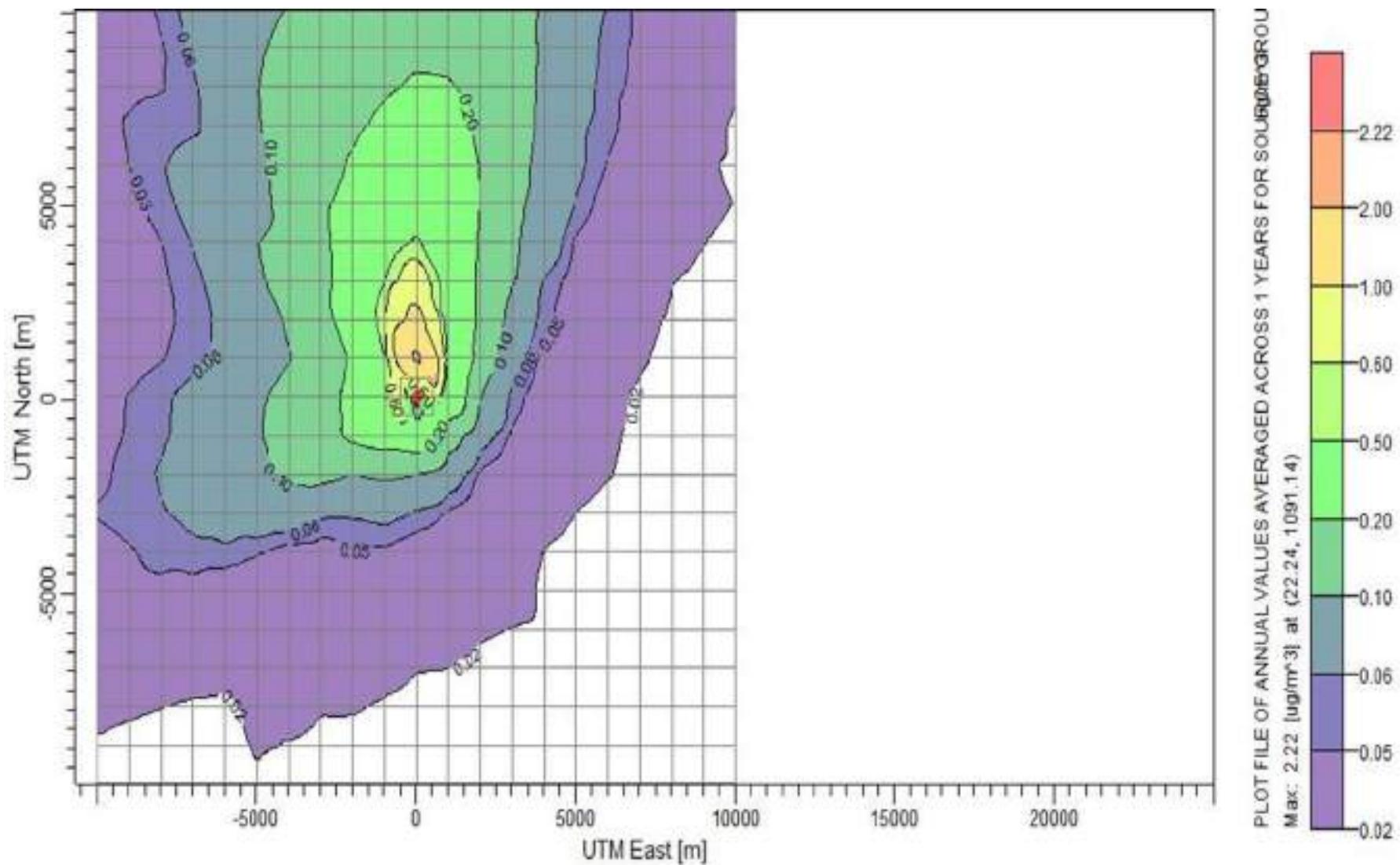


Figure 6.2: Emission contour map showing the NO<sub>2</sub> concentration (Annual average) at 10km radius of the project location

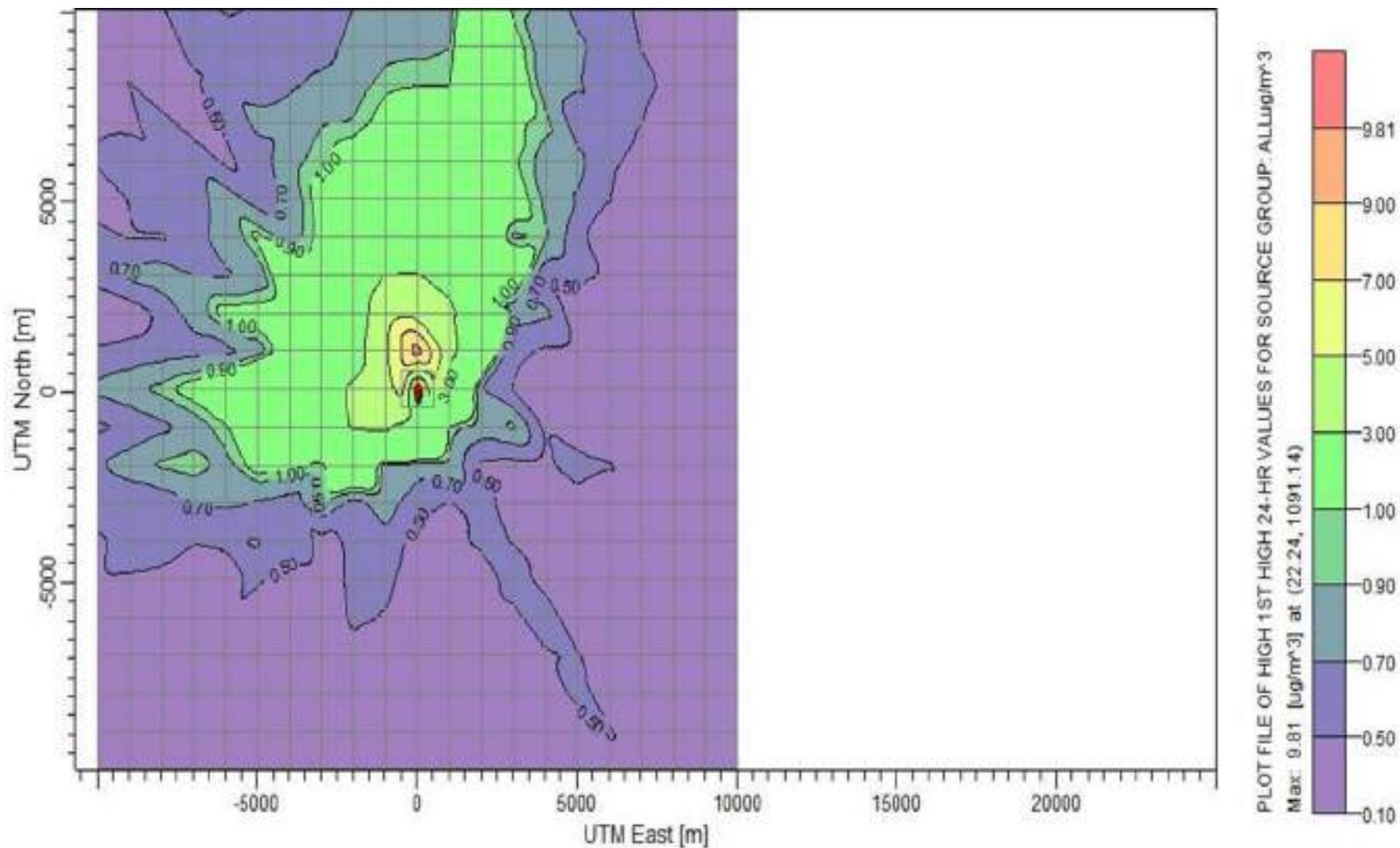


Figure 6.3: Emission contour map showing the SO<sub>2</sub> concentration (24-hour average) at 10km radius of the project location

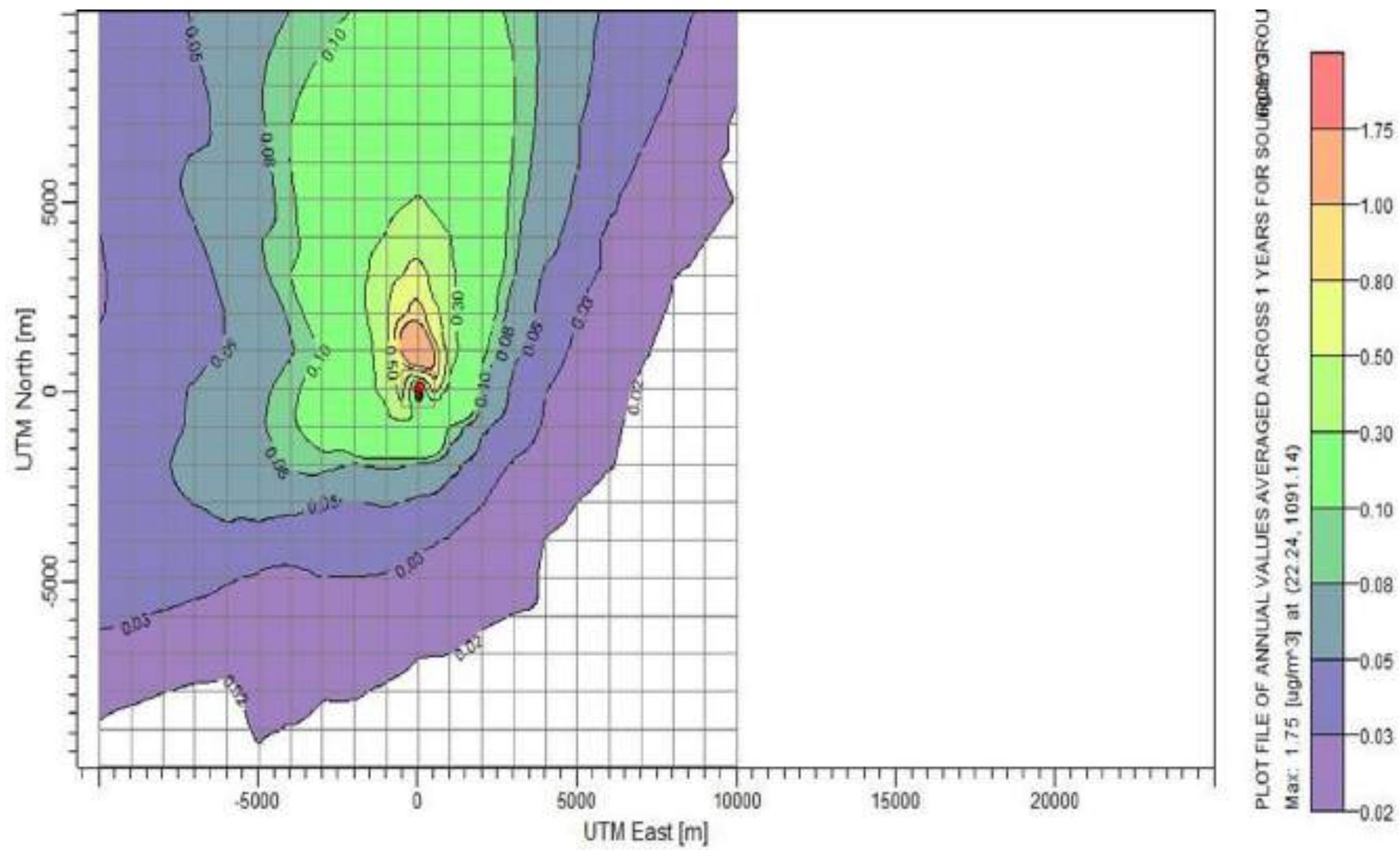


Figure 6.4: Emission contour map showing the SO<sub>2</sub> concentration (Annual average) at 10km radius of the project location

From the Table 4.17, it is evident that the area falls under non degraded air shed (IFC/WB definition) and after taking all above mitigation measures, the Desh Energy Hatiya Power Company Ltd. will contribute very negligible amount of air emission (NO<sub>x</sub>, SO<sub>2</sub>& PM) to the surrounding pollution comparing to the air existing emission source in the study area. For the well dispersion of the hot air from the generator, the project authority will construct 50m high stack from the ground level. The stack heights have been designed to facilitate undisturbed and free dispersion of the emitted air pollutants. Exhaust gas sample extraction facilities shall be installed for emission monitoring on each stack.

### **C. Mitigation Measures for other issues**

- ✓ Implementation of a regular watering and sprinkling for dust suppression regime should be followed, in particular during the dry season;
- ✓ Covering of any aggregate or dusty material or storage piles should be maintained to reduce dust emissions;
- ✓ All vehicles of power plant should have updated fitness license;
- ✓ Fit vehicles with appropriate exhaust systems and emission control devices;
- ✓ Limit the idling time of vehicles not more than 2 minutes.

### **6.4.2 Noise Hazard**

The sound of the exhaust system is one of the most significant environmental noise components of a power plant. Noises that originated from the equipment, if reach a decibel level of 85 can cause permanent damage to the hearing cells in the inner ear, leading to hearing loss to workers and neighbors. Exposure to loud noise can also cause high blood pressure, heart disease, sleep disturbances, and stress. if proper noise mitigation measures are not taken, the noise emission from the engines and exhausts will generate an unacceptably high noise levels in the surrounding environment.

#### **A. Engine room noise**

The generator room will have internal noise level of around 108dBA at 1m distance from the reciprocating engines and generators as Desh Energy will use dual turbocharged system engine which will be minimized by sophisticated acoustic power house building design so as to minimize the noise emission up to standard.

#### **B. External noise emission**

The individual reciprocating engine stack will emit a noise level of 72dBA after providing the silencer (36 dBA abatement).

### **Mitigation Measures**

#### **A. Engine room noise abatement**

Necessary noise abatement measures will be taken as required avoiding adverse noise & vibration impact on the neighborhood. In particular, significant noisy components such as the generators will be enclosed in buildings acoustically designed, providing **Styrofoam filler in between hollow brick & acoustic block**

**walls both side** (sandwich type) of the Styrofoam filler around the power house building. Thick doors will be provided and holes which may create sound pollution will be sealed with sound proof materials. Vibration pad will also be used at the bed of all power generating units to prevent the vibration. The noise abatement capacity of the material which would be used for noise abatement for the engine room noise are as follows:

**Table 6.2: Absorb of noise by Styrofoam filter and brick wall**

Material	Thickness, mm	Approximated noise absorption capacity, dBA
Styrofoam (Acrylic -Poly-Methyl-Meta-Acrylate (PMMA)	100	90
Brick with or without plaster	150	40
	<b>Total</b>	130

It is estimated that the noise abatement measures of the power house building will be capable to absorb around 130dBA noise from the engine room, but the maximum engine room noise is around 108 dBA near the generators, which is lower enough to minimize the engine room noise by the acoustic enclosure and it is expected that the noise emission from the engine room would be within the limit. Moreover, engine anti vibration mounting will also be used at the bed of all power generation units to prevent the vibration.

#### **B. Other Mitigation Measures**

- ✓ All equipment and mechanical machineries shall have to be maintained in good working order;
- ✓ Noise level should be monitored at different selected location within power plant and nearest community as per the monitoring plan;
- ✓ To reduce the effect, Exhaust Gas silencers will be used in the stack which will keep the noise level within DoE limit;
- ✓ Mechanical parts with high noise potential i.e., rotating machinery, engines, fans etc. should be covered with acoustic hood, if possible;
- ✓ The project authority will have to optimize the plant layout in such way that the noise impact will be minimized;
- ✓ Proper and timely preventive maintenance of approach vehicles is to be adopted to reduce noise levels;
- ✓ Workers will use ear plugs while working where applicable;
- ✓ The machines will be acoustically designed to cause less noise pollution;
- ✓ Project boundary wall should be more than man height;
- ✓ The green belt should be of at least 3.5 m width consisting two rows of plantation with the gradual increase of height of plant from inside row to outside row.

#### **6.4.3 Impact on Soil Quality**

Potential impact on soil quality can arise due to:

- ✓ Accidental spillage of untreated effluent on the nearby land from the Plant may impact negatively,
- ✓ Accidental spillage of fuel & lubricant from storage facility or from transport vehicles may negatively impact;
- ✓ Operation of the power Plant, might cause the changes in local infrastructures. i.e. Construction and operation of different infrastructures would ultimately impact the surrounding agricultural land;
- ✓ Improper storage and disposal of sewage wastes, hazardous waste;
- ✓ Surface run-off from spillage area into nearby open land.

### **Proposed Mitigation Measures**

The following mitigation measures will be implemented:

- ✓ Spill control and management procedures at site;
- ✓ Hazardous waste should be carefully handled and disposed off;
- ✓ No liquid waste should be discharged without treatment;
- ✓ Municipal solid waste generated from the project site will be transferred to the designated disposal site in consultation with the Union Parishad;
- ✓ The operation of the power plant should be as such that it does not impact on land.

#### **6.4.4 Impact on Surface Water**

The potential impacts on local hydrology are principally those of altered patterns as a result of project activities. The project would affect natural drainage, surface and ground water quality if the operation activity will not be managed properly.

As per the process flow of the proposed project, there will not be any liquid discharge from the plant. The entire process has been designed considering the zero-discharge policy. Process water system is closed circuit system, so no discharge is required for any waste water. Oily water from steam heated vapor chamber, engine hall area, buffer tank, FOTP area and other processing area will be discharged through oily water drain line and will be vaporized in steam heater. Sludge generated from fuel treatment will be sold to vendors. For Lube oil, sludge will be stored in Sludge tank. This sludge then will be carried to market for sale to DoE approved vendors. Only domestic and sanitary waste water will be generated from the project site during operation phase. During operation phase there will be approximately 50 personnel working at power plant area. There will be septic tank along with soak pit for domestic and sanitary waste water. Layout of septic tank along with soak pit is given below:

#### **Mitigation Measures**

- ✓ Surface drainage shall be controlled to divert surface runoff away from the project area;
- ✓ Hazardous waste should be carefully handled and disposed off to avoid surface runoff or mixing with waterbody;

- ✓ Empty areas should be restored/re-vegetated as soon as practicable;
- ✓ Stockpiling of solid waste at a safe distance from the drainage system;
- ✓ Strict supervision should be maintained to avoid blockage of natural creeks during the operation period, and;
- ✓ Sanitary waste should be adequately disposed of to avoid surface and ground water contamination.

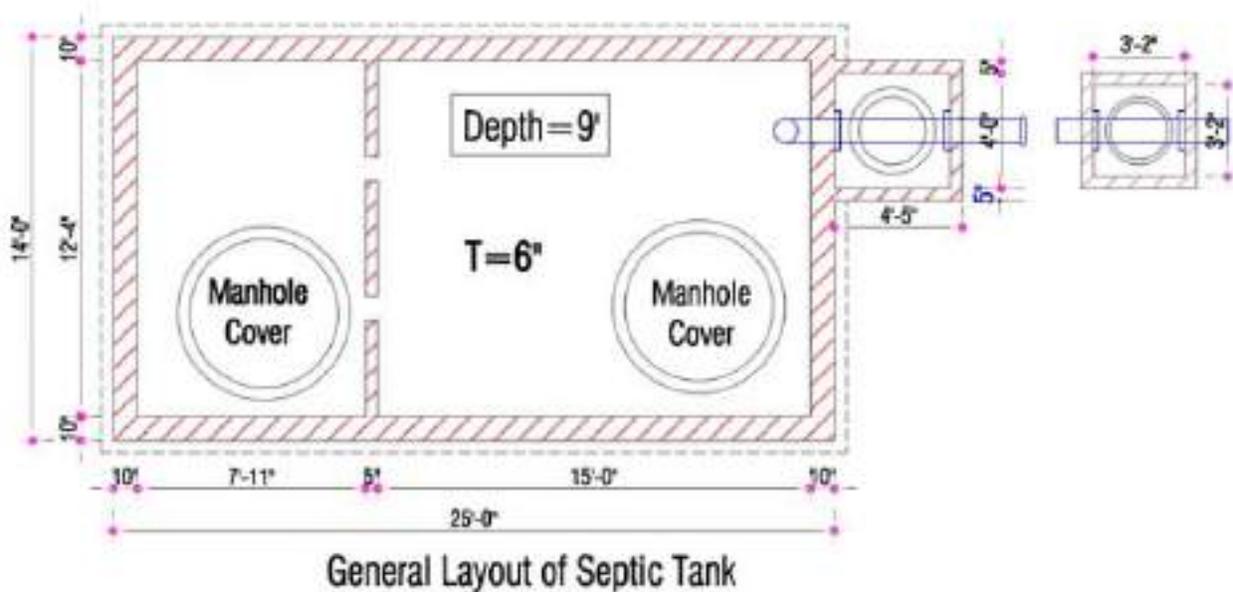


Figure 6.5: General Layout of Septic tank and Soak Pit

**Adequacy of Septic Tank:**

Total Manpower P = 50 Persons

Waste water Q = 0.1 m<sup>3</sup>

Amount of waste water (PQ) = 50 x 0.1 = 5 m<sup>3</sup>/day

**Sedimentation:**

Minimum Mean Hydraulic retention time,

$$T_h = 1.5 - 0.3 \log(PQ)$$

$$= 1.5 - 0.3 \log(50 \times 100) = 0.4 \text{ days.}$$

**The volume required for sedimentation is given by:**

$$V_h = 10^{-3} \times (\text{Persons} \times \text{requirements}) T_h$$

$$= 10^{-3} \times (50 \times 100) \times 0.2234 = 20 \text{ m}^3$$

**Sludge Digestion:**

Assuming a design temperature T = 25°C

$$T_d = 30(1.035)^{35-T}$$
$$= 30(1.035)^{35-20} = 50 \text{ Days}$$

**Volume required for sludge digestion:**

$$V_d = 0.5 \times 10^{-3} \times P T_d$$
$$= 0.5 \times 10^{-3} \times 50 \times 50 = 12.5 \text{ m}^3$$

**Sludge Storage:**

Assuming Sludge accumulation rate:  $C=0.04 \text{ m}^3$  per person year

$$V_{st} = CPN = 0.04 \times 50 \times 1 = 2 \text{ m}^3$$

**Overall Effective Tank Volume:**

$$V = V_h + V_d + 1.4V_{st}$$
$$= 20 + 12.5 + (1.4 \times 2) = 35.3 \text{ m}^3$$

**Existing Septic tank Size:**

Length-7.6m

Width-4.2m

Height-2.7m

$$\text{Volume} = 7.6 \times 4.2 \times 2.7 \text{ m}^3$$
$$= 86.18 \text{ m}^3 > 35.3 \text{ m}^3$$

So, the septic tank design is satisfactory.

### 6.4.5 Impact on Ground Water

Continuous discharge of industrial effluents, domestic sewage, waste dump and over exploitation of the resource have badly impact on ground water sustainability. Over utilization of ground water is the key factor for ground water depletion but there are other factors which have negative impact on ground water sustainability. The most important impact of groundwater depletion is loss of base flow; other impacts being severe crisis of safe drinking water and irrigated water. Total water demand is  $4.0 \text{ m}^3/\text{hr}$  during operation phase which is a very small amount of water to have major impact on ground water quality.

### Mitigation Measures

- ✓ Minimize the extraction and proper management of ground water should be strictly followed;
- ✓ Storage of hazardous material and waste in proper manner and disposal of the waste at a designated location around the site;
- ✓ All hazardous materials will be provided in a secondary containment;
- ✓ Sanitary waste should be disposed through sewage treatment system to avoid ground water contamination;
- ✓ Regular inspections of machinery, equipment, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring;

- ✓ Periodic monitoring of groundwater to detect any contamination;
- ✓ 3R (Reduce, Reuse, Recycle) policy of Government should be followed and the power plant should implement the 3R plan which will be submitted to DoE.

#### **6.4.6 Impact due to Solid Waste**

##### **• Domestic and Kitchen waste**

As a result of the operation of the proposed project, it is expected that some solid waste will be generated. Some food waste, plastic, papers, cartons, metal or plastic binders, etc. may be produced as solid waste during this stage. Improper disposal of papers, tissues, packaging materials, boxes, plastics can lead to littering in the project and surrounding areas. Kitchen waste will be produced as well as sanitary waste will also be produced.

##### **• Office waste**

The operation of the power plant itself would generate some solid wastes i.e., paper, cartoons, bags, boxes, office wastes, pallets etc. Therefore, improper waste sanitization and disposal can cause public health risks due to environmental pollution.

#### **Mitigation Measures**

- ✓ All solid waste will be segregated properly;
- ✓ Some solid waste has secondary demand and they should be sold to the secondary dealers. Other solid wastes will be disposed to the designated landfill area;
- ✓ Municipal solid waste generated from the project site will be transferred to the disposal site in consultation with the Union Parishad;
- ✓ Difficult to dispose wastes (plastic wastes) will be minimized and where practicable avoided such as plastic wastes;
- ✓ All type of solid waste which will be sold or disposed to the disposal site should have proper movement register from the site for waste transfer.
- ✓ The project authority should undertake waste segregation at source to separate hazardous waste from non-hazardous waste;
- ✓ All type of solid waste which will be sold or disposed to the disposal site should have proper movement register from the site for waste transfer.

#### **6.4.7 Hazardous Material Management**

##### **• HFO sludge, Spent Lubricating Oil and Others**

Special wastes such as hazardous waste, industrial solvents and other chemical wastes, and used oil, will be generated during the operational phases of the proposed project. A major operational concern of any oil & chemicals transfer operation is the control, containment and efficient cleanup of any discharges or

spills during transfer. The spillage or accidental escaping of hazardous substances into the surrounding environment can be a potentially devastating, damaging and deadly occurrence for all living creatures and organisms, including humans. When released into the atmosphere or finding its way into watercourses such as streams or rivers, these contaminants can travel and adversely affect great areas, and subsequently, a large number of life forms.

The proposed project will be operated by HFO, so, there is HFO preheating and treatment system in the project before feeding the HFO to the engine. This will end up with some sludge & oily water. This sludge is of great demand in market and will be sold to the DoE approved vendors. Moreover, the project will use lubricating oil in the engine operating & cooling system from where insignificant amount of used lubricating oil would be generated from the plant. For Lube oil, sludge will be stored in sealed Sludge tank and later it will be sold directly to the DoE approved vendors. Spent lubricating oil and used oil filters will be sold to the DoE approved vendors. Oily water from steam heated vapor chamber, engine hall area, buffer tank, FOTP area and other processing area will be discharged through oily water drain line and will be vaporized in steam heater. This sludge then will be carried to market for sale to DoE approved vendors.

### **Mitigation Measure**

- ✓ The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility for storage tank;
- ✓ An appropriate storage site should be provided for disassembled spare parts (e.g., motors and compressors) that contain oil or other types of fluids. They should be stored in containers that are secured that will not allow oil and other fluids to escape with an impermeable surface and a sealed drainage system;
- ✓ All the valves and possible places of fuel leakage should be regularly checked to prevent any leakage;
- ✓ Components should be segregated having regard to their eventual destinations and the compatibility of the component types;
- ✓ Oil Sludge, spent lubricating oil will be sold only to those vendors who have approval from DoE;
- ✓ Residual filtrate or jute cotton for wiping fuel oils should be incinerated;
- ✓ Skilled labors should be appointed for the unloading work;
- ✓ In case of any spillage, it should be immediately acted up on. Spillage equipment i.e., safety goggles, gloves, PPE, disposal bags, containers, absorbent material, suction pump, boom skimmer etc. should be available at the site;
- ✓ Secondary containment for all hazardous liquid storage required;
- ✓ Regular inspections of machinery, equipment, pipe work, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring.

### **6.4.8 Traffic and Transportation**

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

- Trucks ferrying raw material (HFO, Lube oils etc.) to site;
- Trucks ferrying waste material (i.e., sludge, spent oil, kitchen waste etc.) from site; and
- Ferrying in of plant tools and equipment.

***Potential Negative Environmental Impacts Likely to Result from Increased Vehicular Traffic in the Area***

- ✓ Possible traffic congestion of local roads and lanes;
- ✓ Occasional experience of delays on the said local roads;
- ✓ Increased number of vehicles on local roads will result in increased wear and tear of local roads thus reducing lifespan of affected roads;
- ✓ Pedestrians and cyclists using local roads may face accidents on the said roads; and
- ✓ There will be an increase of exhaust emission from vehicles, which will pollute local atmospheric air.

Power plant fuel i.e., HFO will be transported through river route by Lighter vessel and will be collected from the existing jetty at Tamuruddin ghat. For inland transportation (Receiving station to power plant site) of fuel, Tanker truck will be used.

**Mitigation Measures**

The following measures will be adopted to mitigate possible negative impacts likely to result from increase in vehicular traffic in the area:

- ✓ Management to provide for adequate internal parking, for all vehicles coming to the plant premises;
- ✓ All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road;
- ✓ Restrict the transport of oversize loads;
- ✓ All tanker truck should have updated fitness certificate and regularly checked for any kind of leakage;
- ✓ Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions;
- ✓ Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc.;
- ✓ Marking of the roads, warning signs / lights, road signs to be clearly used.

**6.4.9 Sanitation Hazard & Drinking Water**

The health of the project personnel, workers and laborers could be impacted if arrangement of sanitation and drinking water is not ensured adequately and properly. During operation stage, workers and laborers generate human waste and other waste. These are the potential source for spread of diseases, as various

insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also.

### **Mitigation Measures**

- ✓ Project personnel and workers will follow appropriate means of waste removal and sanitation measures;
- ✓ All the employees should follow the safety protocol (i.e., Physical distancing, Face coverings, Gloves, Goggles & Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation;
- ✓ Adequate number of toilets and bathrooms for both male and female workers will be made;
- ✓ Proper disposal system of sewage waste will be implemented for sanitation purpose and the workers will be made aware to practice those facilities;
- ✓ There will be septic tank along with soak pit for sewage treatment and discharge;
- ✓ There will be enough arrangement for the supply of safe drinking water to the workers.

#### **6.4.10 Labor and Working Condition**

Working conditions and terms of employment examples are wages and benefits; wage deductions; hours of work; overtime arrangements and overtime compensation, breaks, rest days and leave for illness, maternity, vacation or holiday.

### **Mitigation Measures**

- ✓ The proponent will adopt and implement human resources policies and procedures as per the Labor Act, 2006;
- ✓ The proponent will not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements;
- ✓ Proponent should maintain standard salary, salary deductions; hours of work; overtime arrangements and overtime compensation;
- ✓ Leave for illness, maternity, vacation or holiday should also be maintained by the contractor
- ✓ Child labor and forced labor should strictly be prohibited;
- ✓ Discrimination between male and female labor should be avoided;
- ✓ The proponent will not employ forced labor, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty.

#### **6.4.11 Occupational Health and Safety**

The workers who work inside the project area will face occupational health hazards due to different operational processes. Safe and good occupational health status of the employees and workers is important for the persons working in the project area.

## **Mitigation Measures**

- ✓ The proponent will provide all kinds of treatment facilities and pay compensation according to Bangladesh Labor Act 2006;
- ✓ The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessities as per requirements;
- ✓ Provide adequate lighting in all workrooms;
- ✓ Material Safety Data Sheets (MSDS) for each chemical used should be available and readily accessible at the facility;
- ✓ A safety manual for storage and handling of Hazardous chemicals will be prepared and implemented;
- ✓ The staff will be trained for first-aid and firefighting procedures. The rescue team will support the first-aid and firefighting team;
- ✓ A first-aid center with the trained personnel;
- ✓ Train staff on how to prevent and manage incidences. This should involve proper handling of electricity, water etc. and sensitization on various modes of escape, conduct and responsibility during such incidences;
- ✓ Use signage to warn staff and/ or visitors of dangerous places. The signage must be visible and placed strategically;
- ✓ Pollution control measures would duly adopt if necessary, including noise and air pollution;
- ✓ Orient all staff on safe work practices and guidelines;
- ✓ Firefighting systems, such as sprinklers, portable extinguishers (appropriate to the flammable hazard in the area) and automated fire extinguishers will be provided at strategic locations with clear labelling of the extinguisher type;
- ✓ Firefighting system will be tested periodically;
- ✓ Develop evacuation procedures to handle emergency situations
- ✓ A near miss and accident reporting system will be followed and corrective measures shall be taken to avoid / minimize near miss incidents;
- ✓ Safety measures in the form of DO and Don't Do will be displayed at strategic locations;
- ✓ Safety audits will be conducted periodically as per the regulatory requirements;
- ✓ A Permit to enter the project area will be established to ensure that only authorized persons can entry to the site;
- ✓ Regular medical checkup would be done to ensure the soundness of health of employees and workers;
- ✓ An understanding has to be built with a local hospital for the emergency incident related to the worker's health;
- ✓ In addition, necessary steps to be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.

#### **6.4.12 Community Health and Safety**

The project manager will evaluate the risks and impacts to the health and safety of the Affected Communities during construction phase. Impact on Community Health, Safety and Security are possibility of occurring accidents and local people may come to contact of hazardous material related to the project.

##### **Mitigation Measures**

- ✓ Isolate local people from project area for safety purpose;
- ✓ Proper fencing should be done around the project site to control the movement of local people;
- ✓ All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road;
- ✓ Marking of the roads to be clearly done;
- ✓ Speed limit and proper sign board should be provided along the said road;
- ✓ Kitchen waste and sanitary waste should be properly handled and disposed to avoid outbreak of diseases.

#### **6.4.13 Impact on Terrestrial Habitat**

- ✓ Improper management of solid waste may adversely impact the fauna of that area, they may get affected or infected due to disposal of infectious waste;
- ✓ Fugitive emission from power plant operation may negatively impact terrestrial habitat;
- ✓ Pollutant and dust emission in the atmosphere may impact negatively to the terrestrial flora and fauna;
- ✓ NO<sub>2</sub> at higher level can damage plant cells and affect the metabolic process;
- ✓ Noise & vibration and Heat generated due to power plant operation may negatively impact terrestrial habitat like they may get scared;
- ✓ Illumination at night time for operation work may also hamper the eco-system.

##### **Mitigation Measures**

- ✓ Proper disposal and management of solid and liquid waste should be maintained;
- ✓ No waste should be dumped in adjacent natural water bodies or agricultural land during operation;
- ✓ Site should be kept clean;
- ✓ To avoid low transpiration rate of plants it is suggested to use sprinkle of waters in the roads and nearby area at 12-hour interval to reduce the rate of dust particulates which will be generated by vehicle movements;
- ✓ Piling of raw material at plant site should be done under strict supervision;
- ✓ Raw material, debris, solid waste and spent oil should be properly, stored and disposed off;
- ✓ Lights of the power plant area should install downwardly to avoid disturbance to the wildlife and birds;

- ✓ Plantation of local species in surrounding areas of the Project site;
- ✓ Greenbelt area should be built-up on at least 33% land as per the guideline of DoE.

There is mangrove forest area approx. 4 km and more away from project site. If the above-mentioned mitigation measures are implemented then it is expected that the impact on them will be negligible.

#### **6.4.14 Impact on Aquatic Habitat**

- ✓ Aquatic habitat would be affected due to discharge of water and disposal of solid waste into adjacent surface water body;
- ✓ If any hazardous waste is thrown to the surface water body, then it may greatly impact the aquatic flora and fauna;
- ✓ Runoff erosion from the project site may have negative impact on aquatic fauna.

The proposed project will not discharge any liquid waste as it follows a Zero discharge policy.

#### **Mitigation Measures**

- ✓ Specific procedures and necessary preparedness to contain any accidental spill at source and also to prevent their spread in the surrounding environment;
- ✓ Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off;
- ✓ Wastewater should not be disposed-off in the water bodies without proper treatment;
- ✓ There will be septic tank along with soak pit for sewage treatment.

There are few ponds and khals around the project area (approx. 25~30) within 5 km radial zone. The adjacent land area is predominantly agricultural type. If the above-mentioned mitigation measures are implemented then it is expected that the impact on aquatic habitat will be negligible.

#### **6.4.15 Social acceptability of workers to the host communities**

The differences in the cultures of workers (in case hiring is required) and local community may create some problems. In the rural area, the local people especially the religiously conservative section of the community will not accept the foreign workers in general.

#### **Mitigation Measures**

The project authority has practice of working with the workers of different cultures. Adequate training or awareness would be done to the migratory workers about local culture and behavior. So, there may be no major problem raising in dealing with foreign or migratory workers.

#### **6.4.16 Employment Generation**

One of the main positive impacts during the operation phase will be the availability of employment opportunities. The increase in temporary and permanent jobs in staffs, engineers and officers would result in more transaction of money locally for purchasing of different goods and services. A number of local people will be engaged in project related activities and may have employment opportunity. Employment opportunities are of benefit both economically and in a social sense.

#### **Mitigation Measures**

- ✓ Encourage local and equitable employment;
- ✓ Salaries and other benefits based on qualification and experience;
- ✓ Priority given to local residents for both professional and nonprofessional positions.

#### **6.4.17 Social and Economic enhancement around project area**

After the implementation of this project, the economic condition of the area will be developed. The electricity connection of that island will be available and social livelihood of the people will be improved due to the implementation of this project. Apart from this, it includes benefit to local economy due to employment, community development etc.

#### **6.4.18 Indigenous People**

There is no existence of indigenous people within the vicinity of the project area. So, there is no impact in this regard.

#### **6.4.19 Cultural Heritage**

There is no cultural heritage site within the vicinity of the project area and no structure of national cultural heritage will be affected due to project development.

## **7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

### **7.1 General Considerations**

In the context of a project, Environmental Management Plan (EMP) is concerned with the implementation of the measures necessary to minimize and offset the adverse impacts and to enhance beneficial impacts. Unless the mitigation and benefit enhancement measures are identified in EIA and fully implemented, the prime function of the EIA cannot be achieved. Thus, the objectives of EMP for the present project are:

- ✓ Identification of monitoring requirements and Monitoring indicators;
- ✓ Mitigation measures to reduce or eliminate negative impacts; and
- ✓ Enhancement measures to maximize positive impacts.

### **7.2 Mitigation/Benefit Enhancement Measures**

For effective and environmentally friendly operation of a project, a set for guiding tools and suggestions are necessary which need to be followed at various stages of project installation, operation and maintenance. This plan generally has various components of management depending on the type of project activity and types of discharge and their pollution potential. The project authority may also be needed to expand the suggested outline of the EMP proposed in this report.

All beneficial and adverse impacts which may likely to occur at different phases of the project are identified and aspect of mitigation and benefit enhancement measures has also been discussed in section 6.0. In view of the earlier discussion summary of recommended mitigation and benefit enhancement measures, proposed EMP are presented in **Table 7.1**.

**Table 7.1: Recommended Management Plan**

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
<b>Pre-Construction Phase</b>					
<b>Land Acquisition and Involuntary Resettlement</b>	Within the project site	<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	Supervised by Desh Energy authority
<b>Disruption of Earth Surface</b>	Around the project site	<ul style="list-style-type: none"> <li>Regular sprinkling of water will be done on open surface and dust grounds.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Change in Landscape</b>	Within the project site	<ul style="list-style-type: none"> <li>Project should be designed considering key criteria of landscape;</li> <li>Altered green area can be turned into its original visual quality by plantation of trees.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Impact on Ecological Habitat</b>	Around the project site	<ul style="list-style-type: none"> <li>No waste should be dumped in water bodies;</li> <li>Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off;</li> <li>Re-vegetation should be done as soon as possible.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Solid Waste</b>	Around the project site	<ul style="list-style-type: none"> <li>Organize disposal of all wastes generated during pre-construction phase in the designated disposal sites approved by the Project authority;</li> <li>Waste should be properly segregated in different colored drums;</li> <li>No solid waste should be dumped in water bodies;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Difficult to dispose wastes will be minimized where practicable.</li> </ul>			
<b>Indigenous People</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Cultural Heritage</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Construction Phase</b>					
<b>Impact on Air Quality</b>	Around the project site	<ul style="list-style-type: none"> <li>Regular sprinkling of water will be done on open surface and dust grounds until paving was done;</li> <li>Transportation of materials in tarpaulin-covered trucks;</li> <li>The sand and other such dispersible material will be stored at site for minimum working period;</li> <li>Removal of soil/mud from trucks and other appliances prior to leaving the project area;</li> <li>Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses);</li> <li>Project management and contractor to enforce strict use of personal protective clothing of labors;</li> <li>Complains of dust related ailments among employees and neighbors to be given access to medical attention;</li> </ul>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>The equipment design will be chosen for least suspension of dust/sand into atmosphere;</li> <li>The construction activity will be carried out during day time only.</li> </ul>			
<b>Noise Hazard</b>	Around the project site	<ul style="list-style-type: none"> <li>Noisy construction works to be limited to day time hours;</li> <li>Proper Acoustically designed machinery should be used;</li> <li>Cutting pipes and other related works should be done in a safe zone;</li> <li>Immediate neighbors to be notified in writing on the date of commencement of construction work at one month in advance;</li> <li>All employees likely to be exposed to noise to be provide with ear protectors;</li> <li>Where applicable and possible exceptionally noisy machines to be fitted with noise reduction devices;</li> <li>Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor;</li> <li>Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A);</li> </ul>	Noise at different locations at day and night	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Workers should wear Personal Protective Equipment (PPE) for protecting them from the sound induced hazard;</li> <li>Noise protection wall or barrier should be constructed in case of long-term noisy construction.</li> </ul>			
<b>Impact on Soil Quality</b>		<ul style="list-style-type: none"> <li>Construct appropriate spill containment facilities for all fuel storage areas;</li> <li>Train personnel and implement safe work practices for minimizing the risk of spillage;</li> <li>Develop site specific waste management plan for various waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior construction work;</li> <li>Construction waste will be utilized for filling of Project site;</li> <li>Fuel, chemical and lubricant will be stored in paved storage areas;</li> <li>Properly stripping of top soil and conserve it for future use (greenbelt development);</li> <li>Municipal solid waste generated from the construction site will be transferred to the disposal site in consultation with the Union Parishad.</li> </ul>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Contractor	Supervised by Desh Energy authority
<b>Impact on Surface Water</b>	Near Project Site	<ul style="list-style-type: none"> <li>Surface drainage shall be controlled to divert surface runoff away from the construction area;</li> </ul>	Temperature, pH, TDS, TSS, DO, BOD, COD,	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Laying barrier net;</li> <li>Undertaking construction work during dry seasons;</li> <li>Completed areas should be restored/re-vegetated as soon as practicable;</li> <li>Temporary silt-trap or digging of pond toward siltation prevention;</li> <li>Stockpiling of spoil soil at a safe distance from the drainage system;</li> <li>Strict supervision should be maintained to avoid blockage of natural creeks during the construction period;</li> <li>Sanitary waste should be adequately disposed of to avoid surface and ground water contamination;</li> <li>Making provision for temporary storage of wastes inside construction yard and disposal of solid wastes in an appropriate manner and at appropriate site at regular interval;</li> <li>Adequate provision has to be retained for the treatment and disposal of cuttings, drilling fluids and other chemicals and lube oil wastes generated during drilling, testing and commissioning stage.</li> </ul>	Cd, Cr, Pb and Oil & grease		
<b>Impact on Ground Water</b>	Near Project Site	<ul style="list-style-type: none"> <li>Proper spill control and management at site;</li> </ul>	pH, TSS, TDS, Ammonia, Nitrate,	Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Storage of hazardous material and waste in proper manner and disposal of the waste at a designated location around the site;</li> <li>Minimize the extraction and proper management of ground water should be strictly followed;</li> <li>Regular inspections of machinery, equipment, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring;</li> <li>Periodic monitoring of groundwater to detect any contamination;</li> <li>Provision for treatment of waste water from labor camp, on site.</li> </ul>	Hardness, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform		
<b>Impact due to Solid Waste</b>	Around the project site	<ul style="list-style-type: none"> <li>Construction waste should be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses;</li> <li>The contractor should be committed to ensure construction materials left over at the end of construction will be used in other projects rather than being disposed off; some of the waste can be sold or donated or recycled/reused by construction companies, local community groups or institutions;</li> <li>Waste should be properly segregated in different colored drums;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Difficult to dispose wastes (plastic and hazardous waste) will be minimized and where practicable and avoided such as plastic wastes;</li> <li>• The contractor must dispose the wastes regularly at an approved refuse disposal site to ensure that waste does not build up on site and result in aesthetic impacts or odors;</li> <li>• Hazardous waste will not be mixed with other solid waste generated and should be managed by way of incineration or land-filling.</li> </ul>			
<b>Hazardous Materials Managements</b>	Around the project site	<ul style="list-style-type: none"> <li>• All hazardous materials will be provided in a secondary containment;</li> <li>• Spill kits should be available to contain any accidental release of hazardous material;</li> <li>• Skilled labors should be appointed for unloading the work;</li> <li>• In case of any spillage, it should be immediately acted up on. To combat spillage equipments i.e. safety goggles, gloves, PPE, disposal bags, containers, suction pump, boom skimmer etc. should be available at the site;</li> <li>• Regular inspections of machinery, equipment, pipe work, storage areas are</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		needed to ensure that poor maintenance is not responsible for a spillage occurring.			
<b>Traffic and Transportation</b>		<ul style="list-style-type: none"> <li>• Emphasizing on road safety aspects;</li> <li>• Licensed and trained drivers should be appointed;</li> <li>• Management to provide for adequate internal parking for all vehicles;</li> <li>• Avoid transportation of materials and machinery during the off-peak traffic periods;</li> <li>• Stick to agreed traffic routes, avoiding narrow routes;</li> <li>• Prevent unauthorized access to the construction site;</li> <li>• Implementation of a safety program (speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area;</li> <li>• All vehicles should have updated fitness certificate;</li> <li>• Regular maintenance of vehicles;</li> <li>• Speed limits, Proper signage, visibility and traffic awareness and pedestrian safety should be followed by the drivers.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Occupational Health and Safety</b>		<ul style="list-style-type: none"> <li>• The EPC contractor will provide all kinds of treatment facilities and pay compensation according to Bangladesh Labor Law 2006;</li> <li>• It is suggested that worker's health have to be checked regularly;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Emergency response policy of the EPC contractor/ Project authority should be followed;</li> <li>• All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor;</li> <li>• Necessary first aid facilities should be available at site;</li> <li>• Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order;</li> <li>• All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded;</li> <li>• All scaffolds will be erected and inspected and the appropriate records maintained by the Contractor;</li> <li>• Safety hoops or cages will be provided for ladders with a height in excess of two meters;</li> <li>• The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress;</li> <li>• Supervision of works shall be done regularly to ensure that safety conditions are met while</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work;</p> <ul style="list-style-type: none"> <li>• The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessities. So, there may not be major health hazard issue during the construction;</li> <li>• An understanding has to be built with a local hospital for the emergency incident related to the worker's health of the plant and EPC contractor/ Project Authority has to establish such health monitoring system of the workers shortly;</li> <li>• In addition, necessary steps to be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.</li> </ul>			
<b>Community and Safety</b>	<b>Health</b>	<ul style="list-style-type: none"> <li>• Water sprinkling on the access roads and at the construction sites would reduce dust emissions considerably;</li> <li>• To reduce noise related impacts, night time movement of vehicles and construction activities will be restricted;</li> <li>• Pre-employment health check-up for construction workers;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Isolate local people from project area for safety purpose;</li> <li>Construction camps equipped with proper sanitation facilities and regular pest control (i.e., to pest control for mosquitos or other insects for housing workers / labors);</li> <li>Proper fencing should be done around the project site to control the movement of local people;</li> <li>All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road.</li> </ul>			
<b>Sanitation Hazard and Drinking Water</b>		<ul style="list-style-type: none"> <li>Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured;</li> <li>Contractors and workers should obey appropriate means of waste removal and sanitation measures;</li> <li>All the labors should follow the safety protocol (i.e., Physical distancing, Face coverings, Gloves, Goggles &amp; Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Adequate number of portable toilets and bathrooms should be made for the workers;</li> <li>• Proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities;</li> <li>• Male and female toilets should be isolated as per requirement;</li> <li>• There will be enough arrangement for the supply of safe drinking water to the workers.</li> </ul>			
<b>Labor and Working Condition</b>	Project area	<ul style="list-style-type: none"> <li>• Contractor should maintain standard wage, wage deductions; hours of work; overtime arrangements and overtime compensation;</li> <li>• Leave for illness, maternity, vacation or holiday should also be maintained by the contractor;</li> <li>• Child labor and forced labor should strictly be avoided;</li> <li>• Temporary labor camp should be made for labors;</li> <li>• Discrimination between male and female labors should be prohibited.</li> </ul>		Contractor	Supervised by Desh Energy authority
<b>Terrestrial Habitat</b>	Around the project site	<ul style="list-style-type: none"> <li>• Plantation of local species in surrounding areas of the Project site;</li> <li>• Bare surfaces should be grassed as soon as possible after construction to minimize time of exposure;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Only locally occurring, indigenous grasses should be used;</li> <li>• The construction area and immediate surroundings should be monitored regularly for emergent invasive vegetation;</li> <li>• Water sprinkling for dust suppression;</li> <li>• Lights of the construction area should install downwardly to avoid disturbance to the wildlife and birds;</li> <li>• Avoid working at night time.</li> </ul>			
<b>Aquatic habitat</b>		<ul style="list-style-type: none"> <li>• Wastewater from labor camp and construction site should not be disposed-off in natural water bodies;</li> <li>• Proper disposal and management of construction waste;</li> <li>• No solid, liquid or hazardous waste should be dumped in water bodies during construction;</li> <li>• septic tank along with soak wells should be provided to dispose-off the wastewater from construction camp;</li> <li>• Excavation activities should not be undertaken during monsoon season;</li> <li>• Piling of raw material at construction site should be avoided;</li> <li>• Raw material, debris and fuel should be stored on paved surfaces under covered areas;</li> </ul>		Contractor	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off.</li> </ul>			
<b>Employment Generation</b>		<ul style="list-style-type: none"> <li>Service and materials for construction will be to the extent possible locally sourced;</li> <li>Prioritization of employment of skilled and non-skilled workers from the local communities;</li> <li>Priority given to local residents for both professional and nonprofessional positions;</li> <li>In order to increase the size of local employment, women should also be employed in the construction phase.</li> </ul>		-	Supervised by Desh Energy authority
<b>Social acceptability of workers</b>	Around the project site	<ul style="list-style-type: none"> <li>The project proponent and the contractor have practice of working with the workers of different cultures;</li> <li>It is recommended to aware the foreign workers (if any) about the social &amp; religious actability in the area so that they could maintain those when they are in touch with local community.</li> </ul>		-	Supervised by Desh Energy authority
<b>Increase in local business</b>		<ul style="list-style-type: none"> <li>Service and materials for construction will be to the extent possible locally sourced;</li> <li>Priority given to local residents for both professional and nonprofessional positions;</li> <li>Encourage local people with small-scale business plans.</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
<b>Indigenous People</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Cultural Heritage</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Operation Phase</b>					
<b>Impact on Air quality</b>	Around the project site	<ul style="list-style-type: none"> <li>Installation of the Best Available Control Technology (BACT) to minimize air emission;</li> <li>The SO<sub>2</sub>, NO<sub>x</sub> emission from the power plant would be kept at a minimum level with optimum designed cycle efficiency in order to maximize the MW output;</li> <li>Stack of 50m height will be used;</li> <li>Implementation of a regular watering and sprinkling for dust suppression;</li> <li>Covering of any aggregate or dusty material or storage piles should be maintained to reduce dust emissions.</li> </ul>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Project proponent	Supervised by Desh Energy authority
<b>Noise Hazard</b>	Around the project site	<ul style="list-style-type: none"> <li>All equipment and mechanical machineries shall have to be maintained in good working order;</li> <li>Noise level should be monitored at different selected location within power plant and nearest community as per the monitoring plan;</li> <li>To reduce the effect, Exhaust Gas silencers will be used in the stack which will keep the noise level within DoE limit;</li> <li>Mechanical parts with high noise potential i.e., rotating machinery, engines, fans etc.</li> </ul>	Noise at different locations at day and night	Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>should be covered with acoustic hood, if possible;</p> <ul style="list-style-type: none"> <li>• The project authority will have to optimize the plant layout in such way that the noise impact will be minimized;</li> <li>• The power house building would be constructed by double insulated casing;</li> <li>• Thick doors will be provided and holes which may create sound pollution will be sealed with sound proof materials;</li> <li>• Vibration pad will also be used at the bed of all power generation units to prevent the vibration;</li> <li>• Proper and timely preventive maintenance of approach vehicles is to be adopted to reduce noise levels;</li> <li>• Workers will use ear plugs while working where applicable;</li> <li>• The machines will be acoustically designed to cause less noise pollution;</li> <li>• Project boundary wall should be more than man height;</li> <li>• The green belt should be of at least 3.5 m width consisting two rows of plantation with the gradual increase of height of plant from inside row to outside row.</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
<b>Impact on Soil Quality</b>	Near the project site	<ul style="list-style-type: none"> <li>Spill control and management procedures at site;</li> <li>Hazardous waste should be carefully handled and disposed off;</li> <li>No liquid waste should be discharged without treatment;</li> <li>Municipal solid waste generated from the project site will be transferred to the designated disposal site in consultation with the Union Parishad;</li> <li>The operation of the power plant should be as such that it does not impact on land.</li> </ul>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Project proponent Project proponent	Supervised by Desh Energy authority
<b>Impact on Surface Water</b>	Around the project site	<ul style="list-style-type: none"> <li>Surface drainage shall be controlled to divert surface runoff away from the project area;</li> <li>Hazardous waste should be carefully handled and disposed off to avoid surface runoff or mixing with waterbody;</li> <li>Empty areas should be restored/re-vegetated as soon as practicable;</li> <li>Stockpiling of solid waste at a safe distance from the drainage system;</li> <li>Strict supervision should be maintained to avoid blockage of natural creeks during the operation period, and;</li> </ul>	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Sanitary waste should be adequately disposed of to avoid surface and ground water contamination.</li> </ul>			
<b>Impact on Ground Water</b>	Around the project site	<ul style="list-style-type: none"> <li>Minimize the extraction and proper management of ground water should be strictly followed;</li> <li>Storage of hazardous material and waste in proper manner and disposal of the waste at a designated location around the site;</li> <li>All hazardous materials will be provided in a secondary containment;</li> <li>Sanitary waste should be disposed through sewage treatment system to avoid ground water contamination;</li> <li>Regular inspections of machinery, equipment, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring</li> <li>Periodic monitoring of groundwater to detect any contamination;</li> <li>3R (Reduce, Reuse, Recycle) policy of Government should be followed and the power plant should implement the 3R plan which will be submitted to DoE.</li> </ul>	pH, TSS, TDS, Ammonia, Hardness, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform	Project proponent	Supervised by Desh Energy authority
<b>Impact due to Solid Waste</b>	Around the project site	<ul style="list-style-type: none"> <li>All solid waste will be segregated properly;</li> <li>Some solid waste has secondary demand and they should be sold to the secondary dealers.</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>Other solid wastes will be disposed to the designated landfill area;</p> <ul style="list-style-type: none"> <li>• Municipal solid waste generated from the project site will be transferred to the disposal site in consultation with the Union Parishad;</li> <li>• Difficult to dispose wastes (plastic wastes) will be minimized and where practicable avoided such as plastic wastes;</li> <li>• All type of solid waste which will be sold or disposed to the disposal site should have proper movement register from the site for waste transfer.</li> <li>• The project authority should undertake waste segregation at source to separate hazardous from non-hazardous waste;</li> <li>• All type of solid waste which will sold or disposed to the disposal site should have proper movement register from the site for waste transfer.</li> </ul>			
<b>Hazardous Material Management; Impact due to HFO and Lubricating Oil</b>	Around the project site	<ul style="list-style-type: none"> <li>• The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility;</li> <li>• An appropriate storage site should be provided for disassembled spare parts (e.g. motors and compressors) that contain oil or other types of fluids. They should be stored in containers that are secured that will not allow</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>oil and other fluids to escape with an impermeable surface and a sealed drainage system;</p> <ul style="list-style-type: none"> <li>• Components should be segregated having regard to their eventual destinations and the compatibility of the component types;</li> <li>• Oil Sludge, spent lubricating oil will be sold only to those vendors who have approval from DoE;</li> <li>• Skilled labors should be appointed for the unloading work;</li> <li>• In case of any spillage, it should be immediately acted up on. Spillage equipment i.e. safety goggles, gloves, PPE, disposal bags, containers, absorbent material, suction pump, boom skimmer etc. should be available at the site;</li> <li>• Secondary containment for all hazardous liquid storage required;</li> <li>• Regular inspections of machinery, equipment, pipe work, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring.</li> </ul>			
<b>Traffic and Transportation</b>		<ul style="list-style-type: none"> <li>• Management to provide for adequate internal parking, for all vehicles coming to the plant premises;</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road;</li> <li>• Restrict truck deliveries, where practicable, to day time working hours;</li> <li>• Restrict the transport of oversize loads;</li> <li>• All tanker truck should have updated fitness certificate and regularly checked for any kind of leakage;</li> <li>• Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions;</li> <li>• Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc.;</li> <li>• Marking of the roads, warning signs / lights, road signs to be clearly used.</li> </ul>			
<b>Terrestrial Habitat</b>		<ul style="list-style-type: none"> <li>• Proper disposal and management of solid and liquid waste should be maintained;</li> <li>• No waste should be dumped in adjacent natural water bodies or agricultural land during operation;</li> <li>• Site should be kept clean;</li> <li>• To avoid low transpiration rate of plants it is suggested to use sprinkle of waters in the roads and nearby area at 12-hour interval to</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>reduce the rate of dust particulates which will be generated by vehicle movements;</p> <ul style="list-style-type: none"> <li>• Piling of raw material at plant site should be done under strict supervision;</li> <li>• Raw material, debris, solid waste and spent oil should be properly, stored and disposed off;</li> <li>• Lights of the power plant area should install downwardly to avoid disturbance to the wildlife and birds;</li> <li>• Plantation of local species in surrounding areas of the Project site;</li> <li>• Greenbelt area should be built-up on at least 33% land as per the guideline of DoE.</li> </ul>			
<b>Aquatic Habitat</b>		<ul style="list-style-type: none"> <li>• Specific procedures and necessary preparedness to contain any accidental spill at source and also to prevent their spread in the surrounding environment;</li> <li>• Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off;</li> <li>• Wastewater should not be disposed-off in the water bodies without proper treatment.</li> </ul>		Project proponent	Supervised by Desh Energy authority
<b>Sanitation Hazard and Drinking Water</b>		<ul style="list-style-type: none"> <li>• Project personnel and workers will follow appropriate means of waste removal and sanitation measures;</li> <li>• All the employees should follow the safety protocol (i.e., Physical distancing, Face</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<p>coverings, Gloves, Goggles &amp; Face Shields, Hand hygiene, Coughing/Sneezing hygiene, Personal disinfection, request for cleaning supplies and Face coverings to others) due to the Covid situation;</p> <ul style="list-style-type: none"> <li>• Adequate number of toilets and bathrooms for both male and female workers will be made;</li> <li>• Proper disposal system of sewage waste will be implemented for sanitation purpose and the workers will be made aware to practice those facilities;</li> <li>• There will be enough arrangement for the supply of safe drinking water to the workers.</li> </ul>			
<b>Occupational Health &amp; Safety</b>		<ul style="list-style-type: none"> <li>• The proponent will provide all kinds of treatment facilities and pay compensation according to Bangladesh Labor Act 2006;</li> <li>• The workers should wear PPE (Personal Protective Equipment), safety goggles, and other necessities as per requirements;</li> <li>• Provide adequate lighting in all workrooms;</li> <li>• Material Safety Data Sheets (MSDS) for each chemical used should be available and readily accessible at the facility;</li> <li>• A safety manual for storage and handling of Hazardous chemicals will be prepared and implemented;</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• The staff will be trained for first-aid and firefighting procedures. The rescue team will support the first-aid and firefighting team;</li> <li>• A first-aid center with the trained personnel;</li> <li>• Train staff on how to prevent and manage incidences. This should involve proper handling of electricity, water etc. and sensitization on various modes of escape, conduct and responsibility during such incidences;</li> <li>• Use signage to warn staff and/ or visitors of dangerous places. The signage must be visible and placed strategically;</li> <li>• Pollution control measures would duly adopt if necessary, including noise and air pollution;</li> <li>• Orient all staff on safe work practices and guidelines;</li> <li>• Firefighting systems, such as sprinklers, portable extinguishers (appropriate to the flammable hazard in the area) and automated fire extinguishers will be provided at strategic locations with clear labelling of the extinguisher type;</li> <li>• Firefighting system will be tested periodically;</li> </ul>			

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Develop evacuation procedures to handle emergency situations</li> <li>• A near miss and accident reporting system will be followed and corrective measures shall be taken to avoid / minimize near miss incidents;</li> <li>• Safety measures in the form of DO and Don't Do will be displayed at strategic locations;</li> <li>• Safety audits will be conducted periodically as per the regulatory requirements;</li> <li>• A Permit to enter the project area will be established to ensure that only authorized persons can entry to the site;</li> <li>• Regular medical checkup would be done to ensure the soundness of health of employees and workers;</li> <li>• An understanding has to be built with a local hospital for the emergency incident related to the worker's health;</li> <li>• In addition, necessary steps to be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.</li> </ul>			
<b>Community Health and Safety</b>		<ul style="list-style-type: none"> <li>• Isolate local people from project area for safety purpose;</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Proper fencing should be done around the project site to control the movement of local people;</li> <li>• All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road;</li> <li>• Marking of the roads to be clearly done;</li> <li>• Speed limit and proper sign board should be provided along the said road;</li> <li>• Kitchen waste and sanitary waste should be properly handled and disposed to avoid outbreak of diseases.</li> </ul>			
<b>Labor and Working Condition</b>	Around the project site	<ul style="list-style-type: none"> <li>• The proponent will adopt and implement human resources policies and procedures as per the Labor Act, 2006;</li> <li>• The proponent will not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements;</li> <li>• Proponent should maintain standard salary, salary deductions; hours of work; overtime arrangements and overtime compensation;</li> <li>• Leave for illness, maternity, vacation or holiday should also be maintained by the contractor</li> </ul>		Project proponent	Supervised by Desh Energy authority

Issues/aspects	Location	Management Plan	Key verifiable indicator	Responsibility	
				Implementation	Supervision
		<ul style="list-style-type: none"> <li>Child labor and forced labor should strictly be prohibited;</li> <li>Discrimination between male and female labor should be avoided;</li> <li>The proponent will not employ forced labor, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty.</li> </ul>			
<b>Social acceptability of workers to the host communities</b>		<ul style="list-style-type: none"> <li>The project authority has practice of working with the workers of different cultures;</li> <li>Adequate training or awareness would be done to the migratory workers about local culture and behavior. So, there may be no major problem raising in dealing with foreign or migratory workers.</li> </ul>		-	Supervised by Desh Energy authority
<b>Employment Generation</b>		<ul style="list-style-type: none"> <li>Encourage local and equitable employment;</li> <li>Salaries and other benefits based on qualification and experience;</li> <li>Priority given to local residents for both professional and nonprofessional positions.</li> </ul>		-	Supervised by Desh Energy authority
<b>Social and Economic enhancement</b>		<ul style="list-style-type: none"> <li>Improvement of economic condition of the project area.</li> </ul>			
<b>Indigenous People</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-
<b>Cultural Heritage</b>		<ul style="list-style-type: none"> <li>No management plan required.</li> </ul>		-	-

### **7.3 EMP Monitoring and Review**

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

#### **7.3.1 Review of the EMP**

The environmental unit of Desh Energy Power Company Limited shall review the EMP & EIA to assess its effectiveness and relevance as follows:

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

➤ The review of the EMP should consider the following:

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

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

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

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

## 7.4 Capacity Building and Training

For proper implementation of the EMP, qualified manpower is absolutely essential. There should be a core group of people in the power plant who should be well trained on environmental issues but all plant staff should be given basic training on environmental issues. The skills of staff should be upgraded periodically through need-based training program.

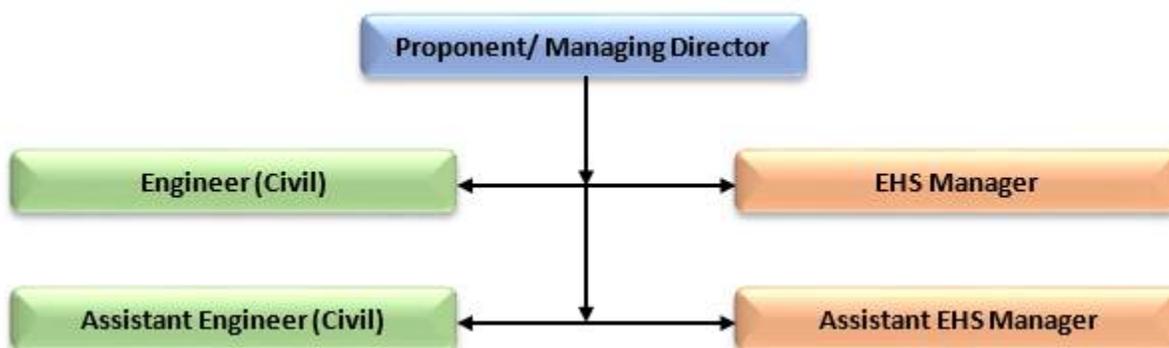


Figure 7.1: Team for Environment Management of proposed power plant

## 7.5 Green Belt Development

Even after taking stringent measures for pollution control, in different stages, a significant amount of pollutants is produced such as dust, noise and NO<sub>x</sub> during the operational phase. A sustainable and green solution for this problem could be minimized by developing a "Green Belt". In the surrounding areas, trees of specific species can reduce the pollution as well as can provide enhanced oxygen for the surrounding area.

Table 7.2: Suitable plant Species for "Green Belt Development"

Sl. No.	Name of the Plant	Name in Bangla	Type	Function
1.	Australian Wattle	আকাশমণি	Tree	Reduces Particulate Matter
2.	Bael tree	বেলগাছ	Tree	Reduces Particulate Matter
3.	The Siris Tree	শিরিষগাছ	Tree	Reduces Particulate Matter
4.	White Siris	করই	Tree	Reduces Particulate Matter
5.	Sugar Apple	আতাগাছ	Tree	Reduces Particulate Matter
6.	Kadam	কদম	Tree	Reduces Particulate Matter
7.	Neem	নিম	Tree	Reduces Particulate Matter
8.	Bamboo	বাঁশ	Tree	Reduces Particulate Matter
9.	Australian Whistling Pine	ঝাউ	Tree	Reduces Particulate Matter
10.	Rongon	রঙ্গন	Shrub	Noise Attenuation
11.	Kamini	কামিনী	Shrub	Noise Attenuation

Sl. No.	Name of the Plant	Name in Bangla	Type	Function
12.	Karabi	করবি	Shrub	Noise Attenuation
13.	Guava tree	পেয়ারা	Shrub	Noise Attenuation
14.	Tagar	টগর	Shrub	Noise Attenuation
15.	Mastered Green	সরিষা	Forb/Herb	NO <sub>x</sub> Absorption

### 7.6 Zero Liquid Discharge/ 3R (Reduce, Reuse, Recycle) Plan

Minimizing the use of resources in the manufacture, distribution and use of products consumed by factories with maximum reuse, recycling and recovery has embodied as a concept of 3Rs (Reduce, Reuse and Recycle). In recent days, the 3Rs principle has started to gain more attention due to the depletion of natural resources and increase of pollution level in the environment.

In this mission, in 2010 Government of Bangladesh has formulated National 3R strategy for waste management. It is further endorsed by the Local Government Ministry for implementation by the City Corporations and the Municipalities. The 3R strategy sets the goal of waste reduction, reuse and recycling and minimizing waste disposal in open dumps, rivers, flood plains and landfills by 2015 and promotes recycling of waste through mandatory segregation of waste at source as well as creates a market for recycled products and provides incentives for recycling of wastes.

As per the process flow of the proposed project, there will not be any liquid discharge from the plant. The entire process has been designed considering the zero-discharge policy. Process water system is closed circuit system, so no recycling is required for any waste water. Oily water from steam heated vapor chamber, engine hall area, storage tank area, FOTP area and other processing area will be discharged through oily water drain line and will be vaporized in steam heater. For Lube oil, LO separator will be used and sludge will be stored in Sludge tank. This sludge then will be carried to market for sale. Only domestic and sanitary waste water will be generated from the project site during operation phase. There will be septic tank along with soak well for domestic and sanitary waste water.



Figure 7.2: Flow diagram of 3R Plan

**Desh Energy Power Company Ltd** will implement 3R plan during their operation period to minimize the use of resources, reuse and recycling them. For example, the proponent can use Rotating Biological Contactor (RBC) technology to treat the sewage and recycle the water for flushing purpose. They can use Rain water harvesting system for reusing the rain water. To optimize the use of electricity, they can use LED lights. Other than this, the project already committed to make no liquid discharge from the process and implement zero liquid discharge.

## 7.7 Cost of EMP implementation

**Table 7.3: EMP implementation cost**

Item	Number	unit cost (Taka)	Total cost per year (Taka)
Environmental monitoring during Construction period		Refer Table 8.5	6,94,000.00
Environmental monitoring during Operation period		Refer Table 8.6	9,34,000.00
Occupational Health, Safety and Security implementation		500,000.00	500,000.00
Community Health Safety and Security implementation		500,000.00	500,000.00
Capacity Building and Training		5,00,000.00	500,000.00
Greenbelt development		5,00,000.00	500,000.00
Firefighting and suppression equipments, training		4,00,000.00	400,000.00
Environmental Compliance Audit	02	3,00,000.00	600,000.00
<b>Subtotal</b>			<b>4628,000.00</b>
<b>Contingency budget (10% of subtotal cost)</b>			<b>462,800.00</b>
<b>Total cost</b>			<b>5090,800.00</b>

## 7.8 Contingency plan

A contingency plan is a plan devised for an outcome other than in the usual (expected) plan. It is often used for risk management for an exceptional risk that, though unlikely, would have catastrophic consequences. Contingency budget will be 10% of subtotal estimated cost of EMP implementation cost mentioned in **Table 7.3**

## 7.9 Decommissioning and Dismantling

At the stage of the project planning & implementation process, the necessity for planning and timing of the decommissioning of the construction equipment & structures after the completion of construction and end of life power plant project is important. Desh Energy Power Company Limited authority should plan to prepare a full-scale decommissioning plan for the project after construction and after the life expectancy of the project to clean up the site.

### **7.9.1 After Completion of the Construction of Plant**

The project proponent/designated contractor is responsible for the decommissioning of the Equipment and temporary structure at the project site. After the completion of the construction, there will have plenty of construction equipment, scrap metal, construction materials, different types of waste chemicals. The project proponent/designated contractor should follow the Decommissioning plan. It will be ensured by the project proponent/designated contractor that no hazardous substance will be discharged to the atmosphere.

### **7.9.2 At the End of Plant's Life**

After the power plant reaches its end of life, project authority should dismantle the entire project and restore the project site back to the normal unless otherwise mentioned by the BPDB. Decommissioning may involve adverse impacts not perceived at this stage of the project. As the environmental and social condition of that time is not fully predictable, so a detail time & project specific decommissioning plan should be prepared prior to closure of the power plants. Such a plan might include:

- ✓ Strict adherence to all appropriate waste management techniques, including the reuse and recycling of materials wherever possible;
- ✓ Disposable of hazardous waste materials in a legal and responsible manner;
- ✓ Remediation of soil and/or groundwater contamination (if applicable); and
- ✓ Rehabilitation and enhancement of terrestrial habitats within the power plants footprints;
- ✓ Mitigation measures to control dust and air emissions during the construction phase will be implemented;
- ✓ Soil and groundwater monitoring to determine subsurface impacts (if any) for the restoration to baseline conditions;
- ✓ Impacts during the decommissioning phase will be similar to those for the construction phase. So, mitigation measures suggested for construction phase should be followed.

## **8 MONITORING, EVALUATION AND REPORTING**

### **8.1 Introduction**

Environmental monitoring is an essential tool in relation to environmental management as it provides the basic information for rational management decisions. The prime objectives of monitoring are -

- To check on whether mitigation and benefit enhancement measures are actually being adopted and are effective in practice;
- To provide a means whereby impacts which were subject to uncertainty at the time of preparation of EIA, or which were unforeseen, can be identified, and steps to be taken to adopt appropriate control measures;
- To provide information on the actual nature and extent of key impacts and the effectiveness of the mitigation measures which, through a feedback mechanism, can be taken into account in the planning and execution of similar projects in future.

There are two basic forms of monitoring:

- Visual observation or checking, coupled with inquiries
- Physical measurement of selected parameters

In the case of industrial projects in general, monitoring is done by physical measurement of some selected parameters like air, water, noise etc. It should be mentioned here that the monitoring program should be such so that it can ensure compliance with national environmental standards. The importance of this monitoring program is also for ensuring that the plant does not create adverse environmental changes in the area and providing a database of operations and maintenance, which can be utilized if unwarranted complaints are made.

### **8.2 Monitoring Indicators**

Environmental monitoring requires a set of indicators that could be conveniently measured, assessed and evaluated periodically to establish trends of impacts. The indicators may be independent or may be functionally related. The physical, chemical, ecological and human interest including socio-economic indicators should be well understood. The monitoring program, in view of the possible impacts as assessed earlier, should consider the indicators for the impact assessment related to following issues is presented in **Table 8.1** to **Table 8.4** in the following pages.

It is desirable that the mitigation measures for the negative impacts and environmental enhancement for positive impacts are implemented according to the suggestions presented in this report. There are two

types of environmental monitoring activities associated with the project, during construction and during operation of the project. Each of the components is to be dealt with according to the requirement of suggested measures.

### 8.2.1 Monitoring During Construction

The environmental monitoring during the construction phase should primarily be focused on addressing the possible negative impacts arising from:

- Deterioration of Air Quality
- Increased traffic
- Generation of noise
- Generation and disposal of sewage, solid waste and construction waste

The environmental monitoring should also focus on enhancing the possible beneficial impacts arising from employment of local workforce for construction works. **Table 8.1 & Table 8.2** summarizes the potentially significant environmental parameters needed to be monitored during the construction phase.

**Table 8.1: Monitoring Plan during Construction Phase of the Project (Visual)**

Issue	Key aspects	Monitoring Frequency	Responsibility
<b>Traffic volume</b>	Incoming & outgoing traffic, traffic movement records	Quarterly	EPC Contractor/ Consultant
<b>Site Security</b>	Proper fencing, isolation of site from general access, marked passage for workers and visitors	Quarterly	EPC Contractor/ Consultant
<b>Personal Protective Equipment</b>	Ensure every single person involved in the construction activity wear proper PPE	Quarterly	EPC Contractor/ Consultant
<b>Incident record &amp; reporting</b>	Documented record of all incident, accident and its remedial process.	Quarterly	EPC Contractor/ Consultant
<b>Solid waste</b>	Quantity of solid waste, segregation, disposal process and transfer	Quarterly	EPC Contractor/ Consultant
<b>Worker's health</b>	Monitoring process of worker's health	Quarterly	EPC Contractor/ Consultant
<b>Complaint from neighbours</b>	Any significant complaint from neighbours and its remedial procedure	Quarterly	EPC Contractor/ Consultant
<b>Safety orientation &amp; training of workers</b>	Frequency of training & orientation of workers for safety	Quarterly	EPC Contractor/ Consultant

Issue	Key aspects	Monitoring Frequency	Responsibility
<b>Sanitation &amp; drinking water facility to workers</b>	Availability of safe drinking water and sanitation to the workers	Quarterly	EPC Contractor/ Consultant
<b>Site Drainage</b>	Maintaining proper drainage	Quarterly	EPC Contractor/ Consultant

**Table 8.2: Monitoring Plan during Construction Phase of the Project (Analytical)**

Issue	Parameters	Monitoring Frequency	Responsibility
<b>Ambient Air Quality</b>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Once in 3 months	EPC Contractor/ Consultant
<b>Noise level</b>	Noise at different locations	Once in 3 months	EPC Contractor/ Consultant
<b>Soil</b>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Once in 6 months	EPC Contractor/ Consultant
<b>Surface water</b>	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	Once in 3 months	EPC Contractor/ Consultant
<b>Ground water</b>	pH, TSS, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform	Once in 6 months	EPC Contractor/ Consultant

### 8.2.2 Monitoring During Operation

Post construction monitoring is limited to a number of impact parameters to see the actual performance of the project. Environmental monitoring requires set of indicators that could be conveniently measured, assessed and evaluated periodically to observe the trends of change in base line environmental quality. Most of the environmental parameters will experience beneficial effects during the operation phase of the project. The plant management authority should be responsible for overall environmental monitoring during the operation phase of the project. The environment monitoring during the operation phase should primarily be focused on addressing the following issues:

- Deterioration of Air Quality
- Generation of noise
- Solid waste generation
- Accidental spillage of Hazardous Material
- Fire hazard, explosion or any medical emergency
- Sanitation and drinking water

Table 8.3 & Table 8.4 summarizes the potentially significant environmental parameters needed to be monitored during the operation phase.

**Table 8.3: Monitoring plan during Operational Phase of the Project (Visual)**

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

**Table 8.4: Monitoring plan during operational phase of the Project (Analytical)**

Issue	Parameters	Monitoring Frequency	Responsibility
Ambient Air Quality	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	Once in 3 months	Project authority
Stack emissions	CO, NO <sub>x</sub> , SPM, O <sub>2</sub> and temperature	Once in 3 months	Project authority

Issue	Parameters	Monitoring Frequency	Responsibility
Noise level	Noise at different locations	Once in 3 months	Project authority
Soil	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	Once in 6 months	Project authority
Surface water	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	Once in 3 months	Project authority
Ground water	pH, TSS, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, Total Coliform and Fecal Coliform	Once in 6 months	Project authority

### 8.3 Cost of Monitoring

The following are the cost of monitoring for the environmental parameters during construction and operation period of the proposed project respectively:

**Table 8.5: Cost Estimate for Environmental Monitoring during Construction**

Item	Parameters	Unit cost (Taka)	Unit per year	Total cost per year (Taka)
<b>Ambient Air Quality</b>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	15000.00	16	2,40,000.00
<b>Noise level</b>	Noise at different locations	5,000.00	20	1,00,000.00
<b>Surface water</b>	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	10,000.00	08	80,000.00
<b>Ground water</b>	pH, TSS, TDS, Hardness, Ammonia, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, TC and FC	12000.00	02	24,000.00
<b>Soil</b>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	5,000.00	02	10,000.00
<b>Visual monitoring</b>	Table 8.1	60,000.00	04	2,40,000.00
<b>Total Cost</b>			694	<b>6,94,000.00</b>

**Table 8.6: Cost estimate for Environmental Monitoring during Operational Phase**

Item	Parameter	Unit cost (Taka)	Unit per year	Total cost per year (Taka)
<b>Ambient Air Quality</b>	SO <sub>2</sub> , NO <sub>x</sub> , CO, SPM, PM <sub>10</sub> and PM <sub>2.5</sub>	15,000.00	16	2,40,000.00
<b>Stack emissions</b>	CO, NO <sub>x</sub> , SPM, O <sub>2</sub> and temperature	30,000.00	08 for 2 stacks	2,40,000.00

Item	Parameter	Unit cost (Taka)	Unit per year	Total cost per year (Taka)
<b>Noise level</b>	Noise at different locations	5,000.00	20	1,00,000.00
<b>Surface water</b>	Temperature, pH, TDS, TSS, DO, BOD, COD, Cd, Cr, Pb and Oil & grease	10,000.00	08	80,000.00
<b>Groundwater</b>	pH, TSS, TDS, Hardness, Ammonia, Nitrate, Phosphate, As, Fe, Mn, Free Residual Chlorine, TC and FC	12,000.00	02	24,000.00
<b>Soil</b>	pH, Porosity, texture, Electrical Conductivity, Pb, Cd, Cr	5,000.00	02	10,000.00
<b>Visual monitoring</b>	Table 8.3	60,000.00	04	240,000.00
	<b>Total cost</b>			<b>9,34,000.00</b>

## 9 ALTERNATIVE ANALYSIS

### 9.1 Alternative Analysis

Assessments of alternatives involve evaluating different options related to project concept, design and site selection. This helps in finalizing the best option that is techno-commercially viable having minimum impact on the local environmental and social conditions.

Analyses of alternatives were considered for the following aspects of the Power Plant Project -

- ✓ No build scenario
- ✓ Site Location Alternatives
- ✓ Fuel Alternatives
- ✓ Technology Alternatives

### 9.2 The 'No Build' Scenario

From a purely physical environmental point of view, the 'do-nothing' is preferable to any project implementation, since it would avoid creation of any of the adverse impact associated with the project. However, the potential socio-economic benefits of the nation would be foregone and solving the problem of power generation and power demand disparity would be hampered.

Electricity demand is growing day by day. In order to mitigate the demand-supply gap, an aggressive plan is prepared by the Government for new generation addition. As part of the plan, 43 power generation projects of capacity 15,294 MW are now under construction. The plan envisages around 21,977 MW new generation addition by 2025. The highest peak generation was 12,738 MW and the total energy generated 71,419 GWh which was 1.20% lower and 1.26% higher than the previous year respectively. (BPDB Annual Report 2019-20).

**Table 9.1: Key Statistics**

Net Energy generation (GWh)	Year 2018-19	Year 2019-20	% Change over the previous year
a) i. Public Sectors	35,107	35,316	0.60
ii. Private Sectors (IPP, SIPP and Rental)	26,723	27,651	3.47
iii. Power Import	6,786	6,674	-1.65
iv. Total Generation (In account of Single Buyer)	68,616	69,641	1.49
b) REB (for PBS's only)	1,917	1,778	-7.25
c) System Total Generation (GWh)	70,533	71,419	1.26

(BPDB Annual Report, 2019-20)

Hatiya Island in Bangladesh is an off grid remote locality. Despite being only twenty kilometers away from shore, the island lacks any electricity grid connection. The government has taken a move to install a 15-megawatt (MW) HFO based power plant in Hatiya island for uninterrupted electricity supply. People of this area depends on solar power system. Only in Ochkhali bazar, there is electric connection via HSD power production source within approx. 3 km radial zone which is not sufficient. Rather than this, the entire island has no electricity connection. 'No build' alternative will not bring these huge changes and other benefits to the socio-economic condition of the adjacent project area. Considering the overall scenario, it is concluded that the 'No build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimized to an allowable level.

### **9.3 Consideration of Alternatives**

#### **9.3.1 Site Alternative**

The proposed power plant project is going to build up on BPDB's own land which does not require any Land acquisition or resettlement. Moreover, there is a good equipment, machineries and fuel transportation route to the project site via water way. Due to the rural setup, the project won't hamper the environmental condition much. So, the selected location of 15 MW HFO Fired Power Plant is quite expectable for the proposed project from environmental point of view.

#### **9.3.2 Fuel alternative**

##### **a. Hydroelectricity:**

Hydroelectricity is produced by harnessing the gravitational force of flowing water. Compared to fossil fuel-powered energy plants, hydroelectric power plants emit fewer greenhouse gases. But the construction of hydroelectric power plants and dams requires huge investment. Moreover, the country is having relatively limited potential for hydroelectricity.

##### **b. Geothermal Plant:**

The three main types of geothermal plants include dry steam power stations, flash steam power stations and binary cycle power stations, all of which use steam turbines to produce electricity. Geothermal power plants are considered to be environmentally friendly and emit lower levels of harmful gases compared with coal-fired power plants. But unfortunately, no active geothermal site has been found.

##### **c. Solar Power Plant**

Solar power plants require significantly larger land areas compared to conventional power plants. A simple rule of thumb is to take 100 sq ft of land for every 1kW of solar panels. Extrapolating this, a 1 MW solar PV power plant will require about 100000 sq ft (about 2.5 acres, or 1 hectare) of land. As the proposed

project is located in BPDB's allotted land and land area available is 5.56 acre. So, if we consider solar energy for power plant, required land area will exceed the amount of allotted land area. Though, from environmental perspective solar power plant is more appreciated but from the land involvement point of view, it is not acceptable.

**d. Coal-Fired Plant:**

If Coal is used as the fuel in this power plant, it will be cost effective because coal is quite cheap but it will pollute the atmosphere due to the production of a large amount of smoke. Besides, coal handling and ash disposal is quite difficult and requires large area. Coal is environmentally less friendly as it gives high emission of carbon dioxide and leads to acid rain because of high Sulphur content.

**e. Gas fired Plant:**

A gas-fired power plants burns natural gas to generate electricity. Although natural gas is a fossil fuel, the emissions produced from its combustion are much lower than those from coal or oil. Gas based combined-cycle power plant using both gas and steam turbines, they produce higher amounts of electricity from a single fuel source compared to a traditional power plant. They capture heat from the gas turbine to increase power production and are also found to release low amounts of harmful gases into the atmosphere. But as gas is not available in Hatiya island so, this alternate is not acceptable.

**f. HFO fired plant:**

Heavy fuel oil (HFO) is a petroleum distillate, or hydrocarbon fuel, that is produced from crude oil, from which lighter hydrocarbon products like diesel and gasoline are also extracted. HFO is a cost-effective, reliable fuel that is used in power generators. Power plants that make use of hydrocarbon fuels, such as HFO, can operate solely on the energy that they create; during the electricity creation and supply process, they can remain entirely off the grid. Though HFO fired power plants have negative environmental impacts but due to easier fuel transportation scope and size of allotted land, HFO fired power plant is the best suited option for this project.

**9.3.3 Technology Alternative**

The technology being offered by Desh Energy Power Company Limited is considered to be state of the art in terms of being environment friendly, energy efficiency and modern plant & process design. The plant will be built according to the applicable Best Available Technologies (BAT) defined for similar plants. In comparison to combined cycle power plants or Super critical or Ultra super critical power plants this technology that Desh Energy Power Company Limited will be using is safer or more lenient. So, from technological point of view this proposed HFO Fired power plant is more suitable.

## Chapter 10

# 10 EMERGENCY RESPONSE, HEALTH & SAFETY AND DISASTER MANAGEMENT PLAN

### 10.1 Emergency Response

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

- Assist personnel in determining the appropriate response to emergencies
- Provide personnel with established procedures and guidelines
- Notify the appropriate Company Emergency Response Team personnel and regulatory/ Govt. agencies
- Manage public and media relations
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs
- Respond to immediate requirements to safeguard the subtending environment and community

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

1. People
2. Property
3. Environment

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

- I. Emergency**
  - ❖ Fire,
  - ❖ Electric shock,
  - ❖ Medical emergency.
  
- II. Natural Disasters**
  - ❖ Flood,
  - ❖ Earthquake/ cyclone,
  - ❖ Storm/ typhoon/ tornados, and
  - ❖ Cloud burst lightning.

### **III. External Factors**

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

#### **10.1.1 Six Steps in Emergency Response**

##### **Step-1**

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

##### **Step-2**

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

##### **Step-3**

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

##### **Step-4**

Initiate redress procedures.

##### **Step-5**

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

##### **Step-6**

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

#### **10.2 Reporting Incidents and Accidents**

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

#### **10.3 Approaches to Emergency Response**

For this project, emergency response systems should be in place to deal with dangerous goods, uncontrolled

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

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

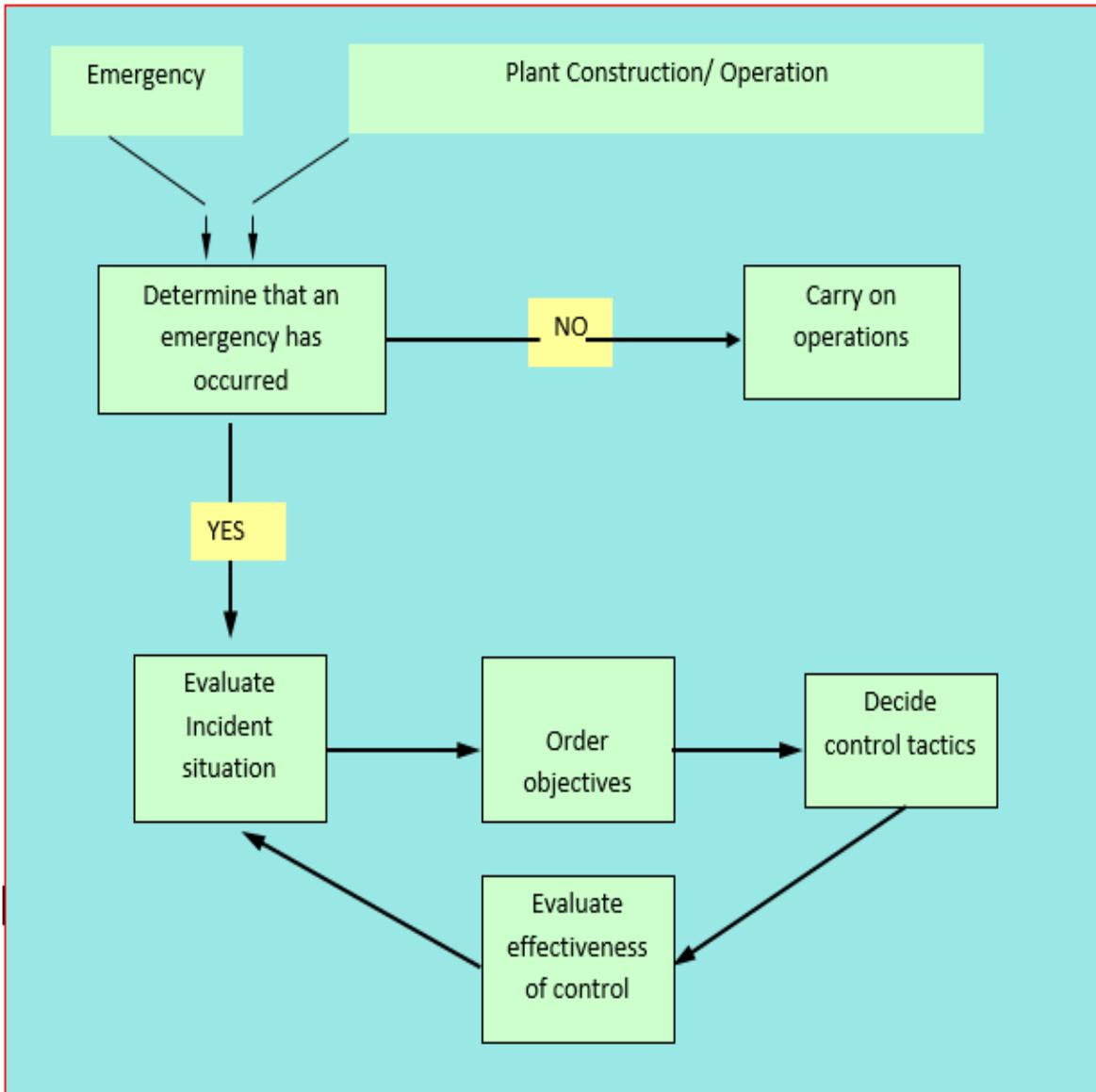


Figure 10.1: Illustrates an Example System Approach to Plant Construction & Operations

## **10.4 Disaster Impact Assessment**

### **❖ Impacts of Disaster**

#### **➤ Earthquake**

- Damages in equipment support structures because of weakness in structure such as carelessness in construction procedure;
- Loss of electrical connections;
- Sudden generation of fire;
- Structural/functional failures of the materials.

#### **➤ Flood**

- Risk of damage of equipment;
- Decreasing power generation capacity;
- Risk of power failure;
- Loss of communication networks;
- Failure of electrical components.

#### **➤ Cyclone/Tornado**

- Reduction of power output;
- Reduction of efficiency of generator;
- Decreased electricity generation if power plant is destroyed or damaged;
- Loss of communication and connections.

#### **➤ Fire**

- Risk to power plant equipment;
- Risk of electrical faults and cable damage;
- Risk of electrical short circuit;
- Increased number of hydrogen fires;
- Generation of smoke;
- Loss of power supply.

#### **➤ Fatal Accidents**

- Possibility of injury;
- Possibility of equipment failure;
- Leakage of hazardous material.

### **10.4.1 Disaster Management Plan**

Disaster Management is a planned and systematic approach to minimize damage to life, property and environment. It involves the systematic observation and analysis of measures relating to disaster

prevention, mitigation, preparedness, emergency response, rehabilitation and reconstruction. It is also to be realized that disaster management involves community preparedness so as to achieve the desired objective of minimization of damage. Community preparedness plan involves all pre-disaster planning to reduce the loss. It is basically a synthesis of various specific plans to solve a common purpose.

In normal operation of the plant, when all environmental protection equipment works according to design specification, then there would be no environmental problems for the present plant. Disaster (to certain degree) may occur if the environmental protection equipment fails to work at normal condition. This situation may arise for any of the following causes-

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

Therefore, appropriate management plan should have to be taken by the project proponent to prevent any unwanted disaster in the plant. The disaster management plan should consist of preventive measures including, among others, the following:

- ✓ Formulation and strict implementation of safety codes and measures;
- ✓ Preventive maintenance;
- ✓ Aware the workers about electric shock
- ✓ Declaring the factory, a “no smoking zone”
- ✓ Provision and inspection of firefighting equipment and fire hydrant system in all the sections;
- ✓ Proper training of the employees about the importance of codes;
- ✓ Training the employees and the residents of the surrounding villages about the actions to be taken during an accident, disaster etc.

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

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

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

- ✓ All safety precautions and provisions covering the general cleanliness of the entire facility down to, ventilation, lighting, sanitary, waste collection, smoke detector, heat detector, sand bucket, water bucket, fire blanket, first aid box provision, adequate fire extinguishers and site security by fencing.

#### **10.4.1.1 Earthquake**

Bangladesh National Building Code widely known as BNBC Code, is the ultimate code that is followed in Bangladesh to build safe houses and buildings. Earthquakes and wind effect of different building systems are incorporated in this code. Moreover, this code is almost similar to ACI code which is recognized as one of the most practiced building codes of the world. Socio-economic factors have also been taken into consideration while preparing this code. This code is very helpful to the related professionals like architects and town planners as it takes into account the conditions specific to Bangladesh. This code should be followed in designing the power plant structures. The below mentioned plan should be implemented during the construction and operation of this proposed plant.

- ✓ In case of earth quake, all the personnel inside the project are instructed to shut down their operations and come to open yard and assemble at the assembly points;
- ✓ If required, transportation will be arranged for sending the people to safer places;
- ✓ Rescue operation will be carried out by security personnel for any possible casualties and the same are given first aid treatment and will be sent to the nearest hospitals in case of requirement.

#### **10.4.1.2 Flooding (Heavy rains)**

When floods are caused due to heavy rains, those who will work in the project area should move to safer places and should stay in safe place until the water recedes. Actions to be taken:

- ✓ Monitor conditions and escape routes;
- ✓ Shut off electrical power and utilities if flooding is imminent;
- ✓ Slam dams for flood management should be used around the power house building [As power plant is a nationally important and huge cost involving project so quick and effective flood management technology should be used to protect the power house or turbine building from inundation. Slam dam is one such technology that takes only two hours for 2 people to prepare a 100-meter emergency dam. Retains elasticity from -35 degrees Celsius to +120 degrees Celsius. Slam dam is available at a length of 500 cm and can be stored in a standard plastic storage box (80 x 60 x 42 cm).];
- ✓ After getting alert from media, government agencies and any other appropriate source start preparing the slam dam around the power plant area to protect it from inundation. As the slam dam can withstand flooding of the power house building;
- ✓ Call fire services, if needed.

#### **10.4.1.3 Cyclones / heavy winds**

Actions to be taken:

- ✓ Know about the severity / direction of the cyclone from news bulletins / meteorological dept.;
- ✓ Review the activities / operations planned and stop operations which may create an emergency situation due to cyclone / high winds;

- ✓ Ensure emergency equipment such as batteries / torches etc., are in availability;
- ✓ Ensure food supplies to the work force;
- ✓ Ensure readiness of emergency vehicles / medicines, medical center with staff etc.

#### 10.4.1.4 Fire Hazard & Fire Evacuation Plan

##### ❖ Fire Hazard

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

In addition, some people in charge of fire protection do not have an adequate knowledge of necessary inspection and testing frequencies, or they use the minimum frequencies prescribed by their authority having jurisdiction. Suitable fire protection and detection systems shall be provided designed to the requirements of National Fire Protection Association (NFPA) standards. Gas detection systems and alarms shall also be included.

Fire protection shall consist of wet pipe, automatic deluge systems, hydrants, CO<sub>2</sub> gas flooding systems, and portable extinguishers of CO<sub>2</sub> and dry powder in sufficient quantities.

##### ❖ Fire Evacuation Plan

In this case, the proponent needs to consider how you will arrange the evacuation of the premises in the light of your risk assessment and the other fire precautions they have or intend to put in place. Possible fire evacuation plan can be as follows:

- Simultaneous Evacuation
- Vertical Phased Evacuation
- Staff Alarm Evacuation
- Defend in Place

##### ➤ Emergency response procedural steps for fire hazards

- ✓ **All personnel at site** - shall move out of their workplace and assemble at the nearest safe assembly point;
- ✓ **Emergency mitigating (Firefighting) team** – Mitigate the Fire as per procedure (Trained);
- ✓ **Emergency technical support team** – Mobile resources as need for the situation;

- ✓ **First aid team** – Provide first-aid to the affected persons before sending them to actual medical aid;
- ✓ **Rescue team** – Assist and ensure all personnel in the emergency affected site are evacuated; carry out intensive search in the area to make double sure that no person is left un attended ;
- ✓ **Security** – Stop vehicle / personnel entry in to the site; control traffic within site ;
- ✓ **Head – HR** - Coordinate with rescue team and arrange for additional help such as logistics and other medical arrangements for the affected personnel;
- ✓ **Incident controller** – Blow siren for all clear indication after the emergency is over;
- ✓ **Concerned HODs and Contractors** – Shall ensure that they take stock of their personnel to determine whether anybody is missing. Coordinate with security, HR as needed.

There will be a Fire water reservoir of 1200m<sup>3</sup> capacity at the power plant site. In addition to that firefighting equipment that will be available in the premises of the project site for the management of fire safety are mentioned in the table below.

**Table 10.1: List of Firefighting Equipment**

1. Fire extinguisher	8. Equipment box	15. Gas mask
2. Fire extinguisher (CO2)	9. Stature	16. Gum boot
3. Fire extinguisher (Foam)	10. Lock cutter	17. Hand gloves
4. Hose box	11. Fire bitter	18. Fire blanket
5. Hydrant point	12. Fire hook	19. Sand/Water bucket
6. Fire alarm bell	13. Belcha	20. Sand/Water stand
7. Fire alarm switch	14. Helmet	



**Figure 10.2: Various Fire Fighting Equipment**

## **11 RISK ASSESSMENT AND MANAGEMENT**

### **11.1 Risk Assessment**

Risk assessment is a part of the EIA process which aims at identifying all the potential hazards, exposure to hazardous condition or hazards, and their mitigation or safety measures. The approach of risk assessment is in combination of qualitative and quantitative assessment of hazard sources, exposures, consequences and possible mitigation measures. A comprehensive risk management plan, occupational health and safety plan, and environment health & safety plan are the outcome of the risk assessment process.

In the EIA, risk assessment has been carried out to identify the potential hazard associated with or inherent in the design process and to identify possible measures to avoid the hazard along with the safety plan for minimizing the risk. Incorporating these measures and safety plan in design, planning and operational procedure of the proposed power plant the potential hazard points can be eliminated.

Hazard means unsafe conditions that may cause harm or has the ability to cause harm. Risk is the likelihood of hazard being occurred. Risk assessment is examination of potential hazards, which may occur and the measures to be taken to prevent such hazards. The identified hazards for the proposed power plant are listed in **Table 11.1** and **table 11.2**.

**Table 11.1: Possible Risk/ Hazards in Construction Stage**

Risk/ Hazard	Sources	Consequences	Safety measures
<b>Stuck by</b>	Falling/moving machineries, tools/ debris dropped from elevated location, vehicles, any rotator machinery or parts, turbine and its ancillary	Health injury and loss of life	<ul style="list-style-type: none"> <li>• Fall protection, use of Personal Protection Equipment's (PPEs).</li> </ul>
<b>Falls</b>	Fall from elevated areas, high heights, etc.	Health injury and loss of life	<ul style="list-style-type: none"> <li>• Fall protection, awareness, use of PPEs.</li> </ul>
<b>Electrocution</b>	Cutting and welding, switchyard etc.	Health injury and loss of life	<ul style="list-style-type: none"> <li>• Use of PPEs, proper training, awareness, keeping safe distance from hazardous points, maintaining safety of high switchyard etc.</li> </ul>
<b>Fire and Explosion</b>	Generator and its ancillary components, flammable chemical, power transformer etc.	Health injury and loss of life	<ul style="list-style-type: none"> <li>• Arrangement of firefighting equipment's with training to the staffs from workers to officers;</li> <li>• Staffs should be trained on emergency handling procedures;</li> <li>• Adoption of fire safety for each of the equipment's and machinery subject to fire hazard;</li> <li>• Safe handling and storage of flammable chemicals and fuels;</li> <li>• Regular inspection and monitoring of pressure parts and units;</li> <li>• Use of PPEs and Consciousness during working period.</li> </ul>
<b>Noise and Vibration</b>	Noise and vibration from machinery, traffic and testing of main plant, etc.	Hearing complexity; vomiting to the pregnant women; scaring to wildlife, livestock, human being, etc.	<ul style="list-style-type: none"> <li>• Compliance with the national Noise Control Rules and Regulations and IFC occupational health and safety standards;</li> <li>• Equipment to be used by competent operatives;</li> </ul>

Risk/ Hazard	Sources	Consequences	Safety measures
			<ul style="list-style-type: none"> <li>• Provision of equipment with low noise and vibration outputs where possible;</li> <li>• Personal protective equipment's (PPEs) provided and used where necessary;</li> <li>• Consider suitable timing of the work to reduce disturbance;</li> <li>• Appropriate choice of modern equipment and machinery to reduce noise.</li> </ul>
<b>Traffic Accident</b>	Onsite and off site	Health injury, life loss, property damage, etc.	<ul style="list-style-type: none"> <li>• Driver should strictly follow the traffic rules and regulations of the country;</li> <li>• Proper traffic marking on the road and effective signaling system should be implemented in and around the Project site;</li> <li>• Traffic safety should be ensured for long vehicle;</li> <li>• Provision and use of high visibility clothing;</li> <li>• Provision of walkways.</li> </ul>
<b>Intoxication/ Toxic exposure</b>	Chemical storage, Hazardous atmosphere in confined space	Health injury and loss of life	<ul style="list-style-type: none"> <li>• Safe storage of chemicals should be ensured;</li> <li>• Safe working condition;</li> <li>• Use of PPEs, Emergency Health Services, etc.;</li> </ul>
<b>Unsafe Working Place</b>	Lack of safe working condition, employee having contagious disease	Health injury, electrocution, organ disease outburst, loss of health, loss of life	<ul style="list-style-type: none"> <li>• Keeping all safety &amp; precaution measure in order, maintaining first aid &amp; well-equipped primary health center &amp; training on awareness;</li> <li>• Monthly health inspection, provision of medical leave for labor, awareness, etc.</li> </ul>

**Table 11.2: Possible Risk/ Hazard during Operation Stage**

Risk/ hazard	Source	Consequences	Safety Measures
<ul style="list-style-type: none"> <li>Mechanical hazard</li> <li>Fire hazard/explosion</li> <li>Electrical hazard</li> <li>Noise generation</li> </ul>	<ul style="list-style-type: none"> <li>Mechanical failure</li> <li>Lack of sound buffers</li> </ul>	<ul style="list-style-type: none"> <li>Health injury</li> <li>Fatalities</li> <li>Property damage</li> <li>Environmental damage</li> </ul>	<ul style="list-style-type: none"> <li>Arrangement of firefighting equipment's with training to the staffs from workers to officers;</li> <li>Staffs should be trained on emergency handling procedures;</li> <li>Compliance with the national Noise Control Rules and Regulations and IFC occupational health and safety standards;</li> <li>Use of PPEs, proper training, awareness, keeping safe distance from hazardous points, maintaining safety of high switchyard etc.</li> </ul>
<ul style="list-style-type: none"> <li>Fire due to resulting arc flash/arc blast</li> <li>Other electric hazard due to unprotected cables</li> <li>Slips and trips from unorganized/lose cables lying in the floor</li> </ul>	<ul style="list-style-type: none"> <li>Short circuit in control room and switch gears</li> <li>Faulty cables and wires</li> <li>No safe connection to earth</li> <li>Using cables with different voltage and current ratings</li> <li>Unorganized cables</li> </ul>	<ul style="list-style-type: none"> <li>Health injury from electric shock, fires etc.</li> <li>Fatality from electrocution, fires etc.</li> <li>Electric burns</li> </ul>	<ul style="list-style-type: none"> <li>Staffs should be trained on emergency handling procedures;</li> <li>Adoption of fire safety for each of the equipment's and machinery subject to fire hazard;</li> <li>Safe handling and storage of flammable chemicals and fuels;</li> <li>Regular inspection and monitoring of pressure parts and units.</li> </ul>
<ul style="list-style-type: none"> <li>Fire (near burner)</li> <li>Explosion</li> </ul>	<ul style="list-style-type: none"> <li>Presence of contaminant in fuel</li> <li>Accidental leakage, lack of heat sink for combustion process</li> </ul>	<ul style="list-style-type: none"> <li>Incomplete combustion</li> <li>Equipment damage</li> <li>Health injury</li> <li>Loss of life</li> <li>Environmental degradation</li> </ul>	<ul style="list-style-type: none"> <li>Safe handling and storage of flammable chemicals and fuels;</li> <li>Regular inspection and monitoring of pressure parts and units.</li> </ul>

Risk/ hazard	Source	Consequences	Safety Measures
	and non-functional safety and valve		
<ul style="list-style-type: none"> <li>Chemical hazard</li> </ul>	<ul style="list-style-type: none"> <li>Spillage/accidental release</li> <li>Mishandling and misuse</li> </ul>	<ul style="list-style-type: none"> <li>Health injury (chronic or acute toxicity)</li> <li>Disability</li> <li>Loss of life</li> <li>Degradation of air, water and soil quality</li> </ul>	<ul style="list-style-type: none"> <li>Safe storage of chemicals should be ensured;</li> <li>Safe working condition;</li> <li>Use of PPEs, Emergency Health Services, etc.</li> </ul>
<ul style="list-style-type: none"> <li>Toxic accidental release due to multifunction of equipment &amp; callousness of operator</li> </ul>	<ul style="list-style-type: none"> <li>Chemical spillage</li> <li>Chemical fires</li> <li>Mishandling and misuse</li> </ul>	<ul style="list-style-type: none"> <li>Health injury (chronic or acute toxicity)</li> <li>Disability</li> <li>Loss of life</li> </ul>	<ul style="list-style-type: none"> <li>Safe storage of chemicals should be ensured;</li> <li>Safe working condition;</li> <li>Use of PPEs, Emergency Health Services, etc.</li> </ul>
<ul style="list-style-type: none"> <li>Fire in Generator Hall</li> </ul>	<ul style="list-style-type: none"> <li>Electrical short circuit or electrical failure</li> <li>Violent mechanical failure of rotating parts, shafts, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Damage of the generator, fire may lead fire in other area of the plant e.g. electric bay, fuel tank, fuel supply line, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Preventive maintenance with regular inspection and monitoring as per the operational protocol of the manufacturer;</li> <li>The EHS team should develop a safety guideline for preventing fire damage;</li> <li>An automatic Carbon Dioxide (CO<sub>2</sub>) gas fire protection system should be provided in all machinery except in the unit local control package;</li> <li>Automatic fire detection, alarming and fighting system.</li> </ul>

## 11.2 Risk Management

Risk Management include all measures and work required for reducing the hazards to occur. The management include:

- ✓ Safety Training;
- ✓ Documentation of Implementation of Safety Measures;
- ✓ Formation of the safety management team;
- ✓ Hazardous material management measures;
- ✓ Fire hazard & Evacuation plan (refer section 10.4.1.4);
- ✓ Medical emergency measures;
- ✓ Occupational health & Safety.

### 11.2.1 Safety Training

To reduce the risks a safety training program is essential for workers of the plant operation and local people of the plant surrounding area. There should be a regular training program on safety for the workers to increase their awareness and also to reduce the risks. A yearly professional training for health and safety would increase safety. A safety training may be planned for the local people living around the project area so that they can be aware of the risk possessed by the power plant and can take appropriate preparedness. A possible training schedule is given in **Table 11.3**.

**Table 11.3: Training Schedule**

Trainee	Training Schedule
Worker	Four training per year
Professional	Two training per year
Local People	Two training per year
Drivers	Four training per year
Safety Professional	Two training per year

A professional training needs to be given to the designated fire team. The training would include the following:

**Table 11.4: Type of training and training actions**

SL No.	Type of Training	Training Actions
1	Actions to be taken in the event of a fire	<ul style="list-style-type: none"> <li>• Use fire exit and educating workers and staffs of the nearest emergency evacuation zone;</li> <li>• Proper evacuation procedure in the event of a fire;</li> <li>• Training on locating emergency equipment and use of portable fire extinguishers to extinguish fires;</li> <li>• Training on whom to contact in case of an emergency.</li> </ul>

SL No.	Type of Training	Training Actions
2	Handling of flammable liquids	<ul style="list-style-type: none"> <li>• Training on the safe handling and storage of volatile/flammable chemicals/oils;</li> <li>• Training on waste classification system and use of various color-coded bins for various waste disposals;</li> <li>• Training on the use of PPEs.</li> </ul>
3	Emergency Drills	<ul style="list-style-type: none"> <li>• Regular monthly training on mock fire drills;</li> <li>• Regular monthly workshop on emergency response and preparedness plan.</li> </ul>
4	First-aid and medical assistance	<ul style="list-style-type: none"> <li>• Training on first-aid treatment for broken bones/fractures, burns, cuts/wounds, unconsciousness, breathlessness.</li> </ul>

### 11.2.2 Documentation of Implementation of Safety Measures

The status of the implementation of safety plans will be monitored and documented. Monthly monitoring report should be prepared based on regular inspection and should be submitted to the Chief of the Power Plant.

### 11.2.3 The Environmental Safety Management Team

There will be an Environmental Safety Management Team for implementation, inspection, documentation, and reporting of the safety plans. The team will also be responsible for implementing emergency plans under the Directorate of Environment, Health and Safety. The team will be formed by the combination of multidisciplinary professionals. The team could be as:

- i. Environmental Quality and Safety Manager (Team Leader)
- ii. Emergency Manager
- iii. Fire Safety Manager
- iv. Safety Manager
- v. Chief Security Officer
- vi. Security Officer
- vii. Chief Medical Officer
- viii. Medical Officer and
- ix. Rescue Officer

### 11.2.4 Hazardous material management measures

Hazardous material can cause different types of accidents while transporting to or from the project site. They may cause damage during inadequate storage, transportation, treatment, or disposal operations. Regular inspections of machinery, equipment, pipe work, storage areas are needed to ensure that poor maintenance is not responsible for a spillage occurring. An appropriate storage site should be provided

for disassembled spare parts (e.g. motors and compressors) that contain oil or other types of fluids. The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility. In case of any spillage, it should be immediately acted up on. Spillage equipment i.e. safety goggles, gloves, PPE, disposal bags, containers, absorbent material, suction pump, boom skimmer etc. should be available at the site.

#### **11.2.5 Medical emergency measures**

A chief medical officer and a medical officer should be present in order to supervise all works to ensure the safety conditions and best practices regarding safety at work. A local hospital for the emergency incident related to the worker's health should be established. Necessary steps should be taken for arrangement of ambulance service in the project area to support any emergency medical aid and shifting to the hospital/ medical Centre.

#### **11.2.6 Emergency Recovery**

After the emergency situation had passed, the Safety Management Team would assess and categorize the damage and would provide for compensations for the injured; provide provisions for temporary services; reinstate normal environmental and working standards; initiating investigation process for the cause of disaster; evaluating response procedure and providing a recommendation to mitigate future emergencies.

#### **11.2.7 Emergency Evacuation Plan**

The EPC contractor will formulate a plan for evacuation in the event of an emergency. He/she will make a layout plan, showing all the possible emergency fire exits and the location of the evacuation zone. An emergency contact list should also be prepared by the EPC contractor consisting of Hospitals, Police, Ambulance services and other relevant contact details.

#### **11.2.8 Occupational Health and Safety Plan**

Occupational health and safety means preventing accidents and work-related ill health. Improved health and safety management can bring significant benefits to the business. It reduces individual and human costs of accidents and ill health, direct and indirect cost to the business, improves customer perception and company profile and workers' morale. Under occupational health hazards, one can group several categories of working conditions impairing the health conditions of workers, though this impairment is slow. Safety relates more to health hazards that results from accidents and can cause instantaneous impairment of the workers' health.

**Table 11.5: General Occupational Health and Safety Plan**

Occupational Hazards	Safety Measures
<b>General Safety</b>	<ul style="list-style-type: none"> <li>• All the work should be carried out in line with the safety requirements of ECR 1997;</li> <li>• General Health and Safety Policy of Desh Energy should be implemented;</li> <li>• Personal and continuous visual supervision of the worker who is not competent to perform the job;</li> <li>• Workers to be conversant on the codes and standards of safety;</li> <li>• A general Health and Safety Guideline and specific Safety Procedure of plant operation, maintenance and decommissioning should Developed by the EPC contractor.</li> </ul>
<b>Hazardous Materials</b>	<ul style="list-style-type: none"> <li>• Hazardous materials should be handled in accordance with the safety data procedure as mentioned in the safety data sheet of the particular materials;</li> <li>• Only the trained personnel should be involved in hazardous material handling;</li> <li>• Other appropriate regulations and codes complied with (e.g. chemical Regulations);</li> <li>• Provide suitable personal protection equipment;</li> <li>• Workers must be confident that they have adequate training on handling of unsafe hazards material.</li> </ul>
<b>Maintenance of Equipment</b>	<ul style="list-style-type: none"> <li>• Employer shall ensure that all equipment used on a work site is maintained in a condition that will not compromise the health and safety of workers using or transporting the equipment;</li> <li>• Will perform the function for which it is intended or was designed;</li> <li>• Is of adequate strength for that purpose;</li> <li>• Is free from potential defects.</li> </ul>
<b>Electricity</b>	<ul style="list-style-type: none"> <li>• Compliance with Electricity at Work Regulations and Health and Safety Manager’s guidance notes;</li> <li>• Planned inspection and maintenance of electrical tools and equipment;</li> <li>• Use of electrical safety devices (e.g. Residual Circuit Device);</li> <li>• Supply High Voltage and Low Voltage cable plans;</li> <li>• Cable locations and permits.</li> </ul>
<b>Manual Handling</b>	<ul style="list-style-type: none"> <li>• Appropriate lifting equipment should be used for handling heavy equipments;</li> <li>• The personnel and labor involved in equipment handling should have proper training;</li> </ul>

Occupational Hazards	Safety Measures
	<ul style="list-style-type: none"> <li>• Specific training should be provided to those employees regularly required to lift;</li> <li>• For ensuring health and safety, reduce handled loads to less than 20kg.</li> </ul>
<b>Traffic Hazard</b>	<ul style="list-style-type: none"> <li>• Where there is a danger to workers from traffic, an employer shall take appropriate measures to ensure that the workers are protected from traffic hazards;</li> <li>• Where the operator of vehicle does not have a clear view of the path to be traveled on a work site, he will not proceed until he receives a signal from a designated signaller who has a clear view of the path to be traveled.</li> </ul>
<b>Noise and Vibration</b>	<ul style="list-style-type: none"> <li>• Compliance with Noise Control Rules 2006, ECR 1997 (hereafter amendments), and IFC standards;</li> <li>• Vibration should be limited to IFC standard;</li> <li>• Equipments generating significant noise should be equipped with noise hood;</li> <li>• PPEs should be provided to all employees working in area exposed to noise above the allowable limit;</li> <li>• Provision of equipment with low noise outputs where possible;</li> <li>• Timing of the work to reduce disturbance;</li> <li>• Appropriate choice of equipment to reduce noise;</li> <li>• Noise Mitigation Measures suggested in the EMP chapter should be followed strictly.</li> </ul>
<b>Fire and Explosion</b>	<ul style="list-style-type: none"> <li>• Ensure Building Code has been followed strictly in designing and constructing the buildings, and other civil structures;</li> <li>• Procedures established to minimize risk of gas ignition if relevant;</li> <li>• Firefighting equipment should be provided;</li> <li>• Staff trained in emergency procedures.</li> </ul>
<b>Use of Machinery</b>	<ul style="list-style-type: none"> <li>• Machinery operated in compliance with work equipment Regulations;</li> <li>• Machinery used by competent operators;</li> <li>• Planned maintenance of machinery;</li> <li>• Compliance with legislation under the Management of Health and Safety at Work Regulations.1999.</li> </ul>
<b>Illumination</b>	<ul style="list-style-type: none"> <li>• Ensure that illumination at a work site is sufficient to enable work to be done safely;</li> <li>• Where failure of the normal lighting system would endanger workers, the employer shall ensure that emergency lighting is</li> </ul>

Occupational Hazards	Safety Measures
	<p>available that will generate sufficient dependable illumination to enable the workers to-</p> <ol style="list-style-type: none"> <li>a. Leave the work site in safety;</li> <li>b. Initiate emergency shutdown procedures;</li> <li>c. Restore normal lighting.</li> </ol>
<b>Trips and falls</b>	<ul style="list-style-type: none"> <li>• Compliance with workplace regulations;</li> <li>• Suitable access equipment provided and inspected.</li> </ul>
<b>House keeping</b>	<ul style="list-style-type: none"> <li>• Ensure that each work site is clean and free from stepping and tripping hazards;</li> <li>• Waste and other debris or material do not accumulate around equipment, endangering workers.</li> </ul>
<b>Sanitary facilities &amp; drinking Water</b>	<ul style="list-style-type: none"> <li>• Ensure that an adequate supply of drinking fluids is available at the work site;</li> <li>• Ensure toilet facilities in accordance with the requirement of general health protection guidelines.</li> </ul>
<b>Proper clothing of worker</b>	<ul style="list-style-type: none"> <li>• Ensure that where is a possibility that a worker or worker's clothing might come in to contact with moving parts of machinery, the worker: <ol style="list-style-type: none"> <li>a. wears close-fitting clothing;</li> <li>b. confines or cuts short his head and facial hair;</li> <li>c. avoids wearing jewelry or other similar items.</li> </ol> </li> </ul>
<b>Head, Eye &amp; Foot protection</b>	<ul style="list-style-type: none"> <li>• Ensure that during the work process adequate alternative means of protecting the workers head is in place ;</li> <li>• Where there is a danger of injury to or irritation of a worker's eyes, his employer shall ensure that the worker wears property fitting eye protective equipment;</li> <li>• Where there is a danger of injury to a worker's feet, ensure that the worker wears safety footwear that is appropriate to the nature of the hazard associated with particular activities and conditions.</li> </ul>
<b>Respiratory protective Equipment</b>	<ul style="list-style-type: none"> <li>• Where the worker is exposed to hazards gases, gums, vapors, or particulates appropriate respiratory protective equipment to be supplied.</li> </ul>

### 11.2.9 Environment, Health and Safety (EHS)

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

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

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

## **12 STAKEHOLDER CONSULTATION**

### **12.1 Stakeholder Consultation**

Stakeholder consultation forms an important part of the EIA study. The main objective of the consultation process is to apprise the local inhabitants about the proposed project and to seek their opinions regarding the possible impacts of the project. It was recognized that their opinions would be more useful as they are accustomed to construction and operation of a number of power plant units in the locality in last few years.

Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision-making. Stakeholder consultation was therefore conducted in the project area not only to satisfy the legal requirements of the EIA process in Bangladesh but also to improve and enhance the social and environmental design of the project.

### **12.2 Objectives of Stakeholders Consultation**

The process of public participation and consultation was endorsed in the United Nations Conference on the Environment and Development (UNCED) in 1992 through one of the key documents of the Conference- Agenda 21. Agenda 21 is a comprehensive strategy for global action on sustainable development and deals with issues regarding human interaction with the environment. It emphasizes the role of public participation in environmental decision-making for the achievement of sustainable development.

- For projects that have environmental and social impacts, consultation is not a single conversation but a series of opportunities to create understanding about the project among those it will likely affect or interest, and to learn how these external parties view the project and its attendant risks, impacts, opportunities, and mitigation measures;
- Listening to stakeholder concerns and feedback can be a valuable source of information that can improve project design and outcomes and help a company to identify and control external risks. It can also form the basis for future collaboration and partnerships;
- For stakeholders, a company's consultation process is an opportunity to get information, as well as to educate company staff about the local context in which a project will take place, to raise issues and concerns, ask questions, and potentially help to shape the project by making suggestions for the company to consider and respond to.

Through the public consultation process, the project proponent hopes to:

- Promote better understanding of the project, its objective, and its likely impact;

- Identify and address concerns of all interested and affected parties of project area;
- Provide a means to identify and resolve issues before plans are finalized and development commences, thus avoiding public anger and resentment and potentially costly delays;
- Encourage transparency and inculcate trust among various stakeholders to promote cooperation and partnership with the communities and local leadership.

### **12.3 Consultation Process**

- ✓ Primary stakeholders were consulted during informal and formal meetings;
- ✓ The consultation process was carried out in the Bangla language. During these meetings a simple, non-technical, description of the project was given, with an overview of the project's likely human and environmental impact. This was followed by an open discussion allowing participants to voice their concerns and opinions. In addition to providing communities with information on the proposed project, their feedback was documented during the primary stakeholder consultation ;
- ✓ The issues and suggestions raised were recorded in field notes for analysis and interpretation;
- ✓ By reaching out to a wider segment of the population and using various communication tools—such as participatory needs assessment, community consultation meetings, focused group discussions, in-depth interviews, and participatory rural appraisal—EIA involved the community in active decision-making;
- ✓ This process will continue even during construction and operation phase of the project to create consensus among stakeholders on specific environmental and social issues raised in the context of proposed project;
- ✓ Secondary stakeholder consultations were more formal as they involved government representatives and local welfare organizations consulted during face-to-face meetings and through telephonic conversations. They were briefed on the EIA process, the project design, and the potential negative and positive impact of the project on the area's environment and communities.

It was important not to raise community expectations unnecessarily or unrealistically during the stakeholder consultation meetings in order to avoid undue conflict with local leaders or local administrators. The issues recorded in the consultation process were examined, validated and addressed in the EIA report.

### **12.4 Stakeholders Consulted & Consultation Technique**

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

- Consultation with relevant Government & Non-government officials;
- Informal meetings with communities in surrounding areas. Men and local elders attended these meeting.

## 12.5 Stakeholder Concerns and Recommendations

The findings of the Community consultations are given in **Table 12.2**. All these have been addressed in various sections of the EIA, and the mitigation plans have been incorporated in the EMP. The summary of the various stakeholder consultations is given below. Participants list of Public Consultation is attached as **Annexure 8**.

**Table 12.1: Participants in the Stakeholder Consultation meeting (Local Community)**

Date	Location	Name	Age	Occupation
10-09-2021 & 11-09-2021	Harendra Road Bazar	Sahjahan Vuiya	23	Private job
		Abul Kashem	38	Farmer
		Mahfuzur Rahman	42	Farmer
		Dilip	35	Fisherman
		Md. Azad	28	Farmer
		Sharmita Biswas	45	School Teacher
		Kader Ali	37	Businessman
		Md. Alauddin	48	Businessman
		Fakrul Islam	58	Businessman
		Utpal Kumar	42	Businessman
		Riajul Alam	45	Farmer
		Kader Hosen	40	Fisherman

**Table 12.2: Summary of Consultation and Discussion (Community People)**

Issues	Issues Discussed by Community people	Comments of Community People
<b>Employment</b>	Creating more employment opportunity	Due to lack of electricity, not much industry has been developed in this area. After the implementation of this project, various kinds of industry will be developed here which will create a lot of employment opportunity and socio-economic development for us.
<b>Agricultural Development</b>	Availability of water for crops	As we don't have any electricity, we have to depend on rain and nearest sweet water of khal

Issues	Issues Discussed by Community people	Comments of Community People
		for watering our crops which is only available during rainy season. After the implementation this project, a change may happen in agricultural sector as we will get water from motorized pump.
<b>Conservation of Hilsa Fish</b>	Development of Ice Industry	Meghna is one of the habitats of Hilsa Fish. People of Hatiya mainly depend on fishing of Hilsa & other fishes. They request the authority not to discharge any kind of liquid waste directly into the river as it is harmful for fish. They expect that they will get electricity connection after the implementation of this project.
<b>Environment</b>	Possibilities of air, noise & water pollution	We have a humble request to the authority that they should follow all laws and regulations of environment. Besides, they should use high technology in order to protect air, water and soil from pollution.
<b>Resettlement/Relocation</b>	Community people will not face any resettlement/relocation	The proposed project doesn't require any land acquisition and involuntary resettlement. Local people are in support of this project as they expect to get electricity connection after the implementation of this project.
<b>Repair and maintenance of local roads</b>	May damage the existing local roads	They requested to the Project authority that they should keep the existing road in good condition and should also request the local authority to do the repairing work when needed.
<b>Community development</b>	Overall development of Hatiya Upazila	We think this project will change our life as well as the existing condition of Hatiya. They expect that the socio-economic condition of local people will flourish. People are in favor of the project and they ask to prioritize local people and employ them during different phases of the project.





Figure 12.1: Photographs of Public Consultation around the project site

**Table 12.3: Summary of Consultation and Discussion (Govt. & Non-Govt. Officials)**

Authority	Name	Occupation	Age	Comments
<b>Government Officials (Hatiya)</b>				
Bangladesh power development Board (BPDB)	Md. Golam Mostofa	Sub-Assistant Engineer	27	<ul style="list-style-type: none"> <li>We produce HSD based electricity (About 1.2 MW) but it is very insufficient with respect to the demand and we supply it for few hours of day &amp; night just around the Ochkhali Bazar;</li> <li>This project may bring a lot of positive change in commercial &amp; industrial sector;</li> <li>The authority should use high technology so that it does not harm the elements of Environment.</li> </ul>
Desh Energy	Nasir Uddin	Senior Engineer	32	<ul style="list-style-type: none"> <li>Environmental Laws and Regulation should be strictly followed at different phases of the project;</li> <li>All the emission (air, noise, water etc.) level should meet the DoE guidelines;</li> <li>I hope that the project activity will not hamper the regular movement of the community people and will bring betterment to their lives.</li> </ul>
Burirchar Union	Yeasin Arafat	Secretary	31	<ul style="list-style-type: none"> <li>The project authority must follow all environmental laws and regulations to protect the environment;</li> <li>We support this project but the authority must give high priority on Environment.</li> </ul>
UNO	Md. Imran Hosen	Upazila Nirbahi Officer	42	<ul style="list-style-type: none"> <li>We support this project because we need to develop the socio-economic condition of this island and this project will help us to achieve that goal;</li> <li>The authority must follow all laws and regulations of environment so that the biodiversity of River and Mangrove Forest do not get harm;</li> </ul>

Authority	Name	Occupation	Age	Comments
				<ul style="list-style-type: none"> <li>The project should follow and implement zero liquid discharge policy;</li> <li>Solid &amp; Hazardous waste should be properly handled and disposed to designated landfill area.</li> </ul>
<b>Govt. Officials, Noakhali</b>				
Bangladesh Water Development Board (BWDB)	Syed Arshad Ali	Assistant Engineer	37	<ul style="list-style-type: none"> <li>Proper mitigation and management plan should be adopted so that aquatic ecosystem is not disturbed;</li> <li>Care must be taken to ensure that any leakage of oil or other waste does not happen.</li> </ul>
Department of Environment (DOE)	Soumen Maitra	Visitor	30	<ul style="list-style-type: none"> <li>Must maintain all the environmental laws and code as per the DoE guideline;</li> <li>Should use high technology so that it does not harm environment;</li> <li>Should prepare a project specific environmental management plan;</li> <li>The project should follow and implement zero liquid discharge policy.</li> </ul>
Department of Forest	Md. Abdul Jalil	Head Assistant	43	<ul style="list-style-type: none"> <li>As Mangrove Forest is located at the shore areas of Hatiya Upazila, the authority must make an environmental management plan so that it doesn't create any severe impact on mangrove forest.</li> </ul>
Department of Fisheries	Baraek Hosen	Officer	50	<ul style="list-style-type: none"> <li>Liquid waste should not be discharged into river or nearest khal without proper treatment;</li> <li>Authority should closely monitor so that any kinds of hazardous materials do not mix with water.</li> </ul>

Authority	Name	Occupation	Age	Comments
<b>NGO, Noakhali</b>				
ASA	Md Yousuf Ali	Assistant Branch Manager	42	<ul style="list-style-type: none"> <li>We will provide all kinds of support for the better establishment of the project;</li> <li>Local people should be given priority for both skilled, semi-skilled and unskilled job opportunities.</li> </ul>
RIC	Sayed Rabiul Islam	Branch Manager	39	<ul style="list-style-type: none"> <li>We support this project and think that, this project will create employment opportunity for local people;</li> <li>We expect, many industries will develop after the implementation of this project.</li> </ul>
Dwip Development Foundation	Md. Delowar Hosen	NGO Service	36	<ul style="list-style-type: none"> <li>Should use high technology so that any severe accident does not occur at the power plant;</li> <li>All the emission from plant should meet the guidelines of DoE;</li> <li>We expect the socio-economic condition of this area will flourish.</li> </ul>
BURO Bangladesh	Md. Jahir Ali	Accountant	50	<ul style="list-style-type: none"> <li>Authority must be aware of Environmental pollution;</li> <li>We need both power plant and pollution free environment, so the authority should make proper balance between them.</li> </ul>

## 12.6 Disclosure

The draft EIA report will be available for the public review Desh Energy Hatiya Power Company Limited website. Once the final version is ready, it will replace the draft version on the Desh Energy Power Company Limited website. The executive summary will be translated into Bangla and will be made available to the public.



**BPDB**



**Desh Energy**



**Burirchar Union**



**UNO**

**Government Officials, Hatiya**



**DOE, Noakhali**



**BWDB**



Department of Forest



Department of Fisheries

Government Officials, Noakhali



ASA



BURO Bangladesh



Dwip Development Foundation



RIC

NGO's, Noakhali

Figure 12.2: Photographs of Public Consultation at different Government Offices

## *Chapter 13*

### **13 GRIEVANCE REDRESS MECHANISM AND DISCLOSURE**

#### **13.1 Grievance Redress Mechanism**

Public participation, consultation and information disclosure undertaken as part of the local EIA process have discussed and addressed major community environmental concerns. Continued public participation and consultation has been emphasized as a key component of successful project implementation. As a result of this public participation during the initial stages of the project, major issues of grievance are not expected. During the operational phase of the project, the complaints that may be anticipated are mostly related to dust, noise & vibration of the engines and some other social and environmental issues. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances will be established. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable process. It should also be readily accessible to all sections of the community at no cost and without retribution.

The Grievance Mechanism will be implemented during both the construction and operational period of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties.

The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations should be available. Confidentiality and privacy for complainants should be honored where this is seen as necessary or important.

A grievance redress mechanism and procedures is setup to provide opportunity for project affected persons (PAPs) to settle their complaints and grievances amicably. The established grievances redress procedures and mechanism ensures that project affected persons are provided with the appropriate compensations and that all administrative measures are in line with the law. It also allows project affected persons not to lose time and resources from going through lengthy administrative and legal procedures. Grievances are first preferred to be settled amicably.

**15 MW HFO Fired Power Plant** shall set-up a grievance redress committee that will address any complaints during both the construction and operational period of the project.

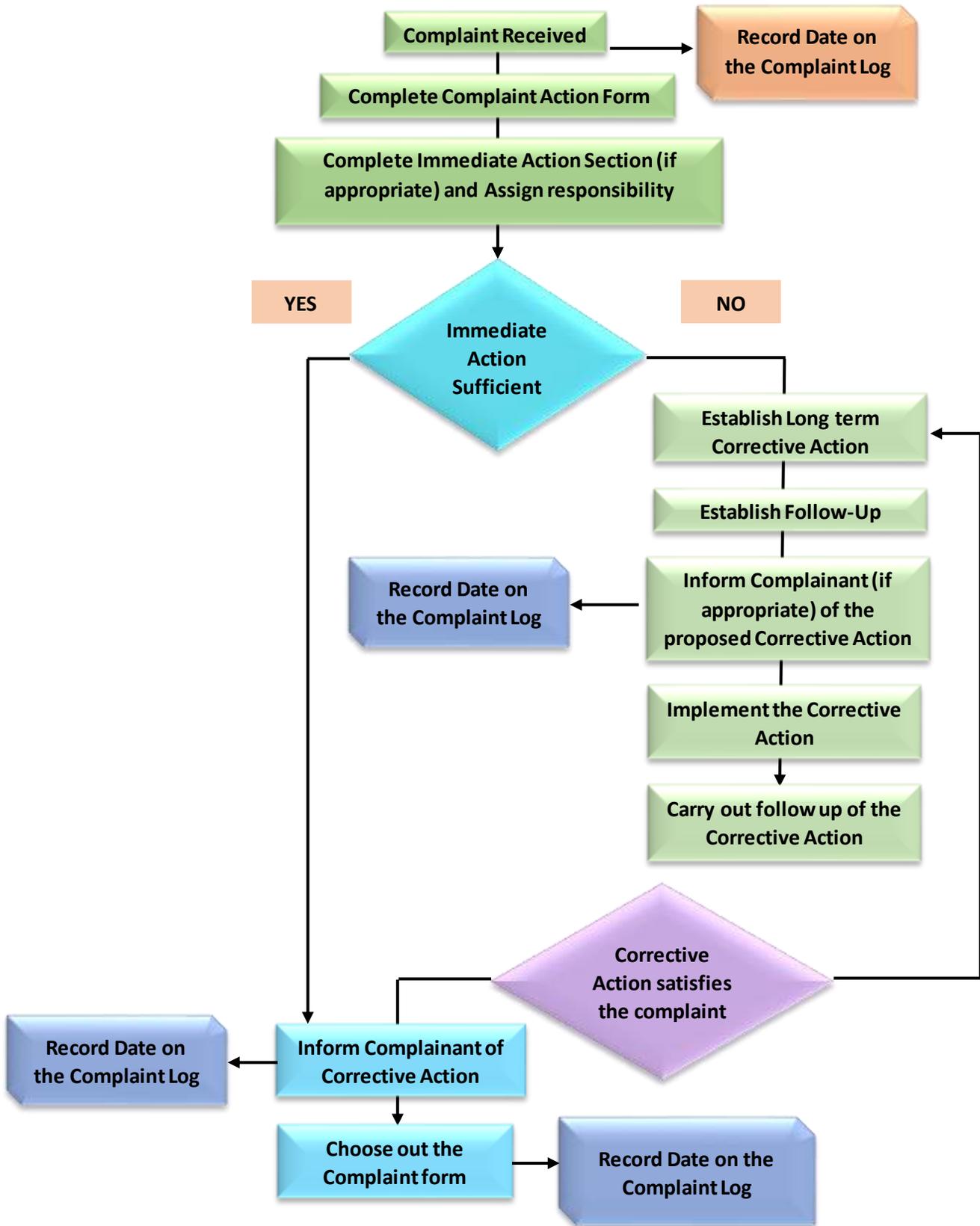


Figure 13.1: Flowchart of Complaints/Grievance procedure

The representation in the committee makes PAP'S to have trust and build confidence in the system. The grievance redress committee reports its plan and activities to the Implementation committee. The following list presents members of the committee:



**Figure 13.2: Member list of the Grievance committee**

- ✓ GRC will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome;
- ✓ The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand or uniform process for registering complaints provide project affected persons with free access to the procedures;
- ✓ The response time between activating the procedure and reaching a resolution should be as short as possible;
- ✓ An effective monitoring system will inform project management about the frequency and nature of grievances;
- ✓ GRC will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints Database are to be monitored and reviewed by third party consultant to ensure the required transparency;
- ✓ In addition to the above, if there are any grievances related to social or environmental management issues in the project area, the GRC will record these grievances and suggestions and pass it on to the relevant consultant for necessary action and follow-up;

- ✓ In case a dispute is not resolved by arbitral tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law;
- ✓ The preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties concerned.

A grievance form is presented below and hard copies of both English and Bangla will be made available at the project office.

**Table 13.1: Sample Grievance Reporting Form**

Contact Details	Name:
	Address:
	Telephone Number/ Cell Phone Number:
	Email:
How would you prefer to be contacted (please tick box)	<ul style="list-style-type: none"> <li>▪ By Phone</li> <li>▪ By Email</li> </ul>
Details of your Grievance  (Please describe the problems, how it happened, when, where, and how many times, as relevant)	
What is your suggested resolution for the grievance?	
Signature:	Date:

### **13.2 During Construction**

During construction phase there might be some complaints regarding constructional noise, dust pollution, Solid waste etc. However, unforeseen issues may occur. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances should be established during construction period.

### **13.3 During Operation**

During the operational phase of the project, the complaints that may be anticipated are mostly related to air, noise, vibration of the engines, solid waste generation and accidental issues due to the project etc. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

## **14 CONCLUSION AND RECOMMENDATIONS**

### **14.1 Conclusions**

The present EIA report finds that; though there are certain adverse environmental impacts associated with the industrial unit under consideration, these are manageable provided recommendations in the EMP are followed with due diligence.

The proposed project is located at Hatiya Island which is an off grid remote locality. Despite being only twenty kilometers away from shore, the island lacks any electricity grid connection. Desh Energy Hatiya Power Company Ltd. is going to set up the 15 MW power plant at Hatiya Island from which the state-owned Bangladesh Power Development Board (BPDB) will purchase electricity for over the next 15 years. This proposed power plant will supply uninterrupted power at Hatiya island for various purposes. The environmental impacts are of limited nature, whereas the benefits of the project are many.

The significant impacts during construction phase are-

- Dust and noise due to the construction activities;
- Dumping of construction wastes, accidental spillage of machine oil;
- Water pollution due to constructional waste;
- Increase in traffic volume;
- Occupational health and safety hazards;

If the management plans suggested are followed properly i.e. Regular water sprinkling to minimize fugitive dust emission; Noisy construction works to be limited to daytime hours and all employees likely to be exposed to ear noise to be provide with ear protectors; Collection and segregation of wastes and safe storage should be done; Supply good quality drinking water and adequate standard toilet facilities must be available at the construction site to the workers; The quality of drinking water should be checked periodically; Access to workplace must be restricted for community people to provide higher degree of safety and people working in the site must wear PPEs; Standard wage, wage deductions, hours of work, overtime arrangements, overtime compensation, leave for illness, maternity, vacation or holiday should also be maintained by the contractor; Child labor and forced labor should strictly be avoided; Speed limit and proper sign board should be provided along the connecting roads to the project site etc. then it is expected to mitigate the negative impacts due to the construction of this proposed power plant.

During operation phase the potential environmental and social impacts are associated with

- Air pollution due to fuel burn to produce electricity
- Dust and noise due to the operation activities;

- Solid and Hazardous waste management;
- Dumping of operational wastes, accidental spillage of machine oil etc.;
- Occupational health and safety hazards sanitation etc.

For mitigation of air pollution, the state-of-the-art technology will be used and emission of NO<sub>x</sub> and Sulfur dioxide (SO<sub>2</sub>) will be within the standard limit set by the Government. For noise, silencer in stack (noise level will be kept within 65dBA) will be used, ear protector equipment should be provided to the workers, green belt should be developed around the project site and the operation activity will be done in a housed condition. Moreover, Collection and segregation of wastes and safe storage should be done. Supply good quality drinking water and adequate standard toilet facilities must be available at the project area. Most of solid and hazardous materials will have to be disposed in safe disposal area while others will be sold in the market. Spill mitigation supplies including hoses, a boom of sufficient length, and absorbent materials should be located at the oil & chemicals unloading station.

One of the most critical issues for the project is safety. This has been adequately addressed through compliance with national building code (BNBC) in the construction to ensure safety during natural disasters like earthquake and cyclone and a full-containment for the HFO storage tank.

It is expected that the project will be an ideal for the nation. The project operator will use modern technology and follow all necessary measures to make it successful. Minimum impacts shall be produced on the surrounding environment on the condition that the mentioned mitigation measures are taken. The project site is reasonably selected and the project construction is feasible from the perspective of environmental protection.

Having reviewed all the potential environmental impacts and if followed by our proposed mitigation measures, the project is expected to proceed without having unacceptable environment. The area is likely to witness growth of industries and the growth can become certain if electric supplies could be provided to the area without much of load shedding. In this context, the proposed power station of a 15 MW capacity would be a welcome relief for the people in that area.

## **14.2 Recommendations**

- Plantation of trees of at least 33% of the total area of the power plant need to cover as green belt as per stipulation of DOE. However, plantation of trees shall be provided by planting trees of local species around the power plant boundary. Arrangement shall be kept for reusing water from effluent monitoring pond, etc. to the green belt area and horticulture elsewhere within the plant boundary;
- Internal environmental management in the company shall be reinforced to make sure that the environmental protection actions are implemented, the facilities are in normal operation and assistances are provided to enable the local environmental protection authorities to carry out the monitoring activities;

- Solid and Hazardous waste management is an important issue in this project. Some raw materials have secondary demand can be sold but other wastes must be disposed properly;
- All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP and regular monitoring of the project activities as mentioned in the environment monitoring plan during different phases of the project should be done;
- Environmental Management Plan and, Occupational Health and Safety Plan should be implemented at every step of plant construction and operation as per the suggestion;
- Greater efforts shall be made in the job training for operators of recycling devices to enable them to master the operational procedures and techniques so that the safety procedures are better managed;
- Public consultation/stakeholder consultation should be conducted regularly in every stage of the project to know the problems of local people and stakeholders related to the project activities.

However, no development can be expected without any adverse impact on the environment. The beneficial impacts on the nation as well as human beings would only be meaningful and sustainable development would only be possible if adverse impacts are minimized through strict maintenance and control measures as mentioned for this project. All this would need vigilant care and money and the project authority should take these into consideration.

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