AECOM

Environment

Volume I- Executive Summary (Chapter-1)

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Environmental Impact Assessment Study

635 MW Coal based Thermal Power Plant, Munshiganj District, Bangladesh

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1. EXECUTIVE SUMMARY

1-1 Introduction

1. Orion Group is one of the leading industrial conglomerates in Bangladesh with operations in the power and energy pharmaceuticals, cosmetics, infrastructure development, real estate and construction, high-tech agro products, hospitality, textiles and garments, sports event managements and trading sectors.

2. Orion Group proposes to develop a coal based power plant in Munshiganj District, Bangladesh through Orion Power Unit-2 Dhaka Limited (OPDL-2). Bangladesh Power Development Board (BPDB) had issued a Letter of Intent to Orion Group to design, finance, construct, own, commission and maintains coal based power plant (CPP) in Munshiganj district of Bangladesh for a period of 25 years. The plant will use ultra-supercritical steam technology, which will provide greater efficiency than conventional subcritical coal-fired power plants and require relatively lower coal consumption. The gross installed capacity of the plant will be 700 MW, with net output of 635 MW.

3. The proposed project being a thermal power project falls under the Red category as classified under Schedule- I of the Environment Conservation Rules, 1997. Hence, OPDL-2 has engaged AECOM India Private Limited to undertake an Environment and Social Impact Assessment (ESIA) for the project as per the requirements of the Environment Conservation Rules, 1997 and Term of Reference (ToR) approved by Department of Environment (DoE) for the project and to obtain Environmental Clearance Certificate (ECC).

4. ***Need of the Project***: Government of Bangladesh has assigned top priority to the development of power sector realizing its importance in economy, industrial and social development of the country. In this regard the government has set the vision to provide access to affordable and reliable electricity to all by the year 2021. The proposed project is part of the overall effort of the government to mitigate the energy crisis. Hence, to serve the purpose, Orion Group has taken initiative to install the proposed plant in Munshiganj, Bangladesh.

1-2 Justification for Acceptance

5. As per data gathered from Power Division's (subsidiary of Ministry of Power, Energy and Mineral Resources, Government of Bangladesh) estimates, an alarming increase of 38.05 % in power deficit has been depicted.
6. Between 2010 and 2016 the Bangladesh Government has plans to generate 14,773 MW of power. Among these, 6204 MW which is 42% of the total target will be from public sector. 8569 MW which is 58% of the total target will be from the private sector. Henceforth, to achieve the targets, the proposed Thermal Power Plant has been accepted.
7. Also as per generation plan presented by Power Plant, Bangladesh, nearly 800 MW of power could not be availed from the power plants due to shortage of gas supply. With a power sector which is almost dependent on natural-gas fired generation, the country is confronting a simultaneous shortage of natural gas and electricity.

8. Due to strong navigation networks in Bangladesh, transportation of coal with less sulphur content has become viable. Coal will be transported from Indonesia through barges to the site.

1-3 Key Facts and Findings for Decision Making

9. The Project is an Independent Power Producer (IPP) Project allocated to the Orion Group by the Bangladesh Power Development Board (BPDB), Government of Bangladesh (GOB). The Government of Bangladesh has provided Sovereign Guarantee in the form of repayment guarantee through the Implementation Agreement (IA) and BPDB has provided Off-take guarantee through the Power Purchase Agreement (PPA).
10. BPDB will set up Inter connection & Transmission Line at its own cost for Bulk Power Transmission to nearest substation, which is Meghnaghat substation of Bangladesh.
11. The BOD has also approved a) Warehousing Policy Asset Disposal Policy and c) Procurement Policy.
12. Orion Group has a long standing successful track record in the infrastructure implementation work and power sector development in Bangladesh. The Group has so far completed the commissioning of 2 power plants totalling up to 200MW. All of these projects have been completed within the original time frame and budget.
13. The Operations and Maintenance of the power plant would be done by a reputed and experienced O&M Contractor. The O & M Contractor will be required to guarantee 85% plant load factor throughout the Term of the Agreement.
14. The project will utilize coal for generation of electricity. However, the emissions will be controlled by incorporation of various pollution abatement equipments like ESP, low Nox burners to capture SOX, NOx and particulate materials. The project would comply with all applicable environmental rules as mentioned in ECR, 1997.
15. A thermal plume study has evaluated the impacts of the heated water discharged from the outfall to the Meghna River and Dhaleswari River. Temperature exceedance plots showed that the plume is localized around the outfall. The heated water from the outfall has low impact on the main Meghna River.
16. There are no houses on proposed land, hence no issues related to resettlement or rehabilitation was identified.

1-4 Any Alternative Considered

17. The total Power Generation of BPDB, comprises 68% from Gas, whilst 21% from HFO/HSD/FO and rest from Hydro. Although the cost of Coal fired generation of Electricity is proved to be comparatively cheaper than HFO/HSD, the available potential for Coal Fired Electricity has not been harnessed throughout last few decades. With depleting resources of Gas Reserves, the BPDB has now diverted the attention largely on Coal Fired Generation of Electricity, if the country is to meet the ever increasing Power demand for Domestic & Commercial Purposes.
18. The availability of gas in Bangladesh is on decline. Non-availability and un-affordability of fuel such as natural gas or oil is an important factor to consider in Bangladesh. To transport natural gas, large investment in infrastructure is also required. Also, there is a significant

demand existing for gas from other industrial consumers and transportation making it a commercially unviable option furthermore. Hence, by considering the alternative of fuels supplied, coal based thermal power plant is most feasible one.

19. Towards this objective, Bangladesh Power Development Board (BPDB) has issued Letter of Intent (LOI) to Orion Power Dhaka Ltd to design, finance, insure, construct, own commission and maintain (635x1) MW (Net) coal fired power plant in Dhaka for a period of 25 years. This Power Plant will be built on super technological mechanism to minimize/eliminate the exhaust waste to ensure environmental friendly.

1-5 Approach and Methodology

20. The Environment Impact Assessment study for the project has been carried out as per the requirements of the Environment Conservation Rules, 1997 and IFC's Performance Standards and approved TOR by the DoE. A regulatory review was undertaken in order to understand the applicable, local and national legislation and regulatory frameworks. Collection of secondary information on social aspects of the site and consultations with the local community to understand community perception with regard to the project and its activities has also been carried out. Assessment of impacts, including cumulative impacts was undertaken based on understanding of the project activities and existing baseline status.

1-6 Policy, Legal and Administrative Framework

21. This ESIA study has been commenced with the objective of obtaining Environmental Clearance Certificates from the DoE. A set of Policy, Acts and Administrative Framework require for a new coal based thermal power plant. According to the ECR, 1997 this power plant project falls under red category where environmental clearance certificate from DoE is mandatory. Chapter 3 of ESIA has detailed out of the relevant national acts and rules in different phases of the power plant project.

22. A brief description of the relevant legal relevant enforcement agencies has been described which are responsible for enforcing the relevant policies and EHSS legislations. Applicable national and international standards pertaining to ambient air quality, noise levels, water quality, discharge of liquid effluents, has also been detailed. Bangladesh has signed and ratified several Multilateral Environmental Agreements (MEAs), International Labour Organisation (ILO) Conventions and international maritime conventions. Details have been provided in section 3.9 of ESIA report.

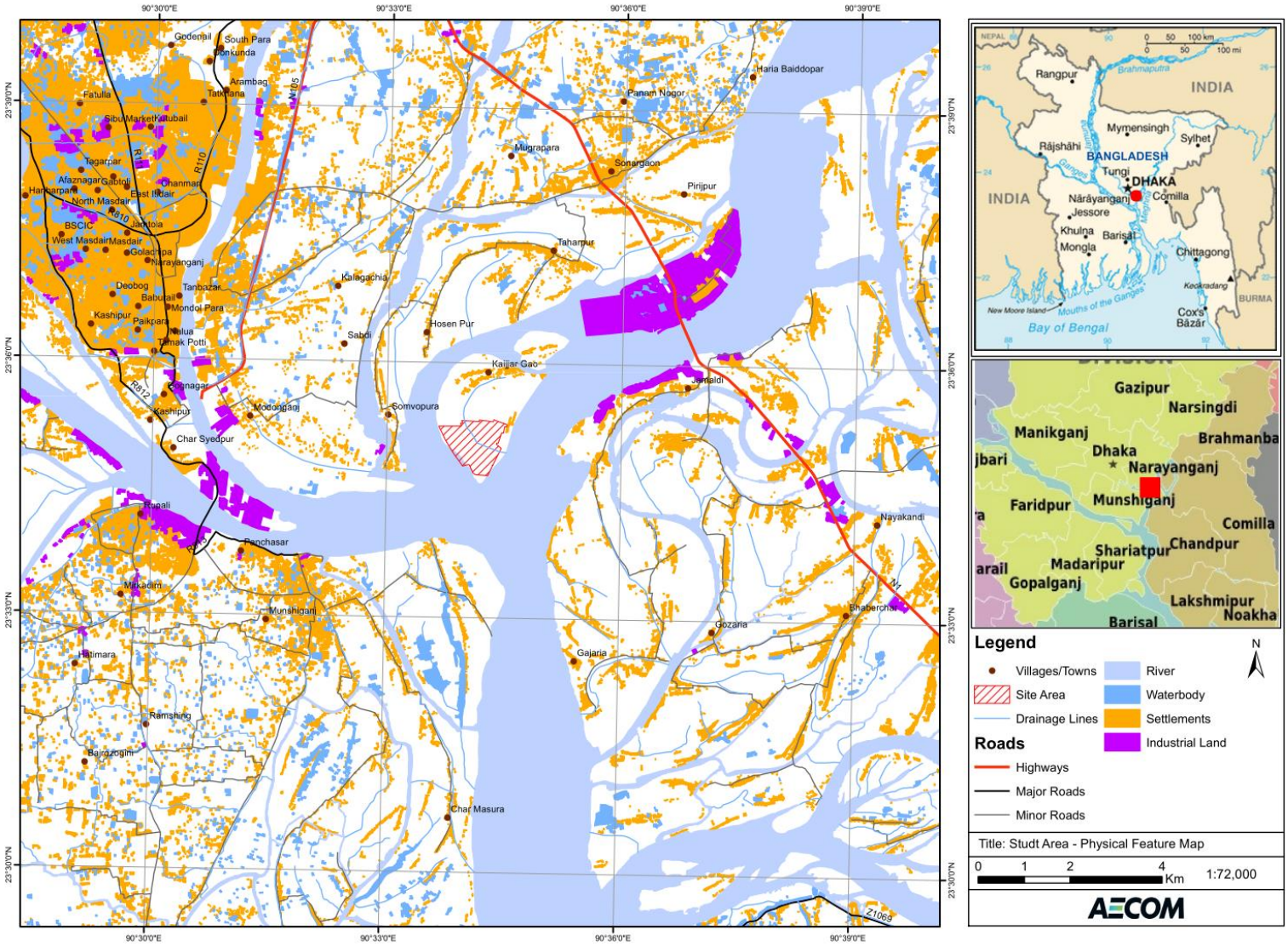
1-7 Project Description

A. Site Location

23. The project site is located at a distance of about 40 km from Dhaka in the southeast direction. The district headquarter, Munshiganj is located at an aerial distance of about 5 km from the project site. The Dhaka–Chittagong Highway (N1) is located at a distance of about 5.3 km from the site in the south west direction. At present, the site is not accessible by

roads and can be approached only through country boats plying from Meghna Ferry Ghat which is at a distance of about 5 km from the project site. The physical features map of the site has been illustrate in Figure below.

Figure 1-1: Site Connectivity



B. Process Description

24. The proposed power plant is based on Pulverised Coal (PC) combustion and a water-steam thermodynamic cycle. It is proposed that the coal will be a very fine powder that will be mixed with preheated air. The water will be heated and pressurized beyond the critical point to superheat temperatures and pressures (279.9 bar, 603˚C) in the once through ultra-supercritical Benson type boiler. The proposed plant layout has been shown in Figure below.

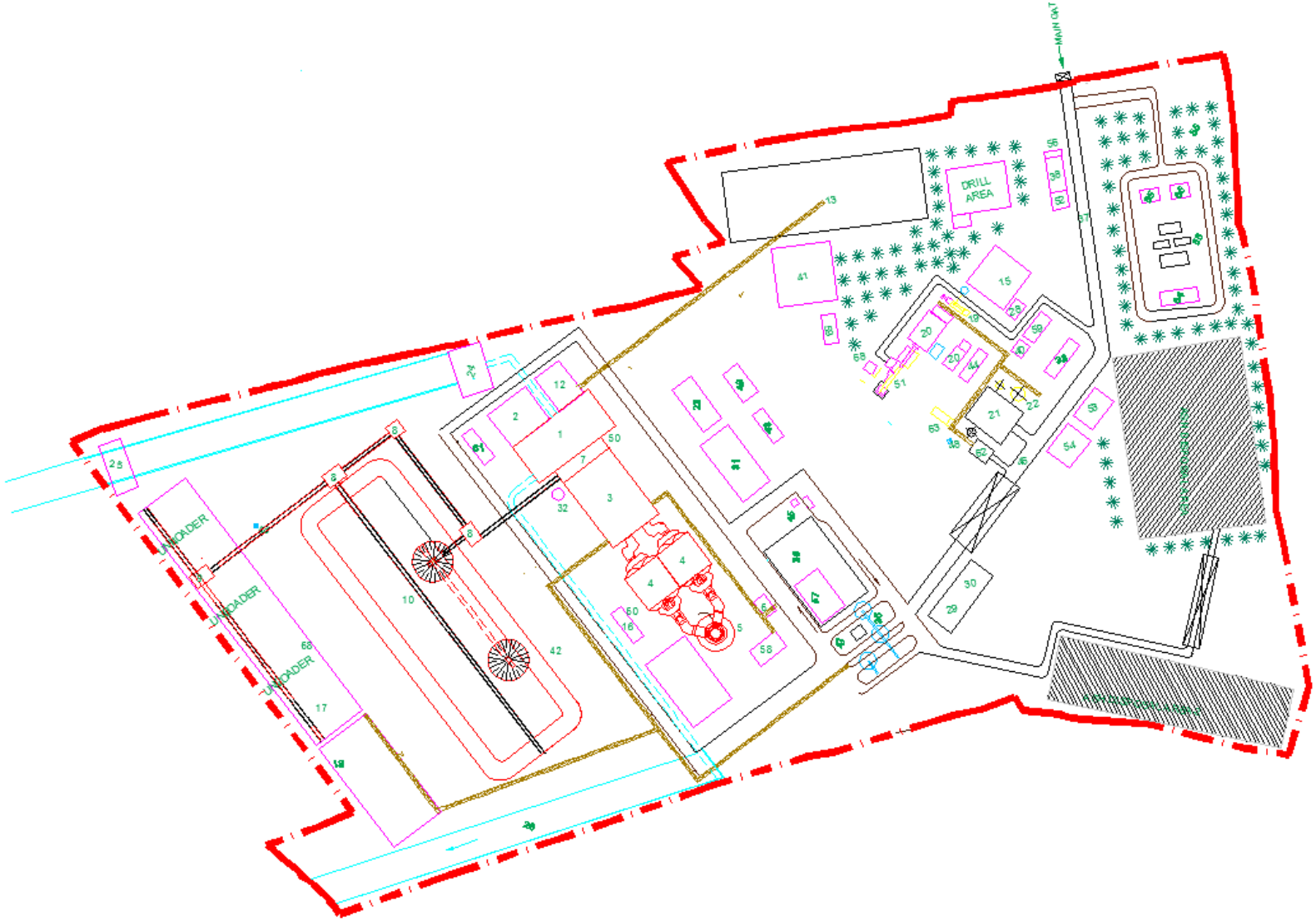
25. The steam that will be formed will be piped to the three turbine sets connected to three-phase electrical generators which will generate an intermediate level voltage. This will be stepped up by the unit transformer to a voltage suitable for transmission (typically 400 kV) and will be sent out onto the three-phase transmission system.

Table 1-1: Project Components at a Glance

Component	Design condition
Plant Configuration	Ultra-supercritical PC (Pulverised Coal)
Carbon capture	Nil
Gross power output	700 MW
Net power output	635 MW
Plant Load Factor	85 %
Primary fuel (type)	Bituminous and Sub-bituminous Coal having GCV of 26,050 KJ/Kg (after mixing) and Sulphur content (maximum 0.9%)
Source of fuel	Coal will be imported from Australia, Indonesia and South Africa.
Coal Consumption	212 tonnes/hour (at 100% plant load factor)
Land Area	112 acres
Stack height	275 m
Water Intake (Make up water)	80140 m^3/hr
Water discharge after treatment	80000 m^3/hr
Water consumed	140 m^3/hr

Source: OPDL-2

Figure 1-2: Plant Layout



C. Plant Configuration

26. **Coal Systems:** The coal for the proposed project will be sourced from Australia and Indonesia. It will be transported to the site in barges. The wharf will be provided with 6 shore cranes of 25 tonne capacity each fitted with 8 tonne grabs. The coal will be conveyed from the wharf to the coal yard by means of belt conveyor. The covered coal yard will have a minimum capacity of 300,000 tonnes. The entire coal handling system should be designed as an enclosed conveyor system and will be equipped with automatic dust detectors and runoff pits with drains.

27. **Boiler Specifications**: The proposed plant will comprise of a opposed wall fired Benson once through two pass radiant- type super critical boiler with a super heater steam system. The rated steam conditions at Boiler Maximum Continuous Rating (BMCR) will be having 279.9 bar as outlet pressure and 603°C as outlet temperature. Light diesel oil (LDO) will be used for the cold start of boiler load up to 7.5 % BMCR and for auxiliary steam boiler. Heavy fuel oil (HFO) will be used for start-up of the boiler and during low load up to 35% BMCR.

28. **Steam Turbine Unit**: The steam turbine will receive steam from the boiler unit and will run at a speed of 3000 revolutions per minute (RPM). The turbine unit will be provided with five (5) low pressure heater steps, one (1) de-aerator storage tank, three (3) high pressure heater steps and one (1) high pressure de super heater. The turbine unit will generate 700MW at Turbine Maximum Continuous Rating (TMCR). It is also capable of generating 723 MW at valve wide open (VWO) condition.

29. **Cooling Water Systems**: The cooling water system will be once through cycle (OTC) which will provide the water for condenser that will be drawn from Meghna River.

30. **Air Flue Gas and Combustion System**: The air intake will be as per the ambient design condition (i.e. Temperature – 7 to 42 ˚C, Relative Humidity – 40-70% and pressure of 1013 mbar). The mills will be equipped with rotating classifiers and meet the design coal specifications. The boiler will be equipped with low NOx burners to reduce primary NOx.

31. **Power Evacuation System**: The power generated will be evacuated through 400 kV transmission lines to the Meghnaghat substation of Bangladesh Power Development Board located at a distance of about 3.5 km from site. This transmission line will then connect to the 400 kVA national grid line and finally connect to the existing Meghnaghat Substation.

1-8 Resource Requirements

32. **Land**: The proposed project will be spread over an area of 112 acres across Bhati Balakia and Char Balakia villages falling under Char Betaki Mauza. The project area comprises of low lying land and is vulnerable to submergence during the monsoon season. The land for the proposed project comprises of private agricultural land. The land has been procured on willing seller willing buyer basis and individual negotiations were carried out by OPDL-2 with the land owners.

33. **Water:** About 80,140 m^3 /hr of surface water will be sourced from Meghna River for once through cooling water system of the proposed project. The major demand for water will be for cooling water system and has been estimated as 80,000 m^3/hr which will involve extraction of water from the river and discharge of the heated water back to the river. The total water consumed for the cooling purpose is 140 cubicmeter/ hour while the total water to be consumed is 273 cubicmeter/ hour including domestic purposes.

34. **Manpower:** During construction phase, the labour requirement will range from 1000 – 1500 during normal operations and 2500-3000 workers for peak construction activities. About 250-275 workers will be involved in the Operations and management (O&M) activities for the proposed plant. The construction labour is proposed to be accommodated in two labour camps.

1-9 Project Utilities

35. **Water Treatment Systems**: The raw water will be treated with treatments comprising of disinfection, aeration, clarification, continuous sludge removal and final filtration. A demineralisation (DM) plant will be installed to supply make-up water to the water steam cycle, condensate make up and condensate polishing regeneration. A potable water treatment system will be provided to supply water for domestic consumption.

36. **Waste Water Treatment Systems**: Process effluents will comprise of effluents from clarifier, DM Plant, condensate polishing unit, boiler blow down and other process drains, service waste water, Boiler air pre-heater washing etc. Domestic waste water will be generated from the accommodation facility provided for the workers and staff during the operation. There will be runoff from process and other plant areas which will be channelized to collection basins or to natural drainage, as appropriate.

37. **Fire Protection Systems**: The system will comprise of water firefighting system, fire extinguishers, fire extinguishing water tank and fire extinguishing water pumping station.

38. **Air emission control system:** An electrostatic precipitator (ESP) and Fabric Filter combination will be installed to effectively remove the small particulate matter from the exhaust flue gas. The nitrogen oxides will be controlled through installation of low NOx burner and through other techniques such as over fire air. There will be provision of stack with a height of more than 275 m.

39. **Effluent treatment system**: A central effluent treatment plant with the facilitation of Central Monitoring Basin (CMB) has been planned to collect, treat and dispose all the plant effluents. All the plant liquid effluents shall be mixed in CMB and quality of the effluent shall be measured and monitored as per DoE's standard for effluent quality.

40. **Ash Handling and Management System**: Pneumatic conveying system (either vacuum system or pressure system) will be employed for conveying of fly ash from the electrostatic precipitator / Fabric Filter hoppers in dry form. Dry ash will be collected and transported in

dry form to storage silo for utilization. A slag type wet bottom boiler will be provided for bottom ash handling and storage.

41. **Green Belt Development**: Green spaces have been planned near the Administration building, Parking area, Dormitory Area, and Ash Disposal Area. A three-tier greenbelt has been proposed at various locations within the plant premises.

1-10 Project Cost

42. The total cost of the project has been estimated at USD 856 Million . The cost for pollution control abatement measures will be USD 1.98 Million.

1-11 Evaluation of Alternative Sites

43. Two sites were considered as part of project conception, the locations considered were:

- Near **Mawa,** 5-6 km away from Dhaka – Mawa road , along the bank of Padma River
- Approximately 2km from **Kajjar Gao**, along the bank of Meghna River

The locations considered have been shown in Figure Below:

Table 1-2: Selection Criteria for Proposed Plant

Criteria	Site I	Site II
Location	Near **Mawa,** 5-6 km away from Dhaka – Mawa road , along the bank of Padma River	Approximately 2 km from **Kajjar Gao**, along the bank of Meghna River
Topography and Land Use	Flat with the presence of scattered settlements.	Low lying area requiring filling
Need for Resettlement	There are scattered settlements on the proposed site.	There are no houses on the proposed project site.
Connectivity/ access	The road connectivity needs to be developed apart from river navigation	River navigation is the only mode of transportation.
Fly Ash Transportation	No industrial units are located near the proposed site.	Cement manufacturing plants are located near the proposed project site.

Source: Assessment of GIS Maps, AECOM

Site II is selected for the following reasons:

- No physical displacement is envisaged.
- Utilization of fly ash in nearby cement manufacturing units.

Figure 1-3: Site Opted for the Proposed Project

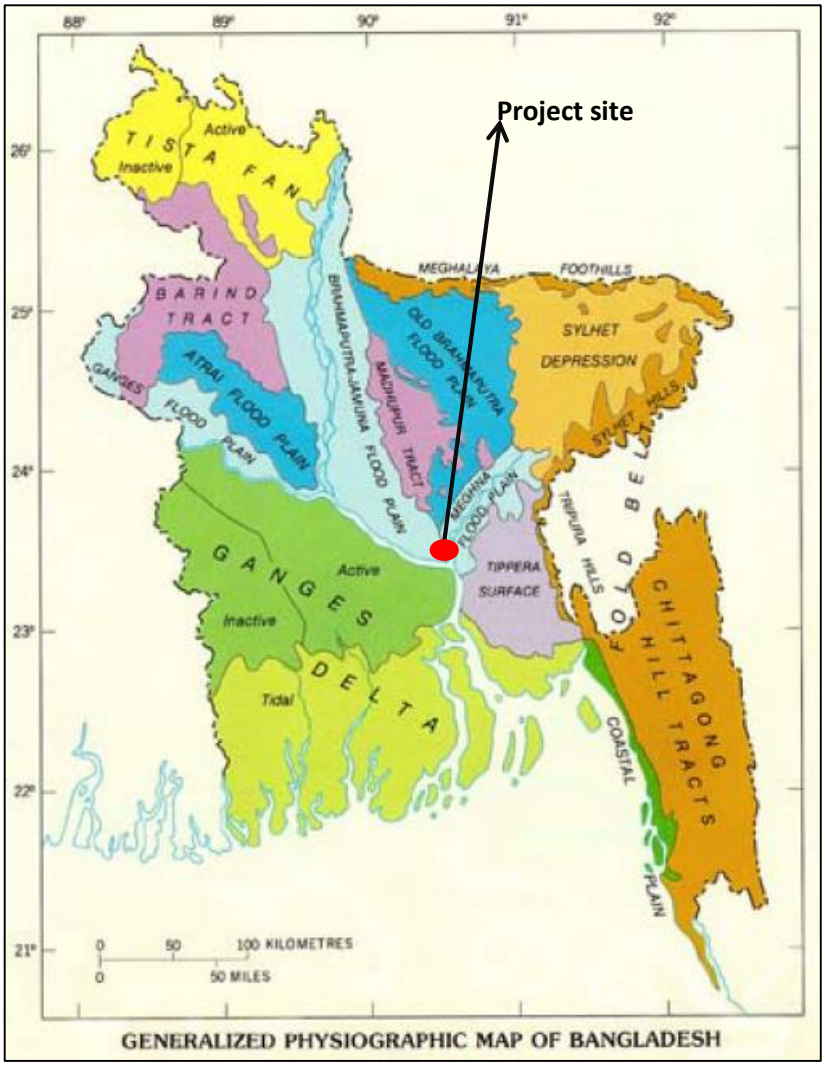
1-12 Existing Baseline Environment of the Project Area

44. Baseline information about the project area was collated through site surveys, primary monitoring and literature review by AECOM and information collected from various agencies i.e. Bangladesh Meteorological Department, Geological Survey of Bangladesh, Forest Department, Bangladesh Water Development Board, Ministry of Water Resources, Bangladesh Agricultural Development Corporation (BADC), and primary monitoring carried out during the period of April, 2016 to February, 2017 by Adroit Environment Consultants Limited (AECL).

45. **Study Area:** An area of 10km radius from project site was considered as the "study area" for baseline assessment.

46. **Site Settings**: The proposed project site is located within Hossaindi Union of Gazaria Upzila (Sub-district) in the central Zila (District) viz., Munshiganj Zila of Bangladesh. The site is located at an elevation of about 2-5m above mean sea level (amsl), with River Meghna and River Dhaleshwari flowing to its east and west borders respectively. The site is situated to the south of a V- shaped island formed through meandering of River Meghna from its main course. No archeologically important monuments or ecologically sensitive zones are located within the study area. The rural population in the study area reside in scattered settlements separated from the island. Physiographic map of Bangladesh has been shown below.

Figure 1-4: Physiographic Map of Bangladesh



47. **Surface Geology and Seismicity**: The study area tectonically is located in Barisal-Chandpur High tectonic zone, which forms a part of Bengal basin –an extensive alluvial plain of the Quaternary sediments laid down by Ganges-Brahmaputra-Meghna river system. It is characterized by general gravity maxima with slope towards SW-NE direction. The study area occurs in the seismic zone II where the possible maximum earthquake magnitude in Richter's scale is 8.0.

48. **Geomorphology**: The study area falls in Arial Beel agro ecological zone which comprises majorly of lowland and a part of Medium lowland. The soils of this area are dark grey and comprises of acidic heavy clays. Organic matter content generally exceeds 2% in the top and subsoil present in this zone and moisture holding capacity is inherently low. They have high Cation Exchange Capacity (CEC), and general fertility level is medium to high.

49. **Hydrogeology:** Most of the present land surface of the study area is covered by the Holocene flood plains deposited by the Ganga Brahmaputra Meghna river systems. These

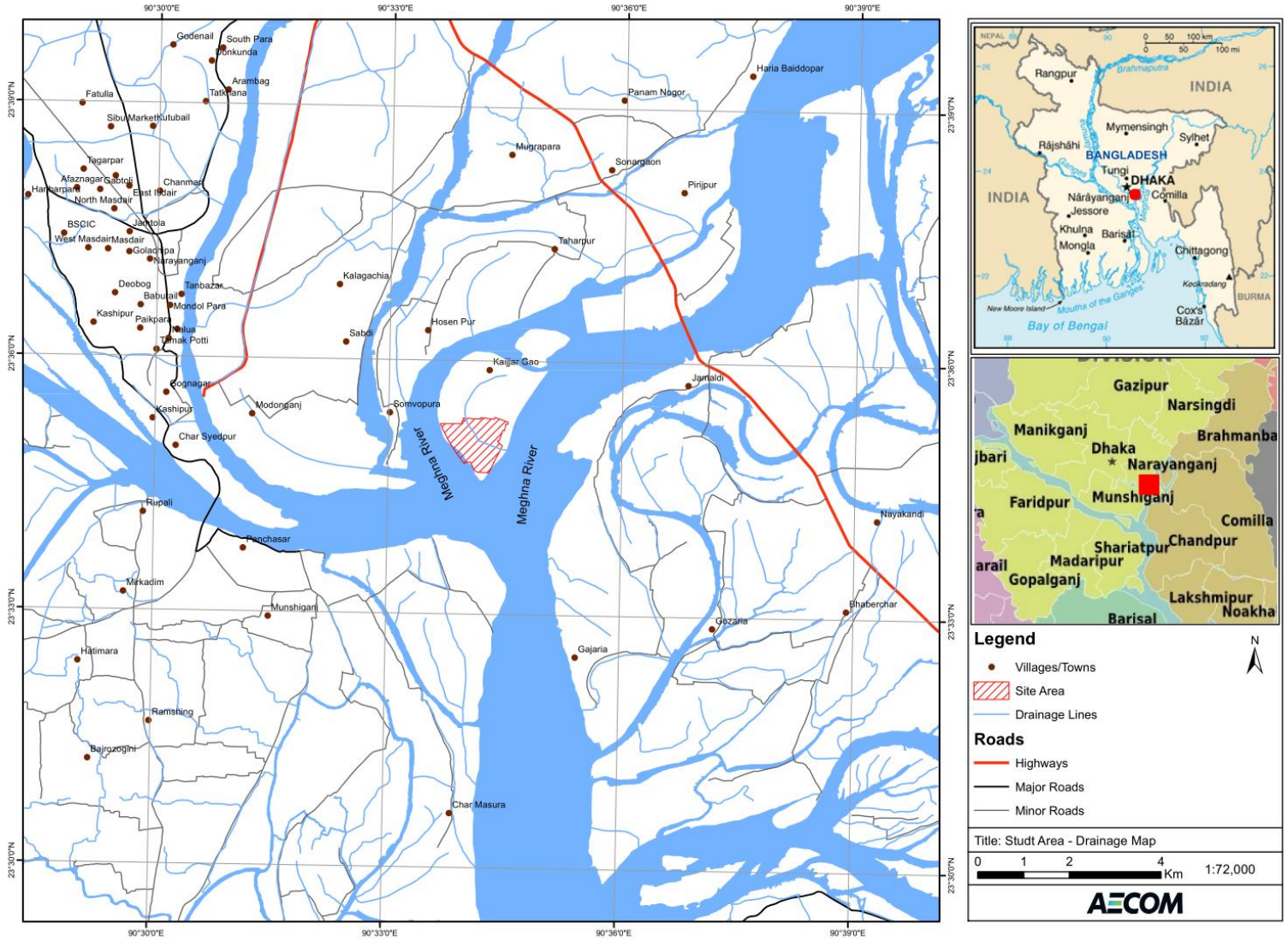
deposits are composed primarily of silt and sand of appreciable thickness extending to depth of more than hundred meters.

50. **Surface Water Quality**: It was observed that Total Dissolved Solids (TDS) in the samples varied from 133mg/L to 370 mg/L. They are significantly lower than the DoE permissible limit of 2100mg/L. The BOD of the water samples collected ranged from 6 - 8 mg/L whereas the COD values ranged from 14 – 18 mg/L. The values indicate that organic matter present in the water is very less and are significantly lower than the maximum limits prescribed by the DoE viz. 50mg/L and 200 mg/L respectively.

51. **Ground water quality:** Three ground water samples were collected and evaluated against the DoE prescribed standards for drinking water. The TDS levels in the samples were found to vary from 170 -270 mg/L and TSS concentration from 2.6 – 3.9 mg/L. All three samples were found to be colourless and turbidity was well within the prescribed limit of 10 NTU. Presence of Total and Faecal Coliforms was observed to be present in sample location of Pachani.

52. **Drainage Pattern and Flood Scenario:** The study area forms part of large depression lying between the Meghna and Dhaleshwari rivers in the south of Dhaka region. The area is characterised by low-lying delta plains and flood plains with meander channels, meander scrolls, natural levee and back swamps formed by the River Meghna and its tributaries with elevations ranging between 1-4 m above mean sea level. The main causes of floods are excessive precipitation, low topography and flat slope. Drainage map of the area has been shown below.

Figure 1-5: Drainage Map of Study Area



53. **Climate and Meteorology**: The climate of this region is tropical accompanied with monsoons and characterized by a change of four seasons. The annual average rainfall in the area is 1900 mm and more than 90% of the annual rainfall occurs during June to September. Pre-monsoon season commence from March and continues till the last week of May. Dry or winter season starts from in early December which remains till end of February. The annual average wind speed during the period (2007-2012) was observed to be 1.6 m/sec at Dhaka meteorological station.

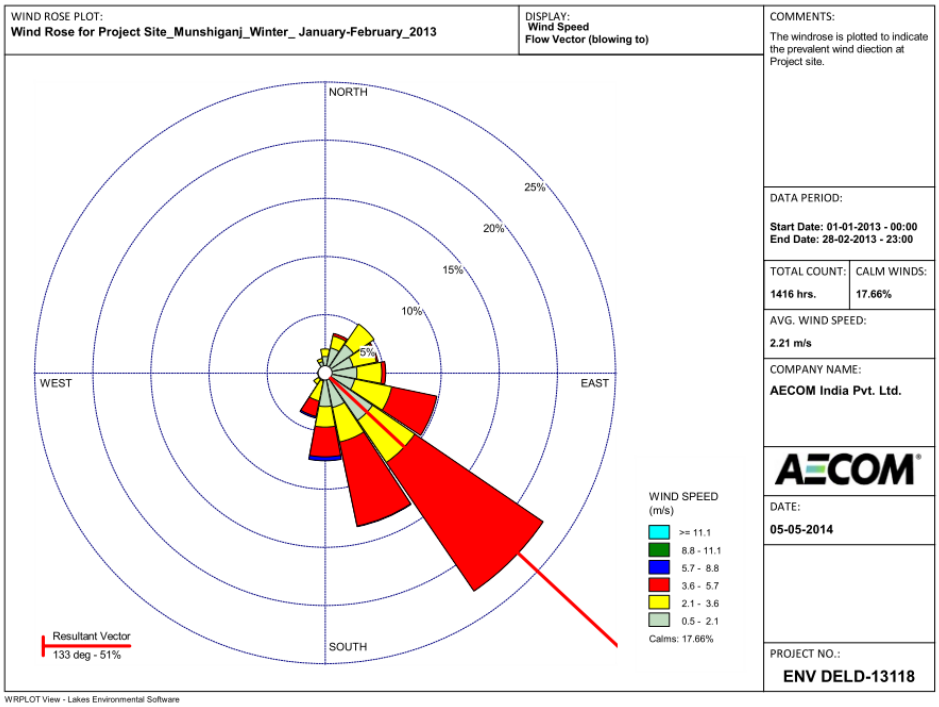
Table 1-3: Meteorological Data (based on observations from 2007-2012)

Month	Temperature		Relative Humidity (%)	Rainfall (mm)	Mean Monthly Wind Speed (m/sec)
	Daily Max(°C)	Daily Min (°C)		Monthly Average	
January	9.92	28.53	69.2	5.7	1.4
February	12.13	32.25	57.7	22.7	1.6
March	16.67	36.07	57.8	29.7	1.9
April	16.52	31.02	66.5	116.2	1.7
May	17.80	30.70	72.2	184.5	1.7
June	18.92	29.93	65.7	368.7	1.6
July	20.27	29.17	67.2	456.8	1.3
August	20.27	29.38	67.2	342.5	1.1
September	20.32	29.20	66.3	188.7	1.3
October	16.93	29.40	62.5	151.2	1.7
November	13.68	27.27	57.8	19.2	1.4
December	9.62	24.32	60.8	13.5	1.1

Source-Bangladesh Meteorological Department

54. A weather station was installed at Vati Bolaki Govt.Primary School, Hossendi, Gozaria, and Munshiganj for continuous recording of data for 24-hour period for during April 2016–February 2017. The average temperature in the study area during monitoring period was 20.2°C while the maximum temperature went up to 31.9°C. It is observed that the predominant wind directions are towards SE during winter (northeast monsoon), NNE during summer (pre-monsoon), and NNW during monsoon and WNW during autumn (post-monsoon) months.

Figure 1-6: Wind Rose diagram for study area for Winter Season (January-February 2013)



Source: Lakes Pre-processed Met Data

55. **<u>Ambient Air Quality</u>**: Ambient air quality was monitored at four locations for a period of 12 weeks within study area. Six parameters were analysed which includes PM2.5, PM10, SPM, SO2, Nox and CO. PM 2.5 values monitored at all four locations were in the range of 17-86 µg/m^3 and well within the DoE limits except at Chorhogla (AQ-3). PM 10 concentrations in excess of the prescribed limit were recorded at all the four locations ranging from 46-310 µg/m^{3}owing to the proximity to cement plants, market areas and busy ship routes.

56. SPM concentrations at all the four locations were found to be significantly higher than the DOE limits due to proximity to cements plants, markets areas and busy ship routes. The concentration across the locations ranged from 107µg/m^3 to 589µg/m^3. SO2 concentration at all the four locations is well within the DoE limit which 365 µg/m^3. NOx levels at all the monitoring locations are much lower than the maximum limit prescribed by the DOE. The observed concentrations of CO at all the four locations are significantly lower than the prescribed limits.

57. **<u>Surface Water Quality</u>**: Total Dissolved Solids (TDS) in the samples varied from 133mg/L to 370 mg/L in all three samples collected. The total hardness in the samples varied from 57.0 mg/L to 75.0 mg/L. The recorded total alkalinity in the samples ranged from 50 – 70 mg/L. Calcium (Ca 2+) concentration in the water samples were found to range from a minimum of 14.8 mg/L in sample taken from Pachani village (SW 3) to a maximum of 18.4 mg/L in sample taken from Goalgaon (SW2).

58. The BOD of the water samples collected ranged from 6 - 8 mg/L whereas the COD values ranged from 14 – 18 mg/L. A significant number of total and faecal coliform bacteria were

found in the collected water samples. The lead, cadmium and arsenic concentrations in water samples collected were observed to be less than prescribed limits of DoE.

59. **Soil Quality**: Soil Samples were collected from three locations and tested for nine (9) parameters. The soils in the area are slightly basic in nature with pH values ranging from 6.02 –6.78. Electrical conductivity values in the samples varied from 0.03 to 1.15 dS/cm. Nitrates in all the three soil samples were found to be 30.0 mg/kg whereas the nitrites ranged from 0.98 – 1.26 mg/kg. Phosphate levels were observed to be 10.94 -13.11 mg/kg.

60. **Ambient Noise Levels**: Noise levels were monitored at six locations within the study area. The noise levels at the receptor locations ranged from 57.8 dBA to 65.3 dBA during daytime and 41.8 dBA to 60.9 dBA during night time.

61. **Traffic Volume Survey**: A traffic volume count survey was conducted at two locations on roads connecting the project site in terms of Trucks, bus, Car, Jeep and Motorcycle. Daily traffic volume at the highway was found to be 9145 units and Daily traffic in the premises of Meghnaghat Power Limited was found to be 334 units.

62. **Terrestrial Ecology**: Six locations were identified to cover the entire study area and it was observed that the survey-area represents a tract of slightly degraded Tropical Seasonal Swamp Forests. Flora recorded from the study area revealed that 5 species were abundant, 25 species were frequent, 54 species were occasional, 44 species were rare. The most commonly found species in the region are Ijol, Jam and Hudo. The region is home to at least two species of mammals, four species of birds and two species of reptiles are endemic. At least seven mammalian species, twenty-one avian ones, fourteen reptilian ones and four Piscean ones, designated as being of special conservation-concern (Critically Endangered, Endangered, Vulnerable, Threatened or Near Threatened) by the IUCN, are associated with the region in which the survey-area is located.

63. **Aquatic Ecology**: A comprehensive aquatic ecological survey was conducted around project site during the month of January, 2014. Several types of big fishes like Rui, Catla, Ayre, Mrigel, Boal along with different types of small fishes were observed during the survey. According to the interviews conducted with fishermen it was learnt that the rivers becomes devoid of fishes in the dry season. However, in the rainy season, few types of fishes become available.

Figure 1-7: Fishing using Bamboo Barrier in River Meghna

Figure 1-8: Vessels polluting River Meghna

Figure 1-9: Species of Fish Captured during Sampling

64. **Socio- Economic Conditions**: The project influence area for this project has been delineated within 3 km around the proposed project area. The total population of the three influenced villages viz. Bhati Balakia, Char Balakia and Shaheed Nagar (extension of Char Balakia village) is 3550, with an average household size of 5. Char Balakia and Hosseindi Union have skewed sex ratios, with 112 males per 100 females and 113 males per 100 females, respectively. The literacy rate in the villages ranges from 28.9% to 53.1%. The highest proportion of workers draws income from agriculture and allied activities, followed by Industries and services. Although Gazaria Upazila has a very small ethnic population, there are no ethnic groups living in the project influenced villages.

65. According to the 2011 census, amongst the three project influenced villages, Goail Gaon has the most access to electricity (31.7%), followed by Bhati Balakia (18.8%) and Char Balakia (15.6%). The project influenced villages utilise ground water the most for consumption. While other villages have a proportion of population using other sources of water, Char Balakia village sources its need for drinking water entirely from bore wells.

66. **Social Consultation:** Consultations were carried out in project influenced villages through social questionnaire survey. In both, Bhati Balakia and Char Balakia villages, everyone interviewed and spoken to was found to be literate and educated till at least 5th standard. Community consultations further revealed that internationally funded and managed health intervention programmes such as the Polio immunization, were routinely conducted. Amongst the respondents, it was observed that not all community members were aware of the project components. However, there were sections that were well appraised about the project's associated benefits and risks.

67. The key concerns of the locals include safety of women due to labour influx, adverse effects on the fish population in Meghna River and preference of outside workers over locals by the project proponent. The locals expect generation of better employment opportunities, improved transportation facilities and enhancement of local businesses due to the upcoming project. The photographs of public consultations has been depicted below

Figure 1.10 Consultations with community members

Figure 1.11: Public hearing near proposed OPDL-2 site, Munshiganj

1-13 Impact Assessment and Mitigation Measures- Pre Construction Phase

Land Form:

68. *Impact:* The land for the proposed project comprises of agricultural and grazing land. A total of 112 acre of private land has been procured for the proposed project. The existing low to medium high land within the project area will be changed to high land by filling it up by river sand.

69. *Mitigation Measures:* No major mitigation measure is required except to ensure that the Project maintains more than 30% of the area under green cover to offset some adverse impact of land use change and merge with the surrounding rural settings.

Natural Resource:

70. *Impact:* Significant amount of aquaculture was also observed around the site with small fish/shrimp ponds strewn all across the proposed site in the Meghna River. Preparation for constructions activities may change the visual landscape of the project area. Site clearance activities, gathering of equipment and construction materials, machinery and camp establishment may affect the natural resources.

71. *Mitigation Measures:* Land surface contours shall be restored in relation to the surroundings. It shall be followed by developing drains and providing adequate slopes across the project site prior to start of construction work thereby ensuring adequate cross drainage for quick evacuation of catchment water. All excavated soil and dredged material shall be utilised for filling up the low lying area;
72. Dredged material shall be tested for its chemical characteristics to avoid contamination of land and surface water. Diversion dykes shall be constructed to channel surface runoff to the Meghna River. Topography and drainage of all areas, under the direct control of Construction Contractor, and affected by the establishment of power plant or other area shall be restored immediately after the activity culminates;

Eco Systems:

73. Impact: The site does not have any significant vegetation cover, as the land though agricultural in nature was not extensively used for the same owing to its submergence during the monsoon period. Also ecology survey suggests that huge number of floating water hyacinth for trapping of fish is practised in the study area. However, clearing and filling of area will have a negligible effect on the aquatic biology.

74. *Mitigation Measures:* The water supply pipeline intake point from the feeder canal shall be provided with sufficient screening to filter out larger aquatic organisms (e.g., fish, frogs, and toads) and foreign matter, preventing them from being drawn into the pumps;

Drum screens shall be provided in order to limit the entrainment of fish in the cooling water system and intake velocities should be as low as possible (preferably less than 0.5 m/s during normal conditions). Spot-check of shipping and barging activities by relevant agencies shall be carried out.

Ambient Air:

75. Impacts: The proposed project involves construction activities like land filling, earth works, site preparation civil construction, mechanical construction, handling and stocking of construction materials, construction materials processing, construction activities, vehicle movement, etc. may generate fugitive dust particles. The generation period will be short and will limited to the project boundary.

76. Emission of greenhouse gases: There could be release of carbon dioxide and nitrogen oxides from combustion of the petroleum products in project related vehicles, machinery, generators, and vessels/barges etc during the construction period.

77. *Mitigation Measures:* Automatic dust detectors will be provided in the coal yard and in case the dust level exceeds beyond a threshold value, water sprinkling will be carried out. The loading and unloading equipment shall be used with a minimized height of drop to the stockpile to reduce the generation of fugitive dust;

Ambient Noise:

78. Impact: There will be Increase in construction noise with operation of heavy equipment and machinery engaged for construction activities (such as excavation, grading, erecting equipment, piling, etc.) and movement of vehicles. The disturbance to habitations is expected to be high as two villages are located within 5km radius from the site.

79. Mitigation Measures: Identification and marking high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >75 dBA). Provision of training and information that ensures the workers are aware of the hazard from excessive noise exposures and how to properly use the protective equipment that has been provided; In addition, equipment shall undergo regular maintenance. Special consideration will be taken to locate machineries during detail design stage to minimize overall noise level.

Water Bodies:

80. Impact: The water requirement for the project will be drawn from the Meghna River and no ground water will be used for the construction purpose. Considering the water availability in Meghna River, there is no potential for conflict with other users.

81. *Mitigation Measures:* There will be no abstraction of water from nearby bodies except Meghna River.

Soil:

82. Impact: During this phase, labour camps will be established which will lead to generation of a significant amount of waste, garbage, kitchen waste. There could be influx of migrant labour for carrying out specific construction activities which can lead to pressure on local facilities, though for a limited period.

83. *Mitigation Measures:* Site backfilling, grading and excavation for foundation shall be undertaken mainly during dry season. It shall be ensured stacking of excavated soil material is done in an earmarked area and care shall be taken to prevent soil erosion. It shall be ensured that retention wall or bund is provided around the storage areas for excavated soil and other construction material in order to arrest the flow of solid with storm water in case of rain.

Solid Waste Disposal

84. Impact: During construction phase, wastes may be generated from foundation works, site establishment, civil construction, stockpile of materials. The wastes might be metals, concrete, spoiled construction material, excavated spoils, spilled oil from machinery and vehicles, etc. Waste from labour camp will also be generated comprising of food waste, sanitary waste etc.
85. *Mitigation Measures:* During this phase proper and adequate sanitation facilities shall be ensured in labour camps.

Transportation of Raw material:

86. Impact: The access to the proposed Project site will be mainly through river transport involving motor boats and barges. The project would result in increased river traffic around the site which may lead to congestion.

87. *Mitigation Measures*: Workers shall be strictly instructed to refrain from random disposal of any waste generated from the construction activities. Storage facilities designed with adequate containment facility at the construction site shall be provided to prevent contamination of soil due to potential spills of lubricating oil, fuel oil and chemicals. Suitable fire protection measures shall be made available onsite before commencement of construction activities. Fire protection system shall be designed to suppress any fires from spillage or storage of flammable substances.

1-14 Impact Assessment and Mitigation Measures- Construction Phase

Land Use:

88. *Impact:* The land for the proposed project comprises of agricultural and grazing land. The proposed project will involve permanent change in land use from agriculture and shrimp farming to industrial land use. Other potential impacts on land use may be due to development of approach road to the Project site and from the induced changes of land use

from agriculture to commercial to fulfil the requirements of construction labour and project personnel.

89. *Mitigation Measures:* No major mitigation measure is required except to ensure that the Project maintains more than 30% of the area under green cover to offset some adverse impact of land use change and merge with the surrounding rural settings.

Natural Resources:

90. *Impact:* The site is located on an island bound by the Meghna River which controls the drainage system of the total study and project area. The project area slopes gently towards Southeast. The runoff from the site will be altered and there will be a permanent change in drainage pattern.

91. *Mitigation Measures:*

- Land surface contours shall be restored in relation to the surroundings. It shall be followed by developing drains and providing adequate slopes across the project site prior to start of construction work;
- All excavated soil and dredged material shall be utilised for filling up the low lying area;
- Dredged material shall be tested for its chemical characteristics to avoid contamination of land and surface water;
- Diversion dykes shall be constructed to channel surface runoff to the Meghna river;
- It shall be ensured that adequate cross drainage is provided along the proposed road to prevent localised flooding.

Site Preparation:

92. *Impacts:* The construction phase of project will require filling of the low lying land with dredge material which will be generated by dredging of Meghna River. During monsoons, the potential for runoff will increase, which can result in loss of significant amount of soil from the site.

93. *Mitigation Measures:*

- Site backfilling, grading and excavation for foundation shall be undertaken mainly during dry season and in an earmarked area;
- Retention wall or bund is to be provided around the storage areas for excavated soil and other construction material in order to arrest the flow of solid with storm water in case of rain;
- It shall be ensured that Project site is properly fenced and project activities including receipt and storage of construction material are kept within the Project footprint;
- Proper routing and adequate capacity of the storm water run-offs drains with catch pits shall be ensured;
- Completed earthworks shall be sealed and/or re-vegetated as soon as reasonably practicable with the help of landscape expert;
- Impervious surfaces for refuelling areas and other fluid transfer areas shall be used in order to prevent percolation of oil in soil due to accidental spills.

Soil contamination due to handling of lube oil, chemicals etc.

94. *Impacts:* Contamination of soil may also occur due to accidental spills of paints, thinners etc. during handling and storage of domestic waste and discarded containers of paint, varnish, thinner, grease, lubricating oil etc. There is a potential for contamination of dredge material with heavy metals, which may ultimately contaminate the soil at site.

95. *Mitigation Measures:*

- It shall be ensured that storage facilities are designed within paved (impervious) surface, provided with covered shed and adequate containment facility at the construction site.
- Proper storage for machine oil, used oil and grease in order to avoid any soil contamination shall be ensured by providing adequate secondary containment;
- Portable spill containment and toolkit with clean-up equipment shall be provided on site. Workers shall be provided adequate training in equipment deployment and handling;
- Assessment of contents of hazardous materials and petroleum-based products in building systems (e.g. PCB containing electrical equipment such as transformers, asbestos-containing building materials), and process equipment shall be ensured.
- Hazardous material containing products shall be procured along with Material Safety Data Sheet (MSDS) which is provided by the product manufacturer.
- Dredge material used for landfill shall be tested for its chemical characteristics and pollution potential prior to use.

Handling, Storage and Disposal of Wastes

96. *Impacts:* The solid waste generated during construction phase will include construction waste/ debris, waste oil and chemicals from construction machinery, and domestic solid waste etc. Improper disposal of domestic waste from site can lead to unhygienic conditions in the project area.

97. *Mitigation Measures:*

- Storage facilities designed with adequate containment facility at the construction site shall be provided to prevent contamination of soil due to potential spills of lubricating oil, fuel oil and chemicals;
- Suitable fire protection measures shall be made available onsite before commencement of construction activities. Fire protection system shall be designed to suppress any fires from spillage or storage of flammable substances;
- Solid wastes shall be segregated on the basis of biodegradable and non-biodegradable contents.
- Construction wastes from site, wharf, road corridors such as metal cuttings debris, plastic packing material, wooden logs etc. shall be segregated and kept in specially identified and properly marked waste bins. All metal scrap shall be sold while concrete waste/debris and other inert materials that cannot be recycled shall be crushed and reused for level raising onsite or in road/pavement construction within the site; and
- Hazardous wastes including used oil, waste oil and residue containing oil or other hazardous substances shall be stored at a designated place with proper markings onsite for disposal through authorized vendors/ recyclers in Bangladesh.

Water Resources and Water Quality

98. *Impacts:* Considering the water availability in Meghna River, there is no potential for conflict with other users. The quantity of water required for construction activities has been anticipated to range from 40 m^3/hour to 100 m^3/hour (peak requirement). It is expected that during construction phase there will be generation of sewage and small quantity of rejected water from testing of utility tanks and pipelines during commissioning of the project.

99. *Mitigation Measures:*

- Rainwater harvesting system prior to onset of monsoon for effective recharge of groundwater during rainy season;
- Construction workers shall be trained for optimal use of water to be ensured ; and
- To minimise adverse impacts due to escape/discharge of untreated sewage outside the project site, adequate number of toilets (at least 8 toilets per 100 labourers) with septic tanks and lined soak pit arrangements to be provided onsite for disposal of sewage as per the design specified for area with high water level.
- Bunds around excavated soil or loose construction material and storage areas to be kept away from water drains.
- Sludge from sanitary wastewater treatment systems shall be disposed in compliance with local regulatory requirements.

Ambient Air Quality

100. *Impacts:* It includes fugitive dust emissions from soil excavation and stock piles of construction material and emissions from onsite operation of diesel generators and heavy construction equipment.

101. *Mitigation Measures:*

- Suppression of fugitive dust emissions shall be ensured by implementing the following measures like water sprinkling at the construction site, wetting of the stockpile etc.
- Covering trucks transporting soil and material at the site with tarpaulin sheets.
- Usage of low-emission vehicles and electrically powered construction equipment wherever feasible ;
- Dust generating activities shall be avoided in conditions of high wind (particularly during summer season) and covers shall be provided for loose construction material at construction site;

Ambient Noise Quality

102. *Impacts:* Increase in construction noise with operation of heavy equipment and machinery engaged for construction activities (such as excavation, grading, erecting equipment, piling, etc.) and movement of vehicles.

103. *Mitigation Measures:*

- Noise control measures such as acoustic enclosures, noise barriers in areas of high noise
- generating sources, and movement of vehicles during night time shall be implemented;
- OPDL-2 or the construction contractor shall ensure that workers wear ear muffs/plugs in areas with potential for high noise generation; and

- All diesel generators to be installed in conformance with acoustic enclosure to achieve the 75 dB(A) level at 1 m from its enclosure;
- Provision of rubber paddings/noise isolators at equipment/machinery used for construction;
- Noise prone activities need to be restricted to the extent possible during night particularly during 2200 to 0600 hours to reduce the noise impact.

Traffic and Transport

104. *Impacts:* The project would result in increased river traffic around the site which may lead to congestion. The residents of the adjoining villages will be affected by increase in transport as it will affect the movement of passenger ferries being used by the people. There will be increase in potential for possible accidents and capsizing of boats/vessels. Spill and leaks from poorly maintained boats /vessels may lead to contamination of water and sediments along the banks.

105. *Mitigation Measures:*

- Close consultation with community when unloading of construction machinery and material will obstruct ferry movement for requirement of local community ;
- Providing dedicated location along the site for exclusive loading and unloading of the construction vessels;
- Necessary training to the ferry operators of construction vessels to ensure safe operations;
- Developing Code of Practice for construction which will include management of traffic for
- construction phase;

Ecology

106. *Impacts:* Release of construction waste water and soil run off can cause contamination to adjoining water bodies, besides increase in turbidity. The increase in turbidity and contamination may affect fish population in the river, especially during the spawning season.

107. *Mitigation Measures:*

- Dredging activities are undertaken frequently in the Meghna River, predominantly for land filling for industries along the banks and for navigation. The bottom topography is frequently and therefore significant impact on benthic communities is not envisaged. The activities proposed are short term and will leave residual impact due to turbidity.
- Noise levels due to construction activities shall be kept to a minimum;
- Movement of labour shall be restricted;
- The construction contractors shall ensure that fuel for resident workers are procured from legal sources and provided free of cost.

Socio- Economic Environment

108. *Impacts:* Some positive impacts are envisaged like payment to land Contributors, increased prospects of supplementary business and better connectivity. The local population is expected to be given preference as semi-skilled and unskilled labour and boost to local businesses. Access to these amenities is expected to improve and contribute to the overall development of the community. There can be loss of livelihood and land, obstructed access

to essential amenities and common property resources. There is likely to be an increased demand on public utilities, due to the presence of migrant labour.

109. *Mitigation Measures:*

- OPDL-2 should ensure that all compensation is paid to the land contributors as mutually agreed upon and within the stipulated time.
- OPDL-2 should provide special assistance to the vulnerable groups in the form of livelihood restoration measures.
- The company management should ensure that stakeholder engagement is initiated right from inception of the project.
- OPDL-2 must provide for their periodic medical evaluation.
- The labourers may be provided with health promotion strategies and basic information on transmission of common infectious diseases. Where in needed, the company should collaborate with the local health department and provide measures to prevent or contain and outbreak of diseases.
- The community must be informed of all major developments prior to each development in the plant, through notices and announcements.
- All sections of the community, except the economically weak, must be provided with equal preference where in CSR measures and employment is concerned.

Occupational Health and Safety

110. *Impacts:* The health and safety during the project construction phase include shocks, burns, ergonomic injuries, respiratory diseases, hearing damage etc.

111. *Mitigation Measures:*

- Ensure necessary safety measures to be taken up before and during the construction activities for all electrically driven machinery;
- Usage of high speed diesel (HSD) shall be provided with proper storage in covered area;
- Vehicle movements to follow the traffic norms and maintain a safe speed while moving through the hilly tracts;
- Personal Protective Equipments (PPEs) e.g., helmets, safety belts, welding masks, shock resistant rubber gloves, shoes, other necessary protective gear etc. should be provided to workers handling welding, electricity and related components.
- An accident reporting and monitoring record should be maintained.

1-15 Impact Assessment and Mitigation Measures- Operation Phase

Air Environment

Coal Handling and Fuel Combustion

112. *Impacts:* The unloading of coal, its conveyance and its storage will involve fugitive dust emissions. The moisture content of the coal will cause dust emissions to be severe. The coal preparation activities will involve emissions of fugitive dust during the coal screening, crushing and conveyance for magnetic separation. The major pollutants from coal combustion are particulate matter (PM), sulphur oxides (SO2), and nitrogen oxides (NOx). An

air modelling exercise has been carried out for the emission sources at using USEPA AERMOD model. The resultant concentrations for all parameters are predicted to be within the prescribed norms of National Ambient Air Quality Standards except for particulate matter.

Table 1-4: Plant Boundary Emissions

S.No.	Coordinates	Incremental SO_2 GLC ($\mu g/m^3$) : Scenario I	Incremental SO_2 GLC ($\mu g/m^3$): Scenario II	Incremental NOx GLC ($\mu g/m^3$)	Incremental SPM GLC ($\mu g/m^3$)
1	615, 560	13.80	10.89	8.44	0.82
2	250, -625	13.68	10.80	8.37	0.82
3	-230, -425	11.73	9.26	7.18	0.70
4	-790, 370	13.58	10.72	8.31	0.81

Source: AERMOD for air dispersion modelling

- Incremental concentrations of SO2 if Sulphur content in 0.38%; range from 11.7-13.8 µg/m3.
- If a spray drier with 50% efficiency is used (with 0.6% S), the incremental concentration of SO2 will range from 9.3-10.9 µg/m3 at the plant boundaries.
- Increase in GLC of Nox varies from 7.2-8.4 µg/m3 and incremental concentrations of SPM range from 0.7-0.8 µg/m3.
- The nearest settlements are located beyond 1km from the boundary of the project area.

The impact on the air shed due to the plant operations can be considered as moderate

113. *Mitigation Measures:*

- Automatic dust detectors will be provided in the coal yard;
- All transfer points shall be provided with dry fog dust suppression system
- The loading and unloading equipment shall be used with a minimized height of drop to the stockpile to reduce the generation of fugitive dust;
- The coal dust extraction system shall be designed to suck the dust laden air from the confined areas such as screening and belt feeders and at transfer points;
- Provision of space for Flue Gas Desulfurization system (FGD) shall be provided in the plant area.
- Ensure the proper functioning of electrostatic precipitators/ Bag Filters to achieve a minimum claimed efficiency of 99.67% to keep the particulate matter emission less than 50mg/Nm^3. The flue gas to be exhausted at 275 m height;

Greenhouse Gas Emissions

114. *Impacts:* The proposed project qualifies as a High carbon intensity Project as it will lead to significant emissions of carbon dioxide (CO_2), which is a greenhouse gas.

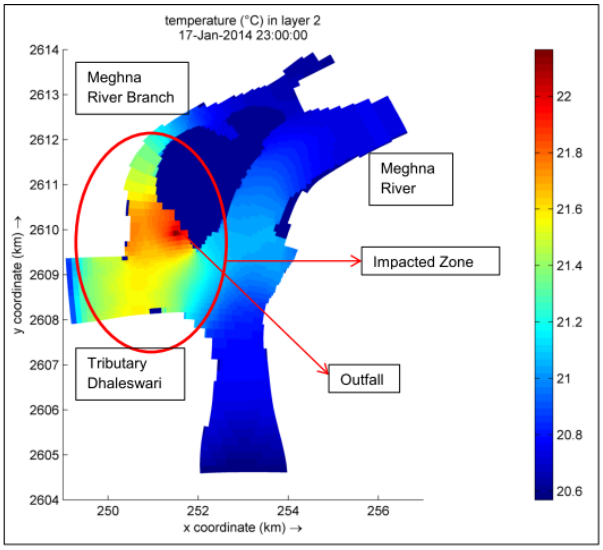
115. *Mitigation Measures:* The project shall install CO_2 monitor and analyse CO_2 equivalent emission from its power generating units once the Project achieves commercial operation date (COD).

Water Resources and Quality

116. *Impacts:* No groundwater abstraction is envisaged for the power plant operations and the net water demand of 273m^3/hr for the plant operation will have negligible impact on the water resource availability in Meghna River. The quality of Meghna River however may get impacted due to discharge of effluents. Fuel transport and unloading activities may also impact the river water quality due to accidental release/spill from fuel tank and discharge of ballast water. Improper disposal of dredged material from maintenance dredging activities may also affect the water quality. Discharge of heated water from the cooling system might fatally affect the stenothermic organisms present in the Meghna River, due to sudden temperature changes that are beyond the tolerance limits of their metabolic systems.

117. Thermal plume modelling exercise carried out by using a 3D numerical model (DELFT-3D) Modelling has been carried out in a branch of Meghna River on the western side of the island where the outfall is located. Water used for cooling: 22.2 m3/s (80,000 ton/h).Heated cooling water discharged to the river: 22.2 m^3/s (80,000 ton/h). Outfall temperature - 8°C higher than the inflow water temperature. Depth near the plant site -1.5m to -4.5m.Measured temperature at plant site - 20.3°C to 21.8°C.Depth at the intake is ~ 4mDepth at the outfall is ~-7m.

Figure 1-12: Overview of Modelled Temperature for the whole domain



118. The modelling grid is curvilinear in nature and at less than 20m resolution with 10 vertical sigma layers .Currents was used as upstream boundary condition both in the main river and branch and also in the tributary while water level was used as downstream boundary condition. The temperature near the outfall was in the order of 22°C and above during the simulated period. The temperature in Dhaleswari River ranged from 21.2° to 21.8°C. The temperature in the branch of Meghna River ranged from 21.2°to 22°C. However, along the main river the temperature was below 21.2°C.The difference between the measured and modelled data is within the 10% acceptable range.

119. The rise in temperature across the river cross-sections has been undertaken at four locations Temperature exceedance of up to1.5°C was observed in the immediate vicinity of the outfall both during flood and ebb tides. River and upstream of the outfall along the branch of Meghna River ranged between 0.8°-1.0°C

120. *Mitigation Measures:*

- Records will be maintained to monitor the quantity of water being used;
- Appropriate treatment shall be provided to the process effluents and runoffs prior to
- discharge into the River;
- Treated water effluent (about 15 m^3 /hr) shall be mixed with the cooling water (`80,000 m^3 /hr) to dilute the concentration of the treated effluents;
- The vessel speed, river flow and erosion shall be monitored in accretion prone areas.

Ambient Noise Levels and Vibration

121. *Impacts:* It was observed from modelling results that the noise levels decrease significantly and merge with the background concentration before reaching the nearest village Vati Bolaki. However, the workers in the proposed thermal power plant are likely to be exposed to high noise levels for short term. The impact of vibrations beyond the project site would be negligible in view of aerial distance. However, the impacts on workers engaged in the plant area would be considerable due to occupational exposure depending on work places.

122. *Mitigation Measures:*

- Workplace noise sampling including personal noise monitoring which identifies which employees are at risk from hazardous levels of noise;
- Provision of sound-insulated control rooms with noise levels below 60 dBA ;
- Use of physical barriers and green belt development around the plant to restrict the noise from going outside the proposed plant boundary during operation; and
- Provision of training and information that ensures the workers are aware of the hazard from excessive noise exposures and how to properly use the protective equipment that has been provided;
- Installing suitable mufflers on engine exhausts and compressor components and acoustic barriers without gaps in order to minimize the transmission of sound;

Soil Quality

123. *Impacts:* It is anticipated that about 90% of the residues will be collected as fly ash and 10% will be collected as bottom ash. The impacts on the soil quality due to the storage of fly ash, bottom ash and other waste streams have been assessed to be negligible.

124. *Mitigation Measures:*

- Fly ash (dry form) generated from the plant should be separated after burning of coal through ESP & BF and commercially utilized to maximum extent possible;
- The hazardous waste such as spent oil as well as non-hazardous wastes shall be disposed off to DoE authorised vendors only.

Ecology

125. *Impacts:* The proposed project will result in discharge of once through cooling water after heat into the Meghna River that will have an impact on aquatic ecology. Potential impacts of project operation on terrestrial ecology include long-term air and noise pollution and disturbance generated by area lighting and traffic.

126. *Mitigation Measures:*

- The water supply pipeline intake point from the feeder canal shall be provided with sufficient screening to filter out larger aquatic organisms.
- Green areas shall be developed in about one-third of the entire project area.
- Implementation of noise control measures shall be done to minimize disturbance to the fauna and avifauna of the area.

Occupational Health and Safety

127. *Impacts:* Occupational health and safety risks associated with the project comprises of heat, noise, confined spaces, electrical hazards, fire and explosion hazards and chemical hazards.

128. *Mitigation Measures:*

- Regular inspection and maintenance of pressure vessels and piping shall be carried out
- Adequate ventilation shall be provided in work areas to reduce heat and humidity;
- Time required for work in elevated temperature environments will be reduced and access to drinking water will be ensured;
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc. shall be done;
- Warning signs near high temperature surfaces and personal protective equipment (PPE) as appropriate, including insulated gloves and shoes shall be provided;
- Provision of sound-insulated control rooms with noise levels below 60 dB.;
- Design of generators to meet applicable occupational noise levels.

Socio-economic Environment

129. *Impacts:* The Company's CSR initiatives and activities are expected to have begun by the time of advent of the power plant's operation phase. On the contrary, there is likely to be a high risk to the surrounding community's health due to smoke emissions and fly ash deposits.

130. *Mitigation Measures:*

- The community must be kept informed of emergency procedures and protocol in case of an accident in the plant and in case of increased emissions from the project operations.
- Vulnerable groups and gender issues may be provided a special focus in the CSR plans, to contribute towards their upliftment.
- The community must be informed of all major developments prior to each development in the plant, through notices and announcements.

Transportation of primary fuels

131. *Impacts:* The transfer of coal at the anchorage point will be prone to spillage leading to contamination of water, effect on route leading to congestion and increase in potential for accidents. During dredging operation, water column may be contaminated due to spillage of oil, grease, machine oil, etc. Unplanned dredging may also cause erosion in some places.

132. *Mitigation Measures:*

- All international vessels supplying coal to the plant shall follow the guidelines of Marpol for disposal of sewage and garbage.
- The contract pertaining to supply of all type of fuels shall mention the responsibility of supplier for safe transportation and compliance to national and international requirements pertaining to environment.
- The Plant will require one vessel arriving every 5.1 days to discharge 25,000 mt each trip, however the frequency will increase to 2.5 days during pre-monsoon for stocking and once every two weeks immediately after post monsoon. Thus the traffic volume in the river will not increase significantly.
- The power plant complex will have well planned road network and walkways with proper signage e.g. speed limits, etc.

Inherent mercury and heavy metal in Coal

133. *Impacts:* Mercury oxidation depends on its chemical form in the vapour phase and mercury can range from a few percent to over 90% in flue gas. Mercury that is adsorbed onto solid surfaces, such as fly ash or unburned carbon, is the particulate-bound mercury that tends to be captured by particulate matter control device. During combustion the mercury is released into the exhaust gas as elemental mercury vapor, Hg. The amount of mercury is flue gas is low as mercury also condenses in ash formed during coal combustion.

134. *Mitigation Measures*

Removal of mercury can be achieved by installation of electrostatic precipitator (ESP) / Bag Filter along with powdered activated carbon which will act as a sorbent in flue gas. Fly ash to be efficiently managed to control the emission of heavy metals in the environment.

1-16 Public Hearing

135. Orion Group conducted a Public Hearing for OPDL-2 on February 15, 2014 at the proposed project site. The key members present at the event included top management officials from Orion Group, Hossaindi Union Chairman, BPDB representatives, DoE officials, local political figures, community leaders such as the Hossaindi High school headmaster etc. Two representatives each from AECOM and Adroit Environmental Consultants Limited (AECL) were also present at the event. Locals were concerned about the effect of the project operations on the fishes present in the Meghna River since fisheries are the biggest source of income for the local communities. The villagers also raised issues about incomplete

payment of compensation to land losers. All key issues and concerns raised by the local people during the hearing were addressed appropriately by OPDL-2 representatives. The key issues and the responses given by OPDL-2 representatives have been summarised in the ESIA report. However, a glimpse has been provided below.

Table 1-5: Key Issues and Responses

Key Issue	Response
Development of a road Requisition for primary and secondary level schools, and madrassas in the vicinity of the project site.	OPDL-2 plans to develop roads from Comilla Vidyut Palli Samiti to project site which shall be accessible to the local villagers. OPDL-2 intends to setup schools with well qualified faculty members near the project site
Pollution from the proposed project Provision of employment and appropriate wages to the land contributors	The proposed power project will operate on ultra-supercritical boiler technology with higher efficiency, fly ash generated will be removed by usage of 99.89% efficient ESPs. 30% of green area is proposed within site Priority to local people for employment .The local people will be hired as unskilled or skilled labourers as per their competence.
Effect of the project effluent disposal on fishes present in the Meghna river	Installation of screens in front of the intake channel to prevent the entry of fishes. OPDL-2 shall follow the IFC effluent discharge standard

Source: Consultations conducted by AECOM

1-17 Risk Assessment

136. Risks associated with handling of chemicals and fuels in the proposed power plant revolve around handling and storage of chlorine, ammonia solution, LDO/HFO and HCl. The concentration which is immediately dangerous to life and health (IDLH) value for chlorine has been identified as is 10 ppm (29 mg/m 3).Chlorine is received and stored in steel cylinder of 926 kg (called a tonner) under a pressure of 10 kg/cm 2 .Hazards from chlorine come from loss of containment which may be leakages, pipe rupture or vessel rupture for which mitigation measures has been detailed out in the relevant section of ESIA report. The risk associated with fuel oil storage and mitigation measures has been incorporated.

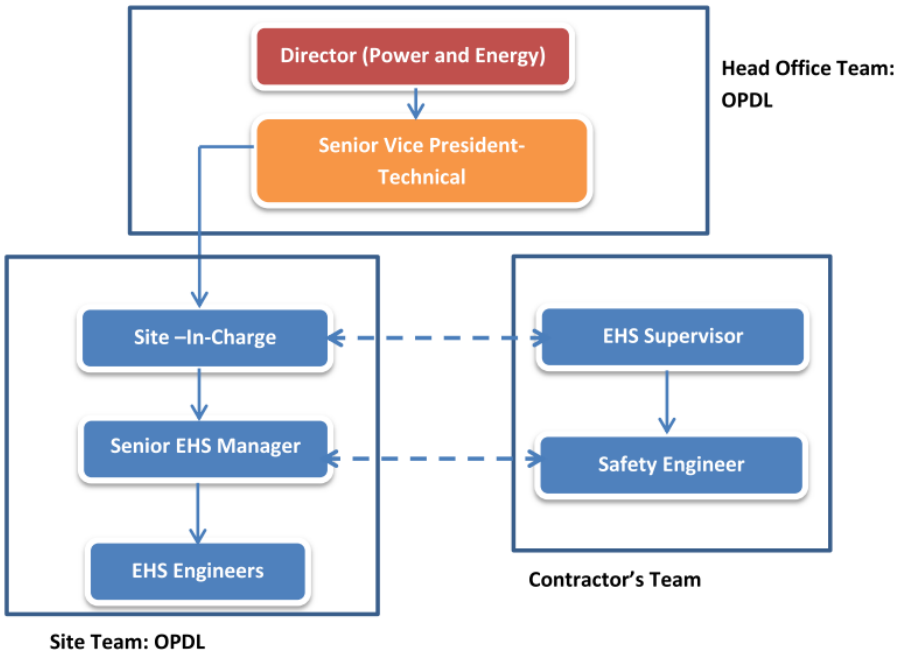
1-18 Environment Management and Monitoring Plan

137. An Environmental and Social Management and Monitoring Plan detailing mechanism for implementation of mitigation measures and monitoring of implementation has been formulated. The Management Plan comprises of separate plan for
    - construction labour management,
    - waste management,
    - pesticide management,
    - emergency preparedness and response,
    - health and safety and
    - Livelihood restoration (including stakeholder engagement).

HSE Organization Structure

138. OPDL-2 has established the structure of Head Office Team and Coal Site Team for operations of Power Plant. The structure of Head Office Team comprises of Chairman, Managing Director and Director of Power & Energy at top level. The structure for Coal site team comprises of a Site –In- Charge followed by Senior Managers of different departments like Civil, Commissioning etc.

Figure 1.13: Implementation Organization Structure



139. A significant portion of the project activities will be undertaken by contractors. It is to be ensured by OPDL-2 that the contractual documentation emphasizes the need to comply with all HSE legal requirements and the Environment and Social Management and Monitoring Plan (ESMMP). OPDL-2, either directly or through its contractors, will arrange for periodic training of the project crew on legal requirements and ESMMP. OPDL-2 will also undertake regular inspections of the installation works and camp sites to ensure compliance to legal requirements and the provisions of ESMMP and document them.

Environmental and Social Monitoring Plan

140. A comprehensive environmental monitoring plan has been developed for the project. Monitoring of stack emission, ambient air quality, noise levels, and soil and groundwater quality to be carried out by recognized laboratories at a given frequency to assess the effectiveness of the environment management plan. Online Air and Water monitoring system shall be fully functional throughout the entire lifetime of the project. Monitoring of aspects like land procurement, grievance redressal and CSR activities is also considered.

141. Implementation status of the all management plans should be monitored and documented regularly. Monthly monitoring report should be prepared based on regular inspection and should be submitted to the Site in-charge of the Plant of the Power Plant. There shall be regular disclosure of the report through workshop and website and response should be taken care regularly.

142. A dedicated Management Information System (MIS) will be developed for OPDL-2 Project which will represent the real time monitoring data including environmental parameters to any permitted users through web based service. The regulatory authorities of Department of Environment will give full access to monitor the real time environmental data.

143. Stakeholders consultation meeting will be conducted in routine basis to monitor CSR activities and any complains/ suggestions from stakeholders will be addressed with top priority.

144. As per monitoring plan, third party / independent monitoring bodies will be engaged for monitoring of all the activities during pre-construction, construction and operation phase as per proposed monitoring plan.

1-19 Proposed CSR Strategy

145. A specific budget will be allotted by the project proponent to undertake the activities associated with proposed CSR activities. The suggested CSR activities include indirect employment opportunities in terms of contractors, opening up of training centres for specific skill sets required. Provision of drinking water in form of deep tube wells is also recommended. The project proponent can provide services and aid to the existing schools in the area and diagnostic centres or ambulances can also be developed.

1-20 Cost and Benefit Assessment

146. Three separate values have been calculated from the cost benefit assessment of the proposed project which is Net Present Value, Benefit Cost Ratio and Internal rate of Return. Total benefits obtained from the project are 8214.7 million USD, which will acquire over the project life cycle. Net present value has been calculated by offering discounted rates of 14%, 12% and 10% respectively. Two options have been considered in evaluating the sensitivity of the coal cost with respect to cost of electricity for the proposed project.

1-21 Project Benefit and Cost

147. Boost to Power Sector: The supply of electricity has a great positive impact on Gross Domestic Product (GDP) and is one of the key indicators to measure the economy of a country. There has been an increase in the demand for electricity in the recent years as a

result of industrial development and population growth. The proposed project will generate 635 MW net to the present electricity availed to the population of Bangladesh.

148. Socio Economic Benefits: The proposed is likely to have positive impact on the nearby surrounding resulting in overall development of the area in terms of infrastructure development, employment generation and boost to local business.

149. Project cost is estimated to be at USD 784.8 Million (equivalent to BDT 63,568.77 Million). The cost for pollution control abatement measures will be USD 1.98 Million. Inclusion of various Pollution abatement measures will be implemented specifically to manage air emissions and fly ash generated, details of which has been provided in the subsequent sections of ESIA report.

1-22 Conclusion and Categorization

150. Based on the requirement of US Exim Bank and the findings of this ESIA study, the proposed 635 MW Dhaka power plant is categorized as “Category A” project. The plant will use ultra-supercritical steam technology, which will provide greater efficiency than conventional subcritical coal-fired power plants and require relatively lower coal consumption. Numbers of measures and management plan have been distinctly instructed in this ESIA study which is to be implemented. The proposed project will create enormous potentiality of regional economic and social development. It will offer large number of job opportunity and infrastructure development.